Deutsche Physikalische Gesellschaft DPG

DPG-Frühjahrstagung 2025

(DPG Spring Meeting 2025)

of the Divisions

Hadronic and Nuclear Physics, Mass Spectrometry

as well as the Working Group

“Young DPG“

©Th. Josek

10 – 14 March 2025

University of Cologne

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Content

Dear participants,

Welcome on the campus of the University of Cologne to the DPG Spring Meeting of the Divisions Hadronic and Nuclear Physics, Mass Spectrometry and the Working Group “Young DPG”.

Our Spring Meetings are the DPG‘s flagship events for promoting scientific exchange — both for internal communication within the DPG and for exchange with researchers from all over the world. We expect a total of up to 10,000 guests at our Spring Meetings, which will once again make the DPG conferences the largest platform for scientific exchange in the field of physics in Europe this year. The comprehensive inclusion of presentations by young scientists in the conference programme is also a unique selling point at both national and international level. This is by no means a matter of course: on the one hand, this is due to the well-coordinated cooperation of our many committed conference organisers in the DPG and the support of our DPG office in Bad Honnef. On the other hand, it is thanks to the generous support of the universities that are excellent hosts for our conferences. For a whole week, the universities are almost entirely dedicated to physics and thus become internationally visible “beacons” of physics research.

We are also working on making our conferences even more international, in the spirit of „Science bridges cultures.“ I am therefore very pleased that Italy, represented by the Italian Physical Society (SIF), is the guest country at this DPG Spring Meeting. Strengthening and fostering international scientific exchange cannot be overestimated — especially in these times! And I am also very pleased that the DPG communication programme, which enables young scientists to actively participate in DPG conferences as early as possible, has been expanded thanks to the generous support of the Wilhelm und Else Heraeus-Stiftung: by awarding additional scholarships to young scientists from the countries supporting the electron storage ring “SESAME” in the Middle East as well as from Central and Eastern European countries to participate in our conferences.

As the world‘s largest physics society, the DPG is also one of the main initiators of this year‘s “International Year of Quantum Science and Technology“ (IYQ). The DPG is taking the lead in implementing the IYQ proclaimed by the UN in Germany. The formulation of quantum mechanics in 1925 created a lasting foundation for our physical understanding of nature. Quantum technologies have changed our daily lives and have become pillars of our prosperity, which is why we are celebrating their successes and highlighting future prospects. Under the motto “Quantum2025 — 100 years is just the beginning...” within the framework of IYQ, a wide variety of events and activities are being organized and coordinated by DPG, see quantum2025.de. I would like to thank all those who are contributing to the success of the quantum year!

The success of this Spring Meeting is only possible with the greatest commitment. I would like to express my sincere thanks to everyone involved. First of all, I would like to thank the University of Cologne for their hospitality and support. Many thanks also to the Wilhelm und Else Heraeus Stiftung for generously supporting all DPG Spring Meetings. I would also like to thank the participating DPG divisions and the “Young DPG” for organising the scientific programme. My special thanks also go to the local organising committee at the University of Cologne, Prof. Dennis Mücher, Institute for Nuclear Physics and his team. Finally, I would like to thank the DPG Head Office for its support of all Spring Meetings.

I wish you a great Spring Meeting at the University of Cologne with many new insights and excellent discussions!

Prof. Dr. Klaus Richter

President
Deutsche Physikalische Gesellschaft e. V.

Deutsche Physikalische Gesellschaft DPG

2nd DPG Fall Meeting

of the Deutsche Physikalische Gesellschaft

Quantum Physics

Topics:

- Quantum Physics in Research and Technology
- The Path to the Modern Quantum World
- Applications of Quantum Technologies

Joint Meeting of the

- Atomic, Molecular, Quantum Optics and Photonics Section (SAMOP)
- Condensed Matter Section (SKM)
- Matter and Cosmos Section (SMuK)

100 years ago, Göttingen played a central role in creating quantum physics as we know it today. In 1925 Werner Heisenberg, then an assistant at the Göttingen Institute for Theoretical Physics, published his famous article “Quantum-Theoretical Re-Interpretation of Kinematic and Mechanical Relations”. This article marks the beginning of quantum mechanics and therefore the United Nations, the German Physical Society (DPG) and numerous Physical Societies around the world will celebrate 2025 as the “Year of Quantum Science and Technology”.

The activities of the Quantum Year 2025 in Germany will culminate in an international conference in Göttingen (2nd DPG Fall Meeting, Sept. 8-12, 2025). The meeting will cover the present status and perspectives of all fields of modern physics reigned by quantum mechanics (condensed matter physics, atomic and molecular physics, quantum optics, elementary particle physics, quantum information and computing, and many others) as well as the historical roots of quantum mechanics and conceptual questions that still challenge us today.

Apart from high profile speakers covering all fields of modern physics there will be contributed sessions, all together creating a unique opportunity to look across the boundaries of individual research topics under the umbrella of quantum physics.

Save the Date!
8-12 Sep 2025

quantum25.dpg-tagungen.de

8-12 September 2025

Local and Scientific Organisers:

Prof. Dr. Stefan Kehrein
Institut für Theoretische Physik
Friedrich-Hund-Platz 1
37077 Göttingen

Prof. Dr. Thomas Weitz
I. Physikalisches Institut - Experimentalphysik
Friedrich-Hund-Platz 1
37077 Göttingen

Conference Venue:

Georg-August Universität Göttingen, Zentrales Hörsaalgebäude,
Platz der Göttinger Sieben 5, 37073 Göttingen

Abstract Submission: 31 March - 6 June 2025

Organisation

Organiser
Deutsche Physikalische Gesellschaft e. V.
Hauptstraße 5, 53604 Bad Honnef

Phone	+49 (0) 2224 9232-0
Email	dpg@dpg-physik.de
Homepage	www.dpg-physik.de

Scientific Organisation

Local Organiser
Prof. Dr. Dennis Mücher
Universität zu Köln
Institut für Kernphysik
Zülpicher Straße 77, 50937 Köln
Email koeln25@dpg-tagungen.de

Chairs of the Participating Divisions

(HK)	Hadronic and Nuclear Physics	–	Prof. Dr. Bernhard Ketzer (bernhard.ketzer@uni-bonn.de)
(MS)	Mass Spectrometry	–	Ass. Prof. Dr. Karin Hain (karin.hain@univie.ac.at)

Chair of the Participating Working Group
(jDPG) “Young DPG“ – Simon Neuhaus (neuhaus@jdpg.de)

Symposia
SYMM – Mass Matters: Prospects of Bridging Nuclear Physics, Mass Spectrometry, and Astrophysics

Organisation of the Exhibition of Scientific Instruments and Literature
DPG-Kongress-, Ausstellungs- und Verwaltungsgesellschaft mbH
Hauptstraße 5, 53604 Bad Honnef

Phone	+49 (0) 2224 9232-0
Email	dpg@dpg-physik.de
Homepage	www.dpg-gmbh.de

Programme
The scientific programme consists of **398** contributions:

9	Plenary talks
1	Evening talk
1	Prize talk
5	Lunch talks
28	Invited talks
37	Group reports
261	Talks
53	Posters
3	Tutorials

The programme stated in this document corresponds to the status of the programme publication January 22, 2025 and will not be updated! You will find the updated programme at

www.dpg-verhandlungen.de/year/2025/conference/koeln

Information for Participants

The conference will be held March 10 – 14, 2025.

Conference Information

Conference Venue
Universität zu Köln
Institut für Kernphysik
Zülpicher Straße 77
50937 Köln

The conference will take place on the campus of Universität zu Köln in the lecture halls of the Physics Department (Bldg. 321), Zülpicher Straße 77, 50397 Köln. The plenary lectures and some parallel sessions will take place in the neighbouring Chemistry Building (Bldg. 322), Greinstraße 4-6, 50939 Köln. The poster session will take place in the Physics Department.

For a detailed map of the campus and the buildings please see “Map” at the end of this document.

Conference Office / Information Desk
The conference office and the information desk are located in Room 215 “Seminarraum Theorie” of building 321 (Physics). The opening hours are the following:

		Registration	Information Desk
Monday	March 10	11:00 – 18:00	11:00 – 18:30
Tuesday	March 11	08:00 – 17:30	08:30 – 19:00
Wednesday	March 12	08:00 – 17:30	08:30 – 19:00
Thursday	March 13	08:00 – 17:30	08:30 – 19:00
Friday	March 14	08:00 – 12:00	08:30 – 13:00

You will receive your name tag, a receipt for your conference fee, and the login-password for using Wi-Fi (see section Communication/Internet Access) at the registration. The name tag must be worn visibly during the entire conference.

The organisers, the staff of the conference desk, and the student assistants will be identifiable by name tags or Φ-T-shirts in a uniform colour. Please contact them if you have any questions. Do not hesitate to inquire about all necessary information concerning the conference, orientation in Cologne, accommodation, restaurants, going out, and cultural events at the information desk.

Presentations
Scientific presentations will be held orally or by poster and will be given in English (conference language) or German.

Usually, presentations will have the following durations:

- For contributed talks a total of 15 minutes including discussion time and speaker change (12 min talk + 3 min discussion/speaker change).
- For invited talks a total of 30 minutes including discussion time and speaker change (25 min talk + 5 min discussion/speaker change).
- For plenary talks 45 minutes without discussion.

All lecture halls and seminar rooms will be equipped with a projector (16:9 or 16:10) and a laptop computer. Speakers are requested to upload their presentations on the conference website one day before the corresponding session. An email with the access data and the upload deadlines will be sent to the speakers before the conference. If you require to change your uploaded contribution, you may again upload the document at latest four hours before the session (not the talk) starts. In any case you should also bring a copy of your presentation on a USB drive as a backup.

The file formats accepted for all parallel sessions are pdf and PowerPoint. Own laptops cannot be used for the presentation. The presentations will be transferred to the provided laptops in the lecture hall or seminar room before the session.

All lecture halls and seminar rooms will be opened, at the latest, 30 minutes prior to the talks. Speakers are requested to be in the room at least 20 minutes prior to the start of the session, reporting to the chairperson of the session as well as the technical staff to ensure that the presentation upload was successful and to receive a brief introduction to the equipment in the lecture hall or seminar room. If you need other presentation facilities, please ask for availability at the information desk as soon as you arrive at the conference.

Poster Presentation

The site for poster sessions is located at the foyer of the lecture hall building 321. Posters must fit within a rectangle 85 cm wide and 120 cm high (DIN A0, portrait format!).

The poster boards will be marked with the number according to the scientific programme. Authors are asked to mount their poster once the poster board with the corresponding poster number is prepared. Usually this will be arranged in the morning, or two hours before the session. Each poster should display the number according to the scientific programme.

For the mounting of the poster please use the prepared pins/strips at the poster frame or contact the available student staff. The presenting authors should be at hand for discussion at their poster during at least half of the poster session and should note this time at the poster. The posters have to be removed on friday morning the latest. Any posters remaining on display will be removed and disposed without requesting your permission. The conference management accepts no liability for the posters.

Wilhelm and Else Heraeus Communication Programme

Important notes for participants who apply for a grant in the WEH Communication Programme:

At the beginning of the conference you will receive an identification form at the conference office. The participation in the conference must be certified by the conference desk. You have the possibility to leave this certificate with the staff members of the DPG at the conference office (preferably) or submit it to the DPG head office (DPG-Geschäftsstelle, Hauptstr. 5, 53604 Bad Honnef, Germany) by **April 18, 2025 at the latest.** For more detailed information refer to *weh.dpg-physik.de*.

The Deutsche Physikalische Gesellschaft thanks the Wilhelm and Else Heraeus Foundation for the generous financial support of young academic talents. We hope that young physicists will continue to seize the offered opportunity for active scientific communication at scientific conferences. A total of about 41,900 young academics were supported by this programme so far.

Communication / Internet Access

To use the WLAN network on the Campus of the University of Cologne with your own mobile devices, access data, login and password will be issued with the registration documents. The University of Cologne is a member of the eduroam union. If your university is also part of the eduroam union, you can also use the university WiFi in all buildings via your own eduroam access.

Catering

During the breaks between the lecture sessions, coffee, tea and water will be served for free to conference participants. Fruits and small snacks are provided for the coffee breaks. For plenary sessions, catering will be found in the Chemistry Building whereas catering is available in the Physics Department for the afternoon parallel sessions.

Fingerfood and drinks will be included as part of the poster session.

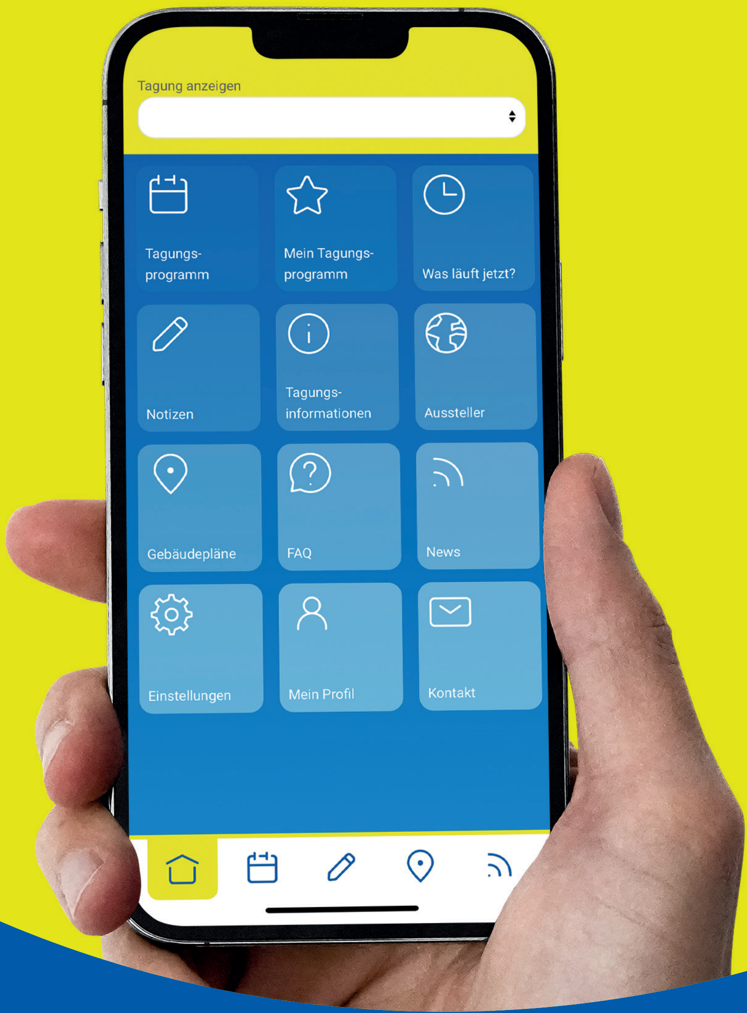
Lunch can be purchased at the Mensa, Zülpicher Straße 70, just a few minutes away from the conference site (see maps). You can only pay via debit or credit card, no cash. The Mensa has multiple dining halls. Depending on the dining hall, you can either pay directly via card (MG north, EG north) or you are required to purchase a ticket via one of the ATM-like machines in the Mensa (MG south, EG south). Showing your DPG name tag will allow you to pay the “guest” price.

Alternatively, there are many restaurants, bakeries, and snack bars in various price categories in the immediate vicinity of the University, mostly along Zülpicher Straße in the downtown direction. Please feel free to contact any local helper to ask for advice.

DPG

Laden im App Store

JETZT BEI Google Play



Navigate the Spring Meeting with the DPG App!

The DPG app informs you about the conference programme, the venues and the exhibitors. Features such as your personal conference calendar and detailed floor plans simplify finding your way around the conference!

for iOS

for Android

Explore conference contributions on the new DPG Map.

CURRENTLY IN BETA

Dive into our network visualization and find related contributions.

Visit our platform at map.dpg-verhandlungen.de

Cloakroom
Participants are asked to look carefully after their wardrobe, valuables, laptops, and other belongings. The organisers decline any liability. In building 321 (Physics) you will find a cloakroom managed by student assistants, see the map for details. The walking distance between the Physics and Chemistry buildings is very short and can be managed without a coat or jacket. The opening hours of the wardrobe are as follows:

Monday	March 10	08:30 – 18:15
Tuesday	March 11	08:30 – 21:00
Wednesday	March 12	08:30 – 21:00
Thursday	March 13	08:30 – 21:30
Friday	March 14	08:30 – 13:30

Notice Board
All changes to the conference programme (i.e. cancellation of presentations, change of rooms, etc.) are also transferred directly to the online version of the programme which will be updated continuously and is available in different formats (sorted by publication date, filterable by conference parts, and as an RSS feed). Please use the form *koeln25.dpg-tagungen.de/programm/notice-board* to notify changes or cancellations. All changes are also displayed in the DPG app so that the displayed programme is always up-to-date.

Lost Property
You can hand in lost property at the information desk. You can also collect your lost property there.

Liability Exclusion
Participants are asked to look carefully after their wardrobe, valuables, laptops and other belongings. There can be no liability assumed.

SAY CHEESE!
The DPG Spring Meetings are basically public to the press. Please note: On behalf of DPG, photos and videos will be recorded during the Spring Meetings. In the context of public relations, these recordings (as the case may be) will be published on our website, in social media or within prints of the DPG for example.

CO_2 Compensation for the DPG Conferences
By decision of its council, the DPG will compensate for fossil CO_2 emissions resulting from mobility for DPG conferences and committee meetings.

Tactfulness
All participants are requested to contribute to a successful and enjoyable conference through respect and tactful behaviour. Please contact the conference office or the local conference organisers in the event of disturbances. §§ 9 and 12 of the DPG’s Statutes are applicable.

Acknowledgement
The Deutsche Physikalische Gesellschaft (DPG) and the local organisers want to thank the following institutions for supporting the conference:

- Wilhelm and Else Heraeus Foundation, Hanau
- Universität zu Köln
- all industrial sponsors of the DPG-Frühjahrstagung (refer to page 10)

for supporting the conference and all staff, who make the conference possible.

Sponsors of the conference:

Social Events

Opening of the Conference

A short opening address will be given by the the local organiser and university representatives on Monday, March 10, at 13:00 in the Kurt-Alder hall (building 322, Chemistry).

Welcome Evening

Monday, March 10, 18:30 – 24:00

On Monday, the welcome evening will be held at the „Herbrand's", Herbrandstraße 21, 50825 Köln, to which all registered participants are kindly invited. Busses will be leaving between 18:15 and 18:30 between the physics and chemistry buildings to bring you to the „Herbrand's" (10-15 minutes drive, depending on traffic). If you prefer to use public transportation we will provide details at the info desk. Food (vegetarian options will be provided) and drinks will be served, so please skip any dinner plans! A DJ will make this a fun and relaxing evening. Register in time (08:00 to 18:00) for the conference and do not miss the opportunity to meet people in an informal atmosphere. Please wear your name tag, which you will have received during registration. Please also note that we do not provide transportation back to the university area after the welcome evening. There are multiple options for public transportation after the welcome evening, depending on the location of your hotel. Please talk to us in case you need help finding your way!

Exhibition of Scientific Instruments

From Tuesday, March 11, to Thursday, March 13, there will be a small exhibition of scientific instruments and literature in the foyer of the Physics Dept. (Bldg. 321). Companies (see list of exhibitors at the end of this booklet) will present their products. Opening hours are from 10:30 to 18:00. All conference participants are welcome to attend the exhibition. The entrance is free.

Meet the Industry!

On Tuesday, March 11, hiring industry partners will give a lunch-talk "Meet the Industry" to provide an overview of current job opportunities and how to best prepare for your future!

"jDPG" Pub Crawl

Tuesday, March 11, 21:30, Meeting Point: „Affenfelsen" (concrete landscape between physics and chemistry department)

If you need a breather during the conference or want to take the opportunity to network with others, join us on a lively pub crawl through Cologne. We will wander through the pubs in groups, enjoying good drinks, great company and the chance to discover the local bar scene. Bring a good mood and energy - it's going to be a great evening!

Physik: Erkenntnisse und Perspektiven — A Publication for Everyone (in German)!

The title 'Physik: Erkenntnisse und Perspektiven' (Physics: Findings and Perspectives) refers to a publication by the DPG, created by nearly 200 authors on a voluntary basis. It provides a detailed exploration of the fundamentals of physics, current research and future developments. It provides readers with engaging and inspiring insights into the world of physics!

The publication is available at www.physik-erkenntnisse-perspektiven.de – complemented by exclusive video interviews. Printed copies can also be ordered by covering the shipping costs. For interested readers: Experience the brand-new book live! Join us for the book launch on Thursday, 13 March, from 12:30 to 13:00 (HS 1 Physik). You will have the opportunity to pick up a free copy – while stocks last!

Public Evening Talk
The Public Evening Talk will take place on Wednesday, March 12, 20:00 – 21:00 in the Kurt-Alder lecture hall (building 322, Chemistry).

Prof. Dr. Roland Diehl from the Max Planck Institute for Extraterrestrial Physics in Garching – Technical University of Munich will talk about *"Kosmische Nukleosynthese: Woher stammen die chemischen Elemente?"*

The talk is open for the interested public and all conference participants. It will be given in German. The entrance is free.

Guest country at the conference

Società Italiana di Fisica

Italy, represented by the Italian Physical Society SIF, is special guest of honor of this DPG Spring Meeting. Italy and Germany have a long-standing tradition of successful cooperation in nuclear and hadron physics. The DPG wishes to strengthen and extend the existing ties between Italian and German physicists. In the programme of the DPG Spring Meeting in Cologne, this is reflected by a number of plenary and main speakers from Italy, representing Italian-German collaborations and common endeavors.

The president of the Italian Physical Society, Prof. Dr. Angela Bracco, will give an overview of existing and future common projects on Thursday at 13:00 (PV XII) in (HS 1 Physik).

Picture a Scientist
On Thursday at 20:30, HS 3 (Physik) the Student Association of Physics at the University of Cologne shows the movie "Picture a Scientist". This 2020 movie by Ian Cheney and Sharon Shattuck is an impressive display of the role of discrimination, sexism, and racism in the context of scientific research of female scientists and teachers.

Laboratory Tours
As part of the DPG Conference week, we warmly invite you to take a look into the accelerator facilities of the Institute for Nuclear Physics of the University of Köln.
There we will been shown to you our 10 MV accelerator, which is used by various research groups in fields such as nuclear astrophysics, nuclear structure physics, medical physics, and radionuclide dating. There will also been shown to you a 6 MV accelerator, primarily utilized for Accelerated Mass Spectrometry (AMS). At the 6 MV accelerator, you will have the opportunity to see the latest development in isobar suppression using a laser.

Registration for the tours will take place during the conference week via a sign-up sheet available at the information desk and are free of charge. We are looking forward to your visit!

Professional and personal development with the DPG

CAREER DEVELOPMENT TRAINING

DPG Akademie

Enhance your methodological and personal skills with practical training and seminars designed to elevate your career.

MORE INFO

STRATEGIC CAREER PLANNING

PIB (Physicists in the Workplace)

Discover valuable guidance and unique insights while networking in the inspiring setting of the Conference Centre and DPG Head Office.

MORE INFO

LEADERSHIP SKILLS DEVELOPMENT

Leading for Tomorrow

Acquire essential leadership skills to thrive in academia, industry and science management.

MORE INFO

STREAMLINED CAREER TRANSITION

DPG Mentoring

Experienced mentors support your career planning (with a focus on industry and business) and accompany you on your journey.

MORE INFO

CONNECTING MINDS

WTT Forum

Connecting students, researchers, founders and industry in DeepTech, spin-offs, joint ventures and startups — a hub for exchange and inspiration.

MORE INFO

Synopsis of the Daily Programme

Monday, March 10, 2025

13:00	Kurt-Alder HS Chemie		**Opening of the Conference**
			Plenary Talks
13:15	Kurt-Alder HS Chemie	PV I	Magic Moments: Exotic Calcium Isotopes in Laser Light •Wilfried Nörtershäuser
14:00	Kurt-Alder HS Chemie	PV II	Tracing ocean circulation with mass spectrometry: AMS and ATTA in focus •Nuria Casacuberta Arola

HK

			Sessions
15:00	HS 2 Physik	HK 1	Structure and Dynamics of Nuclei I
15:00	HS 3 Physik	HK 2	Structure and Dynamics of Nuclei II
15:00	HS 3 Chemie	HK 3	Heavy-Ion Collisions and QCD Phases I
15:00	SR Exp1A Chemie	HK 4	Instrumentation I
15:00	SR Exp1B Chemie	HK 5	Instrumentation II
15:00	SR 0.03 Erw. Physik	HK 6	Nuclear Astrophysics I
16:45	HS 2 Physik	HK 7	Structure and Dynamics of Nuclei III
16:45	HS 3 Physik	HK 8	Structure and Dynamics of Nuclei IV
16:45	HS 3 Chemie	HK 9	Heavy-Ion Collisions and QCD Phases II
16:45	SR Exp1A Chemie	HK 10	Instrumentation III
16:45	SR Exp1B Chemie	HK 11	Instrumentation IV
16:45	SR 0.03 Erw. Physik	HK 12	Nuclear Astrophysics II

MS

			Invited Talks
15:00	HS 2 Chemie	MS 1.1	Recent technical developments and precision mass measurements at ISOLTRAP •Christoph Schweiger
16:45	HS 2 Chemie	MS 2.1	Non destructive mass and lifetime measurement of unstable nuclear states in heavy ion storage rings •Shahab Sanjari
			Sessions
15:00	HS 2 Chemie	MS 1	Heavy and Superheavy Elements
16:45	HS 2 Chemie	MS 2	New Methods, Technical Development I

AKjDPG

			Tutorials
09:00	HS 3 Physik	AKjDPG 1.1	Overview talk on hadron and nuclear physics for young scientists •Jana N. Guenther
10:00	HS 3 Physik	AKjDPG 1.2	Overview of nuclear astrophysics •Artemis Spyrou
11:00	HS 3 Physik	AKjDPG 1.3	Massenspektrometrie und Radioaktivität: Eine Erfolgsstory! •Clemens Walther
			Session
09:00	HS 3 Physik	AKjDPG 1	jDPG Tutorials

18:30	Herbrand's		**Welcome Evening** (for registered participants)

Tuesday, March 11, 2025

			Plenary Talks
09:00	Kurt-Alder HS Chemie	PV III	Nuclear Structure and Reaction Features in Nuclear Astrophysics •Michael Wiescher
09:45	Kurt-Alder HS Chemie	PV IV	Nuclear astrophysics with radioactive beams •Artemis Spyrou

MTI

			Lunch Talks
12:30	HS 2 Physik	MTI 1.1	From Astrophysics to Spent Nuclear Fuel Management: A Journey Through Nuclear Science and Technology •Lars Netterdon
12:50	HS 2 Physik	MTI 1.2	Unternehmensberatung bei einem Hidden Champion -- Abseits von typischen Beraterklischees •Julius Wilhelmy
			Session
12:30	HS 2 Physik	MTI 1	Meet the Industry

SYMM

			Invited Talks
11:00	Kurt-Alder HS Chemie	SYMM 1.1	Mass measurements with RIBs •Guy Savard
11:30	Kurt-Alder HS Chemie	SYMM 1.2	LUNA – Experimental challenges in Underground Nuclear Astrophysics Laboratory •Alba Formicola
12:00	Kurt-Alder HS Chemie	SYMM 1.3	The r-process: connecting astrophysics and nuclear physics •Almudena Arcones
			Sessions
11:00	Kurt-Alder HS Chemie	SYMM 1	Mass Matters: Prospects of Bridging Nuclear Physics, Mass Spectrometry, and Astrophysics
14:00	HS 1 Physik	SYMM 2	Focus Session: Neutron capture reactions in the cosmos and the lab

HK

			Invited Talks
14:00	HS 1 Physik	HK 13.1	Neutron-induced reactions and open questions in the s-process •Alberto Mengoni
14:25	HS 1 Physik	HK 13.2	n-capture experiments in inverse kinematics •Rene Reifarth
14:50	HS 1 Physik	HK 13.3	Single atom counting of live interstellar radionuclides in natural archives •Johannes Lachner
			Sessions
14:00	HS 1 Physik	HK 13	Focus Session I: Neutron capture reactions in the cosmos and the lab
14:00	HS 2 Physik	HK 14	Structure and Dynamics of Nuclei V
14:00	HS 3 Physik	HK 15	Hadron Structure and Spectroscopy I
14:00	HS 3 Chemie	HK 16	Heavy-Ion Collisions and QCD Phases III
15:45	HS 2 Physik	HK 17	Structure and Dynamics of Nuclei VI
15:45	HS 3 Physik	HK 18	Hadron Structure and Spectroscopy II
15:45	HS 3 Chemie	HK 19	Heavy-Ion Collisions and QCD Phases IV
15:45	SR Exp1A Chemie	HK 20	Instrumentation V
15:45	SR Exp1B Chemie	HK 21	Instrumentation VI
15:45	SR 0.03 Erw. Physik	HK 22	Nuclear Astrophysics III
17:30	Foyer Physik	HK 23	Poster

Tuesday, March 11, 2025

MS

			Invited Talk
15:45	HS 2 Chemie	MS 4.1	A big scale to measure the tiniest mass – closing in on the neutrino mass with the KATRIN experiment •Alexander Marsteller
			Sessions
13:00	HS 2 Chemie	MS 3	Members' Assembly
15:45	HS 2 Chemie	MS 4	Application to Astrophysics
17:30	Foyer Physik	MS 5	Poster

AKjDPG

			Invited Talks
19:00	HS 2 Physik	AKjDPG 2.1	Von Teilchen zu Raketen •Steffen Schaepe
19:25	HS 2 Physik	AKjDPG 2.2	Of course we can do that: Working as a data science consultant and software developer in mechanical engineering •Lena Linhoff
19:50	HS 2 Physik	AKjDPG 2.3	Leaving Academia: A Failure? Or the Best Decision I Ever Made? •Edoardo Mornacchi
			Session
19:00	HS 2 Physik	AKjDPG 2	Physicists Beyond Academia

10:30	Foyer Physik	**Exhibition of Scientific Instruments**

21:30	Affenfelsen	**“jDPG“ Pub Crawl**

Wednesday, March 12, 2025

Plenary Talks, Lunch Talk

09:00	Kurt-Alder HS Chemie	PV V	Femtoscopy-for-interactions: a new tool to study low energy QCD •Laura Fabbietti
09:45	Kurt-Alder HS Chemie	PV VI	Ab-initio studies of few-nucleon reactions of astrophysical interest •Laura Elisa Marcucci
13:00	HS 1 Physik	PV VII	Reshaping the History of Quantum Physics: Paths to Gender Equality •Andrea Reichenberger

HK

Invited Talks

11:00	Kurt-Alder HS Chemie	HK 24.1	PUMA: low-energy nuclear physics with antiprotons •Alexandre Obertelli
11:30	Kurt-Alder HS Chemie	HK 24.2	How well do we know the vector quarkonia? •Nils Hüsken
12:00	Kurt-Alder HS Chemie	HK 24.3	Precision redefined: Unlocking new frontiers with Monolithic Active Pixel Sensors •Bogdan-Mihail Blidaru
14:00	HS 1 Physik	HK 25.1	First laser spectroscopic measurements of charge radii along the carbon isotope chain •Kristian König
14:25	HS 1 Physik	HK 25.2	Precision radii of light elements using Metallic Magnetic Calorimeters •Frederik Wauters
14:50	HS 1 Physik	HK 25.3	Precision Radii from the No-Core Shell Model via Neural Networks •Robert Roth

Sessions

11:00	Kurt-Alder HS Chemie	HK 24	Invited Talks I
14:00	HS 1 Physik	HK 25	Focus Session II: Accurate Nuclear Charge Radii of Light Elements
14:00	HS 2 Physik	HK 26	Structure and Dynamics of Nuclei VII
14:00	SR Exp1A Chemie	HK 27	Computing I
15:45	HS 2 Physik	HK 28	Structure and Dynamics of Nuclei VIII
15:45	HS 3 Physik	HK 29	Hadron Structure and Spectroscopy III
15:45	HS 3 Chemie	HK 30	Heavy-Ion Collisions and QCD Phases V
15:45	SR Exp1A Chemie	HK 31	Instrumentation VII
15:45	SR 0.03 Erw. Physik	HK 32	Nuclear Astrophysics IV
17:30	HS 2 Physik	HK 33	Structure and Dynamics of Nuclei IX
17:30	HS 3 Physik	HK 34	Hadron Structure and Spectroscopy IV
17:30	HS 3 Chemie	HK 35	Heavy-Ion Collisions and QCD Phases VI
17:30	SR Exp1A Chemie	HK 36	Instrumentation VIII
17:30	SR 0.03 Erw. Physik	HK 37	Nuclear Astrophysics V
19:00	HS 3 Physik	HK 38	yHEP Annual Meeting

10:30 Foyer Physik **Exhibition of Scientific Instruments**

Public Evening Talk (free entrance)

20:00	Kurt-Alder HS Chemie	PV VIII	Kosmische Nukleosynthese: Woher stammen die chemischen Elemente? •Roland Diehl

Thursday, March 13, 2025

Plenary Talk, Prize Talk, Lunch Talks

09:00	Kurt-Alder HS Chemie	PV IX	Two-proton radioactivity – status and perspectives •Marek Pfützner (Laureate of the Smoluchowski-Warburg-Prize 2025)
09:45	Kurt-Alder HS Chemie	PV X	Towards Solving Computational Challenges in Lattice Field Theory: From Deep Learning to Quantum Computing •Lena Funcke
12:30	HS 1 Physik	PV XI	Book Launch – Physik: Erkenntnisse und Perspektiven (in German) •Jens Kube
13:00	HS 1 Physik	PV XII	Overview and plans of the Italian German Collaboration in hadron and nuclear physics •Angela Bracco

HK

Invited Talks

11:00	Kurt-Alder HS Chemie	HK 39.1	Upgrade programme for the ALICE experiment at the LHC •Andrea Dainese
11:30	Kurt-Alder HS Chemie	HK 39.2	Antiproton production measurement for indirect Dark Matter search at the AMBER experiment at CERN •Davide Giordano
12:00	Kurt-Alder HS Chemie	HK 39.3	New Constraints on the Nuclear Equation of State •Melissa Mendes

Sessions

11:00	Kurt-Alder HS Chemie	HK 39	Invited Talks II
14:00	HS 2 Physik	HK 40	Structure and Dynamics of Nuclei X
14:00	HS 3 Physik	HK 41	Hadron Structure and Spectroscopy V
14:00	HS 3 Chemie	HK 42	Heavy-Ion Collisions and QCD Phases VII
14:00	SR Exp1A Chemie	HK 43	Instrumentation IX
14:00	SR Exp1B Chemie	HK 44	Instrumentation X
14:00	SR 0.03 Erw. Physik	HK 45	Nuclear Astrophysics VI
14:00	SR 0.01 Erw. Physik	HK 46	Computing II
14:30	SR 0.01 Erw. Physik	HK 47	Fundamental Symmetries I
15:45	HS 2 Physik	HK 48	Structure and Dynamics of Nuclei XI
15:45	HS 3 Physik	HK 49	Hadron Structure and Spectroscopy VI
15:45	HS 3 Chemie	HK 50	Heavy-Ion Collisions and QCD Phases VIII
15:45	SR Exp1A Chemie	HK 51	Instrumentation XI
15:45	SR Exp1B Chemie	HK 52	Instrumentation XII
15:45	SR 0.03 Erw. Physik	HK 53	Nuclear Astrophysics VII
15:45	SR 0.01 Erw. Physik	HK 54	Fundamental Symmetries II
17:30	HS 2 Physik	HK 55	Structure and Dynamics of Nuclei XII
17:30	HS 3 Physik	HK 56	Hadron Structure and Spectroscopy VII
17:30	HS 3 Chemie	HK 57	Heavy-Ion Collisions and QCD Phases IX
17:30	SR Exp1A Chemie	HK 58	Instrumentation XIII
17:30	SR Exp1B Chemie	HK 59	Instrumentation XIV
17:30	SR 0.03 Erw. Physik	HK 60	Astroparticle Physics VIII
19:00	HS 2 Physik	HK 61	Members' Assembly

MS

Invited Talks

11:00	HS 2 Chemie	MS 6.1	Isobar analysis in the actinide range and the characterization of an isotopic Np spike •Andreas Wiederin
15:45	HS 2 Chemie	MS 8.1	LABEC, the INFN-university of florence laboratory of nuclear techniques (IBA and AMS) for environment and cultural heritage •Franco Lucarelli

Thursday, March 13, 2025

MS

17:30	HS 2 Chemie	MS 9.1	Development of chemical ionization methods based on plasma driven reactant ion production •Thorsten Benter

Sessions

11:00	HS 2 Chemie	MS 6	Isobar Suppression Techniques
14:45	HS 2 Chemie	MS 7	New Methods, Technical Development II
15:45	HS 2 Chemie	MS 8	Accelerator Mass Spectrometry I
17:30	HS 2 Chemie	MS 9	Actinide Analysis

10:30	Foyer Physik	**Exhibition of Scientific Instruments**

Friday, March 14, 2025

			Plenary Talks
09:00	Kurt-Alder HS Chemie	PV XIII	Compressed Baryonic Matter experiment – becoming reality •Piotr Gasik
09:45	Kurt-Alder HS Chemie	PV XIV	Latest results on gamma spectroscopy with AGATA •Giovanna Benzoni

HK

			Invited Talks
11:00	Kurt-Alder HS Chemie	HK 62.1	New insights into the QCD phase diagram •Fabian Rennecke
11:30	Kurt-Alder HS Chemie	HK 62.2	Overview of the BGOOD experiment at ELSA, Bonn •Rachele Di Salvo
12:00	Kurt-Alder HS Chemie	HK 62.3	Precision experiments with undressed radioactive atoms •Yury Litvinov
			Session
11:00	Kurt-Alder HS Chemie	HK 62	Invited Talks III

MS

			Invited Talk
11:00	HS 2 Chemie	MS 10.1	Rare-RI Ring facility: tool of precision mass spectrometry of short-lived nuclei •Takayuki Yamaguchi
			Session
11:00	HS 2 Chemie	MS 10	Accelerator Mass Spectrometry II

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Plenary, Prize, Lunch, and Evening Talks

Plenary Talk PV I Mon 13:15 Kurt-Alder HS Chemie

Magic Moments: Exotic Calcium Isotopes in Laser Light — •Wilfried Nörtershäuser — TU Darmstadt, Institut für Kernphysik

The chain of calcium isotopes has been of interest for long since it is unique in having two stable doubly magic isotopes and a particular pattern of charge radii with those of the doubly magic ^{40,48}Ca nuclei being similar despite the 40% difference in neutron number. Improvements in experimental techniques allowed us to expand the knowledge of ground-state nuclear structure from ^{36}Ca almost at the neutron dripline up to the neutron-rich ^{54}Ca during the last years. This included laser spectroscopy of ^{54}Ca at a production rate of less than 1 ion/s at ISOLDE/CERN. Progress has also been made in laser spectroscopy in the neighboring elements and results are used to benchmark nuclear structure theory and provide a challenge for ab initio, density functional, and nuclear shell-model calculations.

Plenary Talk PV II Mon 14:00 Kurt-Alder HS Chemie

Tracing ocean circulation with mass spectrometry: AMS and ATTA in focus — •Nuria Casacuberta Arola[1], Christof Vockenhuber[1], Marcus Christl[1], Werner Aeschbach[2], and Markus Oberthaller[2] — [1]ETH Zürich, Switzerland — [2]University of Heidelberg, Germany

Advancements in Accelerator Mass Spectrometry (AMS) and Atom Trap Trace Analysis (ATTA) have, in recent years, disclosed many fairy tales about ocean circulation. In this talk, I will present a summary of the work that we have been doing at ETH Zürich. This project, TITANICA, aimed at deciphering circulation patterns, transport timescales, and mixing in the Arctic and subpolar North Atlantic oceans by using a novel approach that combines the long-lived radionuclides ^{236}U, ^{129}I, ^{14}C, ^{39}Ar. Yet, the big challenge of using these tracers still lies in their precise measurements, owing to their low concentrations in the ocean (i.e., atomic ratios that range from 10^{-8} to 10^{-16} relative to their abundant isotopes, ^{238}U, ^{127}I, ^{12}C, ^{40}Ar). In the last decades, the Laboratory of Ion Beam Physics (ETHZ) and the Kirchhoff-Institut für Physic (University of Heidelberg) have pushed AMS and ATTA performance, respectively, reaching unprecedented precisions, better machine performance, and higher throughput, resulting in comprehensive stories when it comes to ocean circulation and mixing. This talk will thus discuss the potential of combining multiple radionuclide tracers measured with ATTA and AMS technologies, the challenges and successes, and the many adventures that happened between ships and measurement halls.

Plenary Talk PV III Tue 9:00 Kurt-Alder HS Chemie

Nuclear Structure and Reaction Features in Nuclear Astrophysics — •Michael Wiescher — University of Notre Dame, Department of Physics and Astronomy, Notre Dame, IN 46556, USA

This presentation will examine the impact of nuclear threshold effects on nuclear reaction rates. It will highlight a number of significant single-particle and cluster phenomena near the particle threshold that emerge due to quantum coupling effects. These configurations may exert considerable influence on low-energy charged particle and neutron capture reactions in stellar burning environments. The potential consequences of these threshold features will be demonstrated and discussed for a range of quiescent and explosive nucleosynthesis environments.

Plenary Talk PV IV Tue 9:45 Kurt-Alder HS Chemie

Nuclear astrophysics with radioactive beams — •Artemis Spyrou — Michigan State University, East Lansing, MI, USA

Advances during the last decade have shown that the field of Nuclear Astrophysics is more complex than previously thought. The original nucleosynthesis processes proposed in the 1950s are still mostly valid and continue to exhibit important open questions. However, today we understand that additional processes may have significant contributions. In particular, the production of heavy elements, which includes nucleosynthesis in explosive environments, is one of the topics where major discoveries have been made in the last years. These are driven by new astronomical observations, sophisticated new astrophysical models, and new developments in radioactive ion beam facilities around the world. In this talk I will present an overview of the field of nuclear astrophysics, focusing on heavy element nucleosynthesis. I will discuss the exciting opportunities that open up at the new generation of radioactive beam facilities like the Facility for Rare Isotope Beams (FRIB) at Michigan State University. In addition, I will present recent efforts on constraining neutron-capture reactions on short-lived nuclei and their implications on astrophysical processes.

Plenary Talk PV V Wed 9:00 Kurt-Alder HS Chemie

Femtoscopy-for-interactions : a new tool to study low energy QCD — •Laura Fabbietti for the ALICE Germany-Collaboration — Technische Universität München

In recent years a new technique to study the residual strong interaction among hadrons has been developed at the LHC. The ALICE collaboration applied the femtoscopy-for-interactions method to data collected in pp collisions at 13 and 13.6 TeV to study the strong interaction of any hadron pairs containing up, down, strange and charm quarks. The technique provided precision data for systems already studied with scattering experiments, but also allowed to measure for the first time two body interactions which are otherwise not directly accessible. Systems such as Proto-Omega and D meson-pion or D meson-kaon have been investigated with the femtoscopy-for-interactions tool at the LHC. This allowed to test novel lattice calculations, constraint existing chiral models and look for the evidence of bound states. Such studies have recently also be extended to systems containing three hadrons with the aim of accessing genuine three particle interaction in a direct way or investigating the production mechanism of (anti)nuclei in hadron collisions.

The femtoscopy-for-interactions technique opened a plethora of applications in nuclear and hadron physics and this talk will provide an overview of the recent results and future perspectives.

Plenary Talk PV VI Wed 9:45 Kurt-Alder HS Chemie

Ab-initio studies of few-nucleon reactions of astrophysical interest — •Laura Elisa Marcucci — Department of Physics "E. Fermi", University of Pisa, Pisa, Italy — Istituto Nazionale di Fisica Nucleare, Pisa branch, Pisa, Italy

Nuclear reactions involving few-nucleon systems are of great interest for astrophysics, such as in stellar evolution modeling or Big Bang Nucleosynthesis (BBN) theory. Some of these reactions are also considered the best candidates for energy production via nuclear fusion. The great advantage of dealing with light nuclei is that ab-initio techniques can be used to predict cross sections (or astrophysical S-factors for charged nuclei) in the astrophysical energy range, which is difficult to access directly through experiments. In this talk, I will review the most recent ab-initio results obtained for nuclear reactions involving A=3 or 4 nuclear systems.

Lunch Talk PV VII Wed 13:00 HS 1 Physik

Reshaping the History of Quantum Physics: Paths to Gender Equality — •Andrea Reichenberger — TU Munich

We are all familiar with gender dynamics, biases, and stereotypes on the online platforms we visit, use, and co-create every day. They are ubiquitous in large language models (LLMs) and other generative AI technologies trained on large amounts of data. Their spillover effects are now well studied in scientific research. There is comparatively little research on how the history of physics is represented and practiced in today's online spaces. This talk will take you on a journey through the history of quantum physics, exploring new avenues for a gender-sensitive future of the history of physics. And it offers a critical insight into how expertise in the history of physics, science communication and public opinion influence and reinforce each other in the practice of digital history. Drawing on a series of case studies on women in the history of quantum physics, we examine the Matilda effect on online platforms and offer perspectives on how to successfully counteract this effect, which gives a name to the systematic misrecognition of women's contributions to science and technology.

Evening Talk PV VIII Wed 20:00 Kurt-Alder HS Chemie

Kosmische Nukleosynthese: Woher stammen die chemischen Elemente? — •Roland Diehl — Max Planck Institut für extraterrestrische Physik, Garching — Technische Universität München

Die chemischen Elemente und ihre Isotope, die wir auf der Erde und im Sonnensystem vorfinden, sind kosmischen Ursprungs: Kern-Fusions-Reaktionen im Innern von Sternen und Supernova-Explosionen haben den überwiegenden Beitrag geleistet, interstellare Prozesse haben Mischungen und Transport bewerkstelligt. Das so zusammengefasste Wissen ist allerdings etwas vereinfachend, die Vorgänge im Innern von Sternen, das Explodieren eines Sterns, und die Dynamik des interstellaren Mediums stellen Forscher vor viele Rätsel, wie wir sehen werden. Experimente an Teilchenbeschleunigern und im Labor versuchen die kosmischen Bedingungen für Kernreaktionen herzustellen und die möglichen Reaktionen zu bestimmen. Unterschiedliche astronomische Methoden müssen herangezogen werden, ihre jeweiligen Voreingenommenheiten sind kompliziert: Meteoriten liefern uns Sternenstaub, andere Methoden finden diesen auch in der Tiefsee und der Antarktis. Aber meist sind wir auf Strahlung und ihren Einfang in Teleskopen angewiesen, indirekte Daten also, die verstanden werden müssen. Wie kommt also obiges "Wissen" zustande? In diesem Vortrag wird die Astrophysik der Atomkerne im Universum, die "nukleare Astrophysik" portraitiert, ein aktueller Bestandteil dieser DPG Tagung.

Prize Talk PV IX Thu 9:00 Kurt-Alder HS Chemie

Two-proton radioactivity - status and perspectives — •Marek Pfützner — Faculty of Physics, University of Warsaw, Poland — Laureate of the Smoluchowski-Warburg-Prize 2025

Ground-state two-proton ($2p$) radioactivity is a characteristic decay mode for isotopes of even-Z elements located beyond the two-proton drip line. So far, this exotic process has been experimentally observed in a few light- and medium-mass nuclides with $Z \leq 36$. In fact, ground-state, simultaneous two-proton emission is predicted to be observable for every even-Z element up to tellurium. Most of them, however, will be very difficult to reach in the near future. In the region between tellurium and lead the particle instability is expected to be manifested by sequential emission of two protons. In addition to the ongoing search for new $2p$ emitters, an important research direction aims at precision studies of this exotic decay mode. The interesting question in this context is to what extent details of nuclear structure can be inferred from $2p$ decay observables. It is expected that the momentum correlations between the emitted protons may reveal the composition of the initial wave function. Work is in progress to investigate whether the $p-p$ correlations in the three classical cases ^{45}Fe, ^{48}Ni, and ^{54}Zn will shed light on the $Z = 28$ shell closure in this region of the nuclear chart.

In the talk, I will overview $2p$ radioactivity studies with a focus on recent experimental and theoretical developments.

Plenary Talk PV X Thu 9:45 Kurt-Alder HS Chemie

Towards Solving Computational Challenges in Lattice Field Theory: From Deep Learning to Quantum Computing — •Lena Funcke — University of Bonn, Bonn, Germany

In lattice field theory, several parameter regimes remain inaccessible to conventional Monte Carlo methods, including topological terms, non-zero baryon density, and real-time dynamics. Using lower-dimensional benchmark models as examples, I will review new approaches towards overcoming these challenges, based on deep learning, tensor networks, and quantum computing. Finally, I will discuss the requirements for integrating these methods into (3+1)-dimensional lattice simulations in the future, with a focus on Lattice QCD.

Lunch Talk PV XI Thu 12:30 HS 1 Physik

Book Launch – Physik: Erkenntnisse und Perspektiven (in German) — •Jens Kube[1], Joachim Ullrich[2], Ulrich Bleyer[2], Sarah Köster[3], Claus Lämmerzahl[4], Dieter Meschede[5], and Lutz Schröter[2] — [1]Agentur für Wissenschaftskommunikation awk/jk, Bremen — [2]Deutsche Physikalische Gesellschaft e. V., Bad Honnef — [3]Universität Göttingen, Institut für Röntgenphysk, Göttingen — [4]Universität Bremen, Weltraumwissenschaft ZARM, Bremen — [5]Universität Bonn, Institut für Angewandte Physik, Bonn

Join us for the book launch of the new DPG publication. The title “Physik: Erkenntnisse und Perspektiven” (Physics: Insights and Perspectives) refers to a publication, which was produced on a voluntary basis by almost 200 authors. It provides a detailed exploration of the fundamentals of physics, current research and future developments. The book offers readers an engaging and inspiring insight into the world of physics! The publication is also available at www.physik-erkenntnisse-perspektiven.de – along with exclusive video interviews. Printed copies can be ordered by covering the shipping costs.

Lunch Talk PV XII Thu 13:00 HS 1 Physik

Overview and plans of the Italian German Collaboration in hadron and nuclear physics — •Angela Bracco — Università degli Studi di Milano and INFN

The Italian German Collaboration in hadron and nuclear physics has a well established tradition concerning experiments, technical, and theoretical developments. This long lasting collaboration has been growing during the years. Selected results will be presented that are mainly related to activities at the German and Italian Laboratories and at CERN. INFN is the Italian funding agency supporting during the years these successful researches. Presently there are very fruitful collaborations at MAMI and ELSA addressing open questions for unconventional and exotic hadrons via precision spectroscopy. Via heavy ions experiments at FAIR/GSI and at CERN the search of dense quark matter and of hot and dense quark-gluon plasma has been carried out leading to very interesting results from which it is possible to extract quantity relevant for other physics sectors, in particular for the description of neutron stars. Nuclear structure experiments performed at FAIR/GSI and at INFN-LNL mainly via gamma spectroscopy are presently concentrating on new phenomena occurring far from stability and on nuclear properties of interest for the modeling of the nucleosyntheses. The measurements of reactions occurring in the stars at the laboratory LNGS have led to unique results. From the few selected highlights it is clear that there is bright future ahead and thus it will be important to further reinforce this successful Italian German collaboration.

Plenary Talk PV XIII Fri 9:00 Kurt-Alder HS Chemie

Compressed Baryonic Matter experiment - becoming reality — •Piotr Gasik for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH (GSI) — Facility for Antiproton and Ion Research in Europe GmbH (FAIR) — Institut für Kernphysik, Technische Universität Darmstadt

The Compressed Baryonic Matter (CBM) experiment is under construction at the Facility for Antiproton and Ion Research (FAIR) in Darmstadt, Germany. It aims to explore the phase structure and microscopic properties of strong interaction (QCD) matter at large net-baryon densities and moderate temperatures using heavy-ion collisions in the energy range $\sqrt{s_{\rm NN}} = 2.9$ - 4.9 GeV.

CBM is a fixed-target experiment, equipped with fast and radiation hard detector systems and an advanced triggerless data acquisition scheme. It will collect data at unprecedented interaction rates by performing online reconstruction and event selection, thus allowing measurements of rare probes not accessible so far in this energy range. These include: multi-strange hadron production and their flow, higher-order cumulants, dileptons, as well as double-strange hypernuclei.

The presentation will provide an overview of the CBM physics performance and objectives, as well as the detector technologies being developed for the experiment. The status of preparations for CBM commissioning in 2028, including performance evaluations of CBM components at FAIR Phase-0 experiments, will also be presented.

Plenary Talk PV XIV Fri 9:45 Kurt-Alder HS Chemie

Latest results on gamma spectroscopy with AGATA — •giovanna Benzoni — INFN, sez. di Milano, Milano, Italy

The study of nuclear structure around and away from the valley of stability has led to the discovery of new phenomena, such as the occurrence of new shapes, new shell closures and shape coexistence. The detailed study of these features require the use of state-of-the-art gamma spectrometers, such as the AGATA gamma-ray tracking array, providing the highest detection efficiency and position sensitivity, crucial to pin down weak signals.

The Advanced GAmma Tracking Array (AGATA) is a major European project, involving over 40 institutes in 12 countries, to develop and operate a high-resolution gamma-ray tracking spectrometer. AGATA is a travelling instrumentation visiting the major European laboratories, GANIL (Fr), GSI-FAIR (D) and INFN-LNL (I).

In this plenary talk the main features of the AGATA array will be presented, together with highlights of the campigns at the 3 main european laboratories, with a look forward to future campaigns.

Meet the Industry (MTI)

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Overview of Lunch Talks and Sessions

(Lecture hall HS 2 Physik)

Lunch Talks

MTI 1.1	Tue	12:30–12:50	HS 2 Physik	**From Astrophysics to Spent Nuclear Fuel Management: A Journey Through Nuclear Science and Technology** — •Lars Netterdon
MTI 1.2	Tue	12:50–13:10	HS 2 Physik	**Unternehmensberatung bei einem Hidden Champion – Abseits von typischen Beraterklischees** — •Julius Wilhelmy

Sessions

MTI 1.1–1.2	Tue	12:30–13:10	HS 2 Physik	**Meet the Industry**

Sessions

– Lunch Talks –

MTI 1: Meet the Industry

Time: Tuesday 12:30–13:10 Location: HS 2 Physik

Lunch Talk MTI 1.1 Tue 12:30 HS 2 Physik

From Astrophysics to Spent Nuclear Fuel Management: A Journey Through Nuclear Science and Technology — •Lars Netterdon — GNS Gesellschaft für Nuklear-Service mbH, Frohnhauser Straße 67, 45127 Essen

Career opportunities and paths for physicists outside the university are diverse and sometimes confusing, which makes a job search a rather complex endeavor. In this contribution I will share my experiences on my journey from Nuclear Astrophysics at the University of Cologne to industry. In particular, I will give an overview about my current position in cask development for spent nuclear fuel at GNS Essen. I will also make an attempt to point out differences and similarities between working at the university and industry.

Lunch Talk MTI 1.2 Tue 12:50 HS 2 Physik

Unternehmensberatung bei einem Hidden Champion – Abseits von typischen Beraterklischees — •Julius Wilhelmy — d-fine GmbH, An der Hauptwache 7, 60313 Frankfurt am Main

Die geballte Kompetenz von über 1.500 Expertinnen und Experten der Physik, Mathematik, Informatik und Ingenieurwissenschaften vereint in einem europäischen Unternehmen mit einer über 20-jährigen Geschichte, das den Fokus auf mathematische Modellierung, technologischen Fortschritt und Data Science legt – das ist d-fine.

Symposium Mass Matters: Prospects of Bridging Nuclear Physics, Mass Spectrometry, and Astrophysics (SYMM)

jointly organised by
the Hadronic and Nuclear Physics Division (HK), and
the Mass Spectrometry Division (MS)

Anton Wallner
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The symposium will focus on the interplay between nuclear astrophysics, nuclear physics, and mass spectrometry, with particular emphasis on heavy element nucleosynthesis and the role of neutron capture rates. Measuring and understanding the nuclear masses of exotic nuclei are crucial for better constraining explosive nucleosynthesis processes. The afternoon session will spotlight ongoing efforts to measure neutron capture rates in the laboratory and explore their crucial role in shaping "live" remnants of explosive nucleosynthesis events in the cosmos, which are detected on Earth using Accelerator Mass Spectrometry (AMS).

Overview of Invited Talks and Sessions

(Lecture halls Kurt-Alder HS Chemie and HS 1 Physik)

Prepending Plenary Talks

PV III	Tue	9:00– 9:45	Kurt-Alder HS Chemie	**Nuclear Structure and Reaction Features in Nuclear Astrophysics** — •Michael Wiescher
PV IV	Tue	9:45–10:30	Kurt-Alder HS Chemie	**Nuclear astrophysics with radioactive beams** — •Artemis Spyrou

Invited Talks

SYMM 1.1	Tue	11:00–11:30	Kurt-Alder HS Chemie	**Mass measurements with RIBs** — •Guy Savard
SYMM 1.2	Tue	11:30–12:00	Kurt-Alder HS Chemie	**LUNA -Experimental challenges in Underground Nuclear Astrophysics Laboratory** — •Alba Formicola
SYMM 1.3	Tue	12:00–12:30	Kurt-Alder HS Chemie	**The r-process: connecting astrophysics and nuclear physics** — •Almudena Arcones
SYMM 2.1	Tue	14:00–14:25	HS 1 Physik	**Neutron-induced reactions and open questions in the s-process** — •Alberto Mengoni
SYMM 2.2	Tue	14:25–14:50	HS 1 Physik	**n-capture experiments in inverse kinematics** — •Rene Reifarth
SYMM 2.3	Tue	14:50–15:15	HS 1 Physik	**Single atom counting of live interstellar radionuclides in natural archives** — •Johannes Lachner

Sessions

SYMM 1.1–1.3	Tue	11:00–12:30	Kurt-Alder HS Chemie	**Mass Matters: Prospects of Bridging Nuclear Physics, Mass Spectrometry, and Astrophysics**
SYMM 2.1–2.3	Tue	14:00–15:30	HS 1 Physik	**Focus Session: Neutron capture reactions in the cosmos and the lab (joint session HK/SYMM)**

Sessions

– Invited Talks –

SYMM 1: Mass Matters: Prospects of Bridging Nuclear Physics, Mass Spectrometry, and Astrophysics

Time: Tuesday 11:00–12:30 Location: Kurt-Alder HS Chemie

Invited Talk SYMM 1.1 Tue 11:00 Kurt-Alder HS Chemie
Mass measurements with RIBs — •Guy Savard — Argonne National Laboratory, Lemont, Illinois, USA

Mass measurements on short-lived isotopes provide key input to our understanding of many physical and astrophysical processes. The ability to make such measurements has grown tremendously over the last decade with a number of laboratories implementing new techniques that have provided higher sensitivity, higher accuracy, and in some cases both. These new approaches will be surveyed and some high profile results they have enabled presented. Coming new capabilities will also be highlighted.

Invited Talk SYMM 1.2 Tue 11:30 Kurt-Alder HS Chemie
LUNA -Experimental challenges in Underground Nuclear Astrophysics Laboratory — •Alba Formicola — INFN-Roma- P.le Aldo Moro, 2 - 00185 Roma

Stellar evolution and related nucleosynthesis play a fundamental role in the understanding of the origin of the chemical elements, the generation of energy, the luminosity of neutrinos and in many related astrophysical problems. The main goal of nuclear astrophysics is to provide a firm base for all these studies. Thousands of nuclear interactions, either strong or weak processes, are of astrophysical interest. For most of them, the knowledge of their cross sections (or reaction rates) at relatively low energy is required to understand the synthesis of the elements. The Laboratori Nazianali del Gran Sasso (INFN) has been for a long time a unique infrastructure hosting an accelerator devoted to Nuclear Astrophysics, the Laboratory for Underground Nuclear Astrophysics (LUNA). The LUNA Collaboration has shown that, by going underground and by using the typical techniques of low background physics, it is possible to measure nuclear cross sections down to the energy of the nucleosynthesis inside stars. I will give an overview of the experimental techniques adopted in underground nuclear astrophysics and will present a summary of the LUNA main recent results and achievements.

Invited Talk SYMM 1.3 Tue 12:00 Kurt-Alder HS Chemie
The r-process: connecting astrophysics and nuclear physics — •Almudena Arcones — Institut für Kernphysik, Technische Universität Darmstadt, Germany — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — Max-Planck-Institut für Kernphysik, Heidelberg, Germany

Our understanding of the origin of heavy elements by the r-process (rapid neutron capture process) has made great progress in the last years. In addition to the gravitational wave and kilonova observations for GW170817, there have been major advances in the hydrodynamical simulations of neutron star mergers and core-collapse supernovae, in the microphysics included in those simulations (neutrinos and high density equation of state), in galactic chemical evolution models, in observations of old stars in our galaxy and in dwarf galaxies, and in nuclear theory and experiments. This talk will report on recent breakthroughs in understanding the extreme environments in which the formation of the heavy elements occurs, as well as open questions regarding the astrophysics and nuclear physics involved.

SYMM 2: Focus Session: Neutron capture reactions in the cosmos and the lab (joint session HK/SYMM)

Time: Tuesday 14:00–15:30 Location: HS 1 Physik

Invited Talk SYMM 2.1 Tue 14:00 HS 1 Physik
Neutron-induced reactions and open questions in the s-process — •Alberto Mengoni — INFN, Bologna and CERN, Geneva

Despite the enormous progress made in the investigation of the nucleosynthesis of the s-process, there are several open issues that need additional investigations, both experimentally as well as with the help of theoretical modeling. Among these, one of the most critical is the determination of the neutron capture rate for unstable branching points in the s-process path. While difficult to be measured (because of their radioactivity), the neutron capture cross section of branching points nuclei are useful for the determination of the astrophysical conditions in which the s-process is taking place (neutron densities, temperature).

Considerable progress has been made recently in the possibility to measure neutron capture cross section of unstable nuclei. Examples are recent measurements performed at experimental facilities such as n_TOF at CERN, LANSCE at Los Alamos and LiLIT at SARAF. Further developments of these activities will be presented.

Additional aspects of the nuclear physics developments, including those related to the determination of the stellar neutron capture rates and their theoretical modeling, as well as their corresponding beta-decay rates in plasma conditions will be reviewed.

Invited Talk SYMM 2.2 Tue 14:25 HS 1 Physik
n-capture experiments in inverse kinematics — •Rene Reifarth — LANL, Los Alamos, USA

Virtually all of the isotopes heavier than iron would not exist without neutron-induced reactions. Despite there importance in many different astrophysical scenarios, there are almost no direct measurements for isotopes with half-lives shorter than a few years. A radically new approach is necessary to overcome this constraint.

Ion storage rings offer unprecedented possibilities to investigate radioactive isotopes of astrophysical importance in inverse kinematics. During the last years, a series of pioneering experiments proofed the feasibility of this concept for the fusion of charged paricles at the Experimental Storage Ring (ESR) at GSI. In the future, a combination of a free-neutron target and an ion storage ring can bring the half-life limit for direct neutron-induced reactions down to fractions of a minute.

I will review different astrophysical scenarios, status of current experiments as well as prospects of this new experimental endeavor.

Invited Talk SYMM 2.3 Tue 14:50 HS 1 Physik
Single atom counting of live interstellar radionuclides in natural archives — •Johannes Lachner — Helmholtz-Zentrum Dresden-Rossendorf

Recent nearby supernovae and other cosmic explosions produce also long-lived radionuclides that penetrate into the solar system and are collected in terrestrial and lunar archives. Accelerator Mass Spectrometry (AMS) is used to identify minute amounts of these live radionuclides in environmental samples. Such signatures provide insight into the location and frequency of recent nearby Supernova activity and r-process events.

However, only in a few cases the proper combination of environmental archive and long-lived radionuclide allows to identify a clear fingerprint of such a rare input. Measurements of Supernova-produced ^{60}Fe ($T_{1/2}$=2.6 Myr) in deep-sea sediments and FeMn crusts as well as in lunar soil point to multiple Supernovae occurring in our solar vicinity within the past 10 Myr. Besides ^{60}Fe, recently also the pure r-process nuclide ^{244}Pu ($T_{1/2}$=81 Myr) was detected in deep-sea archives demonstrating that r-process indeed occurred within the past few 100 Myr.

In this presentation, I will also discuss present technical constraints in the detection of such radionuclides by AMS and ongoing work increasing the capabilities for the analysis of additional interstellar radionuclides, e.g. ^{182}Hf and ^{247}Cm.

Common discussion: 15'

Hadronic and Nuclear Physics Division
Fachverband Physik der Hadronen und Kerne (HK)

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Overview of Invited Talks and Sessions

(Lecture halls Kurt-Alder HS Chemie, HS 1 & 2 & 3 Physik, HS 3 Chemie, SR Exp1A & SR Exp1B Chemie, SR 0.01 & SR 0.03 Erw. Physik; Poster Foyer Physik)

Invited Talks

HK 13.1	Tue	14:00–14:25	HS 1 Physik	**Neutron-induced reactions and open questions in the s-process** — •Alberto Mengoni
HK 13.2	Tue	14:25–14:50	HS 1 Physik	**n-capture experiments in inverse kinematics** — •Rene Reifarth
HK 13.3	Tue	14:50–15:15	HS 1 Physik	**Single atom counting of live interstellar radionuclides in natural archives** — •Johannes Lachner
HK 24.1	Wed	11:00–11:30	Kurt-Alder HS Chemie	**PUMA: low-energy nuclear physics with antiprotons** — •Alexandre Obertelli
HK 24.2	Wed	11:30–12:00	Kurt-Alder HS Chemie	**How well do we know the vector quarkonia?** — •Nils Hüsken
HK 24.3	Wed	12:00–12:30	Kurt-Alder HS Chemie	**Precision redefined: Unlocking new frontiers with Monolithic Active Pixel Sensors** — •Bogdan-Mihail Blidaru
HK 25.1	Wed	14:00–14:25	HS 1 Physik	**First laser spectroscopic measurements of charge radii along the carbon isotope chain** — •Kristian König, Emily Burbach, Phillip Imgram, Bernhard Maass, Patrick Müller, Wilfried Nörtershäuser, Julien Spahn
HK 25.2	Wed	14:25–14:50	HS 1 Physik	**Precision radii of light elements using Metallic Magnetic Calorimeters** — •Frederik Wauters
HK 25.3	Wed	14:50–15:15	HS 1 Physik	**Precision Radii from the No-Core Shell Model via Neural Networks** — •Robert Roth
HK 39.1	Thu	11:00–11:30	Kurt-Alder HS Chemie	**Upgrade programme for the ALICE experiment at the LHC** — •Andrea Dainese
HK 39.2	Thu	11:30–12:00	Kurt-Alder HS Chemie	**Antiproton production measurement for indirect Dark Matter search at the AMBER experiment at CERN** — •Davide Giordano
HK 39.3	Thu	12:00–12:30	Kurt-Alder HS Chemie	**New Constraints on the Nuclear Equation of State** — •Melissa Mendes
HK 62.1	Fri	11:00–11:30	Kurt-Alder HS Chemie	**New insights into the QCD phase diagram** — •Fabian Rennecke
HK 62.2	Fri	11:30–12:00	Kurt-Alder HS Chemie	**Overview of the BGOOD experiment at ELSA, Bonn** — •Rachele Di Salvo
HK 62.3	Fri	12:00–12:30	Kurt-Alder HS Chemie	**Precision experiments with undressed radioactive atoms** — •Yury Litvinov

Invited Talks of the joint Symposium Mass Matters: Prospects of Bridging Nuclear Physics, Mass Spectrometry, and Astrophysics (SYMM)

See SYMM for the full program of the symposium.

SYMM 1.1	Tue	11:00–11:30	Kurt-Alder HS Chemie	**Mass measurements with RIBs** — •Guy Savard
SYMM 1.2	Tue	11:30–12:00	Kurt-Alder HS Chemie	**LUNA -Experimental challenges in Underground Nuclear Astrophysics Laboratory** — •Alba Formicola
SYMM 1.3	Tue	12:00–12:30	Kurt-Alder HS Chemie	**The r-process: connecting astrophysics and nuclear physics** — •Almudena Arcones

Sessions

HK 1.1–1.5	Mon	15:00–16:30	HS 2 Physik	**Structure and Dynamics of Nuclei I**
HK 2.1–2.4	Mon	15:00–16:15	HS 3 Physik	**Structure and Dynamics of Nuclei II**
HK 3.1–3.6	Mon	15:00–16:30	HS 3 Chemie	**Heavy-Ion Collisions and QCD Phases I**
HK 4.1–4.5	Mon	15:00–16:30	SR Exp1A Chemie	**Instrumentation I**
HK 5.1–5.6	Mon	15:00–16:30	SR Exp1B Chemie	**Instrumentation II**
HK 6.1–6.5	Mon	15:00–16:30	SR 0.03 Erw. Physik	**Nuclear Astrophysics I**
HK 7.1–7.6	Mon	16:45–18:15	HS 2 Physik	**Structure and Dynamics of Nuclei III**
HK 8.1–8.4	Mon	16:45–18:00	HS 3 Physik	**Structure and Dynamics of Nuclei IV**
HK 9.1–9.6	Mon	16:45–18:15	HS 3 Chemie	**Heavy-Ion Collisions and QCD Phases II**
HK 10.1–10.5	Mon	16:45–18:15	SR Exp1A Chemie	**Instrumentation III**
HK 11.1–11.6	Mon	16:45–18:15	SR Exp1B Chemie	**Instrumentation IV**
HK 12.1–12.4	Mon	16:45–18:00	SR 0.03 Erw. Physik	**Nuclear Astrophysics II**
HK 13.1–13.3	Tue	14:00–15:30	HS 1 Physik	**Focus Session I: Neutron capture reactions in the cosmos and the lab (joint session HK/SYMM)**
HK 14.1–14.5	Tue	14:00–15:30	HS 2 Physik	**Structure and Dynamics of Nuclei V**
HK 15.1–15.5	Tue	14:00–15:30	HS 3 Physik	**Hadron Structure and Spectroscopy I**
HK 16.1–16.6	Tue	14:00–15:30	HS 3 Chemie	**Heavy-Ion Collisions and QCD Phases III**
HK 17.1–17.5	Tue	15:45–17:15	HS 2 Physik	**Structure and Dynamics of Nuclei VI**
HK 18.1–18.5	Tue	15:45–17:15	HS 3 Physik	**Hadron Structure and Spectroscopy II**
HK 19.1–19.6	Tue	15:45–17:15	HS 3 Chemie	**Heavy-Ion Collisions and QCD Phases IV**
HK 20.1–20.6	Tue	15:45–17:15	SR Exp1A Chemie	**Instrumentation V**
HK 21.1–21.5	Tue	15:45–17:15	SR Exp1B Chemie	**Instrumentation VI**
HK 22.1–22.5	Tue	15:45–17:15	SR 0.03 Erw. Physik	**Nuclear Astrophysics III**
HK 23.1–23.44	Tue	17:30–19:00	Foyer Physik	**Poster**
HK 24.1–24.3	Wed	11:00–12:30	Kurt-Alder HS Chemie	**Invited Talks I**
HK 25.1–25.3	Wed	14:00–15:30	HS 1 Physik	**Focus Session II: Accurate Nuclear Charge Radii of Light Elements**
HK 26.1–26.5	Wed	14:00–15:30	HS 2 Physik	**Structure and Dynamics of Nuclei VII**
HK 27.1–27.5	Wed	14:00–15:15	SR Exp1A Chemie	**Computing I**
HK 28.1–28.4	Wed	15:45–17:15	HS 2 Physik	**Structure and Dynamics of Nuclei VIII**
HK 29.1–29.5	Wed	15:45–17:15	HS 3 Physik	**Hadron Structure and Spectroscopy III**
HK 30.1–30.5	Wed	15:45–17:15	HS 3 Chemie	**Heavy-Ion Collisions and QCD Phases V**
HK 31.1–31.5	Wed	15:45–17:00	SR Exp1A Chemie	**Instrumentation VII**
HK 32.1–32.5	Wed	15:45–17:15	SR 0.03 Erw. Physik	**Nuclear Astrophysics IV**
HK 33.1–33.5	Wed	17:30–19:00	HS 2 Physik	**Structure and Dynamics of Nuclei IX**
HK 34.1–34.5	Wed	17:30–18:45	HS 3 Physik	**Hadron Structure and Spectroscopy IV**
HK 35.1–35.6	Wed	17:30–19:00	HS 3 Chemie	**Heavy-Ion Collisions and QCD Phases VI**
HK 36.1–36.5	Wed	17:30–19:00	SR Exp1A Chemie	**Instrumentation VIII**
HK 37.1–37.5	Wed	17:30–19:00	SR 0.03 Erw. Physik	**Nuclear Astrophysics V**
HK 38.1–38.1	Wed	19:00–20:00	HS 3 Physik	**yHEP Annual Meeting**
HK 39.1–39.3	Thu	11:00–12:30	Kurt-Alder HS Chemie	**Invited Talks II**
HK 40.1–40.5	Thu	14:00–15:30	HS 2 Physik	**Structure and Dynamics of Nuclei X**
HK 41.1–41.6	Thu	14:00–15:30	HS 3 Physik	**Hadron Structure and Spectroscopy V**
HK 42.1–42.5	Thu	14:00–15:30	HS 3 Chemie	**Heavy-Ion Collisions and QCD Phases VII**
HK 43.1–43.5	Thu	14:00–15:30	SR Exp1A Chemie	**Instrumentation IX**
HK 44.1–44.6	Thu	14:00–15:30	SR Exp1B Chemie	**Instrumentation X**
HK 45.1–45.5	Thu	14:00–15:15	SR 0.03 Erw. Physik	**Nuclear Astrophysics VI**
HK 46.1–46.2	Thu	14:00–14:30	SR 0.01 Erw. Physik	**Computing II**
HK 47.1–47.2	Thu	14:30–15:30	SR 0.01 Erw. Physik	**Fundamental Symmetries I**
HK 48.1–48.6	Thu	15:45–17:15	HS 2 Physik	**Structure and Dynamics of Nuclei XI**
HK 49.1–49.4	Thu	15:45–17:00	HS 3 Physik	**Hadron Structure and Spectroscopy VI**
HK 50.1–50.6	Thu	15:45–17:15	HS 3 Chemie	**Heavy-Ion Collisions and QCD Phases VIII**
HK 51.1–51.5	Thu	15:45–17:15	SR Exp1A Chemie	**Instrumentation XI**
HK 52.1–52.5	Thu	15:45–17:00	SR Exp1B Chemie	**Instrumentation XII**
HK 53.1–53.4	Thu	15:45–17:00	SR 0.03 Erw. Physik	**Nuclear Astrophysics VII**
HK 54.1–54.4	Thu	15:45–17:15	SR 0.01 Erw. Physik	**Fundamental Symmetries II**
HK 55.1–55.4	Thu	17:30–18:45	HS 2 Physik	**Structure and Dynamics of Nuclei XII**
HK 56.1–56.4	Thu	17:30–18:45	HS 3 Physik	**Hadron Structure and Spectroscopy VII**
HK 57.1–57.5	Thu	17:30–19:00	HS 3 Chemie	**Heavy-Ion Collisions and QCD Phases IX**
HK 58.1–58.5	Thu	17:30–19:00	SR Exp1A Chemie	**Instrumentation XIII**
HK 59.1–59.5	Thu	17:30–18:45	SR Exp1B Chemie	**Instrumentation XIV**

HK 60.1–60.3	Thu	17:30–18:30	SR 0.03 Erw. Physik	**Astroparticle Physics VIII**
HK 61	Thu	19:00–20:30	HS 2 Physik	**Members' Assembly**
HK 62.1–62.3	Fri	11:00–12:30	Kurt-Alder HS Chemie	**Invited Talks III**

Members' Assembly of the Hadronic and Nuclear Physics Division

Thursday 19:00–20:30 HS 2 Physik

- Approval of the minutes and the agenda
- Report from HK division chair
- Report from KHuK
- Election of new HK chair and deputy
- Aob

Sessions

– Invited Talks, Group Reports, Contributed Talks, and Posters –

HK 1: Structure and Dynamics of Nuclei I

Time: Monday 15:00–16:30 Location: HS 2 Physik

Group Report HK 1.1 Mon 15:00 HS 2 Physik

Systematic investigation of *E1* strength below S_n in the tin isotopic chain using the (d,pγ) reaction — •Markus Müllenmeister, Michael Weinert, Florian Kluwig, Tanja Schüttler, and Andreas Zilges — University of Cologne, Institute for Nuclear Physics, Germany

The evolution of the electric dipole (*E1*) response in various nuclei has been the subject of intense study for decades [1]. The structure of the so-called Pygmy Dipole Resonance, which emerges around and below the neutron separation energy of most medium- to heavy-mass nuclei, is of particular interest [2]. New insights into its origin can be gained through the well-established method of neutron transfer [3]. When combined with state-of-the-art analysis techniques, theoretical calculations, and comparative studies using different probes, the dipole strength can be examined across different nuclides to obtain detailed structural information [4].

In this contribution, a comparison for the tin isotopes, accessible via the $(d,p\gamma)$-reaction, will be presented and compared to real photon scattering data. Together, these methods highlight the dominance of single-particle excitations at lower energies, while more complex configurations become significant at higher energies.

Supported by the DFG (ZI 510/10-1)

[1] A. Bracco *et al.*, Prog. Part. Nucl. Phys. **106** (2019) 360
[2] D. Savran *et al.*, Prog. Part. Nucl. Phys. **70** (2013) 210
[3] M. Weinert *et al.*, Phys. Rev. Lett. **127** (2021) 242501
[4] D. Savran *et al.*, Phys. Lett. B **786** (2018) 16

HK 1.2 Mon 15:30 HS 2 Physik

Photoabsorption Cross Sections of Tin and Calcium Isotopes — •Martin Baumann[1], Thomas Aumann[1,2], Maike Beuschlein[1], Isabelle Brandherm[1], Meytal Duer[1], Amrita Gupta[1], Phillip Imgram[1], Andrea Jedele[1], Liancheng Ji[1], Igor Jurosevic[1], Marco Knösel[1], Nikolina Wagner[1], Enis Lorenz[1], Hannes Mayr[1], Leandro Milhomes da Fonseca[1], Nikhil Mozumdar[1], Ann Rochele Netto[1], Oliver Papst[1], Thomas Pohl[1], Heiko Scheit[1], Gerhart Steinhilber[1], Sonja Storck-Dutine[1], Dmytro Symochko[1], Iyabo Usman[3], and Patrick van Beek[1] — [1]Institut für Kernphysik, TU Darmstadt, Germany — [2]GSI Helmholtzzentrum, Darmstadt, Germany — [3]University of the Witwatersrand, Johannesburg, South Africa

The photoabsorption setup of the NEPTUN photon tagger at the superconducting linear accelerator S-DALINAC has been used to investigate the photoabsorption cross sections of Sn-112,116,120,124 as well as Ca-40,48 in the region from 5 to 30 MeV using a beam of tagged photons. In this talk the measurement method as well as the current status of the data analysis will be presented.

This work is supported by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) - Project-ID 279384907 - SFB 1245.

HK 1.3 Mon 15:45 HS 2 Physik

Probing the doubly-magic shell closure at ^{132}Sn by Coulomb excitation of neutron-rich ^{130}Sn — •Maximilian Droste[1], Peter Reiter[2], and Thorsten Kröll[2] for the IS702-Collaboration — [1]IKP, Universität zu Köln — [2]IKP, TU Darmstadt

Excited states of ^{130}Sn, the even-even neighbour of doubly-magic ^{132}Sn, were studied by safe Coulomb excitation using the highly-efficient MINIBALL array. The ^{130}Sn ions were accelerated to 4.4 MeV/u at the HIE-ISOLDE accelerator and collided with a ^{206}Pb target. Deexciting γ rays from excited states were detected in coincidence with scattered particles. In addition to γ rays from the first 2^+ state of ^{130}Sn, deexcitation from higher-lying states was observed, attributed to an isomeric ^{130}Sn $J^\pi = 7^-$ beam component. A new $B(E2; 0^+_{\text{g.s.}} \to 2^+_1)$ value is compared to recent theoretical results from state-of-the-art MCSM calculations which differ strongly from previous measurements [1,2]. These calculations also indicate a transition from a slightly oblate to a prolate configuration of the first excited 2^+ state across doubly magic ^{132}Sn. The high statistics of the performed experiment allows for an experimental investigation of the Q_{2^+} value.

[1] D. Rosiak *et al.* Phys. Rev. Lett. 121, 252501 (2018)
[2] T. Togashi *et al.* Phys. Rev. Lett. 121, 062501 (2018)

Supported by the German BMBF 05P21PKCI1, 05P24PKCI1, 05P21RDCI2 and European Union*s Horizon Europe Frame- work research and innovation programme under grant agreement no. 101057511

HK 1.4 Mon 16:00 HS 2 Physik

Lifetimes of excited states in ^{116,118}Sn — •Sarah Prill, Elias Binger, Anna Bohn, Tobias Langel, Michael Weinert, and Andreas Zilges — University of Cologne, Institute for Nuclear Physics, Germany

The proton-magic tin isotopic chain has the highest number of stable isotopes and is therefore an ideal candidate to study nuclear properties in a wide range of nuclei. Lifetimes of excited states in the femtosecond range have already been determined in Cologne for ^{112}Sn and ^{114}Sn [1] using the Coincidence Doppler-Shift Attenuation Method (CDSAM) [2,3]. The study was continued for the nuclei ^{116}Sn and ^{118}Sn, using not only inelastic proton scattering but also alpha particles as the beam.

Coincidence data were recorded with the SONIC@HORUS setup [4] at the tandem accelerator of the University of Cologne. Combining particle and γ-ray detection allowed the reconstruction of the reaction kinematics and enabled the analysis of single levels without feeding contributions.

This presentation will show the lifetime results for ^{116}Sn and ^{118}Sn and discuss the influence of different beam particles.

Supported by the DFG (ZI 510/9-2).

[1] M. Spieker *et al.*, Phys. Rev. C **97**, 054319 (2018).
[2] A. Hennig *et al.*, Nucl. Instr. Meth. A **758**, 171 (2015).
[3] S. Prill *et al.*, Phys. Rev. C **105**, 034319 (2022).
[4] S. G. Pickstone *et al.*, Nucl. Instr. Meth. A **875**, 104 (2017).

HK 1.5 Mon 16:15 HS 2 Physik

Determination of the energy-resolvable $E1$- and $M1$-strength distribution in ^{70}Zn — •J. Hauf[1], V. Werner[1], A. D. Ayangeakaa[2,3], D. Balabanski[4,5], M. Beuschlein[1], R. Beyer[6], S. W. Finch[2,7], A. Gupta[1], D. Gribble[2,3], T. Hensel[6], M. Heumüller[1], F. E. Idoku[2,3], J. Isaak[1], X. James[2,3], R. V. F. Janssens[2,3], S. R. Johnson[2,3], A. Junghans[6], J. Kleemann[1], P. Koseoglou[1], T. Kowalewski[2,3], A. Kusoglu[4], J. Lu[1], E. Masha[6], C. M. Nickel[1], O. Papst[1], M. Pichotta[6], N. Pietralla[1], K. Prifti[1], K. Römer[6], A. Saracino[2,3], P.-A. Söderström[4], K. Schmidt[6], R. Schwengner[6], A. Thees[6], S. Turkat[6], J. Vogel[1], A. Wagner[6], and A. Yadev[6] — [1]TU Darmstadt, IKP — [2]TUNL — [3]University of North Carolina — [4]ELI-NP — [5]Horia Hulubei National Institute — [6]Helmholtz-Zentrum Dresden-Rossendorf — [7]Duke University

Nuclear resonance fluorescence experiments with bremsstrahlung and quasi-monoenergetic photon beams have been conducted on ^{70}Zn at γELBE and HIγS. The investigation of the most neutron-rich stable zinc isotope aims to achieve a better understanding of nuclear structure phenomena, such as shape coexistence and the Pygmy dipole resonance, at the $N = 40$ harmonic oscillator shell closure. The status of the analysis, including spectra and preliminary results for the $E1$- and $M1$-strength distributions, are shown and discussed.

This work is supported by DFG under Project-IDs 499256822*GRK 2891, 279384907*SFB 1245 and by ELI-RO under ELI-RO/RDI/2024 002 and ELI-RO/RDI/2024 007.

HK 2: Structure and Dynamics of Nuclei II

Time: Monday 15:00–16:15 Location: HS 3 Physik

Group Report HK 2.1 Mon 15:00 HS 3 Physik

Latest Results from TITAN's Multiple-Reflection Time-Of-Flight Mass Spectrometer — •Ali Mollaebrahimi for the TITAN-Collaboration — Justus-Liebig-Universität Gießen

TRIUMF's Ion Trap for Atomic and Nuclear science (TITAN) specializes in high-precision measurements and isobaric separation of exotic nuclei using advanced electromagnetic traps. These precise mass measurements are crucial for investigating nuclear structure and studying astrophysical processes involving isotopes far from the valley of stability.

TITAN's Multiple-Reflection Time-of-Flight Mass Spectrometer (MR-TOF-MS) enables the study of short-lived and rare nuclei through its fast measurement cycles (on the order of milliseconds) and exceptional sensitivity. This presentation highlights recent developments and experimental results achieved with the MR-TOF-MS. The nuclear physics studies include the first-time mass measurement of neutron-rich 136-138Sn, providing insights into nuclear structure beyond the neutron shell closure at N=82, and exploring their astrophysical implications for the rapid neutron capture process (r-process). Additionally, high-precision mass measurements of 31-33Na and 31-35Mg for refining the topology of the N=20 island of inversions. Finally, measurements of neutron-deficient 74-76Sr isotopes along N=Z line for investigation of A = 74, T = 1 isospin triplet and the impact of the new mass data on the reaction flow of the rapid proton capture process (rp-process) in type I x-ray bursts.

HK 2.2 Mon 15:30 HS 3 Physik

Implementation of a Charge Exchange Cell for Collinear Laser Spectroscopy — •Imke Lopp, Kristian König, Julian Palmes, and Wilfried Nörtershäuser — Institut für Kerphysik, TU Darmstadt, Germany

Collinear Laser Spectroscopy is a high precision technique to record atomic spectra, from which the charge radius and nuclear moments can be extracted. For this purpose an atom or ion beam is superimposed with a laser beam. While ions can easily be accelerated and formed into a beam, their transitions are not always accessible with common laser systems – often it is easier to perform spectroscopy on neutral atoms. To still benefit from the advantages of collinear laser spectroscopy, a charge exchange cell, that neutralises the ion beam before the laser interaction, was newly installed at the Collinear Apparatus for Laser Spectroscopy and Applied Science (COALA) at TU Darmstadt. The very first atomic spectra at COALA were recorded using a strontium beam. The evaluation of these spectra and the resulting isotopic shifts, as well as the application of high-precision techniques enabled by the charge exchange cell – such as state-selective charge exchange measurements and background-free spectroscopy – will be presented, with the examples of strontium and phosphorus.

This project is supported by BMBF (05P24RD8) and the German Research Foundation (Project-ID: 279384907 - SFB 1245).

HK 2.3 Mon 15:45 HS 3 Physik

Laser spectroscopy of neutron-deficient thulium — •Hendrik Bodnar for the COLLAPS/ISOLDE-Collaboration — Institut für Kernphysik, TU Darmstadt, Darmstadt, Germany

Collinear laser spectroscopy is well suited to study nuclear properties of isotopes. Through measurements of the isotope shifts and hyperfine splittings, the differential mean-square charge radii, the magnetic dipole moments, electric quadrupole moments and the nuclear spin can be determined. It excels particularly for short-lived isotopes.

An interesting candidate to study is ^{147}Tm, as it is close to the proton drip line and has a decay branch for proton emission. So far, a charge radius of a proton emitter has never been measured and would constitute a benchmark for nuclear stucture theory, e.g., for Density Functional Theory (DFT). During two beam times at COLLAPS/ISOLDE in 2023 and 2024, the isotopic chain of thulium was measured from ^{175}Tm - ^{152}Tm and provided a wealth of nuclear structure data towards the final goal of studying ^{147}Tm. These results, as well as an outlook towards a measurement of the proton emitter, will be provided. Funding from the BMBF under contracts 05P21RDCI1 and 05P21RDFN1 is acknowledged.

HK 2.4 Mon 16:00 HS 3 Physik

QFS studies with STRASSE at RIBF RIKEN — •Alexandra Stefanescu — Technische Universität Darmstadt, Darmstadt, Germany

STRASSE (Silicon Tracker for RAdioactive nuclei Studies at SAMURAI Experiments) is an advanced tracking system designed for quasi-free scattering (QFS) studies. The setup is optimized for missing-mass spectroscopy in inverse kinematics using a thick liquid-hydrogen (LH2) target, surrounded by double-sided silicon strip detectors (DSSSD) mounted in a compact hexagonal geometry. The tracker array is characterized by fine granularity and high-density electronics readout, high-rate capability and maximized proton tracking efficiency[1].

STRASSE is developed to be used together with the SAMURAI spectrometer at RIBF RIKEN to study the evolution of single-particle states towards the neutron drip-line nuclei, through proton knockout reactions. The accepted experiments with STRASSE are dedicated to (p,2p) and (p,3p) reactions to selectively populate the states of interest in rare isotopes. The physics program with STRASSE will be summarized.

To validate the technical choices made for the STRASSE array, in particular the front-end and back-end readout, the PFAD (Prototype For Advanced Detectors) demonstrator has been developed. Preliminary results of the first experiment with PFAD at SAMURAI, will be presented. *

[1] H.N. Liu, et al., Eur. Phys. J. A 59, 121 (2023).

HK 3: Heavy-Ion Collisions and QCD Phases I

Time: Monday 15:00–16:30 Location: HS 3 Chemie

HK 3.1 Mon 15:00 HS 3 Chemie

Performance study of non-prompt J/ψ production in Pb–Pb collisions $\sqrt{s_{\rm NN}}$ = 5.36 TeV from ALICE — •yuanjing ji for the ALICE Germany-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt

Lattice QCD calculations predict that a strongly-coupled QCD matter, the quark-gluon plasma (QGP), can be formed in relativistic heavy-ion collisions at extremely high temperatures and energy densities. Due to their large masses, heavy quarks (c, b) are predominantly produced in the initial hard scattering process before the hot QCD medium forms. Their final-state dynamics, therefore, encode information about the evolution of the system, making them effective probes of the properties of the hot QCD medium. In high-energy hadronic collisions, inclusive J/ψ production consists of both prompt and non-prompt components. The prompt component includes J/ψ produced directly or from the decays of higher-mass charmonium states (e.g., ψ(2S) or χ_c), while the non-prompt component originates from the weak decays of beauty hadrons. Therefore, the study of the production and properties of non-prompt J/ψ would provide valuable insights into those of the beauty hadrons.

The Time Projection Chamber and Inner Tracking System of the ALICE detector were recently upgraded, allowing a ~ 50 times increase in read-out rate in Run3 of the Large Hadron Collider (LHC). In this talk, we will present the performance of the prompt and non-prompt J/ψ measurements in Pb–Pb collisions at $\sqrt{s_{\rm NN}}$ = 5.36 GeV in ALICE during LHC Run3.

HK 3.2 Mon 15:15 HS 3 Chemie

Charmonium production at midrapidity using TRD-triggered data measured in ALICE — •Jinjoo Seo for the ALICE Germany-Collaboration — Heidelberg University, Heidelberg, Germany

Quarkonium production is considered one of the golden probes of quark-gluon plasma (QGP) formation in heavy-ion collisions. Quarkonium production in small collision systems, such as pp collisions, is also important for investigating production mechanisms and providing a reference for heavy-ion collisions. Charmonium, a bound state of charm and anti-charm quark pairs, has its production mechanism described by perturbative QCD for heavy quark production and non-perturbative QCD calculations for the formation of the bound state. Measurements of J/ψ and ψ(2S) cross sections in pp collisions are crucial for studying charmonium production mechanisms and testing different QCD-based model calculations. Especially, ψ(2S) production relative to J/ψ provides strong discriminating power among quarkonium production models. Thanks to the ALICE online single-electron triggers from the Transition Radiation Detector (TRD), the ψ(2S) signal can be extracted at midrapidity via the dielectron decay channel. In this contribution, the results on $p_{\rm T}$-differential ψ(2S) production cross section at midrapidity with the TRD-triggered data measured in ALICE in pp collisions at $\sqrt{s}$ = 13 TeV will be shown, along with those for J/ψ. In addition, the excited-to-ground state yield ratio (ψ(2S)-to-J/ψ) at midrapidity will be discussed. Results will be compared to measurements at forward rapidity and available model calculations.

HK 3.3 Mon 15:30 HS 3 Chemie

Study of charm hadronization into baryons: azimuthal correlations between Λ_c^+ and charged particles in pp collisions at $\sqrt{s}$ = 13 TeV with ALICE — •Samrangy Sadhu for the ALICE Germany-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn, Germany

Angular correlations between prompt charm hadrons and primary charged particles in high-energy proton-proton (pp) collisions provide insights into the charm-quark hadronization process. This study presents the first measurement of Λ_c^+ baryon correlations, focusing on the azimuthal-angle difference between prompt Λ_c^+ baryons and charged particles in pp collisions at $\sqrt{s}$ = 13 TeV, using data from Run 2 taken with the ALICE detector. Λ_c^+ baryons are reconstructed in the transverse-momentum range $3 < p_T < 16$ GeV/c and correlated with charged particles having $p_T > 0.3$ GeV/c and $|\eta| < 0.8$. The correlation patterns show differences in associated particle yields compared to D mesons, particularly in the low transverse-momentum region. These results suggest that charm-quark fragmentation into baryons may differ from that into mesons. Monte Carlo simulations do not fully reproduce these discrepancies, indicating a need for refined models of charm-quark hadronization. Supported by BMBF.

HK 3.4 Mon 15:45 HS 3 Chemie

Fluid dynamics of beauty quarks at the LHC — •Federica Capellino — GSI Helmholtzzentrum Darmstadt, Germany

Heavy quarks (i.e. charm and beauty) are powerful tools to characterize the quark-gluon plasma (QGP) produced in heavy-ion collisions. Although they are initially produced out of kinetic equilibrium via hard partonic scattering processes, recent measurements of the anisotropic flow of charmed hadrons pose the question regarding the possible thermalization of heavy quarks in the medium. By exploiting a mapping between transport theory and hydrodynamics [1], we developed a fluid-dynamic description of heavy-quark diffusion in the QCD plasma. We will show that a fluid-dynamic description of beauty quarks at LHC energies is supported by the most recent lattice-QCD calculations. We will present results for transverse momentum distributions and integrated yields of beauty hadrons obtained with a fluid-dynamic code coupled with the conservation of a heavy-quark - antiquark current in the QGP [2,3]. This work is funded via the DFG ISOQUANT Collaborative Research Center (SFB 1225).

[1] Phys.Rev.D 106 (2022) 3, 034021
[2] Phys.Rev.D 108 (2023) 11, 116011
[3] Capellino et al., in preparation

HK 3.5 Mon 16:00 HS 3 Chemie

Study of the heavy-quark out-of-equilibrium distribution function — •Rossana Facen — Physikalisches Institut Heidelberg, Heidelberg, Germany

Heavy quarks, i.e. charm and bottom, are unique probes to study the properties of the quark-gluon plasma (QGP). Due to their large masses, heavy quarks are produced at the initial stage of the collision almost exclusively via hard partonic scattering and experience the entire collision history.

Even if the heavy-quark distribution function is out of equilibrium, a fluid-dynamic approach has been demonstrated to be applicable to study the dynamics of charm quarks in the QGP [1]. However, out-of-equilibrium (ooe) corrections of the heavy-quark distribution function must be considered at the freeze-out, to correctly compute charm-hadron momentum distributions and integrated yields. In order to parameterize the ooe corrections, two different theoretical frameworks have been proposed. The Multi-Fluid description, a microscopic approach arising from kinetic theory, assumes that multiple species contribute to the diffusion of heavy quarks. On the other hand, the Maximum Entropy method is based on macroscopic considerations, and computes the ooe distribution maximizing the entropy current. In this work, we study the validity of these two approaches, focusing on their feasibility to describe heavy-quark dynamics.

This work is funded via the DFG ISOQUANT Collaborative Research Center (SFB 1225).

[1] Phys.Rev.D 106 (2022) 3, 034021

HK 3.6 Mon 16:15 HS 3 Chemie

Universal non-equilibrium scaling of cumulants across a critical point — •Leon J. Sieke[1], Mattis Harhoff[3], Sören Schlichting[3], and Lorenz von Smekal[1,2] — [1]Institut für Theoretische Physik, Justus-Liebig-Universität, 35392 Gießen, Germany — [2]Helmholtz Forschungsakademie Hessen für FAIR (HFHF), Campus Gießen, 35392 Gießen, Germany — [3]Fakultät für Physik, Universität Bielefeld, 33615 Bielefeld, Germany

We study the critical dynamics of a scalar field theory with Z_2 symmetry in the dynamic universality class of Model A in two and three spatial dimensions with classical-statistical lattice simulations. In particular, we measure the non-equilibrium behavior of the system under a quench protocol in which the symmetry-breaking external field is changed at a constant rate through the critical point. Using the well-established Kibble-Zurek scaling theory we compute non-equilibrium scaling functions of cumulants of the order parameter up to fourth order. Together with the static critical exponents and the dynamic critical exponent, these fully describe the universal non-equilibrium evolution of the system near the critical point. We further extend the analysis to include finite-size effects and observe good collapse of our data onto two-dimensional universal non-equilibrium and finite-size scaling functions.

HK 4: Instrumentation I

Time: Monday 15:00–16:30 Location: SR Exp1A Chemie

Group Report HK 4.1 Mon 15:00 SR Exp1A Chemie

The MAGIX Experiment at MESA — •Sebastian Stengel for the MAGIX-Collaboration — Institute for Nuclear Physics, Johannes Gutenberg University Mainz, Germany

At the new high-intensity, low-energy electron accelerator MESA, the multi-purpose MAGIX setup will be used for high-precision scattering experiments including dark sector searches, the study of hadron structure and few-body systems, as well as investigations of reactions relevant to nuclear astrophysics.

The MAGIX experiment features a fully windowless scattering chamber housing an internal gas jet target that can be operated with a variety of different gases, two high-precision magnetic spectrometers, and sophisticated detector systems positioned at the spectrometers' focal planes. This setup, combined with MESA's high-intensity electron beam, allows for an exceptionally clean experimental environment, in which effects like multiple scattering or energy straggling are drastically reduced.

The focal plane detectors include a tracking detector realized by a time projection chamber, and a trigger veto system built from plastic scintillation detectors and passive lead absorbers. Moreover, a recoil detector system based on silicon strip detectors can be installed inside the scattering chamber to detect nuclear recoil particles in addition to the scattered electrons.

The present contribution outlines the physics program at MAGIX and provides an overview on the sophisticated setup of the versatile MAGIX experiment.

HK 4.2 Mon 15:30 SR Exp1A Chemie

Design and Calibration Studies of the DarkMESA Experiment — •Michail Kontogoulas for the MAGIX-Collaboration — Institute for Nuclear Physics, Johannes Gutenberg University Mainz, Germany

An electron beam-dump experiment, called DarkMESA, is currently under construction at the new MESA accelerator facility in Mainz. DarkMESA is designed to detect light dark matter particles, which, in the simplest model, could couple via a hypothetical dark photon γ' to Standard Model matter. Such a dark photon could potentially be produced in the beam-dump of the P2 experiment and subsequently decay into a pair of dark matter particles, $\chi\chi$, which scatter off electrons in the DarkMESA calorimeter. The prototype calorimeter Phase A is made up of 25 PbF_2 Cherenkov crystals. The calorimeter is planned to be scaled up to its Phase B which will incorporate a $0.7\,\mathrm{m}^3$ active volume of both PbF_2 and lead glass SF5 blocks. Layers of active and passive shielding will surround the detector to minimize cosmic and beam-related backgrounds.

This contribution will focus on the development of the DarkMESA prototype and the calibration of its individual detectors, which was conducted during the MAMI beam time. The calibrated prototype was then used to measure cosmic radiation to determine its efficiency. A brief outlook of this experiment's future plans will highlight its ongoing development, wherein different types of scintillator crystal as well as liquid scintillators are currently being studied with the purpose of being implemented in DarkMESA's design.

HK 4.3 Mon 15:45 SR Exp1A Chemie

Design Overview of the Segmented Scintillation Detector "*RUBIK*" for Space Radiation Monitoring — •Roman Bergert, Hans-Georg Zaunick, and Kai-Thomas Brinkmann — Institute of Experimental Physics II, Justus Liebig University Giessen

A segmented particle tracking detector for space applications, named *RUBIK*, will be presented. The detector utilizes 125 individual PVT-based scintillator cubes (1 x 1 x 1 cm^3) as the sensitive volume, providing compactness and high efficiency. This scintillation detector array is based on custom-developed front-end readout electronics, utilizing commercial off-the-shelf components, and is specifically designed to meet the stringent power consumption, size, weight and environmental requirements of the ROMEO space mission by the Institute of Space Systems at the University of Stuttgart.

The primary objective of *RUBIK* is to measure fluences and dose rates of charged particles with energies above 100 MeV, while determining their momentum vectors and providing precise event timing. This functionality has been tested under proton beam and laboratory conditions.

The overview will cover the current design concept, including signal processing schematics, as well as the mechanical and electronic layout. The performance of the detector will be evaluated in the context of mission-specific parameters, with a focus on hardware capabilities and the ability of the readout electronics to meet the required performance thresholds.

HK 4.4 Mon 16:00 SR Exp1A Chemie

Cluster-jet target developments for the KOALA experiment — •Hanna Eick and Alfons Khoukaz for the PANDA-Collaboration — Institute for Nuclear Physics, University of Münster

Cluster-jet targets are developed, designed and built at the University of Münster. These unique targets offer a wide range of possible applications ranging from hadron physics to plasma physics experiments. They are characterized by an internal, windowless operation in which densities of up to $2 \cdot 10^{15}$ atoms/cm^2 more than 2 meters away from their origin can be reached.

A future experiment which will be running complimentary to the $\overline{\mathrm{P}}$ANDA experiment at the High Energy Storage Ring (HESR) at the Facility for Antiproton and Ion Research (FAIR) is the KOALA experiment. It has the task to measure the cross section of the antiproton-proton elastic scattering to be able to determine the luminosity of the accelerator beam and the cluster target which is essential for the analysis of the data collected at $\overline{\mathrm{P}}$ANDA.

To ensure the knowledge of the integrated luminosity with an accuracy better than 3 %, a new cluster-jet target is designed in the framework of the KOALA

experiment to fulfill all requirements with regard to the target density, thickness and vacuum conditions at the interaction point with the accelerator beam.
The considerations and developments of the design ideas as well as vacuum simulations are explained and presented.
This project has received funding from NRW Netzwerke (NW21-024-E).

HK 4.5 Mon 16:15 SR Exp1A Chemie

Quasi-real-time range monitoring using positron-emitting therapy beams — •Sivaji Purushothaman for the Super-FRS Experiment-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH

Therapeutic ion beams of positron emitters enable advanced cancer treatments by combining precise dose delivery with quasi-real-time range monitoring. Accurate range determination is critical to enhance treatment efficacy and protect healthy tissue. An experimental study at the FRS fragment separator of GSI Helmholtzzentrum investigated positron annihilation activity profiles during the implantation of positron-emitting oxygen and carbon beams into a PMMA phantom. This study compares ^{10}C, ^{11}C, ^{14}O, and ^{15}O isotopes for quasi-real-time range monitoring. A figure of merit was developed to assess the trade-offs between half-life, beam intensity, and measurement time. Shorter half-lives allow fewer implanted ions for accurate peak determination (e.g., ^{10}C vs. ^{11}C), but lower production cross-sections complicate their use. With a cross-section similar to ^{11}C but a 10-fold shorter half-life, ^{15}O offers quicker, more precise peak localisation with fewer ions. The study also highlights the effectiveness of in-flight production for generating therapeutic-quality ion beams.

HK 5: Instrumentation II

Time: Monday 15:00–16:30 Location: SR Exp1B Chemie

HK 5.1 Mon 15:00 SR Exp1B Chemie

Geant4 Simulations of a Neutron Irradiation Setup — •Maximilian Loepke, Reinhard Beck, Dieter Eversheim, and Dennis Sauerland — Helmholtz-Institut für Strahlen- und Kernphysik Bonn

The Bonn Isochronous Cyclotron provides a beam of protons, deuterons or α-particles with a kinetic energy ranging from 7 to 14 MeV per nucleon. Since 2019, a proton beam is utilized for irradiation of e.g. silicon pixel detectors for radiation hardness studies.

It is planned to extend the facility's irradiation and experimentation capabilities by providing a neutron beam in the near future. The neutrons are produced by splitting-up deuterons into protons and neutrons in a thick target converter. Protons are stopped in the converter whereas the neutrons' flux and angular energy distribution is optimized by a subsequent copper/tungsten collimator. After collimation, the neutron beam can be used for irradiation.

This talk gives an overview of Geant4 simulation results and literature comparisons regarding the neutron field, with its flux and energy distribution generated by light elements (Li, Be, C) being bombarded with protons, deuterons and α-particles compared against literature. Additionally, simulations concerning isotope production and dosimetry were carried out and are compared against experimental results.

HK 5.2 Mon 15:15 SR Exp1B Chemie

Monte Carlo simulation framework for the neutron lifetime experiment τSPECT — •Niklas Pfeifer for the tauSPECT-Collaboration — Institute of Physics, Johannes Gutenberg University Mainz, 55099 Mainz, Germany

The τSPECT experiment aims to measure the free neutron lifetime with an uncertainty goal of sub second by storing ultra-cold neutrons (UCNs) in a fully magnetic bottle using the spin flip technique. Monte Calo simulations of neutron dynamics in the experiment is a key element to study and understand systematic effects, reduce uncertainties and improve the experimental design. Based on different software packages specialized on Monte Carlo simulations, we developed a simulation framework to accurately simulate the production, transport and capture of UCNs in τSPECT.

This talk will summarize the different sub systems of the simulation framework, latest results and challenges of simulations for τSPECT as well as possible future optimizations and performance improvements.

HK 5.3 Mon 15:30 SR Exp1B Chemie

MC simulation of an ultra-low background HPGe detector for meteorite analyses — •Marie Pichotta[1], Axel Boeltzig[2], Steffen Turkat[3,4], and Kai Zuber[1] — [1]Technische Universität Dresden, Dresden, Germany — [2]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany — [3]Università degli Studi di Padova, Padova, Italy — [4]Istituto Nazionale di Fisica Nucleare, Sezione di Padova, Italy

An ultra-low-level gamma-ray counting setup was commissioned at the Felsenkeller shallow-underground laboratory, located at a depth of 140 m.w.e., in Dresden, Germany. This setup features a high-purity germanium (HPGe) detector with 163% relative efficiency, enclosed within both passive and active shielding. These shielding types reduce the remaining background rate to 116(1) counts $kg^{-1}d^{-1}$ within the energy range [40 keV, 2700 keV], making it the most sensitive HPGe detector in Germany and enabling the investigation of samples with activities well below 1 mBq.

In addition to describing the setup design, this contribution will present the Monte Carlo simulation of the detector. A current application of this work is the measurement of a rare meteorite sample, where 3D scanning techniques and simulations were used to determine the specific activities of cosmogenic radionuclides.

HK 5.4 Mon 15:45 SR Exp1B Chemie

Determining the Neutron Detection Efficiency of Lithium-Glass Detectors — •Felix Panholzer — Goethe Universität, Frankfurt am Main, Germany

A novel approach to measuring neutron capture reactions in inverse kinematics is based on Coulomb photo-dissociation. However, this method relies on the detection of the separated neutrons and thus the detection efficiency needs to be determined.

The objective of this talk is to elaborate on the aim of determining the neutron detection efficiency of lithium-glass scintillators. In particular, the Li(p,n)Be reaction is employed for the production of neutrons, which are subsequently measured by a Li-glass detector that partly relies on the ^{6}Li(n,α)T reaction. On the other hand, in order to ascertain the precise number of neutrons produced, the radioactive gamma decay (with an energy of 478 keV) of the ^{7}Be nuclei will be quantified using Broad Energy Germanium (BEGe) detectors. The ratio of these two measurements provides an accurate estimation of the Li-glass detector's detection efficiency.

HK 5.5 Mon 16:00 SR Exp1B Chemie

Development and Commissioning of an RFQ Cooler-Buncher for Laser Spectroscopy — •Finn Köhler[1], Bernhard Maass[1,2], Julian Palmes[1], and Wilfried Nörtershäuser[1] — [1]Institut für Kernphysik, TU Darmstadt, Germany — [2]Physics division, Argonne National Laboratory, USA

At rare-isotope beam facilities, radio-frequency-based beam cooler-bunchers (RFQCB) are used to prepare ion beams for low-energy experiments. They can accumulate rare beams and emit ion bunches with a short time and energy width. This contribution will report on the development of a new RFQCB that produces bunch profiles well suited for laser spectroscopy measurements at the Collinear Apparatus for Laser Spectroscopy and Applied Physics (COALA) in Darmstadt. Additionally, the new RFQCB will serve as a prototype for the laser spectroscopy beamline of the N=126 factory at Argonne National Laboratory (ANL). A two-level differential pumping scheme allows having a high-pressure region at the entrance of the RFQCB to efficiently capture incoming ions despite the short length of the design. The performance of the new design was estimated using Simion flight path simulations that reproduced experimental results from ANL. We will report on the assembly and first commissioning results at COALA. This project was supported by DFG (Project-ID 279384907 - SFB 1245).

HK 5.6 Mon 16:15 SR Exp1B Chemie

Evaluation of different scintillating materials for neutron detection — •Valerii Dormenev, Kai-Thomas Brinkmann, Dzmitry Kazlou, and Hans-Georg Zaunick — 2nd Physics Institute, Justus Liebig University, Giessen, Germany

Non-destructive inspection, safety systems and scientific research use a wide range of physical methods and equipment for detection of different types of ionizing radiation. Among them, neutron counting in a wide energy range is one of most challenging tasks. The method of thermal and epithermal neutron measurements is often based on the interaction with several light isotopes such as ^{3}He, ^{6}Li, ^{10}B or heavy isotopes like ^{155}Gd and ^{157}Gd with high neutron capture cross-section. Scintillation detectors combine nuclei with high neutron capture cross-section and scintillation centers in a single detection medium open an opportunity for the particle identification and separation utilizing pulse shape discrimination (PSD) method. Here we report test results obtained at HZDR (Helmholtz-Zentrum Dresden-Rossendorf, Germany) with 14.1MeV neutrons from deuterium-tritium generator. The response to monoenergetic neutrons and thermalized neutrons after 16 cm of standard polyethylene moderator were measured for different scintillators: $Gd_3Al_2Ga_3O_{12}$:Ce/Mg, $(Gd_x$-$Y_{(1-x)})_3Al_2Ga_3O_{12}$:Ce, $Lu_{2(1-x)}Y_{2x}SiO_5$:Ce, $Lu_{2(1-x)}Gd_{2x}SiO_5$:Ce as monocrystalline materials, $(Gd,Lu,Y)_3Al_2Ga_3O_{12}$:Ce/Mg in form of translucent ceramics, PEN as organic scintillator, two types of glass ceramics materials contained Gd and Li. The aim of the tests was evaluation of the PSD method separation of different particles for the different scintillators.

HK 6: Nuclear Astrophysics I

Time: Monday 15:00–16:30 Location: SR 0.03 Erw. Physik

Group Report HK 6.1 Mon 15:00 SR 0.03 Erw. Physik
Calibrated Nebular Emission Lines from Lanthanides — •Andreas Flörs[1], Ricardo Silva[2], and Gabriel Martínez-Pinedo[1] — [1]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — [2]Laboratório de Instrumentação e Física Experimental de Partículas (LIP), Lisboa, Portugal
With the detection of multiple neutron-star merger events in the last few years, the need for a more comprehensive understanding of nuclear and atomic properties as well as radiative transfer has become increasingly important. Despite our current understanding, there are still large discrepancies in the opacities, leading to variations in the location and strength of spectral features in radiative transfer models and preventing a firm identification of r-process products.

We report on calibrated large-scale atomic structure calculations of all singly and doubly ionised lanthanides. We use the atomic structure to compute forbidden transitions, which become the main cooling mechanism after sim1 week in the evolution of the kilonova. Using these lines, we employ radiative transfer models to predict the nebular spectrum, which can be compared to observations with the JWST. We show that compared to early phase spectra, the nebular phase offers spatially separated features, which can be used to identify individual elements synthesised in the r-process.

AF and GMP acknowledge support by the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation program (ERC Advanced Grant KILONOVA No. 885281) and the State of Hesse within the Cluster Project ELEMENTS.

HK 6.2 Mon 15:30 SR 0.03 Erw. Physik
Impact of hyperons on the equation of state of dense matter — •Samet Dokur[1], Kai Hebeler[1,2,3], and Achim Schwenk[1,2,3] — [1]Department of Physics, Technische Universität Darmstadt — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — [3]Max-Planck-Institut für Kernphysik, Heidelberg
We study the effects of hyperons on properties of dense matter using many-body perturbation theory and interactions derived within chiral effective field theory. Our goal is to systematically incorporate hyperon-nucleon and hyperon-nucleon- nucleon interactions up to next-to-leading order in our existing many-body framework, which in its current state allows to compute the equation of state of dense matter based on nucleon- nucleon and three-nucleon interactions up to N^3LO. In this talk, I will present the many-body framework, discuss the challenges involved in treating hyperonic interactions in many-body calculations, and present first results for the equation of state of neutron-rich matter, including calculations of the chemical potentials of the different particle species.

HK 6.3 Mon 15:45 SR 0.03 Erw. Physik
Hyperons in neutron star mergers — •Hristijan Kochankovski[1,2], Sebastian Blacker[3,4], Andreas Bauswein[4,5], Angels Ramos[2], Laura Tolos[6,7,8], and Georgios Lioutas[4] — [1]Departament de Física Quàntica i Astrofísica and Institut de Ciències del Cosmos, Universitat de Barcelona, Martí i Franquès 1, 08028, Barcelona, Spain — [2]Faculty of Natural Sciences and Mathematics-Skopje, Ss. Cyril and Methodius University in Skopje, Arhimedova, 1000 Skopje, Macedonia — [3]Institut für Kernphysik, Technische Universität Darmstadt, 64289 Darmstadt, Germany — [4]GSI Helmholtzzentrum für Schwerionenforschung, Planckstraße 1, 64291 Darmstadt, Germany — [5]Helmholtz Research Academy Hesse for FAIR (HFHF), Campus Darmstadt, 64291 Darmstadt, Germany — [6]Institute of Space Sciences (ICE, CSIC), Campus UAB, Carrer de Can Magrans, 08193 Barcelona, Spain — [7]Institut d'Estudis Espacials de Catalunya (IEEC), 08860 Castelldefels (Barcelona), Spain — [8]Frankfurt Institute for Advanced Studies, Ruth-Moufang-Str. 1, 60438 Frankfurt am Main, Germany
We study the influence of hyperons on neutron star mergers. Using a large sample of hyperonic equations of state, we make a systematic analysis of their effects. We find that during the post-merger phase of the binary neutron star collision, the average temperature is lower and the maximum density of the hot medium to be higher when they are present in matter. In addition, we also study hyperonic imprints onto ejected mass, secondary peaks, and threshold mass before collapse are. Our findings are of special interest as a venue for answering the question of the composition of ultra dense matter.

HK 6.4 Mon 16:00 SR 0.03 Erw. Physik
Color Superconductivity in Compact Stars with RG-Consistent NJL Model — •Ishfaq Ahmad Rather[1], Hosein Gholami[2], Marco Hofmann[2], Michael Michael Buballa[2,3], and Jürgen Schaffner-Bielich[1] — [1]Institute of Theoretical Physics, Goethe University, Frankfurt am main — [2]Technische Universität Darmstadt, Fachbereich Physik, Institut für Kernphysik, Theoriezentrum, Schlossgartenstr. 2, D-64289 Darmstadt, Germany — [3]Helmholtz Forschungsakademie Hessen für FAIR (HFHF), GSI Helmholtzzentrum für Schwerionenforschung, Campus Darmstadt, D-64289 Darmstadt, Germany
We analyze the renormalization group-consistent (RG-consistent) three-flavor color-superconducting Nambu-Jona-Lasinio (NJL) model to explore possible compact star configurations, focusing primarily on quark stars. By varying the vector (η_V) and diquark (η_D) couplings, we study their effects on the equation of state (EoS), speed of sound, diquark gap, and mass-radius relations.

Our results show that stable color-flavor-locked (CFL) phases often dominate the core of maximum-mass stars, spanning several kilometers in radius. For other cases, the two-flavor color-superconducting (2SC) branch becomes unstable before the CFL transition density. For neutron-star densities, the squared speed of sound reaches up to $c_s^2 \sim 0.6$. Hybrid stars constructed with these models suggest early hadron-quark transitions, impacting tidal deformability at 1.4 $M_\odot$. We constrain NJL parameters using the $2.0 M_\odot$ mass limit and find the resulting EoS consistent with astrophysical measurements.

HK 6.5 Mon 16:15 SR 0.03 Erw. Physik
Neutrino opacities in the NJL model with color superconductivity — •Marco Hofmann[1], Alexander Haber[2], Liam Brodie[3], Mark Alford[3], Hosein Gholami[1], and Michael Buballa[1] — [1]Technische Universität Darmstadt, Germany — [2]University of Southampton, United Kingdom — [3]Washington University in St. Louis, Missouri, USA
Neutrino transport plays a critical role in the evolution of neutron star mergers and the cooling of neutron stars. In this work, the quark core in a hybrid star is modeled with a three-flavor NJL-type model that allows for color-superconductivity (arXiv:2408.06704). We calculate the direct Urca neutrino opacities of quark matter in the unpaired and in the two-flavor superconducting (2SC) phase. At low temperatures, the contribution of the gapped quarks can be neglected and we show how the self-consistently calculated quark masses determine the density-window in which the charged-current direct Urca process is kinematically allowed. While neutrino absorption by down quarks is kinematically forbidden at zero temperature, the process with strange quarks is kinematically allowed.

HK 7: Structure and Dynamics of Nuclei III

Time: Monday 16:45–18:15 Location: HS 2 Physik

HK 7.1 Mon 16:45 HS 2 Physik
Investigation of ^{168}W via lifetime measurement — •Felix Dunkel[1], Christoph Fransen[1], Kalle Auranen[2], Michael P. Carpenter[3], Tuomas Grahn[2], Paul Greenlees[2], Jan Jolie[1], Filip G. Kondev[3], Casper-David Lakenbrink[1], Claus Müller-Gatermann[3], Dariusz Seweryniak[3], Franziskus von Spee[1], and Nigel Warr[1] — [1]IKP, Univ. of Cologne, Germany — [2]JYFL, Jyväskylä, Finland — [3]Argonne Natl. Lab, Illinois, USA
In a cluster of neutron-deficient Os-W-Pt nuclei around A=170, an unexpectedly low ratio of B(E2) transition strengths within the yrast band, with ratios $B_{4/2} < 1$, has been observed. This cannot be explained in standard collective models. Only very recently, $B_{4/2} < 1$ in this region was reproduced with a strong band mixing within an extension of the consistent-Q IBM Hamiltonian [1]. Older lifetime data might suffer from assumptions on side feeding and for the 6_1^+ only a limit is given. We performed an experiment on ^{168}W with the RDDS technique at Argonne Natl. Lab. with the GAMMASPHERE spectrometer to determine transition strengths from level lifetimes using $\gamma\gamma$ coincidences. The measurement of yrast state lifetimes in ^{168}W will be presented. The new data yield that ^{168}W is just at the transition point from "normal" collectivity to the island of nuclei with $B_{4/2} < 1$. Furthermore, a ratio of $B_{6/4} < 1$ indicates that the phenomenon is not solely related to the structure of the 2_1^+ and 4_1^+ states.

Supported by the DFG, grant Nos. FR 3276/3-1.

[1] F. Pan et al., Phys. Rev. C 110, 054324 (2024)

HK 7.2 Mon 17:00 HS 2 Physik
Measurement of the lifetimes of excited states in 56Ti, 58Ti — •Wiktor Poklepa for the HiCARI-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Planckstr. 1, 64291 Darmstadt, Germany
The neutron-rich Ti isotopes lie within the interests of nuclear physicists for several reasons. One of them is the region of validity of the new neutron magic numbers N=32,34 observed in the Ca isotopic chain. The other is approaching

the island of inversion around N=40 with the most exotic Ti isotopes. The $E(2_1^+)$ energies for even-even Ti isotopes have been measured up to N=40 and, unlike in Ca and Ar isotopes with N=34, there is no rise of $E(2_1^+)$ for ^{56}Ti. At the same time the B(E2) values for this set of isotopes have been established only up to N=34. The currently known trend in B(E2) values in Ti isotopes shows staggering behaviour, but experimental uncertainties are too large to draw conclusions on the onset of collectivity towards N=40. Thus, further investigation is needed. In this experiment, the lifetimes of excited states in ^{56,58}Ti were studied employing proton knockout reactions from ^{57,59}V at the RIBF facility in Japan. The secondary beams produced from ^{70}Zn at 345 MeV/u were transported through the BigRIPS spectrometer. Gamma rays emitted by the reaction products were detected by the HiCARI HPGe detector array. The reaction products were identified using the ZeroDegree spectrometer. In this talk, the first preliminary results on the spectroscopy and lifetime measurements for ^{56,58}Ti will be presented.

HK 7.3 Mon 17:15 HS 2 Physik

Investigation of ^{172}Pt via lifetime measurement — •Casper-David Lakenbrink[1,2], Christoph Fransen[1], Claus Müller-Gatermann[2], Michael P. Carpenter[2], Felix Dunkel[1], Jan Jolie[1], and Franziskus von Spee[1] — [1]Institute for Nuclear Physics, University of Cologne, 50937 Cologne, Germany — [2]Physics Division, Argonne National Laboratory, Lemont, IL-60439, USA

The very neutron-deficient Pt, Os and W isotopes around $A = 170$ show an unexpected behavior of $B(E2)$ transition strengths within the yrast band with ratios $B_{4/2} < 1$, which cannot be explained with standard collective models. Shape coexistence lends itself as a possible explanation as this phenomenon is well established in the nearby mid-shell Pt isotopes. The backbending seen in the levelschemes of these nuclei could in this framework be interpreted as a crossing of two different configurations. A different approach was able to reproduce these anomalies without configuration mixing by including 3-body interactions in the IBM (F. Pan *et al.*, PRC **110**, 054324 (2024)).

Lifetimes up to the 8_1^+ state in ^{172}Pt were measured in this work to determine yrast $E2$ transition strengths to test these hypotheses. The experiment employed the recoil distance Doppler-shift (RDDS) method and was performed at Argonne National Laboratory.

This work was supported by the Deutsche Forschungsgemeinschaft (DFG) under contract number FR 3276/3-1 and by the U.S. Department of Energy, Office of Science, Office of Nuclear Physics, under contract number DE-AC02-06CH11357. It used resources of ANL's ATLAS facility, which is a DOE Office of Science User Facility.

HK 7.4 Mon 17:30 HS 2 Physik

Measurements on ^{178}Yb — •Pavlos Koseoglou[1], Theodoros J. Mertzimekis[1], Margarita Efstathiou[1], Polytimos Vasileiou[1], Hannes Mayr[2], Clemens Nickel[2], Norbert Pietralla[2], Volker Werner[2], Andrey Blazhev[3], Arwin Esmaylzadeh[3], Julia Fischer[3], Christoph Fransen[3], Jan Jolie[3], Mario Ley[3], Aaron Pfeil[3], Franziskus Spee[3], Kalin Gladnishki[4], Diana Kocheva[4], Georgi Rainovski[4], and Dennis Bonatsos[5] — [1]Department of Physics, National and Kapodistrian University of Athens, Greece — [2]Technische Universität Darmstadt, Department of Physics, Institute for Nuclear Physics, Germany — [3]Universität zu Köln, Institut für Kernphysik, Germany — [4]Faculty of Physics, St. Kliment Ohridski University of Sofia, Bulgaria — [5]Institute of Nuclear and Particle Physics, NCSR "Demokritos", Greece

All even-even Yb isotopes with mass number 160≤A≤176 are known to present deformation to some extent. The ^{178}Yb isotope (the most neutron-rich Yb isotope with measured excited states) shows signs of high deformation. An experiment was performed in the 10 MV FN Tandem accelerator of the Institut für Kernphysik at the University of Cologne in order to study ^{178}Yb. The excitation function of the ^{176}Yb(^{18}O,^{16}O)^{178}Yb two-neutron transfer reaction was studied during the experiment over several beam energies below and above the Coulomb barrier of the reaction and will be presented in this contribution. Gamma-spectroscopy finds will be presented as well. This work is funded by the German Research Foundation - 539757749.

HK 7.5 Mon 17:45 HS 2 Physik

Lifetime Measurements in odd-*A* Yttrium Isotopes — •Aaron Pfeil[1], Arwin Esmaylzadeh[1], Mario Ley[1], Jean-Marc Régis[1], Jan Jolie[1], Ulli Köster[2], Yung Hee Kim[2], and Jean-Michel Daugas[2] — [1]Institute for Nuclear Physics, University of Cologne — [2]Institut Laue-Langevin, Grenoble, France

Measurements were performed with neutron-rich nuclides produced by thermal neutron induced fission of ^{235}U and mass-separated with the LOHENGRIN recoil spectrometer at the Institut Laue-Langevin in Grenoble, France. Lifetimes of low-lying excited states in the nuclei ^{95}Y, ^{97}Y, ^{99}Y, and ^{101}Y are determined using the fast-timing technique [1]. Investigating odd-*A* nuclei is of special interest for improving the development of theoretical models. In particular, the range from ^{95}Y to ^{101}Y offers valuable insight as these isotopes lie near the rapid shape transition at $N = 59$ and the critical point of the intertwined quantum phase transition. Furthermore, yttrium lies between strontium and zirconium, which are often considered as boson cores. Thus, it is interesting to determine which core is more appropriate, as this provides information about the character of the single particle energies. Experimental values are compared with calculations performed within the framework of the interacting boson-fermion model [2]. Work supported by DFG grant JOL391/18-2.

[1] J.-M. Régis et al., Nucl. Instrum. Methods Phys. Res. 726, 191 (2013)
[2] N. Gavrielov et al., Phys. Rev. C 106, L051304 (2022)

HK 7.6 Mon 18:00 HS 2 Physik

Lifetime measurements of the A=108 beta decay chain — •Senuri Dantanarayana[1], Arwin Esmaylzadeh[1], Mario Ley[1], Jan Jolie[1], J.-M. Régis[1], Aaron Pfeil[1], Ulli Köster[2], Jean-Michel Daugas[2], and Luis M. Fraile[3] — [1]Universität zu Köln, Institut für Kernphysik — [2]Institut Laue-Langevin — [3]Universidad Complutense de Madrid

Neutron-rich isobars in the β-decay chain of $A = 108$ fission fragments were investigated following thermal neutron-induced fission of a ^{241}Pu target and mass separation with the LOHENGRIN recoil separator at Institut Laue-Langevin. Lifetimes of excited nuclear states were measured using the fast-timing technique [1]. The focal plane of the spectrometer was equipped with one clover detector with four Ge crystals, four cylindrical $1.5'' \times 1.5''$ $LaBr_3$(Ce) scintillator detectors and one plastic scintillator for beta detection [2]. The studied Ru-Pd region is known for gamma-softness where the spatial deformation of the nuclear density distribution shows large fluctuations around the equilibrium value [3]. The results of this work will be discussed in the context of gamma-softness.

[1] J.-M. Régis et al. , Nucl. Instrum. Meth. A- 955 (2019),- 163258.
[2] P. Armbruster et al. Nucl. Instrum. Meth.- 139 (1976),- 213.
[3] N. Nazir et al., Phys. Rev. C-,107 (2023) , L021303.

HK 8: Structure and Dynamics of Nuclei IV

Time: Monday 16:45–18:00 Location: HS 3 Physik

Group Report HK 8.1 Mon 16:45 HS 3 Physik

Constraining the density-dependence of the symmetry energy by cross section measurements at R^{3}B — •Lukas Ponnath for the R3B-Collaboration — TU Darmstadt, Darmstadt, Deutschland

The R^{3}B (Reactions with Relativistic Radioactive Beams) experiment, a flagship instrument of the NUSTAR collaboration at the GSI/FAIR facility in Darmstadt, is designed for kinematically complete reactions studies. Part of the R^{3}B physics program is to constrain the asymmetry term of the nuclear equation of state, improving our understanding of highly asymmetric nuclear matter, such as in neutron stars.

One approach to probe the density dependence of the symmetry energy near saturation density is the measurement of the neutron-skin thickness via total interaction or neutron-removal cross sections. These measurements allow for a direct comparison with reaction model predictions.

During the FAIR Phase-0 campaign, total interaction cross sections for ^{12}C+^{12}C collisions and charge-changing cross sections of tin isotopes were measured, serving as a stringent test of the reaction model. Building on this, the experiment was extended to $^{120\text{-}132}$Sn+^{12}C collisions at relativistic energies to study the total interaction and neutron-removal cross sections of neutron-rich systems.

In this talk, I will give an overview of the experimental campaign and present results from the finalized and ongoing analyses, including dipole polarizability studies as an additional observable.

(supported by BMBF 05P19WOFN1, 05P21WOFN1, HFHF, FAIR Phase-0 program, and the GSI-TU Darmstadt cooperation agreement)

HK 8.2 Mon 17:15 HS 3 Physik

Search for near-threshold multi-neutron resonances in neutron-rich nuclei at R^{3}B — •Nikhil Mozumdar[1,2], Thomas Aumann[1,2,3], Antoine Barriere[4], Martina Feijoo-Fontan[5], and Olivier Sorlin[4] for the R3B-Collaboration — [1]Technische Universität Darmstadt — [2]Helmholtz Forschungsakademie Hessen fur FAIR — [3]GSI Helmholtz-Zentrum für Schwerionenforschung — [4]Grand Accélérateur National d'Ions Lourds — [5]Universidade de Santiago de Compostela

In order to constrain the largely unknown multi-neutron interactions, it is necessary to measure the relevant observables sensitive to them. One such property is the possible existence of narrow resonances related to multi-neutron cluster structures and correlations. This can be investigated by studying multi-neutron resonances close to the corresponding neutron removal thresholds in neutron-rich light nuclei. Toward this end, an experiment was performed in the state-of-the-art R^3B setup in GSI, within the FAIR Phase-0 program. Quasi-free scattering $(p, 2p)$ reactions are studied in inverse kinematics, where a radioactive ion "cocktail" beam is impinged on a 5 cm LH_2 target. The complete kinematic information of the resulting reactions is provided by the large combination of detectors in the setup. In this communication, we present a detailed study of the continuum structure of Boron isotopes, with an emphasis on the near-threshold states. This is followed by results of the two-body nn-relative energy distributions corresponding to these resonances. Supported by HFHF, the GSI-TU Darmstadt cooperation and the BMBF project 05P24RD1.

HK 8.3 Mon 17:30 HS 3 Physik

Expert experiments: data analysis, preview to upcoming experiments — •Martin Bajzek[1,2] and Ivan Mukha[1] for the Super-FRS Experiment-Collaboration — [1]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt — [2]JLU Gießen, Gießen

In future experiments at the Facility for Antiproton and Ion Research (FAIR) in Darmstadt, Germany, one of the experimental setups will be EXPERT at the Super-FRS separator. Super-FRS is a high-resolution magnetic spectrometer able to identify nuclei in a beam from hydrogen to uranium. EXPERT (EXotic Particle Emission and Radioactivity by Tracking) experiments explore the structure of unknown nuclei beyond the borders of proton and neutron driplines, including studies of reaction channels with proton/neutron resonances, beta-delayed decays, and in particular exotic 2p and 4p decays.

In this contribution, first results obtained from 2024 EXPERT experiment at the FRS with 9C secondary beam impinging on Be target will be presented.

HK 8.4 Mon 17:45 HS 3 Physik

Study of interaction and charge changing cross-sections of carbon and oxygen isotopes — •Rinku Prajapat for the BARB and Super-FRS Experiment-Collaboration — GSI, Darmstadt, Germany — SMU, Halifax, Canada

The development of radioactive beams and production techniques provide new insight into various dynamic and structural properties of unstable nuclei far from the stability line characterized by short half-lives and an unusual neutron-to-proton ratio. For instance, measurement of interaction (σ_I) and charge-changing (σ_{CC}) cross-sections are important for the deduction of the nuclear radii and also serve as an input in treatment planning programs for radiotherapy with heavy ions. However, the case of positron emitters ($^{10,11}C$ and ^{15}O) is of special interest in ion beam therapy owing to their potential application in range verification via imaging using positron emission tomography (PET).

Thus, two experiments have been performed using the in-flight fragment separator and spectrometer FRS at GSI Darmstadt. The aim of the experiments was to measure the σ_I and σ_{CC} of $^{10,11,12}C$ and σ_{CC} of $^{15,16}O$ nuclei on a carbon, water, and $(CH_2)_n$ target at therapeutically relevant energies. The measurements were done using the transmission method, which means that the unreacted part of the beams is being analyzed. In this contribution, the experimental overview, data analysis, and preliminary results will be presented.

This work is supported by ERC Advanced Grant 883425 (BARB) and performed within the Super-FRS Experiment Collaboration framework of the FAIR Phase-0.

HK 9: Heavy-Ion Collisions and QCD Phases II

Time: Monday 16:45–18:15 Location: HS 3 Chemie

HK 9.1 Mon 16:45 HS 3 Chemie

Accessing the p–Σ^+ interaction via femtoscopy with ALICE — •Benedict Heybeck for the ALICE Germany-Collaboration — Institut für Kernphysik, Johann Wolfgang Goethe-Universität Frankfurt, Frankfurt, Germany

The Σ–nucleon strong interaction is an important ingredient to understand the composition of neutron stars and is also crucial for theoretical predictions on potential Σ-hypernuclei. Data on this interaction is scarce and purely based on scattering experiments. Since data points are only available at rather high relative momenta and their uncertainties are sizeable, theory calculations are not well constrained. Particularly the triplet channel is very uncertain and it is not yet clear if the interaction in this channel is attractive or repulsive. In this regard, two-particle intensity interferometry (femtoscopy) of Σ baryons and nucleons can provide valuable information. Σ^+ baryons decay into a proton and a neutral pion via the weak interaction with a branching ratio of 52%. The neutral pion decays electromagnetically almost exclusively into two photons which are challenging to measure with the ALICE apparatus. In this talk, a novel reconstruction method will be shown, which makes use of sophisticated reconstruction algorithms and machine learning techniques to improve the reconstruction efficiency and purity of the Σ^+ baryons and allow for the measurement of their correlation function with protons for the first time. The obtained correlation function will be discussed and related to latest theoretical calculations, providing new constraints on the Σ–nucleon interaction.

HK 9.2 Mon 17:00 HS 3 Chemie

Modeling charged-particle spectra in high-energy pp collisions with deep neural networks — •Maria Alejandra Calmon Behling, Jerome Jung, Mario Krüger, and Henner Büsching — Institut für Kernphysik, Goethe Universität Frankfurt

During the data-taking campaigns Run 1 and Run 2 of the Large Hadron Collider (LHC), the ALICE collaboration recorded a large amount of proton-proton (pp) collisions across a variety of center-of-mass energies ($\sqrt{s}$). This extensive dataset is well suited to study the energy dependence of particle production. Deep neural networks (DNNs) provide a powerful regression tool to capture underlying multidimensional correlations inherent in the data. DNNs are used to parametrize recent ALICE measurements of multiplicity (N_{ch})- and transverse momentum (p_{T})-dependent charged-particle spectra. This new approach allows extrapolating the measurements towards higher N_{ch} and p_{T} values as well as to unmeasured $\sqrt{s}$, providing data-driven references for future heavy-ion measurements.

In this talk, we present the current status of the analysis. We discuss the potential and limitations of using DNNs to model complex multidimensional data and compare the results to those from event generators.

Supported by BMBF and the Helmholtz Association.

HK 9.3 Mon 17:15 HS 3 Chemie

Uniform description of multiplicity dependent particle p_{T} spectra with ALICE — •Joshua König — Institut für Kernphysik, Goethe-Universität Frankfurt

Identified particle transverse momentum (p_{T}) spectra in ultra-relativistic pp collisions are crucial for constraining fragmentation functions and parton distribution functions, thereby offering deeper insight into the particle production mechanisms in these collisions.

Universal scaling laws are often employed to identify commonalities in particle production mechanisms across different collision energies and across different charged particle multiplicities. Transverse Bjorken-x (x_{T}) scaling is used to showcase a uniform behavior for particle p_{T} spectra across different center-of-mass energies, while KNO scaling provides a framework to describe these spectra uniformly across varying charged-particle multiplicity classes.

Recent results from the ALICE collaboration present data for various identified particles at LHC energies and across different charged-particle multiplicity classes, offering an opportunity to study these scaling laws in great detail.

In this talk, the multiplicity dependence of identified particle p_{T} spectra is investigated by means of x_{T} and KNO scaling. A surprising similarity between the multiplicity dependence and the center of mass energy dependence is shown. Furthermore, these findings are applied to results from MC generators to gain insight into the initial state of the collision.

Supported by BMBF and the Helmholtz Association

HK 9.4 Mon 17:30 HS 3 Chemie

Differential measurement of the common particle emitting source using p–p correlations in pp collisions at 13.6 TeV with ALICE — •Anton Riedel for the ALICE Germany-Collaboration — Technische Unversität München, München, Deutschland

The minimum bias (MB) dataset of pp collisions at $\sqrt{s} = 13.6$ TeV collected by ALICE during Run 3 of the LHC enables the first study of transverse mass (m_{T}) scaling of the femtoscopic source across event multiplicities. Previously observed in high-multiplicity pp collisions, the m_{T} dependence of the source size, linked to collective phenomena, is now extended to the low-multiplicity regime. The resonance source model, which accounts for the effects of strong-decaying resonances, allows comparison of source size dependence on multiplicity in pp collisions with results from larger systems, like Pb–Pb collisions. These results provide a new framework for exploring radial flow effects on source scaling and offer a benchmark for theoretical models on collective phenomena in small colliding systems. They are also essential for coalescence models addressing nuclear cluster production and serve as a crucial reference by fixing the emission source for high-precision studies of interaction potentials in hadron-hadron pairs with strangeness and charm using ALICE Run 3 data. This contribution presents the measurement of m_{T} scaling of the femtoscopic source of proton-proton pairs as a function of event multiplicity using ALICE Run 3 data. This project is funded by DFG (EXC2094 - 390783311) and BMBF Verbundforschung (05P21WOCA1 ALICE).

HK 9.5 Mon 17:45 HS 3 Chemie

Neutral-meson production in pp collisions at $\sqrt{s}$ = 13.6 TeV with the ALICE experiment — •Youssef El Mard Bouziani for the ALICE Germany-Collaboration — University of Frankfurt, Germany

The ALICE experiment at the LHC aims to explore the properties of the quark-gluon plasma (QGP), a state of matter characterized by extreme densities and temperatures and believed to be created in heavy-ion collisions. High-energy proton-proton (pp) collisions offer a unique environment for understanding related mechanisms within the framework of Quantum Chromodynamics (QCD). Measurements of π^0 and η mesons in such collisions deepen our understanding of hadronization processes and provide a baseline for the study of direct photons and dielectrons, which are essential observables in investigating the QGP.

In ALICE, decay photons can be reconstructed through either the energy they deposit in calorimeters or by tracking e^+e^- pairs resulting from photon conversion within the detector material, known as the Photon Conversion Method (PCM). The calorimeter-based technique provides high statistics and resolution for larger momenta, while PCM offers superior precision for studying neutral mesons at low momenta. To enhance the scope and precision of such investigations, significant upgrades to the detector systems were implemented for LHC Run 3.

In this talk, the current status of the measurements of neutral mesons produced in pp collisions at $\sqrt{s}$ = 13.6 TeV is presented, highlighting particle p_T spectra over a broad p_T range.

HK 9.6 Mon 18:00 HS 3 Chemie

Hadron-photon correlations in pp collisions in ALICE using POWHEG and PYTHIA — •Peter Stratmann — Institut für Kernphysik, Universität Münster

Outgoing high-pT partons produced from hard scatterings early in high-energy collisions, such as occurring at A Large Ion Collider Experiment (ALICE) at the Large Hadron Collider, lead to the creation of jets. Photons are produced copiously in these interactions - directly emitted by the quarks as prompt photons, or through the decay of unstable particles. They are valuable probes to study jet fragmentation and nuclear parton distribution functions (nPDF).

Angular correlations between high-pT hadrons, which are likely the leading hadron of a jet, and their associated photons are extracted from ALICE simulations. The photons are reconstructed from conversions in the ALICE material into electrons and positrons using the Photon Conversion Method. Since direct photons cannot be distinguished individually, their spectra are derived using a statistical approach. The decay photon spectra are derived from neutral hadron measurements, and subtracted from the inclusive measurements to extract the direct photon spectra. In this analysis, proton-proton collisions are simulated in Monte Carlo, using stand-alone PYTHIA at leading order (LO), and PYTHIA in combination with POWHEG at next-to-leading order (NLO), and compared with each other. While prompt photons are well defined at LO, ambiguities are introduced at NLO. This analysis aims to understand better the production mechanisms of prompt photons and hence the nPDF at low pT.

HK 10: Instrumentation III

Time: Monday 16:45–18:15 Location: SR Exp1A Chemie

Group Report HK 10.1 Mon 16:45 SR Exp1A Chemie

GEM detectors for AMBER - An Overview of ongoing research — •Jan Paschek[1], Paul Clemens[1], Karl Flöthner[1,2], Pascal Henkel[1], Igor Konorov[3], Michael Lupberger[1,4], Dimitri Schaab[1], and Bernhard Ketzer[1] — [1]Helmholtz-Instituts für Strahlen- und Kernphysik, Universität Bonn, Germany — [2]Gaseous Detector Department, CERN, Switzerland — [3]Physik-Department, Technische Universität München, Germany — [4]Physikalisches Institut, Universität Bonn, Germany

The AMBER experiment at CERN's SPS explores fundamental questions in hadron physics using high-energy muon and hadron beams. By successfully completing its first physics runs in 2023 and 2024, AMBER provides valuable data for dark matter searches by measuring the antiproton production cross-section on hydrogen, deuterium and helium targets. Looking ahead, the experiment will carry out its first measurement of the proton electric form factor in 2025 through elastic muon-proton scattering. To fulfill the requirements of the physics program, next-generation planar GEM detectors are being developed that include a number of technological advances. For the antiproton production measurements, the detectors operated with APV25-based, triggered readout electronics. All future measurements will employ a self-triggering readout system using the VMM3a front-end chip. Extensive tests, both in the laboratory and in test-beam campaigns, have been conducted to asses and optimize the performance of both systems. This presentation will give you a brief overview of the latest results regarding the detector's development. Supported by BMBF.

HK 10.2 Mon 17:15 SR Exp1A Chemie

High-granularity investigations of gain inhomogeneities of new triple-GEM tracking detectors for AMBER — •Paul Clemens[1], Jan Paschek[1], Bernhard Ketzer[1], and Karl Flöthner[1,2] — [1]Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn, Germany — [2]GDD, CERN, Geneva, Switzerland

The fixed-target experiment AMBER at CERN's SPS is dedicated to investigating the fundamental properties of hadrons. Following its first physics run in 2023, which focused on measuring antiproton-production cross sections, future studies will address the proton charge radius and Drell-Yan processes. Critical components for these measurements are 30×30 cm^2 triple-GEM detectors, enabling precise tracking close to the beam. The original detectors developed for the COMPASS experiment will be replaced by next-generation detectors that incorporate a number of advances in technology to fulfill the requirements of the experiment like a free-streaming readout and an active central region.

To ensure stable detector operation and efficiency, a highly homogeneous gain distribution is essential. During the commissioning of the first prototypes of this new detector generation, detector generation, strongly localized gain inhomogeneities were observed, referred to as „hot spots“ and „cold spots“. These findings were enabled by a newly developed setup employing x-ray fluorescence and the triggerless VMM3a front-end chip, allowing for high-resolution investigations of gain variations over the whole detector in a very short time.

In this talk, the results of multiple investigations towards the cause of these inhomogeneities will be presented. Supported by BMBF.

HK 10.3 Mon 17:30 SR Exp1A Chemie

Recent Detector Development and Tests — •Elena Rocco for the Super-FRS Experiment-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

The FRagment Separator [H. Geissel et al., Nucl. Instr. Meth. B70 (1992) 286-297] (FRS) at the GSI is an in-flight separator and a high-resolution magnetic forward spectrometer at the Synchrotron SIS18, operating with relativistic heavy ion beams from proton to uranium, with an energy typically spanning from 500 up to 1500 MeV/u already in successful operation since more than 30 years. The identification in charge (Z) and mass (A) is executed using the Bρ * ToF * DeltaE method. This requires measurements of particle Time of Flight (ToF), magnetic rigidity (Bρ) and energy loss (DeltaE) on an event-by-event basis. Besides the regular maintenance, detector upgrades are performed and planned for the near and far future. This contribution provides a short overview of beam and particle detectors at the FRS, with special emphasis on the time project chamber (TPC), which gives tracking information operating in Ar/CH4 (90/10) at atmospheric pressure and on the planned installation of a second beam profile monitor (current grid) on the second FRS focal plane.

HK 10.4 Mon 17:45 SR Exp1A Chemie

HYDRA: A continuous-readout TPC for hypernuclei studies at R3B — •Andi Messingschlager[1,3], Meytal Duer[1], Alexandru Enciu[1], Piotr Gasik[1,3], Liancheng Ji[1], Leandro Milhomens Da Fonseca[1], Alexandre Obertelli[1], and Georgina Xifra Goya[2,3] — [1]TU Darmstadt — [2]Universidade de Santiago de Compostela — [3]GSI Helmholtzzentrum für Schwerionenforschung

The HYDRA experiment aims to measure the interaction cross-section of hypertriton with 12C nuclei to address the hypertriton puzzle. This puzzle explores the link between the lifetime and binding energy of the hypertriton and its possible Lambda-halo character. Approved at GSI/FAIR, the experiment will take place in the near future at the R3B facility, where hypertriton will be produced by colliding two 12C nuclei at 1.9 GeV per nucleon (18 T.m). The experiment identifies hypertriton by measuring its decay products, a 3He nucleus and a negatively charged pion (pi-), and reconstructing their invariant mass. Central to this is the HYDRA TPC, operating inside the GLAD dipole magnet at R3B. The readout of the TPC is based on the VMM3a front-end electronics and SRS readout system. In the presentation, the TPC and its readout system will be described, as well as first offline validation. Simulations for the front-end cooling will be detailed. Supported by Alexander von Humboldt Foundation, HFHF, BMBF under Verbundprojekt 05P24RD1, and Hessian Research Cluster ELEMENTS

HK 10.5 Mon 18:00 SR Exp1A Chemie

Production of detector modules for the CBM-TRD at FAIR — •Spicker Dennis[1] and Kähler Philipp[2] for the CBM-Collaboration — [1]Institut für Kernphysik, Goethe Uni Frankfurt — [2]Institut für Kernphysik, WWU Münster

At the forthcoming Facility for Antiproton and Ion Research (FAIR), the Compressed Baryonic Matter experiment (CBM) is designed to measure particles resulting from heavy-ion collisions at exceedingly high interaction rates. To this end, the data acquisition system will operate in a free-streaming mode, eliminating the need for a hierarchical trigger system. The Transition Radiation Detector (TRD), a subsystem of the CBM experiment, will comprise four layers of Multi-Wire-Proportional-Chambers (MWPC), each equipped with a foam radiator enabling the generation of transition radiation. The principal objective of the TRD is to distinguish between electrons and pions, to augment the light nuclei identification, and to provide tracking information. This contribution presents the latest advancements towards series production of MWPC modules for the outer region of the detector, as well as providing an update on the status of the final version of the readout electronics for these modules. Supported by the German BMBF-grant 05P24RF2

HK 11: Instrumentation IV

Time: Monday 16:45–18:15 Location: SR Exp1B Chemie

HK 11.1 Mon 16:45 SR Exp1B Chemie

Detailed Study of Afterpulses in MCP-PMTs — •Gabriele Costi, K. Gumbert, S. Krauss, A. Lehmann, and D. Miehling — ECAP, Universität Erlangen-Nürnberg

The PANDA experiment at FAIR uses two DIRC detectors for pion/kaon separation by Cherenkov light detection. Central to their performance are Microchannel-Plate Photomultipliers (MCP-PMTs), which were chosen for their excellent time performance and suitability in high magnetic fields ($\gtrsim$ 1 T). Recent quality control tests of PHOTONIS XP85112-S-BA tubes has provided new insights into performance parameters such as lifetime, quantum efficiency, gain stability, dark count rates, and afterpulses (APs).

APs triggered by feedback ions are suspected to be the main cause of photocathode aging; therefore, it is crucial to understand how, where and how many APs are created in the MCP-PMT. To study this effect in more detail, various measurements and analyses of time-of-flight (TOF) spectra were performed with a TRB/DiRICH DAQ system and compared to simulations. By analyzing the TOF the origin in the PMT and the type of the feedback ions were investigated. In this contribution, we present the results obtained on APs in MCP-PMTs, including comparative data from prototype and series production models.

- Funded by BMBF and GSI -

HK 11.2 Mon 17:00 SR Exp1B Chemie

Performance and problems of the latest series production MCP-PMTs for the PANDA Barrel DIRC — •Steffen Krauss, K. Gumbert, A. Lehmann, and D. Miehling — ECAP, Universität Erlangen-Nürnberg

The PANDA experiment at GSI's Facility for Antiproton and Ion Research (FAIR) in Darmstadt will use DIRC detectors to separate pions and kaons in the 0.5 to 4 GeV/c momentum range. The DIRC focal planes will be located inside the PANDA solenoid magnet. This exposes the photon sensors to a magnetic field of ~1 T. For this and other reasons, microchannel plate photomultipliers (MCP-PMTs) were the only viable option to efficiently detect the few Cherenkov photons.

A barrel DIRC surrounds the interaction region and consists of 16 radiator sectors, each equipped with 8 MCP-PMTs. The selected PMTs, type PHOTONIS XP85112-S-BA with 10 μm pores, have an area of 2x2 inch^2 with 8x8 anode pixels and an ALD coating to increase the lifetime. A total of 165 (128 + 37 spare) tubes are quality evaluated in Erlangen to fulfill the key requirements for the Barrel DIRC.

Essential requirements for the MCP-PMTs are gains of $> 10^6$ in a 1 T field, high detective quantum efficiency (QE*CE), high rate capability, ultra-fast time response and good spatial homogeneity of QE and gain. Internal parameters such as dark count rate, crosstalk and afterpulse fractions are measured with a TRB/DiRICH DAQ system. The main conclusions for meanwhile >80 surveyed PMTs are presented, as well as some severe PMT issues encountered during the evaluation process.

- Funded by BMBF and GSI -

HK 11.3 Mon 17:15 SR Exp1B Chemie

SiPM based neutron detectors for the lifetime experiment τSPECT — •Julian Auler[1], Martin Fertl[1], and Dieter Ries[2] for the tauSPECT-Collaboration — [1]Institute of Physics, Johannes Gutenberg University Mainz, Mainz, Germany — [2]Paul Scherrer Institute, Villigen PSI, Switzerland

The neutron storage experiment τSPECT aims to measure the free neutron lifetime by confining ultracold neutrons (UCNs) in a three-dimensional magnetic trap. A key aspect of this experiment is the detection of UCNs at various locations and times. For this purpose, a multilayer structure consisting of a conversion layer and a scintillator layer on a polyester carrier foil is employed. This design enables flexible coupling to light guides of detectors with diverse geometries. Silicon photomultipliers (SiPMs) are used as photosensors, which are particularly well suited for in-situ detection in τSPECT due to their compatibility with high magnetic fields.

This talk will give an overview of UCN detectors already implemented in τSPECT and discuss recent developments. In particular, we will present our approach to determine the energies of stored UCNs by combining a spatial resolving detector with the magnetic field gradient of the UCN trap. Additionally, a complementary detector in the beamline is employed to monitor fluctuations of the UCN source performance and to normalize measurements in τSPECT accordingly. Lastly, the so-called leakage detector will be introduced, which is intended to investigate systematic effects related to magnetic storage by detecting UCNs that may escape the trap.

HK 11.4 Mon 17:30 SR Exp1B Chemie

Dual sided PMT Readout Studies for the DarkMESA Calorimeter — •Lukas Reitz for the MAGIX-Collaboration — Johannes Gutenberg Universität, Mainz

At the Institute for Nuclear Physics in Mainz, the MESA accelerator will be operational shortly, producing a high-energy beam (150 MeV, 15 mikro Ampere). This beam will be used in the P2 experiment and subsequently absorbed in a beam dump, making the P2 experiment ideally suited for a parasitic dark sector experiment — DarkMESA.

The goal of this experiment is the detection of Light Dark Matter (LDM), which in simple models couples to the dark photon. This dark photon can potentially be produced in the P2 beam dump through a process analogous to bremsstrahlung and may then decay into a dark matter particle pair. A fraction of these dark matter particles will scatter off electrons or nuclei within the DarkMESA calorimeter, generating detectable Cherenkov light.

The Phase A calorimeter consists of 5x5 PbF2 crystals due to their high density and is surrounded by a hermetic veto system made of two layers of plastic scintillators and a 1 cm thick lead shield. For the Phase B calorimeter, SF6 and BGO are also considered as potential calorimeter materials.

This contribution will focus on the feasibility of reading out a BGO calorimeter from both sides using PMTs. A dual-sided readout would enable time-of-flight measurements, allowing for more precise determination of an Event's location and propagation within the calorimeter while also drastically reducing background noise of the detector.

HK 11.5 Mon 17:45 SR Exp1B Chemie

A Look Inside mRICH: Exploring Timing and Performance of a RICH Prototype[*] — •Abhishek Anil Deshmukh for the CBM-Collaboration — Bergische Universität Wuppertal, Wuppertal, Deutschland

The CBM (Compressed Baryonic Matter) experiment to be built at the future FAIR facilities in Darmstadt, Germany aims to investigate the QCD phase diagram at high-net baryon densities and moderate temperatures. The FAIR accelerator will provide high-intensity heavy-ion beams for this fixed target experiment. To ensure the best operability of CBM at day one, a prototype of CBM is set up already now, including scaled-down versions of almost all the detectors later to be employed in the final CBM setup. One main goal of this prototype, called mini-CBM (mCBM), is to establish the free-streaming readout scheme envisioned for CBM. To test this scheme a dedicated test beam time was carried out at the beginning of 2024.

This contribution will focus on the mRICH detector, being part of mCBM. The mRICH is a proximity-focusing RICH detector that utilizes the same readout electronics as the RICH detector planned for the final CBM experiment. Particular emphasis is placed on the RICH ring matching with tracks from other detector systems. The discussion also covers the detector's overall performance, which primarily depends on the aerogel radiator that has been in operation for over four years.

[*]Work supported by BMBF (05P24PX1)

HK 11.6 Mon 18:00 SR Exp1B Chemie

A SiPM-based Ring Imaging Cherenkov detector at CBM. — •Jesus Peña-Rodríguez, Christian Pauly, Jörg Försch, and Karl-Heinz Kampert for the CBM-Collaboration — Fakultät für Mathematik und Naturwissenschaften, Bergiche Universität Wuppertal, Gausstrasse 20, 42119 Wuppertal, Deutschland

The Compressed Baryonic Matter (CBM) experiment at the Facility for Antiproton and Ion Research (FAIR) will study the phase diagram of strongly interacting matter at high densities and moderate temperatures. CBM features a Ring Imaging Cherenkov (RICH) detector for electron detection. The RICH detector will have two photon cameras comprised of Multi-Anode Photomultipliers (MAPMTs), two spherical glass mirrors as focusing elements, and a CO2 radiator gas. In recent years, Cherenkov detectors have been moving toward new photodetection technologies to improve timing, spatial, and amplitude resolutions. Silicon photomultipliers (SiPMs) measure single-photon light intensities with picosecond timing precision, photodetection efficiencies up to 50%, and magnetic field immunity. However, SiPM drawbacks, such as a strong temperature dependence and high dark count rates, make their use challenging in RICH detectors featuring low-rate single-photon signals. We present the implementation and characterization of an 8x8 SiPM (AFBR-S4N66P024M) array adapted to the readout electronics of the CBM RICH. In addition, we evaluate the SiPM radiation hardness under different doses taking into account the radiation levels expected in the CBM photon cameras.

HK 12: Nuclear Astrophysics II

Time: Monday 16:45–18:00 Location: SR 0.03 Erw. Physik

Group Report HK 12.1 Mon 16:45 SR 0.03 Erw. Physik

3α-decay of the 0_2^+ state in ^{12}C — •David Werner[1], Timo Biesenbach[1], Joe Roob[1], Alessandro Salice[1], Peter Reiter[1], Maximilian Droste[1], Madalina Enciu[3], Pavel Golubev[2], Hannah Kleis[1], Nikolas Königstein[1], Dirk Rudolph[2], and Luis Sarmiento[2] — [1]University of Cologne, Institute for Nuclear Physics, Cologne — [2]Lund University, Department of Physics, Lund, Sweden — [3]TU Darmstadt, Institute of Nuclear Physics, Darmstadt

The branching ratios between the direct and sequential three-particle decays of the 0_2^+ excited state in ^{12}C, known as the Hoyle state, serve as key probes for the internal structure of ^{12}C and provide critical insights into stellar nucleosynthesis. To populate excited states in ^{12}C, especially the Hoyle state, a ^{12}C(α, α') reaction at a beam energy of 27 MeV was utilized in two high statistics-experiments at the 10 MV FN Tandem Accelerator at the University of Cologne. The decay products were detected using the Lund-York-Cologne-Calorimeter (LYCCA), which at the time featured 18 segmented double-sided silicon strip detectors, providing a high angular resolution and individual detection of up to four of the reaction's α particles. The data analysis is based on classical kinematic analysis methods as well as machine learning techniques to differentiate between the different decay modes. Results of the study, including the momentum distributions of the decay products and branching ratios of the different decay modes, will be presented.

HK 12.2 Mon 17:15 SR 0.03 Erw. Physik

Exploring CNO Cycle Reactions at the Felsenkeller Underground Accelerator Laboratory — •Axel Boeltzig[1], Daniel Bemmerer[1], Eliana Masha[1], Denise Piatti[2], Konrad Schmidt[1], Jakub Skowronski[2], Anup Yadav[1,3], Peter Hempel[1,3], and Kai Zuber[3] — [1]Helmholtz-Zentrum Dresden-Rossendorf, Germany — [2]Università degli Studi di Padova and INFN Sezione di Padova, Italy — [3]Technische Universität Dresden, Germany

Nuclear reactions in the Carbon-Nitrogen-Oxygen (CNO) cycles are active during the hydrogen burning phase of stars at elevated stellar temperatures. With increasing temperature, the reaction networks extend to fluorine, and breakout reactions from the catalytic cycles move into focus as pathways for the synthesis of neon and heavier elements in stars.

At the Felsenkeller shallow-underground laboratory, jointly operated by HZDR and TU Dresden, a 5 MV Pelletron accelerator is dedicated to sensitive nuclear astrophysics studies in a laboratory with 45 m of rock shielding against cosmic radiation. The CNO cycle reactions ^{12,13}C(p, γ)^{13,14}N were recently studied at this laboratory, and an investigation of the breakout reaction ^{19}F(p, γ)^{20}Ne is being planned. We will present on the status and plans for these measurements, and the future potential at the Felsenkeller Laboratory to explore the CNO cycle reactions.

HK 12.3 Mon 17:30 SR 0.03 Erw. Physik

Assessing the role of composition in the collapse of massive stars — •Justin Schäfer[1,2], Gabriel Martínez-Pinedo[1,2], and Ante Ravlić[3] — [1]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt — [2]Institut für Kernphysik (Theoriezentrum), TU Darmstadt — [3]Facility for Rare Isotope Beams, Michigan State University

The collapse of massive stars after iron core formation is determined by electron captures on a broad range of nuclei. To understand this, a description of electron captures and accurate determination of the composition is crucial. In this work we aim to explore the impact of compositional changes on the deleptonization rate. We show that different treatments of partition functions, which govern the distribution of nuclear states at given temperatures and densities, influence the individual composition substantially. However, the deleptonization rate and therefore the evolution of the collapsing star is rather unaffected by the detailed composition of matter. This behavior provides insight into the nuclear physics relevant for core-collapse supernovae modeling. This work is supported by the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (ERC Advanced Grant KILONOVA No.885281) and the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) - Project-ID 279384907 - SFB 1245, and MA 4248/3-1.

HK 12.4 Mon 17:45 SR 0.03 Erw. Physik

Multidimensional Hydrodynamical Simulations of Thermonuclear Ignition in Oxygen-Neon-Carbon Cores — •Paul Christians[1,2], Gabriel Martínez-Pinedo[1,2], Friedrich Konrad Röpke[3,4], Giovanni Leidi[3], and Róbert Andrássy[4,3] — [1]GSI Helmholtzzentrum für Schwerionenforschung — [2]Institut für Kernphysik, TU Darmstadt — [3]Heidelberger Institut für Theoretische Studien HITS gGmbH — [4]Zentrum für Astronomie der Universität Heidelberg

The fate of intermediate-mass stars ($7-11\ M_\odot$) depends on the evolution of their degenerate oxygen-neon cores, formed from the ashes of prior core carbon burning. Their evolution is mainly driven by electron capture reactions, which either cool or heat the core significantly, potentially determining the final fate of the star. Recently, it has been shown that forbidden electron capture transitions play a key role in the relevant temperature-density regimes, significantly altering the temperature evolution. Furthermore, residual carbon could lead to oxygen ignition at significantly lower densities. The ignition of this residual carbon is triggered by exothermic double electron capture on ^{24}Mg and ^{24}Na, which also heavily relies on the correct inclusion of forbidden rates and the treatment of convection. We study the impact of those key forbidden transitions using a low Mach multidimensional hydrodynamical code called Seven-League Hydro (SLH). This is needed, as highly subsonic convective flows play a crucial role during the final evolution. DFG Project-ID MA 4248/3-1; RO 3676/7-1. We acknowledge support by the Klaus Tschira Foundation.

HK 13: Focus Session I: Neutron capture reactions in the cosmos and the lab (joint session HK/SYMM)

Time: Tuesday 14:00–15:30 Location: HS 1 Physik

Invited Talk HK 13.1 Tue 14:00 HS 1 Physik

Neutron-induced reactions and open questions in the s-process — •Alberto Mengoni — INFN, Bologna and CERN, Geneva

Despite the enormous progress made in the investigation of the nucleosynthesis of the s-process, there are several open issues that need additional investigations, both experimentally as well as with the help of theoretical modeling. Among these, one of the most critical is the determination of the neutron capture rate for unstable branching points in the s-process path. While difficult to be measured (because of their radioactivity), the neutron capture cross section of branching points nuclei are useful for the determination of the astrophysical conditions in which the s-process is taking place (neutron densities, temperature).

Considerable progress has been made recently in the possibility to measure neutron capture cross section of unstable nuclei. Examples are recent measurements performed at experimental facilities such as n_TOF at CERN, LANSCE at Los Alamos and LiLIT at SARAF. Further developments of these activities will be presented.

Additional aspects of the nuclear physics developments, including those related to the determination of the stellar neutron capture rates and their theoretical modeling, as well as their corresponding beta-decay rates in plasma conditions will be reviewed.

Invited Talk HK 13.2 Tue 14:25 HS 1 Physik

n-capture experiments in inverse kinematics — •Rene Reifarth — LANL, Los Alamos, USA

Virtually all of the isotopes heavier than iron would not exist without neutron-induced reactions. Despite there importance in many different astrophysical scenarios, there are almost no direct measurements for isotopes with half-lives shorter than a few years. A radically new approach is necessary to overcome this constraint.

Ion storage rings offer unprecedented possibilities to investigate radioactive isotopes of astrophysical importance in inverse kinematics. During the last years, a series of pioneering experiments proofed the feasibility of this concept for the fusion of charged paricles at the Experimental Storage Ring (ESR) at GSI. In the future, a combination of a free-neutron target and an ion storage ring can bring the half-life limit for direct neutron-induced reactions down to fractions of a minute.

I will review different astrophysical scenarios, status of current experiments as well as prospects of this new experimental endeavor.

Invited Talk HK 13.3 Tue 14:50 HS 1 Physik

Single atom counting of live interstellar radionuclides in natural archives — •Johannes Lachner — Helmholtz-Zentrum Dresden-Rossendorf

Recent nearby supernovae and other cosmic explosions produce also long-lived radionuclides that penetrate into the solar system and are collected in terrestrial and lunar archives. Accelerator Mass Spectrometry (AMS) is used to identify minute amounts of these live radionuclides in environmental samples. Such signatures provide insight into the location and frequency of recent nearby Supernova activity and r-process events.

However, only in a few cases the proper combination of environmental archive and long-lived radionuclide allows to identify a clear fingerprint of such a rare input. Measurements of Supernova-produced ^{60}Fe ($T_{1/2}$=2.6 Myr) in deep-sea sediments and FeMn crusts as well as in lunar soil point to multiple Supernovae occurring in our solar vicinity within the past 10 Myr. Besides ^{60}Fe, recently also the pure r-process nuclide ^{244}Pu ($T_{1/2}$=81 Myr) was detected in deep-sea archives demonstrating that r-process indeed occurred within the past few 100 Myr.

In this presentation, I will also discuss present technical constraints in the detection of such radionuclides by AMS and ongoing work increasing the capabilities for the analysis of additional interstellar radionuclides, e.g. ^{182}Hf and ^{247}Cm.

Common discussion: 15'

HK 14: Structure and Dynamics of Nuclei V

Time: Tuesday 14:00–15:30 Location: HS 2 Physik

Group Report HK 14.1 Tue 14:00 HS 2 Physik

Key observables for quadrupole collectivity in N=80 isotones — •H. Mayr[1], T. Stetz[1], V. Werner[1], U. Ahmed[1], K. Gladnishki[2], K.E. Ide[1], D. Kocheva[2], C.M. Nickel[1], N. Pietralla[1], G. Rainovski[2], and R. Zidarova[1] — [1]TU Darmstadt, Germany — [2]Sofia University, Bulgaria

Quadrupole collectivity near shell closures dominates the structure of low-lying excited states. Predominantly of one-quadrupole phonon character are the isoscalar proton-neutron symmetric 2^+_1 state and the isovector mixed-symmetry $2^+_{1,\mathrm{ms}}$ state. Due to strong fragmentation of the $2^+_{1,\mathrm{ms}}$ state of ^{138}Ce, the underlying shell structure [1] spreads the M1 transition strength to the 2^+_1 state over several 2^+ states. This key feature of the $2^+_{1,\mathrm{ms}}$ state is concentrated in a single 2^+ state in nuclei below the $\pi g_{7/2}$ subshell closure [2,3]. This finding is supported by recently obtained $B(M1, 2^+_{2,3} \rightarrow 2^+_1)$ strengths of ^{132}Te [4]. Shell stabilisation in the heavier N=80 isotones is restored in the $\pi d_{5/2}$ subshell [5,6]. With other key observables like the $B_{4/2}$ ratio, a comprehensive picture of quadrupole collectivity in the N=80 isotones will be drawn.

[1] G. Rainovski *et al.*, Phys. Rev. Lett. **96** (2006) 122501
[2] T. Ahn *et al.*, Phys. Lett. B **679** (2009) 1
[3] N. Pietralla *et al.*, Phys. Rev. C **58** (1998) 796
[4] T. Stetz *et al.*, Submitted to Phys. Rev. C
[5] R. Kern *et al.*, Phys. Rev. C **102** (2020) 041304
[6] T. Stetz *et al.*, Submission in preparation

*Supported by the BMBF under grant numbers 05P21RDCI2 and 05P24RD3.

HK 14.2 Tue 14:30 HS 2 Physik

Many-body emulators for nuclear structure — •Margarida Companys Franzke[1,2,3], Kai Hebeler[1,2,3], Takayuki Miyagi[4,1,2,3], Alexander Tichai[1,2,3], and Achim Schwenk[1,2,3] — [1]Technische Universität Darmstadt, Department of Physics — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — [3]Max-Planck Institut für Kernphysik, Heidelberg — [4]Center for Computational Sciences, University of Tsukuba

Emulation techniques have become a popular tool in nuclear physics to study Hamiltonians with an explicit parametric dependence. An important example is given by two- and three-nucleon interactions derived from chiral effective field theory that depend linearly on low-energy couplings (LECs). Eigenvector-continuation-based emulators allow for the sampling of millions of nuclear interaction models, which is needed, e.g., for large-scale sensitivity studies, lowering the computational cost significantly with respect to explicit many-body simulations. In this work, we construct an emulator from a set of Hartree-Fock training states to study the impact of variations of three-body couplings on the N=32 shell closure in calcium isotopes. The experimentally measured difference in charge radii of ^{52}Ca compared to ^{48}Ca is underpredicted in ab initio calculations and still poses a major challenge to nuclear theory. As an outcome of this work we identify domains in LECs space that can give predictions compatible with the experiments and help construct the next generation of chiral Hamiltonians.

*Funded by the ERC Grant Agreement No. 101020842

HK 14.3 Tue 14:45 HS 2 Physik

Uncertainty quantification for nuclear structure calculations using similarity-renormalization-group-evolved potentials — •Tom Plies[1,2], Matthias Heinz[1,2,3], and Achim Schwenk[1,2,3] — [1]Technische Universität Darmstadt, Department of Physics — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — [3]Max-Planck Institut für Kernphysik, Heidelberg

Uncertainty quantification is a key aspect in modern nuclear theory. Nuclear Hamiltonians are uncertain, with the uncertainty residing in the low-energy constants (LECs) parametrizing the interactions. As these parameter-dependent interactions are used as input for nuclear structure calculations, distributions of many-body observables can be inferred from distributions of LECs. To apply these approaches to potentials transformed to low resolution through the similarity renormalization group, we deploy the singular value decomposition to recover a linear operator basis for our interactions. We use Bayesian methods to infer distributions for the LECs from the theoretical uncertainties in nucleon-nucleon phase shifts and triton observables. We then sample from the LEC posteriors to obtain distributions for the ground-state observables of calcium isotopes. Through this, we investigate the discrepancy between theoretical and experimental trends in calcium charge radii.

* Funded by the ERC Grant Agreement No. 101020842 and by the DFG – Project-ID 279384907 – SFB 1245.

HK 14.4 Tue 15:00 HS 2 Physik

One and two proton removal from neutron-rich nuclei in the region of 52Ca — •Christina Xanthopoulou — Institut für Kernphysik, Technische Universität Darmstadt, D-64289 Darmstadt, Germany

One and two proton removal from neutron-rich medium-mass nuclei are commonly used to populate different final states in a nucleus of interest. (p,2p) and (p,3p) knockout reactions have been investigated in inverse kinematics within the first two SEASTAR campaigns that took place at RIBF in RIKEN, Japan [1]. These studies have been extended to the third SEASTAR campaign where medium-mass radioactive nuclei in the region of 54Ca were sent at about 270 MeV/nucleon onto a 15 cm long liquid hydrogen target surrounded by the MINOS time-projection chamber. MINOS enabled to track the angular distribution of the knocked out protons. (p,2p) and (p,3p) cross sections have been obtained and compared to theoretical reaction models. In particular, the difference in sensitivity of (p,2p) and (p,3p) to the population of individual final states in the same nucleus will be discussed. References: [1] A. Frotscher et al., Phys. Rev. Lett. 125, 012591 (2020)

HK 14.5 Tue 15:15 HS 2 Physik

Basis optimization for in-medium similarity renormalization group calculations — •Max Cincar[1,2], Takayuki Miyagi[1,2,3,4], and Achim Schwenk[1,2,3] — [1]Technische Universität Darmstadt, Department of Physics — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — [3]Max-Planck-Institut für Kernphysik, Heidelberg — [4]Center for Computational Sciences, University of Tsukuba, 1-1-1 Tennodai, Tsukuba 305-8577, Japan

Advances in nuclear many-body methods have enabled the calculation of nuclei up to the lead region. Optimization of the underlying single-particle basis enables the calculation of nuclear observables in smaller model spaces reducing the required computational cost. We explore calculations using natural orbitals constructed from perturbatively improved density matrices. Ground- and excited-state energies of nuclei are obtained using the valence-space in-medium similarity renormalization group. The convergence behavior of ground-state and excitation energies is investigated for different truncation schemes of nuclear Hamiltonians.

* Funded by the ERC Grant Agreement No. 101020842.

HK 15: Hadron Structure and Spectroscopy I

Time: Tuesday 14:00–15:30 Location: HS 3 Physik

Group Report HK 15.1 Tue 14:00 HS 3 Physik

The CBELSA/TAPS experiment: Recent results and future plans — •Tobias Seifen for the CBELSA/TAPS-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Nussallee 14-16, 53115 Bonn

One important step in understanding the baryon spectrum is a precise knowledge of the excited states and their decays. In order to extract the contributing resonances from experimental data a partial wave analysis needs to be performed. To resolve ambiguities, the measurement of polarization observables is indispensable.

The CBELSA/TAPS experiment is ideally suited to measure the photoproduction of neutral mesons decaying into photons due to its good energy resolution, high detection efficiency for photons, and the nearly complete solid angle coverage. In combination with a longitudinally or transversely polarized target and an energy tagged, linearly or circularly polarized photon beam the experiment allows the measurement of a large set of polarization observables.

In addition to recent results from the CBELSA/TAPS experiment, this talk will discuss a new experiment, INSIGHT at ELSA, which will reuse the CB calorimeter, complemented by several new detector systems: a pixel detector surrounding the target and a forward spectrometer consisting of GEMs, a dipole magnet, straw tubes and the PANDA Forward-Endcap calorimeter. This setup will combine high resolution photon measurements with precise charged particle detection over nearly the entire solid angle and extend the measurements of polarization observables e.g. into the strangeness sector.

HK 15.2 Tue 14:30 HS 3 Physik

Determination of polarization observables in the reaction $\gamma p \to p\omega$ — •Lisa Richter for the CBELSA/TAPS-Collaboration — Universität Bonn

Nucleons are bound states composed of quarks and gluons. They interact via the strong interaction, which is described by quantum chromodynamics (QCD). The non-pertubative regime of the QCD is not well understood.

One way of deepening the understanding of this regime is the study of baryon excitation spectrum. The spectrum can be obtained in photoproduction experiments, where single and double polarization observables can be measured using a polarized photon beam and target.

The CBELSA/TAPS experiment in Bonn utilizes a linearly or circularly polarized photon beam impinging on a longitudinally or transversally polarized target. As a result, it is possible to get information on single and double polarization observables for different final states.

The main detector system consists of the Crystal Barrel (CB) and the Mini-TAPS calorimeter. With this system, it is possible to cover a solid angle of almost 4π with high efficiency for the detection of photons. For the identification of charged particles, an inner detector is located inside of the Crystal Barrel detector.

The reaction $\gamma p \to p\omega$ allows the investigation of a non-pionic final state, which could help to get a better understanding of baryon resonances.

This talk gives an insight into possible background reactions and presents my first results of observables for ω photoproduction.

HK 15.3 Tue 14:45 HS 3 Physik

First measurement and investigation of the ρ^0–p final-state interaction with ALICE — •Maximilian Korwieser for the ALICE Germany-Collaboration — Technische Universität Muenchen

Experimental data on the interaction between vector mesons and nucleons are a crucial input for understanding the pattern of in-medium chiral symmetry restoration (CSR) and dynamically generated excited N states. However, accessing these interactions is hampered by the short-lived nature of the vector mesons, making traditional scattering experiments unfeasible. In recent years, the ALICE Collaboration employed femtoscopy to measure similar challenging systems like the p–Ω and ϕ–p. By leveraging the excellent PID capabilities of the ALICE experiment, coupled with the copious production of ρ^0p pairs at the LHC in small colliding systems, ALICE presents the first-ever measurement of the momentum correlation function between ρ^0 and p. The data are interpreted employing calculations within the framework of unitarised chiral perturbation theory in a coupled-channel approach. This measurement represents an unprecedented opportunity to study the nature of the excited N in particular N(1700) and N(1900), possibly unveiling if these states are molecular in nature as well as shedding light on possible signatures of CSR at LHC energies. This work was supported by ORIGINS cluster DFG under Germany's Excellence Strategy-EXC2094 - 390783311 and the DFG through the Grant SFB 1258 *Neutrinos and Dark Matter in Astro and Particle Physics*.

HK 15.4 Tue 15:00 HS 3 Physik

η' beam asymmetry at threshold using the BGOOD experiment — •Leoni Lutter for the BGOOD-Collaboration — Physikalisches Institut, Universität Bonn

The unexpected nodal structure of the beam asymmetry reported by the GRAAL collaboration in η' photoproduction very close to threshold could be explained by a previously unobserved very narrow resonance. BGOOD is one of the few experiments worldwide which is able to verify this result. The experiment is composed of a central calorimeter for neutral meson decays and a forward spectrometer for charged particle identification. Close to threshold the $\gamma p \to \eta' p$ reaction can be reconstructed over all centre-of-mass angles from proton identification at forward angles. A linearly polarised photon beam produced via coherent bremsstrahlung off a diamond radiator makes it possible to measure the η' beam asymmetry. Preliminary results on reaction identification and progress towards the determination of the $\gamma p \to \eta' p$ beam asymmetry will be presented.

Supported by DFG projects 388979758/405882627 and the European Union's Horizon 2020 programme, grant 824093.

HK 15.5 Tue 15:15 HS 3 Physik

Study of neutral-pion pair production in two-photon scattering at BESII — •Max Lellmann, Achim Denig, and Christoph F. Redmer for the BESIII Germany-Collaboration — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz

The anomalous magnetic moment of the muon, a_μ, is one of the most precisely measured observables in the Standard Model; however, a significant discrepancy exists between the Standard Model prediction and experimental measurements. Whether this discrepancy is indicative of new physics or stems from an incomplete understanding of the strong interaction at low energies remains an open question. To gain deeper insight into this discrepancy, it is necessary to reduce the uncertainties in both the Standard Model prediction and the direct measurements. Since the uncertainty in the Standard Model prediction is primarily driven by hadronic contributions, acquiring more detailed information on the relevant hadronic processes is crucial.

The production of pion pairs in two-photon fusion processes is vital for calculating the hadronic light-by-light scattering contribution to a_μ. The BESIII experiment, located at the Institute of High Energy Physics in Beijing, China, provides an ideal platform for investigating two-photon processes at small momentum transfers. The process $e^+e^- \to e^+e^-\pi^0\pi^0$ is measured at BESIII for a center-of-mass energy of 3.77 GeV, with a total integrated luminosity exceeding 20 fb^{-1}. This presentation will outline the current status of the analysis and the tools utilized.

HK 16: Heavy-Ion Collisions and QCD Phases III

Time: Tuesday 14:00–15:30 Location: HS 3 Chemie

HK 16.1 Tue 14:00 HS 3 Chemie

Low-mass, low-momentum virtual photon measurement with HADES — •Iuliana Carina Udrea for the HADES-Collaboration — TU Darmstadt

Collisions of heavy nuclei at relativistic energies create a hot and dense medium, offering a unique environment to explore its microscopic properties using electromagnetic probes.

Dileptons are particularly advantageous for this purpose, as they do not interact strongly with the surrounding matter, allowing them to carry undisturbed information about the QCD matter produced during the reaction. In particular, the study of low-mass and low-momentum dileptons provides valuable insights into transport properties such as electrical conductivity.

In this contribution, we outline the key steps towards investigating soft dileptons. For this purpose data from Ag+Ag collisions at 1.23A GeV with a nominal magnetic field strength are compared with a reduced magnetic field (5% of $B_{\max}$), the latter increasing the acceptance for low-momentum pairs.

Furthermore, we will present simulations at reduced magnetic field strength, which provide optimal parameters for the upcoming run in 2024/2025 with Au+Au collisions at 0.8A GeV, conducted with the HADES experiment.

This work is supported by: GSI F&E and HGS-HIRe.

HK 16.2 Tue 14:15 HS 3 Chemie

Dielectron Analysis for the CBM Experiment in Au+Au Collisions at $\sqrt{s_{NN}}$ = 3.19 GeV — •Luisa Faber for the CBM-Collaboration — Institut für Kernphysik Universität Münster

The Compressed Baryonic Matter (CBM) experiment is currently under construction in Darmstadt and designed to explore the QCD phase diagram at high net-baryon densities using heavy ion collisions with energies ranging from $\sqrt{s_{NN}} = 2.86$ GeV to $\sqrt{s_{NN}} = 4.93$ GeV and high interaction rates up to 10 MHz.

In different stages of the fireball evolution virtual photons are produced and able to leave the medium since they do not interact strongly, making them an important measurement tool. They carry the information with their invariant mass, which can be accessed by their decay into dileptons. The invariant mass spectrum allows for example to determine the temperature of the medium. By extracting this temperature at different collision energies one can access the caloric curve and possibly determine the order of the phase transition between the QGP and confined matter in this region of the phase diagram.

In this talk simulations with a kinetic energy of 3.56 AGeV for Au+Au collisions are used to extract the dielectron mass spectrum. Since dileptons are rare probes it is of utmost importance in this analysis to ensure a high electron efficiency and a high pion suppression. Prior work was carried out for the maximum energy of 11 AGeV. The used cuts on detector parameters are adapted for the lower energy. First results of the analysis are shown in this talk.

HK 16.3 Tue 14:30 HS 3 Chemie

Dielectron Identification with Machine Learning in Ag+Ag collisions at 1.58A GeV at HADES — •Henrik Flörsheimer for the HADES-Collaboration — Technische Universität Darmstadt

The High-Acceptance-Di-Electron-Spectromet (HADES) is a fix target experiment capable of measuring heavy-ion as well as elementary collisions. With beam energies around a few GeV nuclear matter at high densities and moderate temperature can be observed. One way to gain information about these collisions is to study electro- magnetic probes, such as the virtual photon decaying into electron positron pairs. They can be used to characterize the evolution of the fireball or to gain further information using their invariant mass spectrum to determine a fireball temperature or potential in medium modifications.

At HADES, the main components for reconstruction of dileptons are the ring imaging Cherenkov (RICH) detector, two Multi-wire drift chambers (MDCs) before and after the magnet for tracking and momentum determination, an electromagnetic calorimeter (ECAL) measuring the energy loss, and a forward wall for determining the centrality of the collisions.

In this contribution, we discuss new methods to utilize all these detector observables in a multivariate analysis in order to optimally identify leptons. We demonstrate how the performance in the dilepton analysis can be increased using Machine Learning. We also show how to deal with challenges in the efficiency correction and the need for additional checks for unwanted biases.

HK 16.4 Tue 14:45 HS 3 Chemie

Dielectron production and topological separation of dielectron sources with ALICE in Run 3 — •Jerome Jung for the ALICE Germany-Collaboration — Goethe University, Frankfurt, Germany

Dielectrons are an exceptional tool to study the properties of hadronic and nuclear collisions as they can leave the strongly interacting system at any stage of its evolution. However, the interpretation of their spectra relies on a precise understanding of all contributing sources. To single out potential medium contributions in nucleus*nucleus collisions on top of those from hadron decays, studies in hadronic collisions are instrumental to obtain a reference measurement.

To measure prompt sources at invariant masses above 1.2 GeV/c^2, such as Drell-Yan or thermal dielectrons, it is necessary to disentangle these contributions from the large physics background from correlated semi-leptonic decays of heavy-flavor hadrons. The upgraded ALICE detector with its increased pointing resolution and higher data acquisition rates allows disentangling these contributions based on their topology using the distance-of-closest approach (DCA) to the primary vertex with high precision.

This talk presents the status of the analysis of dielectron production in proton-proton collisions at $\sqrt{s} = 13.6$ TeV from LHC Run 3 recorded with ALICE. The increased topological separation power is demonstrated. Finally, DCA templates of expected sources are fitted to the data to separate the yield from prompt and non-prompt sources.

HK 16.5 Tue 15:00 HS 3 Chemie

Testing machine learning against finite size scaling in Lattice QCD — •Simran Singh[1], Reinhold Kaiser[2], Frithjof Karsch[3], Jan Philipp Klinger[2], Owe Philipsen[2], and Christian Schmidt[3] — [1]HISKP Rheinischen Friedrich-Wilhelms Universität Bonn, Bonn, Germany — [2]Institut für Theoretische Physik, Goethe-Universität Frankfurt, Frankfurt, Germany — [3]Fakultät für Physik, Universität Bielefeld, Bielefeld, Germany

Masked Autoregressive Flows (MAFs) provide a machine learning method for estimating the joint probability density of observables from data samples. In [1], MAFs were used to estimate the joint probability density of the chiral condensate and gauge action conditioned on lattice parameters like gauge coupling, bare quark mass and spatial lattice extent for degenerate quarks using highly improved staggered fermions, identifying the critical mass separating crossover and first-order regions. This work extends the MAF analysis to previously published data using unimproved staggered fermions [2], aiming to compare MAF predictions of lattice observables with actual data with the ultimate goal to compare the ML approach to determine the Z2 critical mass with the finite size scaling analysis of the kurtosis, which was used in [3] by the Frankfurt group.

1. F. Karsch et.al., PoS LATTICE2022 (2023)
2. F. Cuteri et.al., JHEP 11 (2021)
3. O. Philipsen, PoS LATTICE2019 (2019)

HK 16.6 Tue 15:15 HS 3 Chemie

QCD Anderson transition with overlap valence quarks on a twisted-mass sea — •Robin Kehr[1] and Lorenz von Smekal[1,2] — [1]Institut für Theoretische Physik, Justus-Liebig-Universität, Heinrich-Buff-Ring 16, 35392 Giessen, Germany — [2]Helmholtz Forschungsakademie Hessen für FAIR (HFHF), GSI Helmholtzzentrum für Schwerionenforschung, Campus Gießen

We investigate the QCD Anderson transition by studying the low-lying eigenmodes of the overlap operator in the background of gauge configurations with 2+1+1 quark flavors of twisted-mass Wilson fermions. The mobility edge, below which eigenmodes are localized, is estimated by the inflection point of the relative volume. The analysis of its temperature dependence suggests a close relation of localization to chiral symmetry restoration. We will present and discuss recent data on lower temperatures and with prior smoothing of the configurations with gradient flow as well as alternative definitions of localization and estimates of the mobility edge.

Based on: 10.1103/PhysRevD.109.074512, 10.48550/arXiv.2304.13617

HK 17: Structure and Dynamics of Nuclei VI

Time: Tuesday 15:45–17:15 Location: HS 2 Physik

Group Report HK 17.1 Tue 15:45 HS 2 Physik

Experiments with exotic nuclei at the FRS Ion Catcher — •Kriti Mahajan for the Super-FRS Experiment-Collaboration — Justus-Liebig Universität Gießen, Germany — Helmholtz Research Academy Hesse for FAIR (HFHF), Campus Gießen, Germany

At GSI Darmstadt exotic nuclei can be produced at relativistic energies by projectile fragmentation or fission and separated in the fragment separator FRS. Then at FRS Ion Catcher, the beam is thermalized inside the cryogenic stopping cell (CSC) and transmitted to the multiple reflection time-of-flight mass spectrometer (MR-TOF-MS), which features a high resolving power of up to 1,000,000, short cycle times of a few ten milliseconds and mass accuracies down to a few 10^{-8}.

At FRS-IC, several masses have been measured so far across the nuclear chart. Direct mass measurements of neutron-deficient nuclides around $N = Z$ below ^{100}Sn and neutron-rich nuclides along $N = 126$ below ^{208}Pb have been performed and shed light on the nuclear structure in these regions. Additionally, broadband mass measurements of fission fragments from a ^{252}Cf spontaneous fission source reveal evidence for shape phase transitions in the $N \sim 90$, $Z = 56-63$ region, and provide direct determination of independent isotopic fission yields (IIFYs). Recently, proof-of-principle experiments were performed focused in the multi-nucleon transfer reactions and study of radioactive molecules driven by the hunt to explore fundamental laws of nature.

An overview of the setup, recent experimental highlights, technical advances and upcoming experiments in FAIR Phase-0 will be reported.

HK 17.2 Tue 16:15 HS 2 Physik

Correlation experiments in fission induced by quasi-monochromatic photons* — •Vincent Wende[1], Dimiter Balabanski[4], Joachim Enders[1], Sean W. Finch[2], Alf Göök[3], Calvin R. Howell[2], Annabel Ibel[1], Forrest Q.L. Friesen[2], Ronald C. Malone[7], Maximilian Meier[1], Andreas Oberstedt[4], Stephan Oberstedt[5], Marius Peck[1], Norbert Pietralla[1], Anthony P.D. Ramirez[6], Jack A. Silano[6], Gerhart Steinhilber[1], Anton P. Tonchev[6], and Werner Tornow[2] — [1]Institut für Kernphysik, Fachbereich Physik, TU Darmstadt, Darmstadt, Germany — [2]Triangle Universities Nuclear Laboratory, Duke University, Durham, NC, USA — [3]Uppsala Universitet, Uppsala, Sweden — [4]ELI-NP, IFIN-HH, Magurele, Romania — [5]EC-JRC Geel, Belgium —

[6]Lawrence Livermore National Laboratory, Livermore, CA, USA — [7]U.S. Naval Academy, Annapolis, MD, USA

Describing the nuclear fission process requires high-precision data from experiments. We present results of an experimental campaign at the High-Intensity γ-Ray Source at TUNL, investigating the fission of actinides using linearly-polarized quasi-monochromatic photon beams between 6.2 and 13 MeV in the entrance channel. Mass, total kinetic energy and angular distributions of fission fragments have been measured simultaneously using a position-sensitive twin Frisch-grid ionization chamber.
*Work supported by DFG, GRK 2891 Nuclear Photonics (project-ID 499256822).

HK 17.3 Tue 16:30 HS 2 Physik

Microscopic description of collective inertias for fission — •Nithish Kumar Covalam Vijayakumar[1,2], Gabriel Martínez-Pinedo[2,1], Luis Robledo[3], and Samuel Andrea Giuliani[3] — [1]Institut für Kernphysik, Technische Universität Darmstadt, Darmstadt, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — [3]Universidad Autónoma de Madrid, Madrid, Spain

The theoretical description of nuclear fission is a challenging quantum many body problem since it involves quantum tunneling of the nuclei through fission barriers. This tunneling is very sensitive to the collective inertia along the fission path. In most of the fission calculations, the collective inertia is evaluated using cranking approximation which neglects the dynamical residual effects. In this work, we are developing a scheme to compute collective inertias using finite amplitude method - quasiparticle random phase approximation (FAM-QRPA) which also takes into account the consistent treatment of dynamical effects. FAM-QRPA code is currently being developed using the finite range Gogny energy density functionals and axial symmetry preserving Hartree-Fock-Bogoliubov framework. The completed FAM-QRPA code will be then used to study the role of collective inertia in fission probabilities and the role of fission in r-process nucleosynthesis. Once the code is developed, it can also be used to study electromagnetic response of nuclei. This work is supported by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) Project-ID 499256822 GRK 2891 'Nuclear Photonics'.

HK 17.4 Tue 16:45 HS 2 Physik

Search for the Double Alpha Decay of Ra-224 at GSI: Final Sensitivity Estimation — •Heinrich Wilsenach — The Hebrew University of Jerusalem, Jerusalem, Israel

Double alpha decay is a predicted decay mode when the atomic nucleus decays via the simultaneous emission of two α-particles. A recent theoretical publication by Mercier *et al.* (PRL 127, 012501 (2021)) has renewed interest in this topic, which was first discussed in the late 1970s. The work proposes an experimentally achievable estimate for the branching ratio of about 10^{-8}. In the last 2 years, three experiments have been performed to search for the double alpha decay of trans-lead isotopes: at GSI (2022), at the ISOLDE facility (CERN, 2023), and at MSU (2024).

In this talk, we will focus on the double alpha experiment performed at the FRS Ion Catcher (FRC-IC) to observe the decay of ^{224}Ra. To reduce the random coincidence detection rate, an offline ^{228}Th source was used at FRS-IC to produce a beam of Ra^{2+} ions. Since the two α-particles are predicted to be emitted in opposite directions with the branching ratio of 10^{-8}, two face-to-face silicon strip detectors were employed to detect all alphas and betas from the known decay transitions in the ^{224}Ra decay chain. A large dataset of 10^9 ^{224}Ra events gives an expected number of signal events of 90 double alpha decays.

The final stage of data analysis is the main focus of this talk. We present the consistent processing of the entire combined dataset and the final evaluation of the detection setup sensitivity.

HK 17.5 Tue 17:00 HS 2 Physik

Measurement of masses of fission products and isotopic yields from a ^{252}Cf spontaneous fission source at the FRS Ion Catcher — •Meetika Narang for the FRS Ion Catcher-Collaboration — University of Groningen, Netherlands — GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany.

Masses of neutron-rich nuclei and the nuclear fission process are essential for understanding nuclear structure far from stability and the abundance of elements synthesized through the r-process.

At the FRS Ion Catcher (FRS-IC) at GSI, fission fragments are produced via spontaneous fission (SF) from a ^{252}Cf source mounted inside a gas-filled Cryogenic Stopping Cell (CSC). These fragments are thermalized and stopped within the CSC. Their masses and IIFYs are then measured with a Multiple-Reflection Time-Of-Flight Mass Spectrometer (MR-TOF-MS). The MR-TOF-MS resolves isobars, incorporating several novel and unique concepts, even with limited statistics. Its broadband nature ensures minimal relative systematic uncertainties among fission products. Extracting IIFYs includes isotope-dependent efficiency corrections for all the components of FRS-IC.

In this talk, I will present our results, including high-accuracy mass measurements representing the first direct mass measurements in the N = 90 and Z = 56-62 region. Additionally, I will discuss our IIFY results, which cover several tens of fission products, extending to the high-mass fission peak and yields as low as 10^{-5}. Future experiments aim to broaden these results to cover a wider range of Z and N values, lower fission yields, and other spontaneously-fissioning actinides.

HK 18: Hadron Structure and Spectroscopy II

Time: Tuesday 15:45–17:15 Location: HS 3 Physik

Group Report HK 18.1 Tue 15:45 HS 3 Physik

Forward angle coherent photoproduction off the deuteron - a puzzle of unexpectedly large cross section measurements — •Thomas Jude for the BGOOD-Collaboration — Physikalisches Institut, Universität Bonn

The BGOOD photoproduction experiment at the ELSA facility is uniquely designed to explore kinematics where a charged particle is identified in a forward spectrometer and a recoiling hadronic system is reconstructed in the central calorimeter at low momentum transfer. The setup enables studies of coherent reactions off the deuteron where the deuteron takes the majority of the beam momentum. Due to the small deuteron binding energy this kinematic regime is expected to be heavily suppressed, however measurements of the reactions, $\gamma d \rightarrow \pi^0\pi^0 d$, $\gamma d \rightarrow \pi^0\eta d$ and $\gamma d \rightarrow \pi^0\pi^0\pi^0 d$ exhibit forward differential cross sections an order of magnitude higher than phenomenological model calculations.

The $\gamma d \rightarrow \pi^0\pi^0 d$ reaction is consistent with a scenario of intermediate dibaryon formation, including the proposed $d^*(2380)$ hexaquark. Other mechanisms however, such as pion exchange in final state interactions may yet prove to play dominant roles in all three measured reactions.

HK 18.2 Tue 16:15 HS 3 Physik

Determination of polarization observables in the reaction γn→n$\pi^0\pi^0$. — •Nadia Reinartz for the CBELSA/TAPS-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Nussallee 14-16, 53115 Bonn

Investigating the baryon excitation spectrum is essential for understanding the internal dynamics of baryons and quantum chromodynamics (QCD) in the non-perturbative regime. Extracting the baryon resonances and their properties from the data is difficult due to the short lifetime of these exited states which leads to broad and strongly overlapping resonances. Using a polarized beam, a polarized target or using the polarization of the recoiling nucleon allows the measurement of single or double polarization observables, that are needed for an unambiguous partial wave analysis solution.

The CBELSA/TAPS experiment uses polarized photons of up to 3.2 GeV energy and a polarized target to determine single or double polarization observables for various final states. The Crystal Barrel calorimeter in combination with the MiniTAPS calorimeter in forward direction and the ability to detect charged particles, allows measurements in a close to 4π coverage. In the last years, the CBELSA/TAPS experiment in Bonn was upgraded in order to significantly boost the efficiency to trigger on final states with only neutral particles.

In this talk a comparison between results of free and quasi-free protons in the reaction γp→p$\pi^0\pi^0$ are discussed, followed by preliminary results for the reaction γn→n$\pi^0\pi^0$.

Supported by the DFG (505387544)

HK 18.3 Tue 16:30 HS 3 Physik

Determination of Polarization Observables in the $\pi^0\eta$-Photoproduction off the Neutron — •Leoniedas Reschke for the CBELSA/TAPS-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Nussallee 14-16, 53115 Bonn

The extraction of double-meson polarization observables from neutron reactions provides a valuable opportunity to refine theoretical models and to compare production processes off neutrons with those off protons. Measurements of polarization observables off neutrons offer access to resonances which couple stronger to the neutron, making them essential for a comprehensive understanding of nucleon resonances. Final states involving two mesons are particularly sensitive to cascading decays via intermediate states, providing unique insights into baryon dynamics. However, data on neutron, and, especially, double meson-neutron reactions are scarce. At the CBELSA/TAPS experiment in Bonn, photoproduction experiments are conducted using a polarized photon beam and various targets, including a polarized deuterized butanol target. This setup enables photoproduction experiments off the neutron. Since only deuteron-bound neutrons can be polarized, but reactions from all target neutrons are measured, advanced analysis techniques are necessary to exclude contamination from the neutrons bound in oxygen and carbon while also accounting for the Fermi motion of the bound neutrons in the deuteron. In this talk, I will present preliminary results for polarization observables in $\gamma n \rightarrow n\pi^0\eta$. Supported by the DFG (Project-Nr.: 505387544).

HK 18.4 Tue 16:45 HS 3 Physik

"Production Mechanism Studies of the N^* and Δ Resonances in Proton-Proton Collisions" — •Saket Kumar Sahu[1], Johan Messchendorp[3], and James Ritman[1,2,3] for the HADES-Collaboration — [1]Ruhr-Universität Bochum — [2]Forschungszentrum Jülich — [3]GSI Helmholtzzentrum fur Schwerionenforschung GmbH

The electromagnetic properties of (excited) hadrons can be investigated through the production of virtual photons in elementary reactions. Our goal is to study Dalitz transitions of N^* and Δ resonances generated in proton-proton collisions. The key challenge is to first understand the production mechanisms of these resonances. A comprehensive understanding of the production mechanisms in elementary reactions will also serve as a crucial reference for interpreting data from heavy-ion collisions. The High Acceptance Di-Electron Spectrometer (HADES) at GSI Darmstadt is a versatile magnetic spectrometer designed for measuring wide range of charged particle final states across large angular acceptance and is ideal for performing these studies. This analysis aims to extract differential cross-sections for the exclusive production of N^* and Δ channels in proton-proton collisions at $\sqrt{s}$ = 3.47 GeV. The data will serve as a good basis to rigorously study the production mechanisms by a detailed comparison with theory calculations. This talk will focus on the initial results of the analysis of proton-proton scattering data collected in February 2022 by the HADES collaboration.

HK 18.5 Tue 17:00 HS 3 Physik

Partial Wave Analysis for Pion-Induced Resonance Studies in the HADES Experiment — •Ahmed Marwan Foda for the HADES-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Deutschland

The High Acceptance Di-lepton Spectrometer (HADES) collaboration at GSI uses a pion-beam to examine baryonic resonances and their decay channels. This pion-beam facility enables baryonic resonance production at a fixed center of mass energy ($\sqrt{s}$) in the s-channel, offering a key advantage over proton-induced reactions and complementing photo-induced studies conducted elsewhere. Partial Wave Analysis (PWA) techniques explore resonance couplings to various final states. HADES focuses on studying vector mesons' role and medium modification in heavy-ion collisions within baryon-dense matter. Elementary pion-induced studies on the proton combined with PWA provide deeper insights into baryonic resonance couplings to ρN and ωN final states, shedding light on the ρ meson melting in heavy-ion collisions and intermediary vector mesons' role in dilepton emissions.

To support broader studies of the resonance regions in pion-proton collisions, a new K-Matrix & ND framework is under development, offering refined resonance mapping. Example fits will showcase its current status and potential.

HK 19: Heavy-Ion Collisions and QCD Phases IV

Time: Tuesday 15:45–17:15 Location: HS 3 Chemie

HK 19.1 Tue 15:45 HS 3 Chemie

Characterising the hot and dense fireball with virtual photons at HADES — •Niklas Schild for the HADES-Collaboration — TU Darmstadt

The High-Acceptance-Di-Electron-Spectrometer (HADES) at GSI, Darmstadt, measures heavy-ion and elementary collisions at a few GeV beam energies, enabling the investigation of nuclear matter at high densities and moderate temperatures. One central pillar of HADES is the study of these collisions via rare electromagnetic probes, as their penetrating nature allows unique insights into the evolution of the collision throughout.

In this contribution, we present measurements of dileptons reconstructed from Ag+Ag and Au+Au collisions at $\sqrt{s_{NN}}$ = 2.55 GeV and $\sqrt{s_{NN}}$ = 2.42 GeV. Combination of these HADES data sets brings a unique opportunity to gain new insights into dilepton observables and their dependence on system size and centrality. For this purpose, we also employ a machine-learning approach, based on real data training, to identify and remove carbon collision contamination from the surrounding target material. This allows to extent previous studies to more peripheral collisions.

The main focus of this investigation is then set on the excess yield, and thereby the temperature of the fireball, as well as studies on collectivity, in particular via the measurement of the azimuthal anisotropy.

This work has been supported by ELEMENTS (500/10.006) and HGS-HIRe.

HK 19.2 Tue 16:00 HS 3 Chemie

Investigation of thermal and freeze-out contributions to the dilepton spectrum — •Jessica Ou Ya Vogel — TU Darmstadt

Measurements of dileptons emitted from heavy-ion collisions provide insights into the properties of the created fireball. As leptons are unaffected by the strong final-state interactions of the collision, they retain valuable information about the hot and dense medium formed during the heavy-ion reaction. The high baryon densities achieved in collisions at a few GeV induce significant medium effects on the spectral functions of vector mesons.

While short-lived ρ mesons predominantly decay within the fireball, radiating thermal dileptons, a substantial fraction of ω mesons decay outside the fireball due to their longer lifetime. These decays contribute to the freeze-out cocktail with the vacuum line shape of the vector mesons. High-statistics data from Ag+Ag collisions at $\sqrt{s_{NN}}$ = 2.55 GeV, measured by the HADES collaboration, may allow for the isolation of these two different contributions and enable studies of in-medium modifications of the ω meson spectral function in the experimental data.

This work presents a framework that describes the vector meson freeze-out contributions using the shining method, while the thermal dilepton spectrum is determined via the coarse-graining model. By combining these two approaches, we aim to achieve a precise theoretical description of the invariant mass spectrum of thermal dileptons in heavy-ion collisions within the few GeV energy range.

This work is supported by the DFG through grant CRC-TR 211.

HK 19.3 Tue 16:15 HS 3 Chemie

In-Medium Vector Meson Polarization from FRG — •Maximilian Wiest[1], Tetyana Galatyuk[1,2,3], Lorenz von Smekal[3,4], and Jochen Wambach[1] — [1]Institut für Kernphysik - TU Darmstadt, Darmstadt, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — [3]Helmholtz Research Academy Hesse for FAIR (HFHF) — [4]Justus Liebig University Giessen, Germany

In this talk, we will discuss the FRG treatment of the chiral parity doublet model (PDM) to extract in-medium vector-spectral functions at finite spatial momenta. The PDM incorporates mesons and baryons as effective degrees of freedom including chiral and parity partners. Our theoretical approach is based on the Functional Renormalization Group (FRG) which represents a non-perturbative framework that is capable of including both quantum and thermal fluctuations. The in-medium rho-meson spectral function is calculated using the analytically-continued FRG (aFRG) method. Our results show strong modifications of the spectral functions with increasing spatial momentum. Using a coarse-graining approach, we can extract dilepton spectra from microscopic transport approaches using the obtained vector spectral functions and extract the impact of the mirror-baryon peak on the dilepton spectra. For comparison, we will also show corresponding calculations for state-of-the-art in medium spectral functions. The extraction of finite momentum spectral functions also gives access to the polarization signal of vector mesons, which carries information of the dominant production processes.

HK 19.4 Tue 16:30 HS 3 Chemie

Dielectron Performance of the CBM Experiment — •Adrian Meyer-Ahrens — Institut für Kernphysik Münster, Münster, Deutschland

The Compressed Baryonic Matter (CBM) experiment is a fixed-target experiment currently under construction at FAIR in Darmstadt which will explore the QCD phase diagram at high net-baryon densities using heavy-ion beams in the kinetic energy range of 2-11 AGeV provided by the SIS100 accelerator complex. Dielectrons serve as versatile probes for properties of the hot and dense medium created in the collisions, since once produced, they do not interact strongly and escape the fireball undisturbed. Dielectron physics relies on the efficient reduction of combinatorial background, dominated by misidentified hadrons as well as electrons from photon conversions in the target or detector material. In this talk, simulation results concerning the dielectron performance of CBM with a focus on central Au-Au collisions at will be presented, with a discussion of background rejection using conventional cut-based selections and machine learning methods, as well as the determination the resulting invariant mass spectra and signal-to-background ratios.

HK 19.5 Tue 16:45 HS 3 Chemie

XGboost based direct photon and neutral meson analysis for ALICE $Pb-Pb$ collision at $\sqrt{s_{\rm NN}}$ = 5.02 TeV — •Abhishek Nath for the ALICE Germany-Collaboration — Ruprecht Karl University of Heidelberg, Germany

Direct photons act as a unique probe to characterize heavy-ion collision as they are color-blind and do not interact strongly with the medium once formed. Furthermore, being produced at all stages of collision, they are perfect to characterize the space-time evolution of the QCD medium. However, due to decays of neutral mesons (mostly π^0 and η) to γ, a large amount of background exists for such signals. This demands a precise measurement of the background since direct and decay photons are indistinguishable in a detector.

The current run 2 direct photons studies utilizing the Photon Conversion Method (PCM) are associated with large uncertainties specifically in $p_T < 2$ GeV making the final direct photon yield less significant. This talk presents the use of classical machine learning models namely XGBoost with PCM to address the problem. We use the models to increase the photon sample's purity and efficiency. This is followed by measuring the neutral mesons via their strongest γ decay channel and finally obtaining direct photon measurement. A comparison between standard cut-based analysis and ML-induced analysis for both photons and neutral meson is conducted to assess the impact of the ML models on the significance of measurement

HK 19.6 Tue 17:00 HS 3 Chemie

Performance of the dielectron analysis in Pb-Pb collisions in Run 3 with ALICE — •Emma Ege for the ALICE Germany-Collaboration — Goethe University Frankfurt, Frankfurt, Germany

Correlated electron-positron pairs (dielectrons) are a unique probe to study the properties of the medium created in relativistic heavy-ion collisions. They are produced in all stages of the collision and leave the system without loss of information as they do not interact strongly with the medium. However, at LHC energies, the thermal dielectrons emitted in the early stages of the collision from the quark-gluon-plasma are outnumbered by a large contribution of correlated e^+e^--pairs from semi-leptonic decays of heavy-flavour (HF) hadrons.

The upgrade of the ALICE detector installed during the Long Shutdown 2 is crucial to boost the precision of thermal radiation measurement. The continuous readout of the TPC allows for higher data acquisition rate of up to 50 kHz in Pb–Pb collisions. Moreover, the new ITS with its higher granularity and closer location to the interaction point improves the pointing resolution by a factor of 2 compared to that in Run 2, leading to a better topological separation of prompt thermal radiation and e^+e^--pairs from HF hadron decays, and to smaller background from photon conversions in the detector material.

In this talk, the status of the dielectron analysis of a large data set of Pb–Pb collisions at $\sqrt{s_{NN}} = 5.36$ TeV, recorded with the upgraded ALICE detector in Run 3, is presented. Topological separation capabilities based on distance-of-closest approach (DCA) and the impact of the detector upgrades on the dielectron analysis will be shown.

HK 20: Instrumentation V

Time: Tuesday 15:45–17:15 Location: SR Exp1A Chemie

HK 20.1 Tue 15:45 SR Exp1A Chemie

Optimizations of the specific energy loss measurement and data to Monte Carlo matching for ALICE TPC — •Tuba Gündem — Institut für Kernphysik, Max-von-Laue-Str. 1, 60438 Frankfurt am Main

The Time Projection Chamber (TPC) serves as the primary detector for tracking and particle identification (PID) in the ALICE experiment. PID is accomplished by reconstructing particle momentum and measuring specific energy loss (dE/dx). The dE/dx value for a given track is derived from the clusters associated with that track. However, in RUN 3, the high interaction rate (IR) leads to significant occupancy effects, which must be corrected to ensure accurate dE/dx calculations. Additionally, factors such as electron attachment and gain variations can introduce discrepancies between the reconstructed dE/dx and the simulated dE/dx in Monte Carlo (MC).

This talk will present methods for optimizing dE/dx calculations, along with techniques for tuning the MC attachment and gain parameters to better align the simulated dE/dx with the reconstructed dE/dx.

HK 20.2 Tue 16:00 SR Exp1A Chemie

Neural Network Corrections for Particle Identification at the ALICE TPC — •Jonathan Witte — University of Heidelberg, Germany — for the ALICE german Collaboration

The Time Projection Chamber (TPC) of ALICE (A Large Ion Collider Experiment) has been a cornerstone of the detector, providing critical insights into the physics of heavy-ion collisions for over a decade. The TPC, a gaseous detector filled with a Neon-CO_2-N_2 (90-10-5) mixture, offers exceptional performance and accounts for more than 90% of the raw data produced by the ALICE detector. Its capability to measure the tracks of hundreds of particles produced in each Pb*Pb collision makes it indispensable. Due to the measurement of the specific energy loss, the TPC allows for extensive particle identification (PID). The Bethe-Bloch formula accurately describes the energy loss of particles in a medium, leveraging the well-characterized properties of the TPC gas to provide up to 152 dE/dx samples per particle. This PID feature is unique among LHC detectors. To identify particles based on their dE/dx samples, a Bethe-Bloch (BB) fit is applied. However, the measured signal and precision alter strongly with environmental conditions, fluctuations in gain calibration, detector occupancy etc. Neural networks (NNs) are the technology of choice for applying corrections here. With large training datasets with clean samples of electrons, kaons, pions and protons, NNs can learn to identify patterns and anomalies, improving the calibration of PID. This talk will present the mechanism of PID of the ALICE TPC and the neural network-based corrections applied to LHC Run 3 data.

HK 20.3 Tue 16:15 SR Exp1A Chemie

Status of the GEM production and quality assurance at the FTD — •Tim Schüttler[1,2], Markus Ball[1,2], Yevgen Bilevych[2], Philip Hauer[1,2], Shania Müller[1], Dmitri Schaab[2], and Bernhard Ketzer[1,2] — [1]Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn — [2]Forschungs- und Technologiezentrum Detektorphysik, Universität Bonn

Gas Electron Multipliers (GEMs) play a crucial role as amplification stages in modern gaseous detectors, offering high spatial and temporal resolution at moderate cost, even at large sizes and high particle rates. At the newly established Research and Technology Center Detector Physics (FTD) in Bonn, we have successfully implemented a reliable process for producing standard 10×10 cm^2 GEM foils that was developed in close collaboration with CERN's MPT workshop, which traditionally acts as the main supplier of GEM foils to the community. This achievement represents an important step forward, providing enhanced flexibility for research and development.

The production process at the FTD employs a double-mask photolithographic technique, and makes use of a wide variety of equipment such as wet benches, a dry-film laminator, and UV exposition systems. Through iterative improvements, each production step has been refined to ensure high-quality results consistently. This talk will detail the production and quality assurance workflow, highlight key innovations, showcase measurement results confirming the reliability of the foils, and outline plans for exploring novel GEM parameters and geometries. Supported by BMBF.

HK 20.4 Tue 16:30 SR Exp1A Chemie

StarryNight - A calibration system for the time projection chamber at MAGIX — •Daniel Steger for the MAGIX-Collaboration — Institute for Nuclear Physics, Johannes Gutenberg University Mainz, Germany

The MESA accelerator will host the MAGIX experiment, which is based on the scattering of an electron beam on a gas jet target. This enables scattering on gases like hydrogen while minimizing interaction with any other materials allowing us to perform high precision experiments. The measurement of the scattered particles is performed by two magnetic spectrometers using a GEM based TPC to track the particle trajectories. To achieve the precision desired an independent system to calibrate the TPC is necessary.

Such a system has been designed, utilizing LEDs with a wavelength of 255 nm that are operated in pulses directed at fused silica panes sputtered with aluminium at the cathode of the active volume of the TPC. This produces individual free electrons at known positions and times which drift along the electric field lines of the TPC and thereby allow a precise characterization of the field.

In this contribution the setup of this calibration system will be presented.

HK 20.5 Tue 16:45 SR Exp1A Chemie

Drift-field distortion corrections of the ALICE TPC in LHC Run 3 — •Matthias Kleiner for the ALICE Germany-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

The Time Projection Chamber (TPC) in the ALICE experiment at the CERN LHC provides excellent tracking and particle identification capabilities. In order to cope with the high interaction rates of up to 50 kHz in Pb–Pb collisions during Run 3, the Multi-Wire Proportional Chambers (MWPCs) in the TPC were replaced by stacks of four Gas Electron Multiplier (GEM) foils to allow for continuous data acquisition. Despite the intrinsic ion-blocking properties of the 4-GEM system, a residual amount of ions produced during the electron amplification drifts into the active volume of the TPC, leading to space-charge distortions of the nominal drift field. Various further effects, such as fluctuations in the interaction rate or the decay of the LHC beam, cause time dependent variations of the distortions due to space-charge. Additional detector effects cause significant static and time dependent drift-field distortions. These drift-field distortions have to be corrected to preserve the intrinsic tracking precision of the TPC.

In this talk, an overview of drift-field distortions in the ALICE TPC in Run 3 will be presented, along with the precision of the correction procedures.

Supported by BMBF and the Helmholtz Association

HK 20.6 Tue 17:00 SR Exp1A Chemie

TPC cluster shape analysis — •Janis Noah Jäger for the ALICE Germany-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

An important aspect of the latest ALICE upgrade is the upgrade of the Time Projection Chamber (TPC). The TPC is the main tracking and particle identification device in ALICE. The replacement of the Multi-Wire Proportional Chambers (MWPC) with stacks of four Gas Electron Multiplier (GEM) foils enables a continuous readout of the TPC. This modification demanded a significant upgrade of the entire readout chain, including the front-end cards, data acquisition and distribution, online reconstruction and data compression. Additionally, the entire reconstruction and calibration software underwent a complete rewrite, along with the TPC cluster finding algorithm.

This talk will address the topic of the TPC cluster shape in relation to track and gas parameters. A comparative analysis of Run 3 data with Monte Carlo simulations will provide insight into the characteristic response functions and diffusion coefficients in the ALICE TPC.

HK 21: Instrumentation VI

Time: Tuesday 15:45–17:15 Location: SR Exp1B Chemie

Group Report HK 21.1 Tue 15:45 SR Exp1B Chemie

Recent results from the mCBM experiment at SIS18 of GSI/FAIR — •Christian Sturm for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

The mCBM experiment, a CBM demonstrator and full-system test-setup, was constructed 2017/18 at the SIS18 facility of GSI / FAIR, taking data within the FAIR Phase-0 program since 2019. The main focus lays on testing and optimizing the complete CBM data chain incl. the online track and event reconstruction as well as event selection algorithms in nucleus-nucleus reactions with collision rates up to 10 MHz (averaged). mCBM comprises pre-series and series productions of all CBM detector systems and their read-out chains. To further validate CBM's read-out and data processing concept, the production yield of rare Λ baryons is studied in nucleus-nucleus collisions serving as a benchmark observable, which will allow comparison with published data. Hence, latest results on performance studies of the CBM detector systems, the CBM online system prototype and on rare Λ reconstruction with the mCBM experiment will be presented.

HK 21.2 Tue 16:15 SR Exp1B Chemie

A High-Rate, Highly-Segmented Charged Particle Tracker — Devin Hymers[1], •Sebastian Schroeder[1], Olga Bertini[2], Johann Heuser[2], Joerg Lehnert[2], Christian Joachim Schmidt[2], and Dennis Muecher[1] — [1]Institute for Nuclear Physics, University of Cologne, Cologne, Germany — [2]GSI, Darmstadt, Germany

Tracking of charged particles with high spatial resolution, and at high event rates, is of significant interest in many sub-disciplines. Here, we present an adaptation of the high-performance detectors from the Silicon Tracking System of the Compressed Baryonic Matter experiment at GSI, to a general-purpose two-layer tracker. To maximize acceptance, the first layer consists of a 6x6 cm^2 sensor, while the second layer is a larger 6x12 cm^2. Each of these double-sided silicon strip detectors is segmented with a 58 μm pitch, for 1024 segments per side, offering a balance between spatial resolution, data rate, and a manageable number of electronic channels.

These sensors are coupled to a fully-digital readout system, currently capable of handling count rates up to 50 kHz per channel, or 100 kHz after a possible hardware upgrade. Tests have been performed tracking particles at rates above 1 MHz, with pileup-related data loss of 0.004%. At these interaction rates, tracking may be performed on the same timescale as data acquisition; on modern workstation hardware, 60 s of such high-rate data was typically reconstructed in 50 s or less using a highly-parallel algorithm. The performance of this system represents a significant opportunity for improvement in measurement and online analysis of particle tracking setups.

HK 21.3 Tue 16:30 SR Exp1B Chemie

Use of microchannel plate detectors for beam tracking at FAIR: test experiment at the Cologne FN Tandem accelerator — •Dennis Bittner[1], Gregor Košir[2], Christoph Fransen[1], Jan Jolie[1], Klemen Žagar[2], Matjaž Skobe[2], Matjaž Vencelj[2], Calum Jones[3], Kathrin Wimmer[3], Jelena Vesić[2], and Magdalena Górska[3] — [1]IKP, Cologne, Germany — [2]Jožef Stefan Institute, Ljubljana, Slovenia — [3]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

At FAIR/GSI, radioactive ion beams of energies of hundreds of MeV/nucleon are available. To perform the low-energy Coulomb excitation experiments, the beams need to be slowed down with a thick degrader. Secondary reactions and scattering within the degrader result in a beam containing many secondary reaction products and a wide angular spread. For the experiments, it is crucial to know the position and momentum vector of the single ions. The approach is to place two foil-MCP (Micro Channel Plate) detectors with delay lines will be placed to obtain position sensitivity. The ions passing the foils generate secondary electrons, which are accelerated towards the MCP. Due to the large distance between the foil and the MCP, permanent magnets are used to force the electrons on circular trajectories. A test experiment of the full particle tracking detector setup was conducted at the 10 MV FN-Tandem accelerator in Cologne. The first results of this experiment will be presented and the further outlook will be discussed. Support by BMBF is acknowledged under ErUM Verbundprojekt 05P2024 (ErUM-FSP T07). Grant 05P21PKFN1.

HK 21.4 Tue 16:45 SR Exp1B Chemie

Microcontroller-based readout for ITS2 Outer Barrel modules — •Bent Buttwill for the ALICE Germany-Collaboration — Physikalisches Institut Heidelberg, Germany

The Outer Barrel Module (OBM) used in the four outermost layers of the Inner Tracking System (ITS2) of ALICE utilizes 2x7 interconnected ALPIDE monolithic active pixel sensors (MAPS). A number of such modules were integrated on dedicated PCBs to facilitate their use in outreach activities and to serve as large-acceptance detectors in particle telescopes.

A simplified readout using a RP2040 microcontroller was developed for tabletop experiments and successfully utilized in a beam test at the DESY II Test Beam Facility in Hamburg. The setup consisted of three OBM planes placed downstream of a particle telescope made up from single ALPIDE sensors, which operated independently from the OBM modules.

This contribution will discuss the synchronization of hits between the single-ALPIDE telescope and the OBM planes by simply using computer-clock-defined timestamps, enabling combination of data from the two separate data acquisition systems. This approach allows the measurement of the spacing between the ALPIDE chips of an OBM using tracks defined by the upstream telescope.

HK 21.5 Tue 17:00 SR Exp1B Chemie

Simulation studies of the Forward Conversion Tracker for ALICE 3 — •Cas van Veen for the ALICE Germany-Collaboration — Physikalisches Institut, Heidelberg, Germany

During the Long Shutdown 4 of the Large Hadron Collider, ALICE will upgrade its complete detector to address new physics cases with unprecedented resolution and higher interaction rates, called ALICE 3. The Forward Conversion Tracker (FCT), located in the forward direction, will measure the photon spectrum predicted by Low's theorem in proton-proton collisions at $\sqrt{s}$ = 14 TeV to address the long standing "soft-photon puzzle". The focus of this talk will be on the status of the simulation studies of the FCT. The O2 framework of ALICE allows for detailed, full simulations of proton-proton collisions including transportation through the detector setup of ALICE 3. The background bremsstrahlung generated by charged particles passing through material in front of the FCT is a major challenge for this study and strategies to reduce this background will be presented. This can be accomplished by an electron particle identification detector (ePID) behind the FCT in the form of a ring imaging Cherenkov detector (RICH) that provides a veto on the events containing an electron that is not part of the signal electron-positron pair.

HK 22: Nuclear Astrophysics III

Time: Tuesday 15:45–17:15 Location: SR 0.03 Erw. Physik

Group Report HK 22.1 Tue 15:45 SR 0.03 Erw. Physik
Neutron activations for nuclear astrophysics — •Tanja Heftrich — Goethe-Universität Frankfurt
About 50% of heavy elemental abundances are produced in the slow neutron capture process (s-process). The main component of the s-process takes place in low-mass thermally pulsing asymptotic giant branch (TP-AGB) stars during the He-shell burning phase. The weak component refers to massive presupernova stars during convective C-shell burning. In AGB stars, neutron densities of 10^{10} cm^{-3} and temperatures of k_BT = 5 and 25 keV are reached, whereas in massive stars neutron densities of 10^{12} cm^{-3} at temperatures of up to k_BT = 30 and 90 keV during C-shell burning are reached.
The activation method is a strong tool to investigate neutron capture measurements corresponding to the stellar sites of the s-process. Stellar neutron spectras are produced by accelerating protons with an energy of 1912 keV onto a metallic lithium target. The resulting neutron spectrum refers to temperatures of k_BT = 25 keV. We developed this working horse method further to measure neutron capture cross section at lower temperatures of k_BT = 5 keV and even higher temperatures of k_BT = 90 keV to cover the whole s-process temperature regime.

HK 22.2 Tue 16:15 SR 0.03 Erw. Physik
Feasibility Tool for Neutron Capture on Radioactive Isotopes — •Muaz Al Halabi — Goethe Universität, Frankfurt am Main, Germany
The slow neutron capture process (s-process) is particularly significant for understanding the production of elements heavier than iron across different astronomical environments. Neutron capture measurements can be used to study the s-process using the activation technique. Three key parameters define such an experiment: a sufficient neutron flux (ϕ_n), a target isotope for activation, and a detector to identify the newly produced product isotope through a direct neutron capture (n, γ) measurement.

It is particularly challenging, however, when both the target and product isotopes are radioactive. In such cases, emissions from the target can create a background that interferes with detecting emissions from the product isotope, making it difficult to identify the product. Therefore, accurately determining the required neutron flux for activation experiments is essential to ensure that detectors can distinguish the product isotope's emissions from those of the target.

This presentation introduces a simulation-based method to help experimentalists quickly estimate the required neutron flux for activation experiments and evaluate their feasibility.

HK 22.3 Tue 16:30 SR 0.03 Erw. Physik
Direct Measurements of Neutron Capture Rates in Unstable Astrophysical Nuclei: A New Frontier — •Abdallah Karaka[1], Timm-Florian Pabst[1], Devin Hymers[1], Erik Strub[2], Gereon Weingarten[1], Markus Schiffer[1], Martin Mueller[1], Michael Weinert[1], Stefan Heinze[1], Tom Sittig[1], and Dennis Muecher[1] — [1]Institute of Nuclear Physics, University of Cologne, Germany — [2]Institute of Nuclear Chemistry, University of Cologne, Germany
The intermediate neutron capture process (i-process) likely occurs in AGB stars and is crucial for explaining elemental abundances in certain CEMP stars. While most aspects of the i-process are well-constrained, neutron capture rates and cross sections remain significant unknowns in nuclear physics.

Indirect measurements have high uncertainties, while direct measurements are challenging as many key nuclei are a few neutrons away from stability and hence unstable.

This talk explores direct measurements of neutron capture cross sections for selected long-lived nuclei to better understand the i-process dynamics. We present the status and initial tests of a beamline designed to produce a high-density secondary neutron beam at the CologneAMS-6MV tandetron. The cross sections will be measured using a novel activation technique based on detection of beta-decay electrons, suited to suppress the high activity of the initial sample by six orders of magnitude. The first physics case is the $^{137}Cs(n_{st}, \gamma)^{138}Cs$ stellar neutron capture cross section, constraining the unusual Lanthanum over Barium abundance ratios observed in many CEMP stars.

HK 22.4 Tue 16:45 SR 0.03 Erw. Physik
3α decay study of resonances ^{12}C — •Joe Roob[1], Peter Reiter[1], Konrad Arnswald[1], Timo Biesenbach[1], Maximilian Droste[1], Madalina Enciu[3], Pavel Golubev[2], Rouven Hirsch[1], Hannah Kleis[1], Nikolas Königstein[1], Dirk Rudolph[2], Alessandro Salice[1], Luis Sarmiento[2], and David Werner[1] — [1]University of Cologne, Institute for Nuclear Physics, Cologne, Germany — [2]Lund University, Department of Physics, Lund, Sweden — [3]TU Darmstadt, Institute of Nuclear Physics, Darmstadt, Germany
Excited states in ^{12}C were populated using a ^{12}C(α,α*) reaction during two experiments conducted at the FN tandem in Cologne. Breakup of ^{12}C resonances into three α particles has been measured in complete kinematics with 18 highly segmented Si-strip detectors of the Lund York Cologne Calorimeter Array. Dalitz plots are used to visualize and analyse the data for the particle unbound states 3^-_1 at 9.6 MeV, 1^-_1 at 10.8 MeV 2^-_1 at 11.8 MeV 1^+_1 at 12.7 MeV and 4^-_1 at 13.3 MeV states of ^{12}C. The Dalitz plot intensity distribution features zero points characteristic of the total spin and parity of the 3α system. Comparison with previous results from [1] and theoretical predictions will be discussed. [1] O. S. Kirsebom, *et al.*, Phys. Rev. C **81**, 064313 (2010)

HK 22.5 Tue 17:00 SR 0.03 Erw. Physik
In-beam gamma-ray spectroscopy of neutron-rich nuclei around the N=20 island of inversion — •Bellona Bles for the e12003 experiment-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — Department of Physics, University of Novi Sad, Novi Sad, Serbia
The ground state wave function of nuclei in the island of inversion at N=20 is dominated by *fp* instead of *sp* configurations, contradictory to the normal shell filling observed near stability. At the center of this region is ^{32}Mg with a characteristic intruder ground state, however, the transition into the island of inversion, especially at the northern shore, is still a subject of discussion. Therefore, this work explores the structure of $^{30-35}$Al isotopes through in-beam gamma-ray spectroscopy, aiming to provide a consistent picture into the island of inversion. The experiment was performed at NSCL, MSU, using fragmentation reactions to create secondary radioactive cocktail beams of different Mg, Al, Si, and P isotopes. The cocktail beams were guided to the secondary Be target, where nucleon knockout reactions occurred, and the gamma rays were detected with the gamma-ray tracing array GRETINA. The reaction products were further directed toward the S800 spectrograph. From the experimental data, exclusive cross-sections and parallel momentum distributions will be extracted to determine the spectroscopic factors and updated level schemes with firmly assigned spin and parity to states. This talk reports on the status of the analysis and presents the first results on the level schemes of neutron-rich Al isotopes.

HK 23: Poster

Time: Tuesday 17:30–19:00 Location: Foyer Physik

HK 23.1 Tue 17:30 Foyer Physik
The effects of gamma irradiation on some properties of CR-39 detectors — •Kahalil Thabayneh[1] and Marwa Shoeib[2] for the PANDA-Collaboration — [1]Hebron University, Hebron, Palestinian Occupied Territories — [2]Hebron University, Hebron, Palestinian Occupied Territories
In this study, the bulk etch rate, bulk activation energy, track density, and the degree of crystallinity percentage were analyzed for CR-39 samples irradiated with γ-rays from a 60Co source at doses ranging from 0 to 200 kGy. After irradiation, the samples were exposed to zirconium sand to collect α-particle tracks. The samples were then etched in a 6.25 N NaOH solution for 4 hours at temperatures of 60, 65, 70, 75, and 80°C. The results showed that the bulk etch rate increased with higher γ- doses at all etching temperatures. Additionally, both the bulk activation energy and track density decreased as the γ- dose increased. The degree of crystallinity was also examined for both etched and unetched samples at various γ doses. The observed increase in bulk etch rate, alongside the decrease in both bulk activation energy and track density with rising γ- doses, is attributed to the degradation of the CR-39 polymeric material.

HK 23.2 Tue 17:30 Foyer Physik
Charge-changing cross sections of oxygen isotopes for biomedical applications — Daria Kostyleva[1] and •Alexander Vitantzakis[2] for the Super-FRS Experiment-Collaboration — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, 64291 Darmstadt, Germany — [2]Goethe-Universität Frankfurt, 60323 Frankfurt am Main, Germany
Charge-changing cross-sections, σ_{cc}, are nuclear properties with significant importance in both basic research and applied physics. One practical application is hadron therapy, which relies on precise knowledge of σ_{cc} to ensure accurate depth-dose calculations. Specifically, Monte Carlo transport codes such as FLUKA and GEANT4 incorporate these properties of ions into their nuclear re-

action models to optimize therapy planning. At GSI, σ_{cc} of oxygen isotopes have been studied as part of the BARB ERC grant. This project, titled Biomedical Applications of Radioactive ion Beams (BARB), aims to assess the technical feasibility and explore the potential advantages of using beams of positron-emitting carbon and oxygen isotopes for hadron therapy. A key goal of BARB was to perform the first in-vivo treatment with radioactive ion beams. In this context, beams of ^{15}O and ^{16}O isotopes at 370 MeV/u were produced using the FRS fragment separator. The σ_{cc} of these isotopes were measured in carbon, water, and polyethylene targets. This work presents the details of the experiment, the data analysis, and preliminary results.

This study was supported by the ERC Advanced Grant 883425 (BARB) to M. Durante.

HK 23.3 Tue 17:30 Foyer Physik

Exploring Few-Body Systems, Nucleon Structure, and More with MAGIX at MESA — •Sören Schlimme for the MAGIX-Collaboration — Institute for Nuclear Physics, Johannes Gutenberg University Mainz, Germany

The upcoming MAGIX experiment at the MESA accelerator combines a high-intensity electron beam with a windowless gas jet target and high-resolution magnetic spectrometers. This advanced setup enables a broad and innovative experimental program in nuclear, hadron, and particle physics at low energies.

The exceptionally clean experimental environment at MAGIX allows for precise investigations into hadron structure. A key focus is the measurement of proton electromagnetic form factors at low momentum transfers, aimed at addressing the proton charge radius puzzle. In nuclear physics, MAGIX will provide high-precision electron scattering data, particularly on few-body systems, which serve as stringent tests for nuclear dynamics models. These systems are ideal for benchmarking effective field theories at low energies, where theoretical predictions are most reliable. Furthermore, the low-density target allows the detection of nuclear recoil fragments in coincidence with scattered electrons, enabling detailed studies of exclusive reactions. This capability is also crucial for exploring reaction cross sections relevant to nuclear astrophysics, including time-reversed radiative capture reactions. In addition, MAGIX will also contribute to the search for dark matter by performing world-class searches for dark photons, investigating both visible and invisible decay modes.

HK 23.4 Tue 17:30 Foyer Physik

Lifetime measurements in ^{96}Zr using the Coincidence Doppler-Shift Attenuation Method — •Elias Binger, Anna Bohn, Sarah Prill, Tobias Langel, Michael Weinert, and Andreas Zilges — University of Cologne, Institute for Nuclear Physics, Germany

The Coincidence Doppler-Shift Attenuation Method (CDSAM) [1,2] is a technique for determining nuclear level lifetimes in the sub-picosecond range. Using the SONIC@HORUS [3] setup at the University of Cologne, the Doppler-shifted γ rays can be detected in coincidence with the scattered beam particles, enabling background reduction, precise transition selection and feeding exclusion.

As part of a series of lifetime measurements in the mass region $A = 100$, a (p,p'γ) experiment was performed on ^{96}Zr. Through the analysis of the recorded data, the lifetimes of many excited states could be determined. The results of this experiment are presented in this contribution.

Supported by the DFG (ZI 510/9-2).

[1] A. Hennig *et al.*, Nucl. Instr. Meth. A **758**, 171 (2015).
[2] S. Prill *et al.*, Phys. Rev. C **105**, 034319 (2022).
[3] S. G. Pickstone *et al.*, Nucl. Instr. Meth. A **875**, 104 (2017).

HK 23.5 Tue 17:30 Foyer Physik

Lifetime measurements of ^{98}Ru using the Reverse Coincidence Doppler-Shift Attenuation Method — •Tobias Langel, Elias Binger, Anna Bohn, Sarah Prill, Michael Weinert, and Andreas Zilges — University of Cologne, Institute for Nuclear Physics, Germany

The Coincidence Doppler-Shift Attenuation Method (CDSAM) has been successfully used for many years at the University of Cologne to determine lifetimes of excited states in the sub-picosecond regime [1,2]. Inelastic scattering experiments are performed, where both the scattered projectile and the Doppler-shifted photon(s) are detected in coincidence at the SONIC@HORUS detector array [3] in Cologne. Due to the nature of coincident detection, a higher degree of background reduction as well as feeding exclusion can be achieved.

To improve this method for weak transitions, the new Reverse CDSAM approach has been developed in recent years. Among several other $A \approx 100$ isotopes, a (p,p$'\gamma$) experiment was performed on ^{98}Ru to determine a variety of lifetimes using both approaches of the CDSA Method. This contribution presents the experimental results and compares the two analysis approaches.

Supported by the DFG (ZI 510/9-2).

[1] A. Hennig *et al.*, Nucl. Instr. Meth. A **758**, 171 (2015).
[2] S. Prill *et al.*, Phys. Rev. C **105**, 034319 (2022).
[3] S. G. Pickstone *et al.*, Nucl. Instr. Meth. A **875**, 104 (2017).

HK 23.6 Tue 17:30 Foyer Physik

Amplitude Measurements with ALICE ITS3 MAPS Detectors — •Henrik Fribert, Berkin Ulukutlu, Roman Gernhäuser, and Laura Fabbietti for the ALICE Germany-Collaboration — TUM School of Natural Sciences, Technische Universität München, Munich, Germany

Monolithic Active Pixel Sensors (MAPS) are becoming increasingly important in future particle physics experiments due to their ease of integration, high spatial resolution, and low material budget. While MAPS have mostly been used for tracking where only binary hit information is stored, measuring signal amplitude could enable particle identification (PID) and enhance tracking capabilities. In this contribution, the feasibility of amplitude measurements using two promising techniques is assessed: time-encoded Time-over-Threshold (ToT), where pixels send a pulse at a signal's rising and falling edge to measure the ToT, and digital oversampling, which samples the signal multiple times above threshold. The methods were tested on two prototype sensors developed for the ALICE ITS3 upgrade: the Digital Pixel Test Structure chiplet (DPTS) and the larger babyMOSS sensor. Additionally, Geant4 simulations are carried out to assess the achievable PID performance of these methods in large-scale detectors.
This research was supported by the Excellence Cluster ORIGINS funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) under Germany's Excellence Strategy EXC-2094390783311 and the DFG through the Grant SFB 1258 "Neutrinos and Dark Matter in Astro and Particle Physics".

HK 23.7 Tue 17:30 Foyer Physik

Investigation of the internal conversion lifetime of ^{229m}Th on various metallic surfaces — •Daniel Moritz, Georg Holthoff, Kevin Scharl, Tamila Teschler, Markus Wiesinger, and Peter G. Thirolf — Ludwig Maximilians Universität München

With its exceptionally low energy of about 8.4 eV, the first isomeric state of ^{229}Th, denoted ^{229m}Th, is in the focus of current research as the presently only suitable nuclear transition accessible with current laser technology to serve as basis for a nuclear clock. For neutral ^{229m}Th, its decay is dominated by internal conversion (IC). One of the isomer's properties still to be investigated is the dependence of the IC lifetime on the electronic environment as hinted at in [1]. This will now be evaluated systematically by neutralizing ^{229m}Th ions on various sputter-cleaned metallic surfaces with different work functions. This poster presents the current status of this experimental campaign at LMU.
This work has been supported by the ERC Synergy Grant "ThoriumNuclearClock" (Grant Agreement 856415).
[1] B. Seiferle, Diss. LMU (2019)

HK 23.8 Tue 17:30 Foyer Physik

Lifetime measurements of excited states in ^{101}Pd — •Sven Wagner, Maximilian Droste, Peter Reiter, Casper-David Lakenbrink, Christoph Fransen, and Franziskus von Spee — Institut für Kernphysik, Universität zu Köln

The ^{101}Pd nucleus is located four protons and five neutrons away from the double-shell closure at ^{100}Sn. Nuclei in this part of the Segrè chart have historically been considered prototypical examples of vibrational nuclei, exhibiting characteristic level schemes in their first excited states. Lifetimes and transition strength values of excited states in ^{101}Pd are scarcely known, and independently evaluated results for the first excited state are contradictory [1,2]. A precise lifetime measurement, serving as a complementary method for determining reduced transition strengths in ^{101}Pd, was performed at the FN Tandem accelerator of the IKP Cologne using the Recoil-Distance Doppler-Shift (RDDS) technique. The excited states of ^{101}Pd were populated via the fusion-evaporation reaction ^{92}Zr(^{12}C,3n)^{101}Pd at a beam energy of 50 MeV. First lifetime values obtained from this study will be presented, providing new insights into the nuclear structure of ^{101}Pd.
[1] D. Ivanova et al., Phys. Rev. C. 105, 034337 (2022)
[2] M. Droste et al., Phys. Rev. C. 106, 024329 (2022)

HK 23.9 Tue 17:30 Foyer Physik

Automated Signal-to-Noise Ratio Optimizations for the ToASt-based Silicon-Strip-Detectors of the PANDA MVD — •Raphael Ratz[1], Kai-Thomas Brinkmann[1], Marvin Peter[1], Nils Tröll[1], Hans-Georg Zaunick[1], Giovanni Mazza[2], Michele Caselle[3], and Daniela Calvo[2] for the PANDA-Collaboration — [1]Justus Liebig University Gießen, Gießen, Germany — [2]Istituto Nazionale di Fisica Nucleare - Sezione di Torino, Turin, Italy — [3]Karlsruhe Institute of Technology, Karlsruhe, Germany

The silicon strip detectors as part of the Micro Vertex Detector of the PANDA experiment are read out by the ToASt ASIC and have a multitude of parameters for the correct execution of Time-over-Threshold (ToT) measurements. Some of these parameters severely affect the noise and the signal, making a calibration for optimal settings necessary.

This contribution presents a system for the automated optimization procedures of a selected set of parameters regarding the Signal-to-Noise Ratio (SNR) using the integrated test pulser of the ToASt chip. The parameters considered were measured pairwise to retrieve the SNR for all available register combinations. With this data, the correlation between different parameters, the behavior of different channels, and the stability and reproducibility of this approach can be investigated.

Lastly, a different approach for measuring the noise, using an S-curve scan, is considered. This is achieved by counting the amount of measured pulses from a set quantity of applied pulses, depending on the test pulser amplitude. *Supported by BMBF.*

HK 23.10 Tue 17:30 Foyer Physik

Simulation Studies with the digital calorimeter EPICAL-2. — •Jan Schöngarth — Institut für Kernphysik Frankfurt, Goethe-Universität Frankfurt

The EPICAL-2 detector has been designed and constructed within the endeavour to develop a novel electromagnetic calorimeter based on a SiW sampling design using silicon pixel sensors with binary readout. The R\&D is performed in the context of the proposed Forward Calorimeter upgrade within the CERN-ALICE experiment and is strongly related to proton CT imaging studies as well as applicable to future collider projects.\par EPICAL-2 consists of alternating W absorber and Si sensor layers employing the ALPIDE sensor developed for the ALICE-ITS upgrade. EPICAL-2 has been successfully tested with cosmic muons as well as in test-beam campaigns at DESY and CERN-SPS. Monte Carlo simulations have been performed using Allpix^2, a generic simulation framework for semiconductor detectors.\par In this poster, the performance of EPICAL-2 in simulation, using different energy proxies, i.e. the number of pixel hits, clusters or charged shower particles per event, is presented. Additionally, the measured particle composition of the CERN-SPS test-beam is presented.\par Supported by BMBF and the Helmholtz Association.

HK 23.11 Tue 17:30 Foyer Physik

The MAGIX spectrometer setup — •David Markus for the MAGIX-Collaboration — Institute for Nuclear Physics, Johannes Gutenberg University Mainz, Germany

The **MA**inz **G**as **I**njection Target E**X**periment has initiated the installation of its advanced spectrometers. In conjunction with with the **M**ainz **E**nergy-Recovering **S**uperconducting **A**ccelerator, MAGIX will perform electron scattering measurements on different gases ranging from hydrogen over helium to argon using an internal gas jet target. With a design luminosity reaching 10^{35} cm^{-2} s^{-1} at beam energies of up to 105 MeV, MAGIX is capable of providing valuable insights into a number of different areas of physics ranging from the S-factor of the alpha capture of carbon-12 to the electromagnetic form factors of the proton.

The scattered electrons will be measured with two identical high resolution magnetic spectrometers, each equipped with a Time Projection Chamber placed around their focal plane and plastic scintillators underneath to serve as a trigger veto system. The complete MAGIX setup, from the internal gas jet target in its scattering chamber over the spectrometers to the TPC, is designed to maximally reduce the material budget and therefore limit multiple scattering. This poster presents an overview of the components of MAGIX and how they will work together to achieve the proposed physics program.

HK 23.12 Tue 17:30 Foyer Physik

Accelerating Femtoscopic Studies with Machine Learning for Source Function Modeling — •Carla Zeyn — Technische Universitaet Muenchen

Femtoscopy probes the strong interaction between hadrons via two-particle correlation functions. The ALICE collaboration has recently measured these functions with unprecedented precision, including those involving strange (Λ, Ξ, Ω) and charm ($D^{\pm}$) quarks. Extracting the final-state interactions requires solving the Schrödinger equation, with the accurate modeling of the source function—describing particles' relative emission distances—posing a key challenge. Advanced models like CECA (Common Emission in CATS) improve our understanding of emission processes but are computationally intensive, limiting simultaneous fits. For the first time, we propose leveraging machine learning (ML) to model the source. The ML model will emulate CECA, providing fast, accurate source modeling and efficient computation of correlation functions, by significantly expediting the analysis of correlation data.

HK 23.13 Tue 17:30 Foyer Physik

Study of rescattering effects in 3π final states with application to CP violation — •Athanasios Kotarelas, Miriam Penners, Dominik Stamen, and Bastian Kubis — Helmholtz-Institut für Strahlen- und Kernphysik (HISKP), 53115 Bonn, Germany

CP violation in the Standard Model is known to originate from phases in the CKM matrix. When hadronic decays are considered, the amount of CP violation is determined by the interplay of these weak phases with the phases of the strong final-state interactions. So far, a commonly used approach to study these interactions is the so-called isobar model, where one of the decay products is assumed to be a spectator and the interactions of the other two are described by resonances. In this poster, we present an improved formalism which employs phase shifts directly, making use of the Omnès formalism, and attempt to include cross-channel effects as well, using the framework of Khuri-Treiman (KT) equations that is well established for low-energy decay processes such as the three-pion decays of kaons, eta, omega, or phi."

HK 23.14 Tue 17:30 Foyer Physik

SONIC@HORUS - A setup for particle-gamma-coincidence measurements at the Cologne Tandem accelerator — •Henrik Boras, Elias Binger, Anna Bohn, Tobias Langel, Markus Müllenmeister, Sarah Prill, Michael Weinert, and Andreas Zilges — University of Cologne, Institute for Nuclear Physics, Cologne, Germany

SONIC [1] is a particle spectrometer used for various experiments at the 10 MV FN-Tandem accelerator at the University of Cologne. In its latest version SONIC is equipped with 12 silicon detectors that can be employed as stand-alone units or in a ΔE-E telescope configuration for particle identification, providing a total solid angle coverage of 9%. Coupled with the HORUS [2] γ-ray spectrometer, SONIC facilitates particle-γ coincidence measurements, allowing detailed investigations of inelastic scattering and transfer reactions across a wide range of nuclear masses. This contribution will outline the features of the SONIC spectrometer and highlight recent experimental campaigns. Supported by the DFG (ZI 510/10-1).

[1] S. G. Pickstone *et al.*, Nucl. Instr. and Meth. A **875** (2017) 104
[2] L. Netterdon *et al.*, Nucl. Instr. and Meth. A **754** (2014) 94

HK 23.15 Tue 17:30 Foyer Physik

ALPACA: A novel setup for enhanced angular and particle coincidence measurements — •Leonardo Berisha, Christian Diefenbach, Markus Müllenmeister, Michael Weinert, and Andreas Zilges — University of Cologne, Institute for Nuclear Physics, Germany

The ALPACA (Array for anguLar PArticle Coincidence Analysis) setup, developed at the University of Cologne, enhances the study of nuclear reactions by offering precise angular and particle coincidence measurements [1]. This setup, designed to operate alongside the 10 MV FN Tandem accelerator, complements the existing SONIC@HORUS setup [2,3]. Twelve silicon ($\Delta E - E$) telescopes, mounted on a rotatable plate, provide flexible angular coverage, while a high-resolution HPGe detector in the chamber lid allows for accurate γ-ray measurements. The chamber is equipped with a height-adjustable target ladder. The modular design of the detector mounts, featuring 3D-printed sleds and adjustable rails, ensures precise positioning of the detectors and ease of modification for future experiments. In this contribution, ALPACA and first commissioning experiments will be presented.

[1] G. Huppelsberg, Master's thesis (2024), University of Cologne
[2] S. G. Pickstone *et al.*, Nucl. Instr. and Meth. A **875** (2017) 104
[3] L. Netterdon *et al.*, Nucl. Instr. and Meth. A **754** (2014) 94

HK 23.16 Tue 17:30 Foyer Physik

Verifying the NeuLAND Calibration Algorithm via the Simulation of the Cosmic Radiation. — •Paula Ulrich, Yanzhao Wang, and Andreas Zilges — Department of Physics, University of Cologne, Germany

The goal of this work is to validate the calibration algorithms using an existing simulation of the NeuLAND detector, which is composed of several scintillators and PMTs. The data acquisition system provides data at different levels from the detection of particle interactions inside the detector. The calibration aims to convert the data into physical values that can be used for further analysis. In this Poster the results of validation will be presented based on calibrating the simulated data of the cosmic radiation.

HK 23.17 Tue 17:30 Foyer Physik

Assessing Ge-Detector Efficiency in Cylindrical Geometries Using GEANT4: Correlation with Radioactive Surface Standard Measurements — •Diandra Richter, Jonny Birkhan, and Norbert Pietralla — IKP, Darmstadt, Germany

Clearence measurements for radiation protection purposes are often done by γ-spectrometric analysis of volumetric environmental samples. This requires calibration of the detection efficiency of the measurement setup using appropriate calibration sources. These sources are generally prepared through the so-called spiking method, in which material is impregnated with a multi-element solution. This method is time-consuming and expensive. An alternative calibration method involves the preparation of a surface standard, made from a circular filter paper sandwiched between two foils [1]. This standard is typically used to estimate the efficiencies for filled Petri dishes, accounting for sample attenuation. Measurements are conducted with the foil placed either between the detector and the sample or directly on the sample. This foil method provides results that are compatible with the spiking method, but its application is limited to flat samples, like for example Petri dishes. In this study, GEANT4 simulations were used to investigate how many stacked Petri dishes can still produce sufficiently accurate results with the foil method compared to the spiking method. Clearence measurements would be simplified, because more material could be measured with the foil method simultaneously. [1] Vahlbruch, Jan-Willem: Dissertation, Uni Hannover, 2004.

HK 23.18 Tue 17:30 Foyer Physik

Lifetime measurements of excited states in ^{99}Pd using the recoil-distance Doppler-shift method — •Ramona Burggraf, Peter Reiter, Andrey Blazhev, Maximilian Droste, Arwin Esmaylzadeh, Christoph Fransen, Jan Jolie, Hannah Kleis, Casper-David Lakenbrink, Mario Ley, Franziskus Spee, and Michael Weinert — IKP, Universität zu Köln, Germany

Lifetime studies in Pd isotopes have been performed to test the nuclear structure of transitional nuclei south-east of doubly-magic ^{100}Sn. Nuclei in this region of the nuclear chart have been considered prototypical examples of vibrational nuclei. Recent lifetime measurements have caused doubt about this behaviour for even-even Pd isotopes (e.g. [1]). Information on lifetimes are surprisingly scarce in odd-mass Pd isotopes. The first excited state of ^{99}Pd has been investigated by Ivanova et al. [2], but no lifetimes of higher-lying states are available. Precise lifetime values for excited nuclear states were determined in ^{99}Pd, which was populated in a ^{90}Zr(^{12}C, 3n) fusion-evaporation reaction at a beam energy of 55 MeV at Cologne. The Cologne plunger device was employed, surrounded by the recently commissioned Cologne CATHEDRAL spectrometer, an efficient detector array consisting of 24 HPGe and eight LaBr detectors. The recoil-distance Doppler-shift method was employed and γ-γ coincidence data were analyzed using the differential decay-curve method in order to determine lifetime values. New lifetime results of excited states in ^{99}Pd will be presented.

[1] M. Droste et al., Phys. Rev. C 106, 024329 (2022)
[2] D. Ivanova et al., Phys Rev. C 105, 034337 (2022)

HK 23.19 Tue 17:30 Foyer Physik

Cooling studies for the ALICE3 Outer Tracker barrel layers — •Lena Kirchner for the ALICE Germany-Collaboration — Technische Universität München, Munich, Germany

The ALICE3 upgrade will feature a new Outer Tracker (OT) detector system based on Monolithic Active Pixel Sensor (MAPS) technology. Four cylindrical layers will form the OT barrel with the support structure segmented into staves similar to the current ALICE Inner Tracking System (ITS2) but significantly scaled up. An effective thermal management is critical to ensure the performance and longevity of this large area silicon detector.

We present a cooling strategy being developed for the OT barrel and experimental investigations to optimize the air cooling system, which is the basis for a modular system that allows for industrial scalability and a cost effective implementation. With a full scale demonstrator setup we can directly compare our measurements to simulations and extrapolate to the final implementation of the OT.

This research was supported by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) under Germany's Excellence Strategy EXC-2094-390783311 and the Bundesministerium für Bildung und Forschung, BMBF-05P24WO4 ALICE.

HK 23.20 Tue 17:30 Foyer Physik

Direct-Photon-Jet Correlations in Pythia Simulations for ALICE — •Julius Kinner — Universität Münster, Germany

Ultrarelativistic collisions of protons and heavy ions are measured with ALICE, which for instance allows the study of quantum chromodynamics and the quark-gluon plasma (QGP). Two interesting observables are jets, collimated hadrons created from the outgoing partons of a hard scattering, and direct photons, which do not stem from particle decays and transverse the QGP unchanged after their production, not interacting via the strong force.

Correlations between jets and photons can be studied with two-particle correlations by collecting the difference $\Delta\varphi$ and $\Delta\eta$ between trigger and associated particles in a correlation function. Hard-charged triggers can be used as a proxy for jets and photons can be used as associated particles. This is done as a phenomenological study with Pythia simulations for pp collisions at $\sqrt{s} = 13$ TeV, focusing on photons of different origins. Namely, the decays of π^0, η, and ω into photons are considered, and correlation functions of these associated hadrons are converted to those of their decay photons. All this is done in the context of a possible measurement of direct photons with a subtraction method. Furthermore, a comparison between two parton-shower models in Pythia (Simple and Vincia) is made. The current state of the analysis using experimental data from ALICE will also be shown.

HK 23.21 Tue 17:30 Foyer Physik

Investigating anisotropic flow in Run 3 Pb-Pb collisions at ALICE — •Luca Italiano for the ALICE Germany-Collaboration — Technical University of Munich, Munich, Germany

In heavy ion collisions, the generation of final-state particle spectra is influenced by the collective expansion of the system in the quark-gluon plasma (QGP) phase, in addition to other non-collective effects. This collectivity is quantified experimentally by determining the v_n harmonics from the Fourier decomposition of the azimuthal spectra. Monte Carlo simulations can also supplement the analysis by providing insights to the initial geometry of the collision events. In this study, observables sensitive to collective anisotropic flow are extracted for Run 3 Pb-Pb collision data, with a focus on how these values are related to the detector occupancy and interaction rates.

HK 23.22 Tue 17:30 Foyer Physik

GEM production and quality assurance at the FTD in Bonn — •Shania Müller[1], Tim Schüttler[1,2], Markus Ball[1,2], Yevgen Bilevych[2], Philip Hauer[1,2], Dimitri Schaab[2], and Bernhard Ketzer[1,2] — [1]Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn — [2]Forschungs- und Technologiezentrum Detektorphysik, Universität Bonn

Gas Electron Multipliers (GEMs) are commonly used for amplification in modern gaseous detectors. A GEM consists of a 50 μm thick polyimide foil coated with copper layers of 5 μm on both sides in which microscopic holes are etched using photolithographic techniques.

A reliable process for producing standard 10×10 cm^2 GEM foils was recently established at the Research and Technology Center Detector Physics (FTD) at Bonn University. The production process was developed in close cooperation with the CERN EP-DT-MPT group.

For the procedure the laboratories at the FTD offer wet benches, a dry film laminator and UV exposition machines. The processing infrastructure is hosted exclusively in clean rooms of classes ISO5-7.

With the equipment and the new procedure, it was possible to successfully produce several standard GEM foils and classify them using an established quality assurance procedure. Furthermore, the completed GEMs were installed in a test detector for a first series of measurements to investigate their properties. In this poster I will give an overview of the GEM production process and present the results of both the QA and test detector measurements.

Supported by BMBF.

HK 23.23 Tue 17:30 Foyer Physik

Hypertriton three-body decay reconstruction with ALICE at the LHC — •Carolina Reetz for the ALICE Germany-Collaboration — Physikalisches Institut Universität Heidelberg

Among the thousands of particles produced in high energy heavy-ion collisions at the LHC, light (anti-)hypernuclei are of special interest. Studying their internal structure provides a unique opportunity to probe the strong interaction between hyperons and nucleons. The lightest known (anti-)hypernucleus, the (anti-)hypertriton, is a bound state of a proton, a neutron, and a Λ hyperon. A precise measurement of its three-body decay into a proton, a pion, and a Λ hyperon gives insight into its internal structure and, particularly in small collision systems, allows to discriminate between different production models for (anti-)hypernuclei.

For a precise decay reconstruction and an effective background suppression, the novel strangeness tracking technique can be employed. It makes use of the upgraded silicon tracker (ITS2) of the ALICE detector in LHC Run 3, allowing to directly track (anti-)hypernuclei and weakly decaying charged strange hadrons in the silicon layers closest to the beam pipe prior to their decay.

This contribution presents the hypertriton three-body decay reconstruction performance with the upgraded ALICE detector in Run 3 proton-proton collisions.

HK 23.24 Tue 17:30 Foyer Physik

Exploring the particle emission source in proton-proton collisions via collective expansion — •Sebastian Wind — Technische Universität München

While the formation of Quark-Gluon Plasma (QGP) and associated collective behavior are well-established in heavy-ion collisions, their existence in proton-proton (pp) collisions remains unknown. Recent femtoscopic measurements have revealed signatures typically associated with collective behavior in pp collisions, challenging our understanding of small system collisions.

In this research, we investigate the mT scaling behavior via collective expansion using the analytically solvable hydrodynamical Gubser solution. By comparing our predictions to ALICE collaboration data and contrasting them with non-hydrodynamical model calculations, we try to understand whether the observed mT scaling behaviour can be related to the collective expansion. This work provides insights into potential QGP formation in small system collisions and the applicability of hydrodynamics in describing pp collisions. In particular it helps to bridge the gap between our understanding of heavy-ion and proton-proton collisions

HK 23.25 Tue 17:30 Foyer Physik

Investigation of strange dibaryons in the weak non-leptonic decay topologies with ALICE — •Zhanna Khuranova for the ALICE Germany-Collaboration — Institut für Kernphysik, Goethe Universität Frankfurt

Searches for exotica is currently a very active field at the LHC. LHCb has for instance discovered the pentaquark candidates $P_c(4312)^+$, $P_c(4380)^+$, $P_c(4450)^+$ and the tetraquark state T^+_{cc}. They all contain at least one charm quark. We are searching for strange exotics in high-energy nuclear collisions that should be produced abundantly at the LHC. These searches within the ALICE Collaboration include currently pentaquarks and dibaryons. The presented investigation focuses on the decay mode of $(\Xi^0 \mathrm{p})_b$ into Λp. Whereas, the reconstruction is utilizing topological and kinematical selections. The analysis is currently performed in Run 2 data and will be conducted in Run 3 data in the next step. The main motivation for this particular search is connected to the H-dibaryon (*uuddss*), which was investigated in ALICE at the LHC and is expected to lie close to the Ξp threshold. The production from a formed QGP, well described within the thermal model, should admit an observation of such exotic states.

HK 23.26 Tue 17:30 Foyer Physik

Recomission of a conversion electron spectrometer with stacked Si pad detectors — •Matthias Kilb, Han-Bum Rhee, Steffen Meyer, Ilja Homm, and Thorsten Kröll — TU Darmstadt, Darmstadt, Germany

De-excitation of an excited nucleus can occur in several ways. In competition with the emission of a gamma ray, the excitation energy can also be transferred directly to a close electron, which is then emitted. In order to be able to measure such transitions, a conversion electron spectrometer is used, which uses a magnetic transport and filter system, called Mini-Orange (MO), as a central unit [1]. The MO consists of 6 wedge-shaped permanent magnets symmetrically arranged around a lead absorber with a copper cap. The resulting magnetic field makes it possible to focus electrons of a specific energy range from a wider solid angle onto a comparatively small area and to suppress interfering factors. The setup offers the possibilty to vary the distances between source, MO and detector, allowing to maximize the transmission of different electron energies.

Due to the damage of the Si(Li) detectors used previously, which were several millimeters thick, the concept of two stacked 1mm and 1.5mm thick Si pad detectors, which are easier to handle, is now being investigated. The data is read out using a digital DAQ. The results of a measurement with a ^{207}Bi source and the transmission curve for electrons of approximately 975 keV of the MO are presented.

[1] D. Gassmann, Dissertation, LMU München, 2003

HK 23.27 Tue 17:30 Foyer Physik

Neural network approach for energy estimation of the digital calorimeter EPICAL-2. — •Jan Scharf — Institut für Kernphysik, Goethe Universität Frankfurt, Frankfurt am Main, Deutschland

The EPICAL-2 prototype has been designed and constructed to study a concept of electromagnetic digital pixel calorimeters. The detector is based on a SiW sampling design using 24 layers, each composed of a W absorber and two ALPIDE chips featuring $\sim 30 \times 30\ \mu m^2$ sized pixels. This results in a high spatial resolution of the detector, making it possible to measure three-dimensional shapes of electromagnetic showers. To estimate the energy of a particle depositing energy in the detector, pixel hits or clusters of pixel hits can be counted as a proxy. The energy resolution of the detector is thereby affected by the energy estimation capability of the proxy used.

In this poster, we present the current status of an effort to employ neural networks to estimate the energy of single initial particles from the three-dimensional pattern of hits or clusters that they generate in the detector. Features and patterns in data used to train the neural network, the network's architecture and its design will be discussed. The energy estimate and effect of the new approach on the energy resolution of the detector for simulated data will be presented. Finally, the potential of neural networks for fast and efficient simulations of electromagnetic showers in digital calorimeters will be addressed.

Supported by BMBF and the Helmholtz Association.

HK 23.28 Tue 17:30 Foyer Physik

Measurement of the particle emitting source in pp collisions at 13.6 TeV using p-Λ correlations with ALICE — •Jaime Gonzalez for the ALICE Germany-Collaboration — Technical University of Munich, Germany

The femtoscopic technique allows the study of the hyperon-nucleon interaction with much lower relative momenta and higher precision compared to conventional scattering experiments. Throughout the years it has helped understand the interaction of stranger and unstable hadrons in greater detail, with the goal of shedding some light on the equation of state (EoS) of neutron stars. This was in previous studies during the Run 2 period of the LHC at the ALICE experiment done by modeling the particle-emitting source which was found to share a common transverse mass mT dependence for all hadron-hadron systems. The latest Run 3 of the LHC has provided a much larger minimum bias data set of pp collisions and for the first time allows the introduction of an event multiplicity dependence of the mT dependent source. This contribution showcases the multiplicity dependent mT scaling of p-Λ pairs in small collision systems, whose interaction is modeled using the state-of-the-art χEFT calculations and its prospect is to help understand the EoS of neutron stars. Furthermore, these results complement similar source size measurements using p-p pairs and overall aim to build the foundation for future femtoscopic studies with ALICE in Run 3.

HK 23.29 Tue 17:30 Foyer Physik

HI-TREX: Compact, high resolution particle detection system for ISOLDE — Roman Gernhäuser, •Sergei Golenev, and Robert Neagu for the MINIBALL collaboration — Technische Universität München, Germany

HI-TREX is an advanced particle detection system designed for the HIE-ISOLDE facility at CERN, optimized for studying transfer reactions with radioactive ion beams. The system features thin double-sided silicon strip detectors (DSSSD), high-resolution front-end electronics based on SKIROC ASICs, and a custom FPGA-based readout board integrated into the fiber-based TRB data acquisition system.

Detector performance was evaluated in a successful system test in Delft with low-energy particles from the^{6}Li(n,α)^{3}H reaction. The series production of detectors has already started, and we will present the first data, highlighting its enhanced capabilities and potential to enable advanced research opportunities.

(supported by BMBF 05P21WOCI1)

HK 23.30 Tue 17:30 Foyer Physik

New PIXE in-air setup at the 10 MV FN-Tandem accelerator — •Ilias Alexandridis, Markus Schiffer, and Dennis Mücher — Institute for Nuclear Physics, University of Cologne, Germany

In order to determine the material composition of geological and ar- chaeological samples studied by different groups at the University of Cologne, a PIXE in-air setup will be installed at the FN-Tandem accel- erator of the Institute of Nuclear Physics. Here, the X-rays induced by irradiation with ionized particles are measured using an SDD(Silicone- Drift-Detector) detector. Conclusions can be drawn about the atomic components of the sample from the characteristic x-rays present in the spectrum. As a non-destructive measurement method, PIXE is partic- ularly suitable for the intended samples. The measurement in air also allows for a large number of potential samples to be measured while minimizing the amount of beamtime being spend. In this contribution we will present the new setup and first measurements of elementary metal samples.

HK 23.31 Tue 17:30 Foyer Physik

A simulation-based feasibility study of the measurement of K^0_L in ALICE — •Laura Gans-Bartl for the ALICE Germany-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

The ALICE experiment is designed to study the characteristics of hot and dense nuclear matter created in heavy-ion collisions. The measurement of a large variety of identified particles can help to better understand the underlying physics processes at play, while particle production in proton proton (pp) collisions serves as a baseline for these measurements. Charged pions, for example, can be measured with the main tracking detectors of the experiment, while neutral pions can be reconstructed from decay photons measured with electromagnetic calorimeters. The production of one of the eigenstates of the neutral Kaon, K^0_S, has already been measured in pp collisions by the ALICE collaboration[1]. The K^0_L has not been measured so far, as the measurement is more challenging due to the long flight time of the K^0_L.

In this contribution, a simulation-based feasibility study of $K^0_L \rightarrow \pi^+\pi^-\pi^0$, $\pi^0 \rightarrow \gamma\gamma$ in pp collisions with ALICE is presented. Based on a PYTHIA simulation, the impact of the efficiency and acceptance of the ALICE experiment on the measurement probability of K^0_L is studied. An estimate of the K^0_L yield with ALICE Run2 statistics is discussed.

Supported by BMBF and the Helmholtz Association.

[1] e.g. *Eur. Phys. J. C 81 (2021) 256*

HK 23.32 Tue 17:30 Foyer Physik

Analysis of the Composition of the Beam from a Penning Ion Source at COALA — •Daniela Tandara, Kristian König, Imke Lopp, and Wilfried Nörtershäuser — IKP, Darmstadt, Germany

High-resolution collinear laser spectroscopy enables precise measurements of nuclear quantities such as the charge radius and magnetic moments through observations of isotopic shifts and hyperfine splittings. The preparation of ion beams with low energy spread is critical for such studies as it contributes to the observed linewidth. Therefore, Penning ionization gauge (PIG) sources are a viable choice for generating ions, particularly from metals. In line with the successful deployment of a comparable source at the BECOLA facility at the Facility for Rare Isotope Beams (FRIB) for the purpose of iron ionisation, a PIG source was constructed for the COALA setup at TU Darmstadt. In this work, first studies on stable Fe^+ were performed to investigate suitable optical transitions for measurements on short-lived isotopes at FRIB. A velocity filter was installed downstream of the source in order to separate ion species by their mass-to-charge ratio and identify the produced ions. Initial measurements identified a significant fraction of Fe^+ among other ionized species, with Fe^+ intensities exceeding expectations from prior literature. These results were corroborated by time-of-flight mass spectroscopy. Laser spectroscopy in $^{54,56}Fe^+$ was performed using the $3d^6 4s\ ^6D_{9/2} \rightarrow 3d^6 p\ ^6D^o_{9/2}$ transition at 259.94 nm, demonstrating the suitability of measurements in the Fe^+ ion for future measurements at online facilities. This project is supported by the German Research Foundation (Project-ID: 279384907 - SFB 1245).

HK 23.33 Tue 17:30 Foyer Physik

Triples extension to Bogoliubov Coupled Cluster theory — •Urban Vernik[1,2], Pepijn Demol[4], Alexander Tichai[1,2,3], and Thomas Duguet[5] — [1]Technische Universität Darmstadt, Department of Physics — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — [3]Max-Planck Institut für Kernphysik, Heidelberg — [4]KU Leuven, Instituut voor Kern- en Stralingsfysica — [5]IRFU, CEA, Université Paris-Saclay

The field of ab initio many-body nuclear physics is advancing steadily, enabling the description of heavier and more exotic nuclei. A key factor is the improved understanding of symmetry breaking in singly open-shell nuclei, which inspired new many-body methods like the Bogoliubov coupled-cluster (BCC). BCC leverages U(1) global gauge symmetry breaking to calculate semi-magic isotopic chains.

BCC calculations are defined by truncation of the cluster operator. Previous implementations were limited to singles and doubles (BCCSD). This work extends the method to include triple excitations, developing BCCSDT. While full self-consistent triples remain computationally prohibitive, approximate non-iterative corrections systematically account for their effects on nuclear observables.

These approximations are implemented in large model spaces for realistic calculations. Applications to the oxygen and calcium isotopic chains demonstrate improved binding energy accuracy. Including triples in BCC thus represents a step forward, offering enhanced predictive power for nuclear observables in semi-magic nuclei.

*Funded by LOEWE Top Professorship

HK 23.34 Tue 17:30 Foyer Physik

Upgrade of a general-purpose data logging system for detector laboratories — •Benedikt Ferdinand Peter, Philip Hauer, and Bernhard Ketzer — Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn

Measurements in laboratories are often prone to variations of environmental conditions such as changes in temperature T, pressure p and humidity H. Therefore, it is indispensable to measure and log these parameters as precisely and reliably as possible.

This is especially important for gaseous detectors, where variations in T and p are known to strongly affect the gas gain. In order to monitor environmental conditions as well as the properties of the detector gases, we have developed a data logger that can be placed in the vicinity of the experiment, inside the gas system or inside the detector to directly measure T, p and H of the active medium during the experiments.

The logger employs different sensors that are connected to a microcontroller which has a built-in WiFi chip. This connects to a local wireless network that is created by a Raspberry Pi. Via the MQTT protocol, the recorded data is sent to the Raspberry Pi, which forwards the data to a database for long-term storage.

The second iteration of these devices first includes a translation of the source code from C to Python, for the purpose of better readability and maintenance. The DHT22 sensor was replaced by the BME280 due to its better resolution and ease of implementation. Secondly, a PCB was designed to plug into the gas tubing.

HK 23.35 Tue 17:30 Foyer Physik

Proton Emission in Ag+Ag Collisions at 1.23 *A*GeV measured at HADES — •Elisabeth van Engelen for the HADES-Collaboration — Goethe University Frankfurt

The HADES experiment investigates the QCD phase diagram at moderate temperatures and high net-baryon densities by analyzing particles emitted in heavy-ion collisions at approximately 1 *A*GeV. Understanding hadronic behavior under these extreme conditions is crucial for advancing our knowledge of the strong interaction at high densities. This poster presents a comprehensive differential yield analysis of protons emitted in Ag+Ag collisions at 1.23 *A*GeV. The analysis is based on measurements taken by HADES in March 2019, during which a smaller sample was recorded at 1.23 *A*GeV alongside the high-statistics sample collected at 1.58 *A*GeV. Combined with the data sample of Au+Au collisions at 1.23 *A*GeV, the collected data will allow for detailed investigations of the energy and system size dependence of proton emission. As the most frequently emitted hadrons at this energy, protons provide a unique opportunity for in-depth analysis with exceptional statistical precision. Their study offers valuable insights into the dynamics of dense nuclear matter, addressing previously underexplored aspects of these collisions.

HK 23.36 Tue 17:30 Foyer Physik

Large-Scale XYZ Digital Microscope — •Konstantin Münning[1], Philip Hauer[1,2], Jonathan Kunecke[2], Jan Paschek[1,2], Benedikt Peter[2], and Bernhard Ketzer[1,2] — [1]Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn, Germany — [2]Forschungs- und Technologiezentrum Detektorphysik, Universität Bonn, Germany

Micropatterned structures are widely used for precise particle detection and identification. An example are Gas Electron Multiplier (GEM) foils or patterned readout electrodes. A process for producing such microstructured flex circuits has recently been implemented at the Research and Technology Center Detector Physics (FTD) of the University of Bonn. An important step in the production is a rigorous Quality Assurance (QA) process, including optical measurements. Commercially available digital microscopes don't cover the sizes of recent large-scale structures. Therefore a large-scale digital microscope for clean-room operation was developed to fill this gap and to allow manual and automatic QA procedures. The XYZ-positioning features 25 μm precision covering $1400 \times 1400\,\mathrm{mm}^2$ area to fully utilize commercially available granite tables. The 20 Mpixel camera with replaceable optics allows to select suitable resolutions, currently up to 1 μm/pixel. By applying image stitching techniques a full image of up to $2{\cdot}10^{12}$ pixels is possible.

The poster introduces the current setup of the microscope with its unique features and presents recent results of GEM foil QA.

HK 23.37 Tue 17:30 Foyer Physik

K0s production in p+p collisions at 4.5 GeV beam energy with the HADES experiment — •Chris Takatsch for the HADES-Collaboration — JLU Gießen, Gießen, Germany

In February 2022 p+p collisions with a kinetic beam energy of 4.5 GeV were recorded with the HADES (High Acceptance DiElectron Spectrometer) experiment at the GSI Helmholtzzentrum für Schwerionenforschung in Darmstadt, Germany. This measurement makes it possible to investigate strangeness production in p+p collisions at low energies and can be taken as a reference measurement for later AA collisions at FAIR. Kaons are the lightest particles that carry strangeness and are therefore ideal to investigate strangeness production at this energy. The K0s primarily decays weakly into pi+ and pi- (off vertex decay) and can be reconstructed with a good significance. Hence the objective of this work is to calculate the multiplicity of K0s in p+p collisions at 4.5 GeV through their decay into two charged pions and compare it with world data. This multiplicity is calculated via a multidifferential analysis of the invariant mass spectra of charged pion pairs in transverse momentum and rapidity.

HK 23.38 Tue 17:30 Foyer Physik

The FRS Virtual Messhütte — •Nicolas Hubbard for the Super-FRS Experiment-Collaboration — GSI, Darmstadt, Germany

The FRS (FRagment Seperator) is a high-resolution magnetic spectrometer located at the GSI Helmhholtzzentrum fur Schwerionenforschung in Darmstadt, Germany. Using the FRS secondary beams of exotic nuclei can be produced by impinging high energy primary beams from the SIS-18 synchotron onto production targets. In order to help the operation of the FRS, to provide long-term recording of the operating conditions during an experiment, and to allow people to monitor and participate in experiments remotely, a remote monitoring system is under development, termed the FRS "Virtual Messhütte", and available using a standard web-browser to authorised users. This poster will highlight some of the developments of the Virtual Messhütte.

HK 23.39 Tue 17:30 Foyer Physik

Energy loss and stopping power of alpha particles in graphenic carbon and areal density measurements — •Konstantina Botsiou for the Super-FRS Experiment-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

A method for measuring areal densities based on alpha particle energy loss was undertaken. It was applied to graphenic carbon (GC) foils from two manufacturers, KETEK and Applied NanoTech. The method is highly precise for thin foils, but the accuracy depends on the stopping power model.

Experimental stopping power data, deduced from the energy loss measurements of alpha particles (in the energy range 5–5.8 MeV) in foils of known areal density (measured from mass and area), was used for selecting the stopping power model. The Bethe formulation, with the respective corrections for this energy regime, was used to describe the stopping power data. The free parameter of the fit was the adjusted mean excitation energy, I_{adj}, defined as $\ln[I_{\mathrm{adj}}] = \ln[I_m] + (C/Z)_{\beta=1}$, where C/Z the shell correction. With this method, accuracies of $0.5 \pm 2\%$ for KETEK foils and $0.01 \pm 0.4\%$ for Applied NanoTech foils with areal densities of 0.2 mg/cm^2 were demonstrated.

This study was motivated by the need for a non-destructive method to measure the areal densities of GC foils produced by KETEK GmbH. This is particularly relevant for components like vacuum windows and stripper foils in accelerator systems, as well as for production targets and degraders in radioactive ion beam facilities.

HK 23.40 Tue 17:30 Foyer Physik

Measurement of Energy Loss in the Silicon Tracking System of the CBM experiment and potential for PID — •David Gutierrez Menendez for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — Goethe University of Frankfurt, Germany

The Silicon Tracking System (STS) in the Compressed Baryonic Matter (CBM) Experiment at FAIR's SIS100 accelerator, aims to precisely track charged particles and determine their momenta. Its 876 double-sided micro*strip sensors are the means to accomplish this task in the high multiplicity environment of heavy ion collisions with high spatial, temporal and momentum resolution. A scaled down version of CBM is installed at the SIS18 accelerator and it serves as a full-system test-setup for the capabilities of the future experiment. The m(ini)CBM experiment has shown promising results in the operational and scientific realms, in beamtime campaign with heavy-ion collisions at 1-2 AGeV. At the core of mCBM resides mSTS, with 3 stations and a total of 12 sensors is able to contribute to the global track reconstruction. The goal of this work is to explore the particle identification (PID) capabilities of mSTS by measuring the collected charge from traversing ionizing particles, this task relies on a correct charge calibration and noise suppression of mSTS data. In the absence of a magnetic field, momentum measurements are not possible, but using the Time Of Flight (TOF) detector of mCBM we can extract the particle velocity and correlate it with dE/dx data from mSTS to show the behavior of multiple particle species.

HK 23.41 Tue 17:30 Foyer Physik

A side access system to the KATRIN beamline — •Kyrill Blümer, Christian Gönner, Kevin Gauda, Volker Hannen, Hans-Werner Ortjohann, Sonja Schneidewind, Leo Wesseler, and Christian Weinheimer for the KATRIN-Collaboration — Universität Münster, Institut für Kernphysik

The KATRIN experiment aims to measure the neutrino mass via spectroscopy of the tritium β-decay. An upper limit $m_\nu < 0.45$ eV/c^2 (90% C.L.) was published in 2024 (arXiv:2406.13516). Despite implementation of efficient countermeasures, an elevated experimental background is observed, which needs to be reduced to reach the design sensitivity. Radioactive decays in the stainless steel vessel of the main spectrometer produce highly-excited Rydberg or autoionizing states of atoms in the spectrometer volume, which release low-energetic electrons. These are energetically indistinguishable from β-electrons at the detector. Their angular distribution, however, is significantly sharper. The "active Transverse Energy Filter" (aTEF) concept was invented to reduce this background by discrimination of electrons in a large magnetic field based on their pitch angle (EPJ C 82 (2022) 922) and successfully tested as a modification of commercial Si-PIN diodes. The presented side-access system to the KATRIN beamline allows in-situ tests of the aTEF-prototypes and can provide direct measurements of the angular distribution of the KATRIN background electrons. Further, it can serve as a platform for calibration tools for the so-called TRISTAN-upgrade of the detector. This work is supported by BMBF ErUM-Pro 05A23PMA.

HK 23.42 Tue 17:30 Foyer Physik

"LowRad"-project: Background Reduction for next generation Dark Matter experiments — •Hannah Ginkel, Lutz Althüser, Robert Braun, Volker Hannen, Christian Huhmann, David Koke, Philipp Schulte, Patrick Alexander Unkhoff, Daniel Wenz, and Christian Weinheimer — Institute for Nuclear Physics, University of Münster

Next-generation dark matter experiments using liquid xenon are advancing the search for Weakly Interacting Massive Particles (WIMPs), a leading dark matter candidate, as well as other rare events such as solar neutrinos, neutrinoless double beta decay, and solar axions, among others. Achieving ultra-low background event rates is essential for probing WIMPs down to the neutrino fog. The "LowRad"-project aims to reduce the background levels below 0.1 μBq/kg by developing innovative techniques, such as active cryogenic distillation methods for the next generation of krypton and radon removal systems (RRS), utilizing differences in vapor pressure. A cryogenic heat pump is being developed to handle the increased throughput of the RRS and provide O(20) kW for the evaporation and reliquefaction processes. Current krypton removal systems suffer from substantial off-gas losses of several tonnes of xenon, hindering continuous operation during data-taking. To address this, LowRad is developing a staged distillation, which aims to reduce the off-gas losses during krypton removal to a few kilograms over the lifetime of the XLZD observatory. This poster presents the current status of the developed systems.

Supported by the ERC Advanced Grant "LowRad" (101055063).

HK 23.43 Tue 17:30 Foyer Physik

Charged kaon SIDIS with CLAS12 — •Áron Kripkó[1], Stefan Diehl[1,2], and Kai-Thomas Brinkmann[1] — [1]Justus Liebig Universität Gießen, 35390 Gießen, Germany — [2]University of Connecticut, Storrs, CT 06269, USA

A multidimensional study of the structure function ratios $F_{LU}^{\sin(\phi)}/F_{UU}$, $F_{UU}^{\cos(\phi)}/F_{UU}$ and $F_{UU}^{\cos(2\phi)}/F_{UU}$ has been performed for charged kaons. It uses the high statistics data recorded with the CLAS12 spectrometer at Jefferson Laboratory. The 10.6 GeV longitudinally polarized electron beam interacted with an unpolarized liquid hydrogen target during the experiment. $F_{LU}^{\sin(\phi)}$ and $F_{UU}^{\cos(\phi)}$ are twist-3 objects that encode information about the quark-gluon-correlations in the proton. $F_{UU}^{\cos(2\phi)}$ is a twist-2 quantity, providing a direct access to the Boer-Mulders function.

The poster presents an analysis of the charged kaon final states $eK^{\pm}X$ using machine learning improved particle identification, over a large kinematic range with virtualities Q^2 ranging from 1 GeV^2 to 8 GeV^2. The precise multidimensional measurement was performed in a large range of z, x_B, p_T and Q^2 for the first time in the valence quark region. The structure function ratios were extracted by beam spin asymmetry and by direct cross section measurements.

This work is funded by DFG (Project No: 508107918).

HK 23.44 Tue 17:30 Foyer Physik

Development of a gas system for the Transition Radiation Detector of the CBM experiment — •Nikolai Podgornov[1], James Ritman[1,2], Peter Wintz[2], and Felix Fidorra[3] for the CBM-Collaboration — [1]Ruhr-Universität Bochum — [2]Forschungszentrum Jülich — [3]Westfälische Wilhelms-Universität Münster

One of the crucial components of the Compressed Baryonic Matter (CBM) experiment is the Transition Radiation Detector (TRD), which is essential for identifying electrons with a momentum above p>1 GeV/c. A high detection efficiency of better than 90% is also required. The TRD uses a mixture of the noble gas xenon and the quenching gas CO2. Since xenon is an expensive gas, a critical part of the TRD is its gas system, which must maintain a stable and optimal gas mixture in a closed circuit. The design of this gas system also involves considerations of gas mixture purity, flow rates, and pressure stability to ensure efficient charged particle and transition radiation detection. To accurately identify electrons amidst a high background of other particles, the gas overpressure in the TRD must be precisely controlled and kept within a range of about 0.2 - 0.6 mbar. This report discusses the gas system requirements, the status of a gas system prototype, and plans for its development into a full-size system, including the design of the gas distribution and circulation system and the implementation of monitoring systems. My contribution to the prototype's development will also be presented. This includes testing stability under various conditions such as power failure, pump failure, and gas leaks, as well as testing the calibration procedure for gas pressure sensors.

HK 24: Invited Talks I

Time: Wednesday 11:00–12:30 Location: Kurt-Alder HS Chemie

Invited Talk HK 24.1 Wed 11:00 Kurt-Alder HS Chemie

PUMA: low-energy nuclear physics with antiprotons — •Alexandre Obertelli — TU Darmstadt, Darmstadt, Germany

The antiProton Unstable Matter Annihilation (PUMA) experiment aims at investigating the neutron skin of stable and radioactive nuclei by use of antiproton-nucleus annihilation. The experiment, approved in 2021 at CERN, will collect antiprotons from the ELENA low-energy ring of the Antimatter Factory before transporting them in a compact particle trap to the ISOLDE radioactive ion beam facility, located a few hundred meters away. At ISOLDE, the particle trap will be connected to the low-energy radioactive ion beam line to receive short-lived rare nuclei. The annihilation between matter and antimatter will occur inside the particle trap, which is surrounded by particle detectors to detect and reconstruct annihilation events. Future perspectives to produce hypernuclei from low-energy antiproton annihilations at the Antimatter Factory of CERN and to investigate their structure will be introduced.

Invited Talk HK 24.2 Wed 11:30 Kurt-Alder HS Chemie

How well do we know the vector quarkonia? — •Nils Hüsken — Johannes Gutenberg-Universität Mainz

Quarkonia, mesons made from a heavy quark and an anti-quark, are considered to be the strong interaction analogues to the hydrogen atom. As such, the spectrum of the $c\bar{c}$ charmonium and $b\bar{b}$ bottomonium hadrons can be calculated using familiar methods from quantum mechanics. Experimentally, below the threshold for the decay into pairs of charm- (bottom-)flavoured hadrons the observed states match these calculations very well. Above that threshold, however, experiments have found a large number of new, exotic hadrons that do not match our expectations for regular quarkonium hadrons - the XYZ states. In e^+e^- annihilation experiments, vector mesons with the same spin and parity as the photon are produced copiously, and indeed exotic vector-states like the $Y(4230)$ and $\Upsilon(10753)$ have been reported in both the charmonium and bottomonium regions. Their interpretation is a matter of hot debate and largely depends on our knowledge of the highly excited regular vector quarkonium states. In this talk, I will summarize the experimental situation of the vector quarkonia, highlight the open questions relating to exotic hadrons, and present the ongoing effort to shed light on both the regular and exotic vector quarkonia above the open-flavour thresholds.

Invited Talk HK 24.3 Wed 12:00 Kurt-Alder HS Chemie
Precision redefined: Unlocking new frontiers with Monolithic Active Pixel Sensors — •Bogdan-Mihail Blidaru for the ALICE Germany-Collaboration — GSI Helmholtzzentrum, Darmstadt
CMOS Monolithic Active Pixel Sensors (MAPS) have emerged as key-enabling detector technologies for heavy-ion experiments, meeting the stringent requirements of high granularity, low mass, excellent spatial resolution, and robust radiation tolerance demanded by these high-density collision environments. Several variations of MAPS developed using mainstream CMOS imaging technologies have been or are successfully being used in experiments (STAR, ALICE ITS2), while some are planned for current and future upgrades (ITS3, ALICE3, Belle2, CBM, LHCb trackers, mu3e), and even prospective FCC-ee detectors.

The recent shift to deeper submicron nodes enhances integration density and enables larger wafer sizes. Alongside process modifications this allows CMOS MAPS to be competitive in terms of radiation hardness with their hybrid counterparts. Moreover, with sensitive layers only few tens of microns thick, the sensors can be thinned even below 50μm, at which point they become flexible enough to be bent into truly cylindrical shapes with radii as small as 2 cm. Combined with processing options such as stitching, this added flexibility allows fabrication of entire detector half-cylinders from a single sensor, substantially reducing support structures and overall material budget. These developments pave the way toward near-massless detector concepts.

This contribution offers an overview of some emerging CMOS MAPS technologies and their applications in heavy-ion physics.

HK 25: Focus Session II: Accurate Nuclear Charge Radii of Light Elements

Time: Wednesday 14:00–15:30 Location: HS 1 Physik

Invited Talk HK 25.1 Wed 14:00 HS 1 Physik
First laser spectroscopic measurements of charge radii along the carbon isotope chain — •Kristian König, Emily Burbach, Phillip Imgram, Bernhard Maass, Patrick Müller, Wilfried Nörtershäuser, and Julien Spahn — TU Darmstadt, Germany
Light nuclei are ideal test cases for nuclear structure calculations as they exhibit many facets of nuclear structure like halos and clustering and are accessible for high-precision ab-initio calculations. The nuclear charge radius is a key observable and in an ongoing effort it is planned to determine absolute and differential charge radii, R_C and $\delta\langle r^2\rangle$, of the light elements Be to N by purely using collinear laser spectroscopy and non-relativistic quantum electrodynamics calculations (NR-QED). Helium-like ions of these species provide laser-accessible atomic transitions that can be calculated with high accuracy in the NR-QED approach. As a first step, the $1s2s\,^3\mathrm{S}_1 \rightarrow 1s2p\,^3\mathrm{P}_J$ transitions in $^{12-14}\mathrm{C}^{4+}$ were determined using the Collinear Apparatus for Laser Spectroscopy and Applied Science (COALA) at the Technical University of Darmstadt. These represent the first optical charge radius measurements in the carbon isotopic chain and will be the starting point for the necessary improvement of the charge radii of the light-mass nuclei. This contribution will give an overview of the project and present the measured transition frequencies along with the extracted nuclear charge radii of $^{12-14}$C, which are compared to results from electron scattering and muonic atom spectroscopy experiments as well as to state-of-the-art theory.
This project was supported by DFG (Project-ID 279384907 - SFB 1245) and by BMBF (05P21RDFN1).

Invited Talk HK 25.2 Wed 14:25 HS 1 Physik
Precision radii of light elements using Metallic Magnetic Calorimeters — •Frederik Wauters — Institute for Nuclear Physics, Johannes Gutenberg University Mainz, Mainz, Germany
Nuclear charge radii are crucial for testing nuclear models and serve as key inputs for precision experiments. While optical isotope shift data provide charge radius differences, absolute radii are typically determined through muonic atom spectroscopy, a method particularly sensitive to nuclear finite size effects. Muonic hydrogen and helium have been measured using laser spectroscopy, achieving unprecedented accuracy. However, other light elements remain beyond reach.

At the Paul Scherrer Institute, a new high-precision X-ray spectroscopy initiative called QUARTET has been initiated, utilizing novel Metallic Magnetic Calorimeters. The goal is to improve the accuracy of charge radii measurements for light nuclei by an order of magnitude. Following a successful proof-of-principle measurement in 2023, a first physics run was completed in the 2024 campaign. I will present the current status and outlook of this project.

Invited Talk HK 25.3 Wed 14:50 HS 1 Physik
Precision Radii from the No-Core Shell Model via Neural Networks — •Robert Roth — Institut für Kernphysik, TU Darmstadt, Germany
The no-core shell model (NCSM) is one of the most rigorous and universal ab initio methods for light nuclei. It is based on the solution of the many-body problem in a finite model space, characterized by a single truncation parameter. For sufficiently large truncation parameters, observables are guaranteed to converge to the exact solution. The convergence pattern varies for different observables, and radii are particularly challenging due to their sensitivity to the long-range behavior of the wave functions. Therefore, fully converged calculations are only possible for few-nucleon systems. For p-shell nuclei, we obtain NCSM sequences that reveal a convergence pattern, but not a fully converged observable. To overcome this limitation, we have developed artificial neural networks (ANNs) that predict converged energies and radii based on NCSM convergence patterns using large sets of NCSM calculations for few-nucleon systems as training data. We demonstrate the application of the ANN-enhanced NCSM for radii of boron and carbon isotopes with different families of chiral two- plus three-nucleon interactions. In addition to the model-space uncertainties that are extracted from the ANNs in a statistical manner, we use Bayesian methods to asses chiral truncation uncertainties. This approach delivers precise NCSM predictions for radii with fully quantified theory uncertainties. Finally, we explore the generalization of ANN-enhanced NCSM calculations to other electromagnetic observables.

Common discussion: 15'

HK 26: Structure and Dynamics of Nuclei VII

Time: Wednesday 14:00–15:30 Location: HS 2 Physik

Group Report HK 26.1 Wed 14:00 HS 2 Physik
State-of-the-art nuclear structure studies with the recoil distance Doppler-shift technique — •Christoph Fransen[1], Andrey Blazhev[1], Felix Dunkel[1], Arwin Esmaylzadeh[1], Carina Heymer[1], Jan Jolie[1], Casper-David Lakenbrink[1], Claus Müller-Gatermann[2], Richard Novak[1], Franziskus von Spee[1], Nigel Warr[1], and Michael Weinert[1] — [1]Institut für Kernphysik, Universität zu Köln — [2]Argonne National Laboratory, Illinios, USA
Absolute transition strengths between excited states yield fundamental information on nuclear structure and can be determined from level lifetimes. The recoil distance Doppler-shift (RDDS) technique employing so-called plunger devices provides a valuable method for the determination of lifetimes in the picosecond range and has been in the focus of our Cologne group since many years. Here, we will present our latest developments of the RDDS technique with respect to the application with very different experimental conditions and the required detection techniques to identify the reaction products. We will also discuss new results from RDDS measurements of our group in tellurium isotopes close to neutron midshell where the data give hints for shape coexistence. Furthermore, we will give an overview of our recent lifetime measurements in neutron-deficient nuclei in the $A = 170$ region. In these nuclei, a $B(E2)$ anomaly was already found for the lowest yrast states. Our new results allow to test different state-of-the-art nuclear model approaches aiming for an understanding of this anomaly also towards higher yrast states.
Supported by the DFG, grant No. FR 3276/3-1

HK 26.2 Wed 14:30 HS 2 Physik
Study of the spin-flip orbitals in N = 83 isotones with lifetime measurement via (n, gamma) reactions — •zhiqiang chen[1], kathrin wimmer[1], elisa maria gandolfo[1], martha reece[1], wiktor poklepa[1], caterina michelagnoli[2], jean michel daugas[2], lorenzo domenichetti[2], and zhihuan li[3] — [1]GSI, Darmstadt, Germany — [2]ILL, Grenoble, France — [3]PKU, Beijing, China
The spin-orbit (SO) splitting is closely linked to nuclear shell gaps and magic numbers. This splitting can be significantly reduced in exotic nuclei with extreme N/Z ratios, a phenomenon that remains poorly understood. The energies of the spin-flip $\nu p_{1/2}$ and $\nu p_{3/2}$ orbitals above the $N = 82$ shell closure are still not well established. Astonishingly, even in nuclei close to stability the $\nu p_{1/2}$ and $\nu p_{3/2}$ orbitals are not well characterized.

To achieve a comprehensive understanding of the SO splitting between the $\nu p_{1/2}$ and $\nu p_{3/2}$ orbitals in $N = 83$ isotones, a thermal neutron capture experiment was conducted at the Institut Laue-Langevin (ILL), Grenoble. γ-rays from (n, γ) reaction were measured using a new HPGe array, comprising eight FIPPS Clover and eight IFIN-HH Clover detectors. Properties of the $\nu p_{1/2}$ and $\nu p_{3/2}$ orbitals in $^{139}Ba_{83}$ and $^{141}Ce_{83}$ will be characterized by deriving the $B(M1; 1/2^- \to 3/2^-)$ values. This involves determining the mixing ratio $\delta(M1/E2)$ through γ-γ angular correlations and the lifetimes of the $1/2^-$ states using the Gamma Ray Induced Doppler Shift Attenuation method. In this talk, I will present some preliminary results on the lifetime measurements of low-lying states in $^{139}Ba_{83}$ and $^{141}Ce_{83}$.

HK 26.3 Wed 14:45 HS 2 Physik

Lifetime determination and level-scheme reconstruction in ^{104}Ru using particle-γ coincidences — •Anna Bohn, Elias Binger, Tobias Langel, Sarah Prill, Michael Weinert, and Andreas Zilges — University of Cologne, Institute for Nuclear Physics, Germany

The Cologne particle-γ detector array SONIC@HORUS [1] is a powerful tool for nuclear structure investigations. It enables the measurement of p-γ and p-γ-γ coincidences, providing full reaction kinematics while excluding feeding contributions from higher-lying states. This capability makes it an ideal setup for the (p,p'γ) Coincidence Doppler-Shift Attenuation Method (CDSAM) [2,3], enabling lifetime measurements in the sub-picosecond regime, as well as level-scheme reconstruction. Several CDSAM experiments on stable even-even isotopes along the A ≈ 100 mass region have been performed at the University of Cologne in recent years [4-6]. Results obtained on ^{104}Ru via p-γ and p-γ-γ coincidence analysis will be presented in this contribution.

Supported by the DFG (ZI 510/9-2).

[1] S. G. Pickstone *et al.*, Nucl. Instr. Meth. A **875** (2017) 104.
[2] A. Hennig *et al.*, Nucl. Instr. Meth. A **794** (2015) 171.
[3] M. Spieker *et al.*, Phys. Rev. C **97** (2018) 054319.
[4] A. Hennig *et al.*, Phys. Rev. C **92** (2015) 064317.
[5] S. Prill *et al.*, Phys. Conf. Ser. **1643** (2020) 012157.
[6] S. Prill *et al.*, Phys. Rev. C **105** (2022) 034319.

HK 26.4 Wed 15:00 HS 2 Physik

First measurement of the lifetime of the 2_1^+ state of ^{200}Pt — •C.M. Nickel[1], V. Werner[1], P.R. John[1], U. Ahmed[1], C. Costache[2], K.E. Ide[1], N.M. Mărginean[2], H. Mayr[1], C. Mihai[2], R.E. Mihai[2,3], N. Pietralla[1], T. Stetz[1], A. Weber[1], and R. Zidarova[1] — [1]IKP, TU Darmstadt — [2]IFIN-HH, Bucharest-Măgurele — [3]IEAP, CTU Prague

The W, Os, Pt and Hg isotopes exhibit shape transitions between oblate, prolate, γ-soft and spherical nuclei [1]. The neutron-rich Pt isotopes transition from γ-softness towards sphericity, as indicated by the energy ratio $R_{4/2}$, when approaching the neutron-shell closure at $N = 126$. In the vicinity of shell closures, quadrupole collectivity is expected to decrease and, hence, the $B(E2; 2_1^+ \to 0_1^+)$ transition strength which is inversely proportional to the lifetime of the 2_1^+ state. ^{200}Pt is the lightest neutron-rich Pt isotope without a known $B(E2; 2_1^+ \to 0_1^+)$ value and could sit at the transitional point between a γ-soft and a spherical shape. Therefore, the ^{198}Pt(^{18}O,^{16}O)^{200}Pt* two-neutron transfer reaction was studied in a recoil-distance Doppler-shift experiment at the IFIN-HH in Bucharest-Măgurele using the ROSPHERE array equipped with 25 HPGe detectors and the SORCERER particle detector. Correcting for contaminants as well as taking de-orientation into account, allowed the application of the differential decay curve method to determine the lifetime of 2_1^+ state of ^{200}Pt for the first time. The analysis and resulting $B(E2; 2_1^+ \to 0_1^+)$ value will be presented.

[1] Z. Podolyák *et al.*, Phys. Rev. C **79** 031305 (2009).

*Supported by the BMBF under Grant No. 05P21RDCI2.

HK 26.5 Wed 15:15 HS 2 Physik

Fast timing@nu-Ball2 fission campaign: first results for the neutron-rich Kr isotopes — •Julia Fischer[1], Andrey Blazhev[1], Jan Jolie[1], Andi Messingschlager[2], Sorin Pascu[3], Martin von Tresckow[2], Nigel Warr[1,4], and Jonathan Wilson[5] for the nu-Ball2 N-SI-120-Collaboration — [1]IKP Cologne — [2]TU Darmstadt — [3]U Surrey — [4]Oliver Lodge Laboratory Liverpool — [5]IJCLab Orsay

Neutron-rich Kr isotopes have been shown to undergo a moderate evolution of collective structure and have been recently studied in two complementary campaigns [1,2]. To further address the nuclear structure, these nuclei were also studied at IJCLab Orsay as part of the Nuball2 fission campaign in 2022, produced by the fast-neutron-induced fission reaction ^{238}U(n,f). The measurement was performed with the nu-Ball2 spectrometer, a hybrid γ-spectrometer equipped with HPGe and $LaBr_3$(Ce) detectors, which provide excellent energy and timing resolution, respectively. In comparison to the first fission campaign in 2018, nu-Ball1, a number of improvements on the spectrometer and the beamline were made, in particular the tripling of the $LaBr_3$(Ce) coincidence efficiency (from 0.7% to 2.1%). First preliminary results of lifetimes in neutron-rich Kr will be presented as well as compared with 5DCH and mapped IBM calculations [2].*Supported by BMBF under Verbundprojekt 05P2021 (ErUM-FSP T07) grant 05P21PKFN1.

[1] R.-B. Gerst et al., PRC 102, 064323 (2020).
[2] R.-B. Gerst et al., PRC 105, 024302 (2022).

HK 27: Computing I

Time: Wednesday 14:00–15:15 Location: SR Exp1A Chemie

HK 27.1 Wed 14:00 SR Exp1A Chemie

Machine Learning Algorithms for Pattern Recognition with the PANDA Barrel DIRC — •Yannic Wolf[1,2], Roman Dzhygadlo[1], Klaus Peters[1,2], Georg Schepers[1], Carsten Schwarz[1], and Jochen Schwiening[1] for the PANDA-Collaboration — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt — [2]Goethe-Universität Frankfurt

Precise and fast hadronic particle identification (PID) is crucial to reach the physics goal of the PANDA detector at FAIR. The Barrel DIRC (Detection of Internally Reflected Cherenkov light) is a key detector for the identification of charged hadrons in PANDA. In comparison to other Ring Imaging Cherenkov detectors, the hit patterns observed with DIRC counters do not appear as rings on the photosensor plane but as complex, disjoint 3D-patterns.

Using the recent advances in machine learning (ML) algorithms, especially in the areas of image recognition and generative AI, we have studied ML PID algorithms for the PANDA Barrel DIRC. Several network implementations were found to be capable of reaching a performance comparable to conventional methods, but only if the network is trained for each particle angle and momentum. To make a trained network usable for different points in phase space, and to optimize the training process and PID performance, we varied the data input structures, increased the parameter space, and included normalizing flow-based generative models in the study. We will show a comparison of the performance of different ML methods to conventional algorithms and discuss the impact on the PANDA Barrel DIRC.

HK 27.2 Wed 14:15 SR Exp1A Chemie

Neutron-Gamma Multiplicity and Discrimination in ^{252}Cf Fission: GEANT4 Simulations and Machine Learning Approaches — •Annesha Karmakar[1,4,5], Frederik Uhlemann[2], Heinrich Wilsenach[3], Anikesh Pal[4], Christoph Scheidenberger[1,2], G. Anil Kumar[5], Mohit Tyagi[6], Timo Dickel[1,2], and Wolfgang.R Plass[2] — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — [2]II. Physikalisches Insti- tut, Heinrich-Buff-Ring 14, Giessen, Germany — [3]FRS Ion Catcher Collaboration, Tel Aviv University, Isreal — [4]Department of Mechanical Engineering, Indian Institute of Technology Kanpur, India — [5]Department of Physics, Indian Institute of Technology Roorkee, India — [6]Technical Physics Division, Bhabha Atomic Research Centre, Mumbai ,India

This study examines neutron and gamma-ray distributions from ^{252}Cf fission, linking them to specific prompt release events using GEANT4 and GEF simulations. The neutron energy spectrum peaks at 2 MeV and extends up to 15 MeV, with event-by-event correlations analysed using plastic scintillation detectors. Pulse Shape Discrimination (PSD) is crucial for accurate neutron-gamma identification, traditionally achieved through charge integration methods but requiring manual optimization. Machine learning techniques, such as deep neural networks (DNN) and convolutional neural networks (CNN), provide faster and more reliable PSD, particularly at low energies, enhancing our understanding of neutron-gamma multiplicity.

HK 27.3 Wed 14:30 SR Exp1A Chemie

TGeoArbN based tessellation in CBM geometry description* — •Simon Neuhaus — Bergische Universität Wuppertal, Wuppertal, Deutschland

Tessellation is a method to describe an arbitrarily shaped volume using a triangle-based surface mesh. This offers promising possibilities to efficiently create ROOT/GEANT detector geometries for simulations directly from CAD output (e.g. STEP files). It facilitates faster iteration cycles in detector design and reduces the risk of potential discrepancies in the generated simulation geometry. However, a notable disadvantage of using tessellated objects for simulation is an increase in simulation time.

TGeoArbN is a software tool that enables the use of tessellated geometries in GEANT3- and GEANT4-based simulations. By employing its own navigation functionality, TGeoArbN operates completely independent of the ROOTnative TGeoTesselation library. Additionally, it features an inbuilt octree-based partitioning method for runtime optimization. Developed at the University of Bonn for the PANDA experiment this tool is now also utilized for simulations within the CBM experiment. This contribution will present the appplication of TGeoArbN and octree-based partitioning for certain components of the CBM experiment.

* Work supported by "Netzwerke 2021", an initiative of the Ministry of Culture and Science of the State of Northrhine Westphalia, and BMBF 05P24PX1.

HK 27.4 Wed 14:45 SR Exp1A Chemie

TGeoArbN in combination with T.Stockmanns STEP-to-ROOT converter — •Ben Salisbury for the PANDA-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Bonn, Germany

In particle physics precise simulations are vital. For this accurate detector geometries are required. Simulateable triangle-meshes can be of great help to increase the automation of converting Computer-Aided-Design (CAD) detector models to simulatable geometries. However, the ROOT geometry package lacks the implementation of such a triangle-mesh. To address this capability gap in the ROOT framework, TGeoArbN, a ROOT compatible geometry class, was implemented allowing the use of triangle meshes (analog to G4TessellatedSolid) in Virtual Monte Carlo (VMC)-based simulation. To improve simulation speed partitioning structures in form of an Octree or bounding volume hierarchy can be used. TGeoArbN in combination with a STEP-to-ROOT converter (based on [1]) allowed for a high level of automation for the conversion of the FwEndcap geometry of the PANDA electromagnetic calorimeter. A short overview over TGeoArbN and a modified STEP-to-ROOT converter version will be given.

[1] T. Stockmanns, ”STEP-to-ROOT -from CAD to Monte Carlo Simulation”, Journal of Physics: Conference Series 396 (2012) 022050, url: https://doi.org/10.1088/1742-6596/396/2/022050

HK 27.5 Wed 15:00 SR Exp1A Chemie

Simulation Comparison of the mSTS Geometry based on Primitive ROOT/TGeo Solids and Tessellated Solids — •Mehulkumar Shiroya for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

The Silicon Tracking System (STS) is the core tracking detector of CBM, tasked with achieving high-precision measurements of particle tracks and momentum. Currently, a prototype system, comprising several detector subsystems, including a scaled version of the STS called mSTS is undergoing extensive testing in the miniCBM (mCBM) experiment at the existing SIS-18 accelerator at GSI, Helmholtzzentrum für Schwerionenforschung, Darmstadt.

The direct conversion of Computer-Aided Design (CAD) based geometry model to Geometry Description Markup Language (GDML), XML-based format using different software toolkits has attracted considerable attention. Solids extracted from CAD models and represented in GDML format typically consist of triangular or quadrilateral facets. `TGDMLParser` in ROOT and `G4GDMLParser` in GEANT facilitate the reading of different volumes from the GDML file and the creation of volume assemblies.

We will present a simulation analysis study of two representations of the mSTS geometry: one employing simplified primitive ROOT/TGeo solids and the other utilizing Tessellated solid-based geometry. The study includes secondary particle production, the significance of passive volumes, and computation time.

HK 28: Structure and Dynamics of Nuclei VIII

Time: Wednesday 15:45–17:15 Location: HS 2 Physik

Group Report HK 28.1 Wed 15:45 HS 2 Physik

Performance of the newly established electron-gamma coincidence facility at the S-DALINAC — •Bastian Hesbacher, Jonny Birkhan, Isabelle Brandherm, Johann Isaak, Igor Jurosevic, Oskar Möller, Norbert Pietralla, Tim Ramaker, Maximilian Rech, and Gerhart Steinhilber — Institut für Kernphysik, Technische Universität Darmstadt

The all-electromagnetic $(e, e'\gamma)$ reaction had first been used for nuclear structure measurements in the 1980s [1]. Since then very few experiments were based on this reaction. One of the challenges of this measurement technique lies in the coincident bremsstrahlung, which - apart from the angular distribution - cannot be distinguished from the γ-radiation of nuclei decaying to their ground state after excitation by inelastic electron scattering. In 2021 first successful $(e, e'\gamma)$ measurements were performed at the S-DALINAC with improved resolution of electron energy, gamma energy and coincidence time by two orders of magnitude [2]. The scattered electrons were registered with the QCLAM spectrometer. The γ-radiation was detected by 6 $LaBr_3$:Ce detectors. Measurements on ^{12}C and ^{96}Ru targets were performed and demonstrated the superior performance of the new facility over previous attempts to study $(e, e'\gamma)$ reactions. Results on the γ-decay behavior and angular distributions of ^{96}Ru will be presented.

This work is funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) - Project-ID 279384907 - SFB 1245

[1] C. N. Papanicolas et al., Phys. Rev. Lett. **54**, 26 (1985).
[2] G. Steinhilber, Doctoral thesis, TU Darmstadt (2023).

HK 28.2 Wed 16:15 HS 2 Physik

Dipole response of the $N = 84$ isotones ^{142}Ce and ^{144}Nd — •Florian Kluwig[1], Miriam Müscher[1], Deniz Savran[2], Ronald Schwengner[3], Tanja Schüttler[1], and Andreas Zilges[1] — [1]University of Cologne, Institute for Nuclear Physics, Germany — [2]GSI, Darmstadt, Germany — [3]Helmholtz-Zentrum Dresden-Rossendorf, Germany

The Pygmy Dipole Resonance (PDR) is a component of the electric dipole response in atomic nuclei. Despite decades of extensive theoretical and experimental investigations [1-3], its structure and origin remain the subject of ongoing research. To address these unresolved questions, systematic studies, e.g. along isotopic or isotonic chains, are essential for deepening our understanding of this excitation mode. Such investigations have been conducted on isotopes near the $N = 82$ magic shell closure, including the $N = 84$ isotones ^{144}Nd and ^{142}Ce, through real-photon scattering experiments known as Nuclear Resonance Fluorescence (NRF). Photons are particularly effective probes for studying the PDR due to their ability to transfer only small angular momenta [4]. In this contribution, results from NRF experiments on ^{144}Nd and ^{142}Ce will be presented and compared.

This work was partly supported by the BMBF (05P21PKEN9).

[1] D. Savran *et al.*, Prog. Part. Nucl. Phys. **70** (2013) 210.
[2] A. Bracco *et al.*, Prog. Part. Nucl. Phys. **106** (2019) 360.
[3] E.G. Lanza *et al.*, Prog. Part. Nucl. Phys. **129** (2023) 104006.
[4] A. Zilges *et al.*, Prog. Part. Nucl. Phys. **122** (2022) 103903.

HK 28.3 Wed 16:30 HS 2 Physik

Nuclear resonance fluorescence of ^{242}Pu — •M. Beuschlein[1], J. Birkhan[1], J. Kleemann[1], O. Papst[1], N. Pietralla[1], R. Schwengner[2], C. A. Ur[3], S. Weiss[2], V. Werner[1], U. Ahmed[1], T. Beck[1,4], I. Brandherm[1], A. Gupta[1], J. Hauf[1], K. E. Ide[1], P. Koseoglou[1], H. Mayr[1], C. M. Nickel[1], K. Prifti[1], T. Stetz[1], and R. Zidarova[1] — [1]IKP, Darmstadt, Germany — [2]HZDR, Dresden, Germany — [3]ELI-NP, IFIN-HH, Bucharest-Magurele, Romania — [4]FRIB, East Lansing, MI, USA

The availability of nuclear structure information of transuranium actinides impacts the modeling of stellar nucleosynthesis and supports isotope-selective material inspection via photonuclear reactions. However, available experimental data are scarce. The first nuclear resonance fluorescence (NRF) experiment on ^{242}Pu was conducted at the S-DALINAC at TU Darmstadt to probe its low-energy dipole response under stringent safety precautions. A PuO_2 sample of 1 g was irradiated by bremsstrahlung up to an endpoint energy of 3.7 MeV. The comparison of NRF spectra to measurements of the sample's activity and natural background revealed photo-excited dipole states of ^{242}Pu. Evidence for fragments of the $M1$ scissors mode and for low-lying $E1$ excitations was found, based on the assignment of intrinsic projection quantum numbers, K, from measured decay branching ratios. Experimental details, γ-ray spectra, and first results on the most prominent observed transitions in ^{242}Pu will be presented.

This work is supported by the DFG through the research grant GRK 2891 "Nuclear Photonics" under Project-ID No. 499256822.

Group Report HK 28.4 Wed 16:45 HS 2 Physik

Two-body currents at finite momentum transfer and M1 transitions — •Catharina Brase[1,2,3], Takayuki Miyagi[1,2,3,4], Kai Hebeler[1,2,3], Javier Menéndez[5,6], and Achim Schwenk[1,2,3] — [1]Technische Universität Darmstadt, Department of Physics — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — [3]Max-Planck-Institut für Kernphysik, Heidelberg — [4]Center for Computational Sciences, University of Tsukuba, 1-1-1 Tennodai, Tsukuba 305-8577, Japan — [5]Departament de Física Quántica i Astrofísica, Universitat de Barcelona, 08028 Barcelona, Spain — [6]Institut de Ciències del Cosmos, Universitat de Barcelona, 08028 Barcelona, Spain

We derived a multipole decomposition of two-body currents (2BCs) to include 2BCs at finite momentum transfer in the calculation for processes with medium-mass nuclei, without approximating the 2BCs. We investigate the effects of 2BCs on the most dominant M1 transition at 10.23 MeV in ^{48}Ca using the valence-space in-medium similarity renormalization group with a set of non-implausible interactions. Experiments, such as (e, e') and (γ, n), disagree on the magnetic dipole transition strength $B(\mathrm{M1})$ of this transition. We find that our results favor larger $B(\mathrm{M1})$ values in agreement with recent coupled-cluster calculations. For validation of our results, we investigate additional observables in ^{48}Ca and M1 transitions in ^{48}Ti. Our predictions agree with these observables.

* Funded by the ERC Grant Agreement No. 101020842.

HK 29: Hadron Structure and Spectroscopy III

Time: Wednesday 15:45–17:15 Location: HS 3 Physik

Group Report HK 29.1 Wed 15:45 HS 3 Physik

Light-Meson Spectroscopy at COMPASS — •Julien Beckers for the COMPASS-Collaboration — Technische Universität München

COMPASS is a multi-purpose fixed-target experiment at the CERN SPS. One of its main goals is to probe the strong interaction at low energies by studying the excitation spectrum of light mesons in diffractive scattering reactions of a 190 GeV/c hadron beam. This is done by decomposing the data into partial-wave amplitudes with well-defined quantum numbers and searching for resonances in these amplitudes.

We have collected the world's largest datasets of various final states. First and foremost, COMPASS' flagship $\pi^-\pi^-\pi^+$ channel has allowed high-precision measurements of many light mesons. Its strange equivalent, $K^-\pi^-\pi^+$, has given insight into the lesser known strange-meson spectrum. New analyses of final states with kaons complement their findings. After briefly presenting the analysis method, we will discuss measurements in the $K_S^0K^-$ final state, which gives access exclusively to a_J mesons at higher invariant masses.

COMPASS has also contributed significantly in the search for exotic (non-$q\bar{q}$) mesons. We will present novel analyses of the $\omega\pi^-\pi^0$ and $\pi^-\pi^-\pi^+\eta$ final states, which are especially interesting as the lightest hybrid meson is theorized to decay into both of these final states.

The COMPASS data also allows for measurements beyond typical spectroscopy. We will discuss one such analysis of the nonresonant double-Regge exchange process, done in collaboration with JPAC.

Funded by the DFG under Germany's Excellence Strategy - EXC2094 - 390783311.

HK 29.2 Wed 16:15 HS 3 Physik

Partial-wave decomposition of the diffractively produced $\pi^-\pi^+\pi^-\eta$ final state at COMPASS — •David Spülbeck[1], Henri Pekeler[1], Philipp Haas[2], Mikhail Mikhasenko[3], and Bernhard Ketzer[1] for the COMPASS-Collaboration — [1]Universität Bonn — [2]Technische Universität München — [3]Universität Bochum

The COMPASS experiment at the CERN SPS was a versatile fixed-target experiment that collected data between 2002 and 2022. The data support a rich physics program from hadron structure to spectroscopy. The latter includes the study of light isovector mesons with total spin J, i.e., a_J and π_J, produced through diffractive scattering of a 190 GeV/c π^- beam off a liquid-hydrogen target. Large data sets of multiparticle exclusive final states containing charged and neutral particles were recorded, providing also unique opportunities to study the spin-exotic meson $\pi_1(1600)$.

We present the first partial-wave decomposition of the $\pi^-\pi^+\pi^-\eta$ final state, which spans a wide range of decay channels, such as $f_1(1285)\pi^-$, $a_2^-(1320)\eta$, and $\rho(770)a_0^-(980)$. Most of these channels are studied for the first time with COMPASS data. This analysis also includes decay channels predicted by theoretical models for the lightest hybrid meson, providing the opportunity to verify the hybrid meson hypothesis of the $\pi_1(1600)$.

Supported by BMBF.

HK 29.3 Wed 16:30 HS 3 Physik

Light and strange meson spectrum from functional methods beyond Rainbow-Ladder — •Stephan Hagel and Christian Fischer — Institut für Theoretische Physik, Justus-Liebig-Universität Gießen, 35392 Gießen, Germany

The study of meson spectra has long been a central topic in theoretical hadron physics, with a variety of approaches and frameworks employed to tackle the problem. One such framework involves the Dyson-Schwinger and Bethe-Salpeter equations, which have been extensively studied within the Rainbow-Ladder truncation. While there has been some progress in going beyond this truncation, it remains a difficult challenge.

In this talk, we present a method for constructing a quark self-energy that satisfies the axialvector Ward-Takahashi identity, starting from any quark-antiquark scattering kernel. By applying this approach to a scattering kernel derived from a 3PI effective action, we compute the spectrum of light and strange mesons with various quantum numbers. In particular, we discuss the kaon spectrum for J=0...5, relevant for the AMBER experiment.

HK 29.4 Wed 16:45 HS 3 Physik

Search for conventional charmonia and light exotic candidates in the decay $\psi(2S) \to \gamma\eta'\pi^+\pi^-$ at BESIII — •Frederik Weidner, Tessa Bertelsmeier, Jans Böing, Anja Brüggemann, Lotta Frese, Nikolai in der Wiesche, Lois Kröger, Hannah Neuwirth, and Alfons Khoukaz for the BESIII Germany-Collaboration — Universität Münster, Münster, Germany

In recent years, the search for exotic hadrons has uncovered an increasing number of states that seem to be incompatible with the conventional classification as two or three quark states. Examples for these are the $\pi_1(1600)$ or the $X(1835)$. One way to study these states is the analysis of the $\psi(2S)$ data sample of the BESIII experiment, which also allows the precise determination of the branching ratios of lower lying charmonium states such as η_c and χ_{cJ}. Considering the decay of the $\chi_{c1,2}$ charmonia into three pseudoscalar mesons, the spin-exotic quantum numbers $J^{PC} = 1^{-+}$ can be accessed. In addition, precision measurements of the branching ratios of the χ_{cJ} states can help to solidify our understanding of charmonia and can be used as input to models such as NRQCD.
In this talk, the search for the $\pi_1(1600)$ in the decay $\chi_{c2} \to \eta'\pi^+\pi^-$ using a partial wave analysis, the determination of branching ratios of $\chi_{cJ}, \eta_c \to \eta'\pi^+\pi^-$ and the search for additional states in the $\eta'\pi^+\pi^-$ system, are presented. This work is supported by the German Research Foundation under project number 443159800 and GRK 2149/2 and by the Ministry for Culture and Science of the State North Rhine-Westphalia under funding code NW21-024-E.

HK 29.5 Wed 17:00 HS 3 Physik

Search for exotic states in η_c decays at BESIII — Tessa Bertelsmeier[1], Jans Böing[1], •Anja Brüggemann[1], Lotta Frese[1], Nils Hüsken[2], Nikolai in der Wiesche[1], Lois Kröger[1], Hannah Neuwirth[1], Frederik Weidner[1], and Alfons Khoukaz[1] for the BESIII Germany-Collaboration — [1]Universität Münster, Germany — [2]Johannes Gutenberg-Universität Mainz, Germany

The BESIII detector at the e^+e^- collider BEPCII in Beijing, China, provides the world's largest data sample of the charmonium J/ψ with more than 10 billion events collected from 2009 to 2019.

Starting from the radiative J/ψ decay into $\gamma\eta_c$, we analyse the reactions $\eta_c \to \eta' h\bar{h}$ (with $h\bar{h} = \pi^0\pi^0$, $\pi^+\pi^-$, $2(\pi^+\pi^-)$, K^+K^-, K_SK_S, $\eta\eta$) to determine the corresponding branching ratios as well as the mass and width of the ground-state charmonium η_c based on signal yields much higher than achieved in former analyses. Moreover, these mesonic η_c decays provide the opportunity to investigate possible exotic content in $h\bar{h}$ intermediate states, that lie in the mass region below 2 GeV/c^2, where the lightest glueball is predicted.

Our studies are based on a partial wave analysis approach that gives access to the properties of the η_c charmonium and to the partial decay widths of contributing resonances decaying into the $h\bar{h}$ subsystems. These widths are directly comparable to theoretical predictions, which assume glueball admixtures carried by certain considered resonances.

The current status of the analysis is presented.

This work is supported by the German Research Foundation (DFG) under the project number 547123630 and the DFG GRK 2149/2.

HK 30: Heavy-Ion Collisions and QCD Phases V

Time: Wednesday 15:45–17:15 Location: HS 3 Chemie

Group Report HK 30.1 Wed 15:45 HS 3 Chemie

Measurement of (anti)hypernuclei production in heavy-ion collisions at the LHC — •Michael Hartung for the ALICE Germany-Collaboration — Institut für Kernphysik, Goethe Universität Frankfurt

At the Large Hadron Collider (LHC) at CERN, light (anti)hypernuclei are produced abundantly in Pb–Pb collisions. Their study provides further insights on the formation mechanism and the nature of the hyperon-nucleon interaction. The most prominent example is the (anti)hypertriton, which is a bound state of a proton, a neutron and a Λ hyperon. It is often discussed as a bound state of a deuteron and a Λ. The Λ-separation energy is only about a few hundred keV, leading to an object size of about 10 fm. The size has consequences for its probability to be formed in a coalescence process, which is not expected from a statistical-thermal model approach. We will show the latest production measurements in different collision systems and a comparison to the production models. Furthermore, we will present a novel technique for the determination of the object size and the Λ-separation energy. Additionally, we were able to study the production and properties of heavier (anti)hypernuclei, namely $A = 4$ (anti)hypernuclei, which lead to the first evidence of the antihyperhelium-4 ever. The known excited states of the (anti)hyperhydrogen-4 and (anti)hyperhelium-4 enable the measurement of their production, mass and antiparticle-to-particle ratio in the available heavy-ion dataset of the LHC Run 2. Moreover, very first results of our (anti)hypernuclei analyses of the ongoing Run 3 heavy-ion dataset are presented.

HK 30.2 Wed 16:15 HS 3 Chemie

Statistical hadronization of hypertriton and other loosely bound nuclei — •Hjalmar Brunssen — Physikalisches Institut, Universität Heidelberg

While compact objects such as hadrons can be treated as point-like particles in the hadronization, this is not an adequate description for loosely bound (hyper-)nuclei. In these cases the spatial extension of the wavefunction matters when calculating production yields. Especially in the case of the hypertriton, where the rms radius is of similar size as the fireball, this effect leads to a major correction in the production yield.

This talk presents how the size of (hyper-)nuclei can be incorporated in a calculation of production yields. In particular, the effect of this correction due to the (hyper-)nucleus-size as a function of the fireball size is discussed. Results of the size-corrected production yield are compared to experimental data from the ALICE experiment for various collision systems. Production yield ratios of ${}^{3}_{\Lambda}\mathrm{H}/\Lambda$, ${}^{3}_{\Lambda}\mathrm{H}/{}^{3}\mathrm{He}$ as well as d/p as a function of $\mathrm{d}N_{\mathrm{ch}}/\mathrm{d}\eta$ are presented.

HK 30.3 Wed 16:30 HS 3 Chemie

Kinetic Mixing in Parity Doublet Model — •Mattia Recchi[1], Lorenz Von Smekal[1], and Jochen Wambach[2] — [1]Institut für Theoretische Physik, Justus-Liebig-Universität Giessen, Heinrich-Buff-Ring 16, 35392 Giessen, Germany — [2]Technische Universität Darmstadt, 64289 Darmstadt, Germany

The parity doublet model (PDM) is an effective hadronic theory with chiral symmetry suitable to describe nuclear matter and its phase transitions. Recently the thermodynamics of PDM has been widely investigated. Here we study the thermodynamics in a renormalization-group invariant mean-field calculation. Moreover, we explore an extension including derivative mixing terms to improve the axial charges for electroweak phenomenology in the PDM. We compare the resulting thermodynamics with that of standard PDM to show that this improvement can be implemented without breaking the phenomenologically successful description of nuclear and neutron matter in this effective hadronic theory for chiral symmetry breaking in presence of a chirally invariant baryon mass.

HK 30.4 Wed 16:45 HS 3 Chemie

Impact of Diquarks on the QCD Phase Structure and Spectral Functions — •Ugo Mire[1] and Bernd-Jochen Schaefer[1,2] — [1]Institut für Theoretische Physik, Justus-Liebig-Universität Gießen, 35392 Gießen, Germany — [2]Helmholtz Forschungsakademie Hessen für FAIR (HFHF), GSI Helmholtzzentrum für Schwerionenforschung, Campus Gießen, 35392 Gießen, Germany

At sufficiently high densities quark matter is expected to become color superconducting through the formation of diquarks. We investigate the role of diquarks in the two-flavor QCD phase structure within a functional renormalization group framework. For sufficiently strong diquark couplings, we find that the onset of diquark condensation precedes the chiral phase transition. By examining the diquark spectral functions, we find that this effect is caused by the behavior of the diquark pole mass. Additionally, we discuss the behavior of the sigma, pion, and diquark spectral functions in the presence of a finite diquark condensate.

HK 30.5 Wed 17:00 HS 3 Chemie

Renormalized quark-meson-diquark model — •Hosein Gholami[1], Lennart Kurth[1], Ugo Mire[2], Michael Buballa[1], and Bernd-Jochen Schaefer[2] — [1]TU Darmstadt — [2]Justus Liebig University Giessen

The Quark-Meson-Diquark (QMD) model is a framework for investigating color superconductivity (CSC) in dense quark matter. Unlike the Nambu-Jona-Lasinio (NJL) model, the QMD models inherent renormalizability offers a more robust theoretical foundation. We previously employed RG-consistent treatments in the three-flavor NJL model, demonstrating how such methods eliminate cutoff artifacts. In this work, we use the QMD model to compare RG consistency and renormalization on firmer ground. This talk will focus on the renormalized QMD model, its interplay with RG-consistent approaches, and highlight their key differences. Finally, we introduce the three-flavor renormalized QMD model as an improved alternative to the NJL model for studying CSC and the physics of dense quark matter.

HK 31: Instrumentation VII

Time: Wednesday 15:45–17:00 Location: SR Exp1A Chemie

HK 31.1 Wed 15:45 SR Exp1A Chemie

The Stabilized Voltage Divider – A Rate-Capable HV-Scheme for GEMs — •Jakob Krauss[1], Philip Hauer[1], Karl Flöthner[1,2], Christian Honisch[1], and Bernhard Ketzer[1] — [1]Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn, Germany — [2]CERN, Geneva, Switzerland

GEM detectors are widely used as tracking detectors in modern particle physics experiments. Typically, stacks of multiple GEM foils are used to provide the required gain. For discharge-safe operation, the potentials of the electrodes are often generated through a resistor chain from a single input channel, and a large-valued resistor is used to limit the current in case of a shorted segment. When such a detector is subjected to high particle rates, of up to several $\mathrm{MHz/cm^2}$, the large number of charges moving inside the detector lead to non-negligible potential drops over the bias resistor. The performance of the detector is degraded, as the detector gain and efficiency are highly sensitive to the potentials, calling for improvements of the high-voltage scheme.

The newly developed Stabilized Voltage Divider (SVD) uses MOSFETs to provide the nominal potentials and limit the current in case of a short circuit in the GEMs, while having a low output impedance during normal operation. Strong emphasis was put on the adequate response of the SVD to discharges, minimizing the risk of damage to the detector's GEMs and readout. Measurements demonstrating the resilience to discharges and the superior rate capability of the SVD will be presented.

Supported by BMBF.

HK 31.2 Wed 16:00 SR Exp1A Chemie

Simulation of the MAGIX 4-stage GEM Time Projection Chamber — •Sara Fechner for the MAGIX-Collaboration — Institute for Nuclear Physics, Johannes Gutenberg University Mainz, Germany

Located at the MESA electron accelerator MAGIX will perform high-precision scattering experiments in the low energy regime. The physics program includes the study of hadrons and few-body systems, as well as reactions relevant to nuclear astrophysics and dark sector searches. The experimental setup is designed to minimize background and multiple scattering. Key parts are the windowless gas jet target and two high-resolution spectrometers with a 4-stage GEM Time Projection Chamber (TPC) for precise tracking around the focal plane.

A dedicated simulation framework accompanies the experiment and aims to model the entire process - from particle generation over scattering to the detector response. For the TPC, this includes the ionization of the Argon gas mixture by the initial electron, the drift of the electrons inside the electric field, their multiplication in the GEM stack, and the subsequent electronic readout.

This contribution will introduce the MAGIX TPC and the physics used to model its detector response.

HK 31.3 Wed 16:15 SR Exp1A Chemie

A Low-Material Time Projection Chamber for MAGIX — •Lucie Bister for the MAGIX-Collaboration — Institute for nuclear physics, Johannes Gutenberg University Mainz, Germany

The MAGIX experiment at the MESA accelerator in Mainz is designed for high-precision electron scattering experiments at low energies, covering nuclear structure investigations, astrophysics, and dark sector searches.

The setup consists of a windowless gas jet target, followed by two high-resolution magnetic spectrometers that focus the scattered electrons onto their focal plane. Due to the significant impact of background effects like multiple scattering at low energies, a low-material time projection chamber (TPC) has been developed to achieve a momentum resolution of $\Delta p/p < 10^{-4}$. In order to have no material in the particle path, an innovative open field-cage design has been developed, ensuring that the only material in the particles' trajectory is a 75 μm thin Kapton foil. This design minimises the material budget and preserves track quality.

This talk will briefly introduce the MAGIX experiment with an emphasis on the low-material TPC, its design considerations, and the field-cage geometry that allows for accurate tracking with minimal material interference.

HK 31.4 Wed 16:30 SR Exp1A Chemie

Test Measurements and Simulation of the PUMA Time Projection Chamber — •Rico Holz[1], Clara Klink[1,2], and Alexandre Obertelli[1] — [1]TU Darmstadt, Darmstadt, Germany — [2]CERN, Genève, Switzerland

The antiProton Unstable Matter Annihilation (PUMA) experiment at CERN studies the distribution of protons and neutrons in the nuclear density tail using low-energy antiprotons. By studying stable and short-lived nuclei, PUMA investigates surface phenomena such as nuclear halos and neutron skins. The experiment leverages the sensitivity of antiprotons to both neutrons and protons, with the neutron-to-proton annihilation ratio serving as the key observable. The antiproton-nucleon annihilation process conserves the electrical charge. PUMA uses this feature to disentangle the annihilation on neutrons and protons by measuring the charges of pions emitted from the annihilation with a time projection chamber (TPC) surrounding the reaction area [1].

The TPC and its operation will be described. The timing of the data acquisition is controlled by a plastic-scintillator trigger barrel positioned on the TPC's outer side. This contribution will present recent developments in the PUMA TPC and its associated simulation code, along with preliminary test measurements.

[1] T. Aumann et al., Eur. Phys. J. A (2022) 58:88

HK 31.5 Wed 16:45 SR Exp1A Chemie

Characterization of a prototype GEM detector with VMM3a readout at AMBER — •Pascal Henkel[1], Michael Lupberger[1], Martin Hoffmann[1], Karl Jonathan Flöthner[1,3], Virginia Klapper[1], Jan Glowacz[2], and Bernhard Ketzer[1] — [1]Helmholtz-Institut für Strahlen- und Kernphysik der Universität Bonn, Germany — [2]Physikalisches Institut der Universität Bonn, Germany — [3]CERN, Geneva, Switzerland

AMBER is a fixed-target experiment at the M2 beamline of CERN's SPS that uses muon and hadron beams for research on fundamental questions of hadron physics. Updating the spectrometer with a free-streaming readout is necessary for the upcoming precision measurement of the proton charge radius in muon-proton elastic scattering. New next-generation large-size triple-GEM detectors will be used for the reconstruction of muon trajectories in the spectrometer. Front-end electronics based on the VMM3a ASIC will allow a self-triggering data acquisition.

A prototype of such a detector was operated during a test run in September 2023. The aim was to define the working point of the detector in terms of thresholds as well as gas and electronics gains that fulfills the requirements both from physics and system readout bandwidth. In this talk, results will be presented which show that tracking efficiencies above 97 percent can be reached in a triple-GEM with VMM3a readout while matching the requirements of time and position resolution.

Supported by BMBF (05P2024 - AMBER).

HK 32: Nuclear Astrophysics IV

Time: Wednesday 15:45–17:15 Location: SR 0.03 Erw. Physik

Group Report HK 32.1 Wed 15:45 SR 0.03 Erw. Physik

Equation of state and Fermi liquid properties of dense matter based on chiral EFT interactions — •Faruk Alp[1,2,3], Yannick Dietz[1,2], Kai Hebeler[1,2,3], and Achim Schwenk[1,2,3] — [1]Department of Physics, Technische Universität Darmstadt — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schw- erionenforschung GmbH — [3]Max-Planck-Institut für Kernphysik, Heidelberg

We give an update on calculations of symmetric nuclear matter and pure neutron matter obtained in many-body-perturbation theory up to third order based on various, recently developed nucleon-nucleon and three-nucleon interactions derived from chiral effective field theory. We extract empirical equation of state parameters and present estimates of the theoretical uncertainties due to neglected higher-order contributions in the many-body expansion as well as the chiral expansion of the interactions. Furthermore, we discuss a Fermi liquid calculations for pure neutron matter and present results for the Landau parameters, quasiparticle effective mass, and the speed of sound.

* Funded by the ERC Grant Agreement No. 101020842 and by the DFG – Project-ID 279384907 – SFB 1245.

HK 32.2 Wed 16:15 SR 0.03 Erw. Physik

Equation of state effects in core-collapse supernova simulations — •Finia P. Jost[1], Andre da Silva Schneider[2], Gerard Navo[3], Yeunhwan Lim[4], Sabrina Huth[1], Almudena Arcones[1,5,6], and Achim Schwenk[1,6] — [1]Institut für Kernphysik, Technische Universität Darmstadt, Darmstadt, Germany — [2]Departamento de Física, Universidade Federal de Santa Catarina, Florianópolis, Brazil — [3]Departament d'Astronomia i Astrofisica, Universitat de Valencia, Valencia, Spain — [4]Department of Physics, Yonsei University, Seoul, South Korea — [5]GSI Helmholtzzentrum fuer Schwerionenforschung GmbH, Darmstadt, Germany — [6]Max-Planck-Institut fuer Kernphysik, Heidelberg, Germany

The equation of state (EOS) of dense matter remains uncertain, especially at higher densities. The dynamics of core-collapse supernovae and the properties of newly formed proto-neutron stars directly depend on the state of matter at these high densities. We provide new EOS tables based on the EOS models of Huth et al. 2021 covering the necessary range in density, temperature, and electron fraction to be used in astrophysical simulations. The EOS are consistent with all currently available constraints from theoretical and experimental nuclear physics as well as observations of neutron stars. We systematically vary cold nuclear matter properties within their uncertainties and explore their impact in simulations of core-collapse supernovae. Additionally, we explore the impact of the new prescription of the density-dependent effective mass of nucleons, which governs the thermal nucleonic contribution to the EOS.

HK 32.3 Wed 16:30 SR 0.03 Erw. Physik

Perturbative quantum chromodynamics constraints on the dense matter equation of state in a Bayesian inference framework — •Anna Hensel[1], Melissa Mendes[1,2,3], Isak Svensson[1,2,3], Kai Hebeler[1,2,3], and Achim Schwenk[1,2,3] — [1]Technische Universität Darmstadt, Department of Physics — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — [3]Max-Planck-Institut für Kernphysik, Heidelberg

We investigate how perturbative quantum chromodynamics (pQCD) calculations at high densities constrain equation of state (EOS) posteriors from a Bayesian inference framework at neutron-star densities. To construct the EOS we use calculations from chiral effective field theory and implement a polytropic (PP) and a speed of sound (CS) high-density extension. The EOS is further constrained by neutron star observations, including gravitational-wave and NICER measurements. We find that pQCD calculations have a small effect on the posteriors in the CS case, and no noticable effect in the PP case.

*Funded by ERC Grant Agreement No. 101020842

HK 32.4 Wed 16:45 SR 0.03 Erw. Physik

Determining proto-neutron stars' minimal mass with chirally constrained nuclear equations of state — •Selina Kunkel, Stephan Wystub, and Jürgen Schaffner-Bielich — Institut für Theoretische Physik, Goethe Universität, Frankfurt am Main, Germany

The minimal masses and radii of proto-neutron stars during different stages of their evolution are investigated. We focus on two stages, directly after the supernova shock wave moves outwards, when neutrinos are still captured in the core and the lepton per baryon ratio is fixed to $Y_L = 0.4$, and a few seconds afterwards, when all neutrinos have left the star. We find for the neutrino-trapped case higher minimal masses than for the case when neutrinos have left the proto-neutron star. Thermal effects, here in the form of a given constant entropy per baryon s, have a smaller effect on increasing the minimal mass. The minimal proto-neutron star mass for the first evolutionary stage with $Y_L = 0.4$ and $s = 1$ amounts to $M_{min} \sim 0.62 M_\odot$ and for the stage without neutrinos and $s = 2$ to $M_{min} \sim 0.22 M_\odot$ rather independent on the nuclear equation of state used. We demonstrate that there is a universal relation for the increase of the proto-neutron star minimal mass with the lepton fraction for all nuclear equations of state used. We discuss a possible extension of our investigation for studying the appearance of color superconducting phases during proton-neutron star evolution.

HK 32.5 Wed 17:00 SR 0.03 Erw. Physik

Uncertainty quantification for the nuclear equation of state — •Hannah Göttling[1,2], Kai Hebeler[1,2,3], and Achim Schwenk[1,2,3] — [1]Technische Universität Darmstadt, Department of Physics — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — [3]Max-Planck-Institut für Kernphysik, Heidelberg

The nuclear equation of state (EOS) characterizes the properties of matter as a function of density, temperature, and proton fraction, and thus connects microscopic strong interaction calculations with descriptions of compact objects in astrophysics. Focusing on the low-energy regime, chiral effective field theory (EFT) provides a systematically improvable description of nuclear systems. With Gaussian processes (GPs) we introduce a tool to realize non-parametric evaluations of the EOS, considering correlations along independent variables. This further enables us to calculate derivatives to provide thermodynamic quantities. Besides constructing an emulator we use GPs for a statistical description of chiral expansion coefficients and apply Bayesian statistics to assess the EFT truncation errors. With that we are able to provide the nuclear EOS for nuclear matter in β-equilibrium with propagated chiral uncertainties.

Funded by the research cluster ELEMENTS (Project ID 500/10.006) and by the DFG – Project-ID 279384907 – SFB 1245.

HK 33: Structure and Dynamics of Nuclei IX

Time: Wednesday 17:30–19:00 Location: HS 2 Physik

Group Report HK 33.1 Wed 17:30 HS 2 Physik
Advancements in R3B towards the FAIR Early Science Campaign — •Tobias Jenegger, Roman Gernhäuser, and Mrunmoy Jena for the R3B-Collaboration — Technische Universität München
The R3B (Reactions with Relativistic Radioactive ion Beams) experiment, a cornerstone of the NUSTAR collaboration at the FAIR research facility in Darmstadt, Germany, is designed to address a broad spectrum of fundamental questions in modern nuclear physics. The R3B setup, in conjunction to the fragment separator FRS, allows to make high precision studies on radioactive beams in inverse kinematics. With its large acceptance on the reaction products and the ability to do complete kinematic reconstruction measurements it offers the unique possibility for understanding the dynamics of nuclear reactions under extreme conditions as they occur in nucleosynthesis processes in astrophysical environments of significant interest such as supernovae and neutron stars. This presentation provides an overview of the experimental setup and its key detectors, as well as a summary of recent experimental campaigns conducted during the FAIR Phase-0 program. Furthermore, it highlights recent advancements and outlines the focus of the experimental studies within the FAIR Early Science Program. These studies will benefit significantly from the cutting-edge capabilities of the FAIR facility, particularly the state-of-the-art Super-FRS.
Supported by BMBF 05P24WO2 and Excellence Cluster Origins.

HK 33.2 Wed 18:00 HS 2 Physik
Pathway to nuclear structure in heavy neutron rich nuclei in the vicinity of N=126 and nuclei northwest of ^{132}Sn via multinucleon transfer reactions — •Rainer Abels and Peter Reiter for the AGATA22.04-Collaboration — IKP, Universität zu Köln, Germany
Multinucleon transfer reactions (MNT) are a competitive tool to populate exotic neutron-rich nuclei. Excited reaction products have been measured in ^{136}Xe + ^{208}Pb at 1 GeV with the high-resolution γ-ray tracking array AGATA coupled to the mass spectrometer PRISMA at LNL (INFN, Italy) positioned at the grazing angle. Energy E, nuclear charge Z, velocity β, charge state q and mass number A of the beam-like isotopes are measured in the range of Z=53-56 to select the nuclei of interest. Kinematic coincidences are exploited in order to achieve best possible identification of the hard-to-reach target-like neutron-rich lead-like isotopes. Based on relative cross-section distributions for various reaction channels, perspectives and limitations for the production of the neutron-rich isotopes with this experimental method will be presented. Preliminary results concerning excited states of the beam-like nuclei in the Xe-Ba region will be discussed.
Supported by the German BMBF (05P21PKFN9), ENSAR2-TNA.

HK 33.3 Wed 18:15 HS 2 Physik
LISA: LIfetime measurements with Solid Active targets — •Kathrin Wimmer for the LISA-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH
The coexistence of single-particle and collective degrees of freedom in atomic nuclei give rise to various exotic phenomena. In nuclei with very asymmetric proton-to-neutron ratios, the strong nuclear interaction drives shell evolution which alters the orbital spacing, and in some cases even the ordering present in stable nuclei. In the absence of large gaps between orbitals, nuclei can take on non-spherical shapes and their excitations proceed through coherent and collective motion of many nucleons. Where and how collectivity emerges from the single-particle dynamics of protons and neutrons is an open question in nuclear structure physics that will be addressed with LISA in a unique way. The aim of the LISA (LIfetime measurements with Solid Active targets) project is to develop a novel method for lifetime measurements in atomic nuclei. Lifetimes probe the collectivity of a nucleus through its electromagnetic transition properties. The experimental approach is based on active solid targets and will dramatically enhance the scope of measurements of excited-state lifetimes and thus transition probabilities achievable in exotic nuclei. Coupled to state-of-the-art gamma-ray tracking detectors such as AGATA, this novel instrument will overcome the present challenges of lifetime measurements with low-intensity beams of unstable nuclei. In this talk, I will present an overview of the LISA project and show the potential for future physics experiments at GSI, FAIR, and FRIB.

HK 33.4 Wed 18:30 HS 2 Physik
Precision Fragmentation Studies at the GSI FRS — •Justus Eder for the Super-FRS Experiment-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung — Justus-Liebig Universität Giessen
The study of nuclear properties and the development of nuclear models require detailed investigations of exotic nuclei at the limits of stability. Moreover, testing fragmentation models demands thorough investigations involving the production, separation and identification of these nuclei. In-flight separators are key instruments for achieving these objectives, enabling the spatial separation and precise identification of reaction products in terms of mass, charge, and momentum. These capabilities provide access to broad regions of the nuclear landscape, facilitating advancements in our understanding of nuclear phenomena. In this presentation, the preliminary analysis of ^{170}Er fragmentation products will be discussed, focusing on yield and cross-section estimates to enable accurate statistical predictions for future experiments. The results originate from measurements conducted at the GSI Fragment Separator (FRS), using a newly developed ^{170}Er beam with 1080 MeV/nucleon impinging on a beryllium target. The study provides insights into the exotic nuclear landscape near the atomic number $Z = 68$, providing valuable data for exploring highly deformed regions of the nuclear chart.

HK 33.5 Wed 18:45 HS 2 Physik
Study of short-range correlations in asymmetric nuclei at R^{3}B — •Manuel Xarepe[1,2,3], Andrea Lagni[4], Hang Qi[5], and Enis Lorentz[2] — [1]Faculty of Science of the University of Lisbon — [2]Technischen Universität Darmstadt — [3]Helmholtz Forschungsakademie Hessen für FAIR — [4]University of Santiago de Compostela — [5]Massachusetts Institute of Technology
Nucleon-nucleon short-range correlations (SRCs), primarily composed of neutron-proton pairs, are a universal feature in atomic nuclei. Previous studies using electron scattering have shown that protons are more likely to form SRCs in asymmetric nuclei as the neutron excess increases. However, such studies are constrained to stable nuclei with limited neutron excess and do not allow for a clear separation of the mass effect from the neutron excess.
To address this limitation, we conducted an inverse kinematics experiment with the R^{3}B setup at GSI-FAIR within the FAIR Phase-0 program. High-energy beams (E = 1.25 GeV/u) of the neutron-rich isotope ^{16}C and the symmetric ^{12}C were used with a liquid hydrogen target. In $(p,2p)$ reactions, single nucleons were knocked out at large momentum transfer, even when bound in an SRC pair.
We will present the experimental methodology, identification of SRC pairs, and preliminary findings on their behaviour in neutron-rich nuclei. These results set the stage for future experiments at FAIR, enhancing our understanding of SRCs and their role in asymmetric nuclear matter. Supported by the Portuguese FCT, Project Refs: 2021.05736.BD and the BMBF project 05P21RDFN2.

HK 34: Hadron Structure and Spectroscopy IV

Time: Wednesday 17:30–18:45 Location: HS 3 Physik

HK 34.1 Wed 17:30 HS 3 Physik
Partial-Wave Analysis of the $\omega\pi\pi$ Final State at COMPASS* — •Philipp Haas for the COMPASS-Collaboration — Technische Universität München
The study of mesons beyond $q\bar{q}$ configurations is of core interest in meson spectroscopy to extend our understanding of QCD. In the non-strange light-meson sector the $\pi_1(1600)$ is the only established of those, so-called exotic, mesons. The COMPASS experiment studied the $\pi_1(1600)$ in great detail in the $\rho(770)\pi$, $\eta\pi$, and $\eta'\pi$ final states and greatly contributed to the foundation of the $\pi_1(1600)$. Recent lattice QCD calculations predict the $b_1(1235)\pi$ decay mode as dominant decay channel with a partial decay width more than 10 times larger than all other decay channels. Further, the decay $\pi_1(1600) \to \rho(770)\omega$ is predicted to be negligible. Both the $b_1(1235)\pi$ and $\rho(770)\omega$ decay prominently to the $\omega\pi\pi$ final state. Thus, the analysis of $\omega\pi\pi$ allows the study of the $\pi_1(1600)$ in its supposedly dominant decay and verification of lattice QCD predictions.
In this talk we present results of the partial-wave analysis of the $\omega\pi^-\pi^0$ final state in COMPASS data. Using the so-far largest $\omega\pi\pi$ dataset allows an analysis of this challenging final state of unmatched precision. We study the decays of $\pi_1(1600)$ to $b_1(1235)\pi$ and $\rho(770)\omega$. Further, we extract resonance parameters and measure decay modes of multiple states, including poorly known ones.
* funded by the DFG under Germany's Excellence Strategy - EXC2094 - 390783311.

HK 34.2 Wed 17:45 HS 3 Physik

Understanding COMPASS data on $\pi^- + p \to \eta^{(\prime)} + \pi^- + p$ in the double-Regge region — •Henri Pekeler, David Spülbeck, and Bernhard Ketzer for the COMPASS-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn, Germany

The COMPASS experiment at CERN's SPS provides a very large data set to study the light-meson spectrum in several final states including $\eta^{(\prime)}\pi^-$, which is known to be the golden channel to investigate the lightest hybrid-meson candidate, the $\pi_1(1600)$. One challenge in the extraction of resonance parameters, like pole positions, is the separation of resonant and non-resonant processes.

To better constrain the non-resonant production mechanism of this final state, we analyse its high-mass region, i.e. $2.4\,\mathrm{GeV} < m_{\eta^{(\prime)}\pi^-} < 6\,\mathrm{GeV}$ using the double-Regge exchange model published by the JPAC collaboration. It was based on fits of published COMPASS data in the mass region below 3 GeV. By performing an event-based likelihood fit to the full COMPASS data set, we expand and test the model up to very high invariant masses. We find that by including the daughter trajectory of the a_2, the a_2', the data can be fitted with only 8 free parameters. The relative strengths of the contributing amplitudes as well as the trajectory parameters for the a_2', determined by the fit, will be shown.

Supported by BMBF.

HK 34.3 Wed 18:00 HS 3 Physik

Partial Wave Analysis of the process $\gamma^*\gamma \to f_1(1285) \to \eta\pi^+\pi^-$ at BESIII — •Jan Muskalla, Achim Denig, Chistoph Redmer, and Max Lellmann — Johannes Gutenberg-Universität Mainz

The anomalous magnetic moment of the muon a_μ is one of the most precisely measured observables of the Standard Model (SM). However, large discrepancies persist between SM predictions and experiment. The uncertainties of the SM prediction are currently dominated by hadronic contributions. Improving the precision requires more accurate measurements of transition form factors (TFFs) for axial-vector mesons contributing to hadronic light-by-light scattering (HLbL). These TFFs serve as experimental input to theoretical calculations and can be accessed from the cross section of meson production in $\gamma\gamma$ collisions at e^+e^- machines.

The BESIII experiment at the Beijing Electron Positron Collider (BEPCII) is collecting data in the τ-charm energy region and offers large datasets ideally suited for studying $\gamma\gamma$ interactions. With a data set of $20\,\mathrm{fb}^{-1}$ at $\sqrt{s} = 3.77\,\mathrm{GeV}$, the process $\gamma^*\gamma \to f_1(1285)$ is investigated in a single tag configuration, where only one of the scattered electrons is detected. This allows the measurement of the momentum dependence of the TFF. To study the interference effects in the decay $f_1(1285) \to \eta\pi^+\pi^-$, a partial wave analysis (PWA) is performed. This talk will discuss the data analysis, amplitudes for the PWA and techniques to extract the TFFs for the different helicity configurations of the $f_1(1285)$.

HK 34.4 Wed 18:15 HS 3 Physik

Investigation of the exclusive pp → ppKK reaction using data collected by HADES — •Valentin Kladov[1,2], Johan Messchendorp[2], and James Ritman[1,2,3] for the HADES-Collaboration — [1]Ruhr-Universität Bochum — [2]GSI Helmholtzzentrum — [3]Forschungszentrum Jülich

This study presents the exclusive analysis of the $pp \to ppK^+K^-$ reaction with data taken with the HADES detector in February 2022 at a center-of-mass energy of 3.5 GeV. A neural network-based particle identification was developed, which compensates for simulation-experiment discrepancies via domain adversarial technique. The background was suppressed by the means of kinematic refit with a 4C constraint, corresponding to the conservation of 4-momentum, which allowed us to obtain a high-purity sample of data with $S/B \approx 15$. Clear signals from $\phi(1020) \to K^+K^-$ and $\Lambda(1520) \to pK^-$ decays were observed with their parameters consistent with those published by the PDG. Moreover the importance of K^+K^- non-resonant final state interactions was confirmed. This talk will discuss the details of our event selection, efficiency corrections and present a number of intermediate results, including total cross section and ϕ/K ratio measurements.

HK 34.5 Wed 18:30 HS 3 Physik

Investigating Proton-Proton Elastic Scattering with the Upgraded HADES Spectrometer — •Gabriela Perez Andrade[1], James Ritman[1,2,3], and Peter Wintz[3] for the HADES-Collaboration — [1]Ruhr Universität Bochum — [2]GSI Helmholtzzentrum für Schwerionenforschung — [3]Forschungszentrum Jülich

An experiment focused on hyperon production was carried out in 2022 with the upgraded HADES spectrometer. The upgrade includes a Forward Detector system (FD) consisting of two PANDA-type Straw Tracking Stations, and an RPC. The measurements were performed with a T = 4.5 GeV proton beam impinging onto a LH_2 target.

Proton-proton elastic scattering events were selected based on kinematic observables, requiring that one proton was detected in the FD ($\theta_{FD} < 6^\circ$) and the other proton within the main HADES acceptance ($70^\circ < \theta_H < 79^\circ$). These events, after corrections for acceptance and reconstruction efficiency, were used for the determination the time-integrated luminosity recorded during the experiment.

The measured differential cross-section $d\sigma$ as a function of the square of the 4-momentum transfer t is well described by the function $d\sigma/dt = d\sigma/dt\big|t = 0 \cdot e^{-B|t|}$, enabling extraction of the optical point $A = d\sigma/dt\big|t = 0$ and the nuclear slope parameter B. In this talk, the selection method for elastic scattering events will be explained in detail. Preliminary results for the integrated luminosity, as well as the parameters A and B, will be presented and compared to data from other experiments.

HK 35: Heavy-Ion Collisions and QCD Phases VI

Time: Wednesday 17:30–19:00 Location: HS 3 Chemie

HK 35.1 Wed 17:30 HS 3 Chemie

Study of (anti)deuteron production in proton-proton collisions with ALICE at the LHC — •Rutuparna Rath for the ALICE Germany-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung, GmbH, Darmstadt, Germany

The measurement of (anti)nuclei production in small collision systems, such as proton-proton (pp) collisions, provides valuable insights into the nucleosynthesis mechanisms in our Universe. Antinuclei can form through two primary processes: the interaction of cosmic rays with the interstellar medium or the decay/annihilation of dark matter candidates. The coalescence model is commonly employed to describe the production of nuclei, where light nuclei are formed from the overlap of nucleon phase-space distributions with the Wigner density of the bound state. Light (anti)nuclei have been extensively studied in small collision systems using ALICE at the LHC. In this contribution, we present results on (anti)deuteron production in pp collisions at various center-of-mass energies. The coalescence parameter, B_2, which quantifies the probability of coalescence, is analyzed within the framework of modern coalescence models.

Furthermore, utilizing the extensive dataset collected by ALICE during Run 3, new results on (anti)deuteron production in pp collisions are reported. These measurements enable, for the first time, the determination of the coalescence parameter and source radii for the lowest energy (900 GeV) achieved yet from the LHC run in small collision systems, providing deeper constraints on their dependence on the initial state.

HK 35.2 Wed 17:45 HS 3 Chemie

Decoding light (anti)nuclei formation with femtoscopy in ALICE — Laura Fabbietti, Bhawani Singh, Dimitar Mihaylov, Maximilian Mahlein, and •Marcel Lesch for the ALICE Germany-Collaboration — TU München, Garching, Germany

The formation of light (anti)nuclei in ultra-relativistic nuclear collisions remains one of the longest-standing puzzles in hadronic physics. In recent years, two primary theoretical frameworks have been proposed to address this question. Statistical hadronization models posit that light (anti)nuclei emerge directly from a thermalized medium alongside all other hadrons. In contrast, coalescence models describe light (anti)nuclei formation due to nucleons fusing together after freeze-out. However, both models can successfully describe key observables, such as deuteron yields. To further investigate this puzzle, we present recent results from ALICE on p–$\pi^\pm$ and d–$\pi^\pm$ femtoscopy in pp collisions at $\sqrt{s} = 13$ TeV. Understanding the pion-multinucleon (d–$\pi^\pm$) system begins with a detailed study of p–$\pi^\pm$ correlations, which serve as a baseline for the pion-nucleon dynamics. These correlations exhibit pronounced resonance structures, providing insights into the life of Δ resonances produced in ultra-relativistic nuclear collisions. Similar structures are observed in d–$\pi^\pm$, revealing residual correlations from pions and nucleons that stem from a common Δ decay before the deuteron formation. These findings suggest that pion-assisted fusion processes play a significant role in light (anti)nuclei production, offering new perspectives on this long-standing puzzle.

Funded by the DFG under Grant SFB 1258.

HK 35.3 Wed 18:00 HS 3 Chemie

A Realistic Coalescence Model for Nuclei Production — •Maximilian Mahlein — Technische Universität München

Understanding the formation of (anti)nuclei in high-energy collisions has attracted large interest over the last few years. According to the coalescence model, nucleons form independently and then bind together after freeze-out if they are close in phase-space. A recent advancement of the model is the Wigner function formalism, which allows the calculation of the coalescence probability based on the distance and relative momentum of the constituent nucleons. The interest in explaining nuclear formation processes extends beyond standard model physics, with implications for indirect Dark Matter searches. Understanding the production mechanism of antinuclei is crucial for correctly interpreting any future measurement of antinuclear flux in space, as it would allow for the differentiation of the background originating from collisions between high-energy Cosmic Rays and the stationary Interstellar Medium. In this presentation, we provide a comprehensive overview of the state-of-the-art coalescence formalism, not only for deuterons but also for the more intricate case of A=3 nuclei. This represents a significant advancement, as previous efforts primarily focused on modeling the formation of deuterons. The model is tested for pp collision data measured by ALICE. Our approach introduces a novel aspect by implementing this model into a purpose-built Monte Carlo generator called ToMCCA offering exceptional adaptability while maintaining superior performance compared to general-purpose event generators. This work was funded by the BMBF 05P24W04 ALICE.

HK 35.4 Wed 18:15 HS 3 Chemie

He-3 inelastic cross section & nuclei production in Run3 — •Rafael Manhart for the ALICE Germany-Collaboration — Technische Universität München

This study focuses on two areas of nuclear and particle physics explored with ALICE at the LHC. First, the inelastic hadronic cross section of Helium-3, previously measured within a limited momentum range in fixed-target experiments, is investigated. Expanding this range up to 10 GeV/c, using data from ALICE, provides critical insights into light nuclei interactions and benchmarks theoretical models. Complementary measurements of deuterons serve as validation for the applied methodology, leveraging the advanced capabilities introduced in the LHC Run 3 campaign. Second, the production of light (anti)nuclei in high-energy hadronic collisions is examined. These measurements are instrumental in understanding the astrophysical sources of antinuclei and evaluating theoretical production mechanisms, which remain a topic of scientific debate. By comparing new data from Pb*Pb collisions at $\sqrt{s_{NN}}$ = 5.36 TeV from Run 3 with results from Run 2, this contribution provides a comprehensive analysis of (anti)nuclei production up to A=3. These advancements offer enhanced precision and scope, significantly contributing to the interpretation of antinuclei observations in astrophysical and experimental contexts.

This work was funded by the BMBF 05P24W04 ALICE.

HK 35.5 Wed 18:30 HS 3 Chemie

Measurement of ^{3}H and ^{3}He production in pp collisions with ALICE at the LHC — •Matthias Herzer for the ALICE Germany-Collaboration — Institut für Kernphysik, Goethe Universität, Frankfurt, Germany

The production of (anti)nuclei in pp collisions at the LHC has become a major topic in the high-energy heavy-ion physics community. In fact, there is a huge overlap between different research directions, from astrophysics, particle and nuclear physics. For instance, the observation of antinuclei in space is considered as possible signature for dark matter, since they would originate from collisions of potential dark matter candidates among each other. We will present the study of the production of ^{3}H and ^{3}He in pp collisions at 13.6 TeV in data sets that were taken in LHC Run 3. Furthermore, we will show the measurement of the ratio of these nuclei. This is an important test of isospin symmetry, which is expected to hold at LHC energies, but can not be tested directly since neutrons are not accessible experimentally. Moreover, the ratio of ^{3}H and ^{3}He can be an important test of nuclei production models such as the coalescence model.

HK 35.6 Wed 18:45 HS 3 Chemie

CBM Performance for Λ Yield Analysis using Machine Learning Techniques — •Axel Puntke for the CBM-Collaboration — Universität Münster

The Compressed Baryonic Matter (CBM) experiment at FAIR will investigate the QCD phase diagram at high net-baryon densities (μ_B > 500 MeV) with heavy-ion collisions in the energy range of $\sqrt{s_{NN}}$ = 2.9 - 4.9 GeV. Precise determination of dense baryonic matter properties requires multi-differential measurements of strange hadron yields, both for the most copiously produced K_0^s and Λ as well as for rare (multi-)strange hyperons and their antiparticles.

In this talk, the analysis of the Λ baryon yield measurement is presented. It is based on simulated events from the SMASH heavy-ion event generator, which are transported through the CBM setup using GEANT4 with subsequent detector response simulation. The Λ hadrons are then reconstructed using methods based on a Kalman Filter algorithm that has been developed for the reconstruction of particles via their weak decay topology. The large combinatorial background is suppressed by applying selection criteria tuned to the topology of the decay. This selection is optimized by training a machine learning model based on boosted decision trees. A routine is implemented to extract multi-differentially Λ yields corrected for detector acceptance and efficiency. The yield extraction analysis chain is validated by comparison with the simulated data from the transport step described above.

HK 36: Instrumentation VIII

Time: Wednesday 17:30–19:00 Location: SR Exp1A Chemie

Group Report HK 36.1 Wed 17:30 SR Exp1A Chemie

Status of the CBM Micro Vertex Detector* — •Julio Andary for the CBM-MVD-Collaboration — Goethe-Universität Frankfurt

The Compressed Baryonic Matter (CBM) Experiment will be a core experiment of the future FAIR facility. Its Micro Vertex Detector (MVD) will be composed of four planes, operating in the experiment's target vacuum. The 0.3 – 0.5% X_0 thin stations will be equipped with Monolithic Active Pixel Sensors MIMOSIS. This sensor is being developed by IPHC Strasbourg and will provide a spatial and temporal precision of 5 μm and 5 μs, respectively, with a peak rate capability of 80 MHz/cm^2.

This contribution will report on the progress made during the concluding phase of R&D. The last prototype full-scale pixel sensors MIMOSIS-2.1 has been successfully validated in several beam tests. Sensors featuring the novel 50 μm epitaxial layer showed very promising results. The sensor and detector integration has been substantially detailed, accompanied by CFD simulations on cooling performance, approaching the final engineering design. Besides the TRB-based stand-alone readout, most relevant for probe testing of the sensors, the CBM-DAQ compatible readout has been prototyped and will be commissioned in the next mCBM beam test, employing the new mMVD detector module. Detector performance simulations have been conducted to further characterize the final detector setup and update the response of the sensors to ionizing particles.

*This work has been supported by BMBF (05P21RFFC2, 05H24RF5), GSI, Eurizon, HGS-HIRe, and HFHF.

HK 36.2 Wed 18:00 SR Exp1A Chemie

Silicon Semiconductor Detectors: DPTS and BabyMOSS — •Tim Stellhorn — Institut für Kernphysik, Münster

In my talk, I will shortly present two different types of Monolithic Active Pixel Sensors (MAPS): the Digital Pixel Test Structure (DPTS) and the Monolithic Stitched Sensor (MOSS). Both serve as prototypes for an upgrade of the Inner Tracking System (ITS) in the ALICE detector. In this upgrade, silicon sensors with a thickness of 50 μm and a surface of $26 \cdot 10$ cm^2 will be produced by applying the stitching technology. With this thinness, it is possible to bend the sensors into a truly cylindrical shape with a distance of 2 mm around the beam pipe. This will improve the tracking efficiency and pointing resolution of ALICE.

I will discuss different properties such as the efficiency and the fake-hit-rate of both prototypes under various settings as well as the possibilities for particle identification with the DPTS chip. Furthermore, I will present results of test-beams performed with a babyMOSS telescope at PS at CERN and at ELSA in Bonn.

HK 36.3 Wed 18:15 SR Exp1A Chemie

Readout electronics and module design of MADHAT — •Malte Grönbeck for the ALICE Germany-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik — Forschungs- und Technologiezentrum Detektorphysik

The ALICE experiment plans a completely new tracking detector based on silicon MAPS technology manufactored in the 65 nm production node as part of the ALICE 3 upgrade for Long Shutdown 4 of the LHC. The size of the whole active area is planned to be 60 m^2 large, with the Outer Tracker spanning 45 m^2.

To reach the material budget target of less than 1% X_0 per layer, open questions like cooling solutions, mechanical structures and electronics have to be answered. A simple sensor prototype MADHAT (Mechanical Assessment Design for Heat And Thermal solutions), mechanically identical to the final sensor, but with integrated heating elements and temperature probes, was developed to study the temperature distribution in the final detector assembly and to assess different mechanical designs of the circuit board that houses the sensor.

This talk will present the readout electronics of MADHAT and discuss different design options of a module prototype for the ALICE 3 Outer Tracker.

This work is supported by BMBF.

HK 36.4 Wed 18:30 SR Exp1A Chemie

Readout Electronics for the Micro Vertex Detector of the PANDA Experiment — •Marvin Peter[1], Kai-Thomas Brinkmann[1], Hans-Georg Zaunick[1], Raphael Ratz[1], Nils Tröll[1], Michele Caselle[2], Giovanni Mazza[3], and Daniela Calvo[3] for the PANDA-Collaboration — [1]II. Physikalisches Institut, Justus-Liebig-Universität Giessen — [2]Karlsruhe Institute of Technology — [3]Istituto Nazionale di Fisica Nucleare - Sezione di Torino

The Micro-Vertex-Detector (MVD) is a tracking detector at the center of the PANDA experiment, closest to the interaction point. To read out the strip sensors of the MVD, the Torino Amplifier for silicon Strip detectors (ToASt) ASIC was developed by INFN in Turin. This chip provides 64-channel self-triggered readout based on the Time-over-Threshold principle. This presentation will provide an overview of the MVD's current status, with an emphasis on the integration of the ASIC with the sensors, the progress in the overall readout system development, and results from recent beam time measurements. Additionally, we will highlight the latest advancements in the characterization of the ASIC. *Supported by BMBF.*

HK 36.5 Wed 18:45 SR Exp1A Chemie

Investigating bent MAPS sensors — •Berkin Ulukutlu for the ALICE Germany-Collaboration — Technische Universität München, Munich, Germany

The ALICE experiment at CERN is upgrading its Inner Tracking System (ITS) as part of the ITS3 project, which replaces the innermost tracking layers with wafer-scale, cylindrically bent Monolithic Active Pixel Sensors (MAPS). The implementation of bent silicon detectors at this scale is unprecedented and requires extensive R&D to address challenges associated with the geometry. This presentation will focus on studies of the effects of bending on sensor performance, carried out using bent ALPIDE sensors currently deployed in the ITS2. Laboratory and test beam measurements confirm that sensor bending does not degrade tracking performance. Studies of charge-sharing behavior and alignment strategies further support the feasibility of using bent detectors in high-energy and nuclear physics applications. Furthermore, the ongoing development of a beam telescope featuring babyMOSS sensors, prototype sensors produced for ITS3 in 65 nm technology, in a bent configuration, will also be presented.

This research was supported by the Excellence Cluster ORIGINS funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) under Germany*s Excellence Strategy EXC-2094-390783311 and the DFG through the Grant SFB 1258 *Neutrinos and Dark Matter in Astro and Particle Physics*.

HK 37: Nuclear Astrophysics V

Time: Wednesday 17:30–19:00 Location: SR 0.03 Erw. Physik

Group Report HK 37.1 Wed 17:30 SR 0.03 Erw. Physik

Towards the Early- and First-Science experiments with the Super-FRS Ion Catcher — •Daler Amanbayev[1,2,3] and The FRS Ion Catcher Collaboration[1,2,3] — [1]Justus-Liebig Universität Gießen, Gießen, Germany — [2]Helmholtz Research Academy Hesse for FAIR (HFHF), Campus Gießen, Gießen, Germany — [3]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany

The Super-FRS Ion Catcher (Super-FRS-IC) setup will enable the measurements of beta-delayed (multiple-)neutron emission probabilities (Pxn) i.e., data for r-process nucleosynthesis models that is lacking the most. Moreover, the setup will study multi-nucleon transfer (MNT) reactions driven by secondary beams as a promising method for accessing the unexplored heavy neutron-rich nuclei. These topics will be in focus in the Early- and First-Science programs at the Super-FRS at FAIR.

At the Super-FRS-IC, the exotic nuclei produced at relativistic energies and separated in-flight will be thermalized in the Cryogenic Stopping Cell (CSC), transported over a radio frequency quadrupole (RFQ) beamline and analyzed via in the Multiple-Reflection Time-Of-Flight Mass-Spectrometer (MR-TOF-MS). The combination of characteristics of the CSC and the MR-TOF-MS enable conducting experiments in new and effective ways e.g., MNT reactions in-cell and simultaneous measurments of Pxn, nuclear masses, half-lives and Q-values.

This contribution presents the status of the Super-FRS-IC setup and provides an overview of the proof-of-principle experiments conducted at GSI with the FRS Ion Catcher setup.

HK 37.2 Wed 18:00 SR 0.03 Erw. Physik

Fast neutrino flavor conversions in a supernova — •Zewei Xiong[1], Meng-Ru Wu[2,4,5], Manu George[2], Gabriel Martínez-Pinedo[1,6], Tobias Fischer[3], Noshad Khosravi Largani[3], and Chun-Yu Lin[7] — [1]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — [2]Institute of Physics, Academia Sinica, Taipei 11529, Taiwan — [3]Institute of Theoretical Physics, University of Wroclaw, plac Maksa Borna 9, 50-204 Wroclaw, Poland — [4]Institute of Astronomy and Astrophysics, Academia Sinica, Taipei 10617, Taiwan — [5]Physics Division, National Center for Theoretical Sciences, Taipei 10617, Taiwan — [6]Institut für Kernphysik (Theoriezentrum), Fachbereich Physik, Technische Universität Darmstadt, Schlossgartenstraße 2, 64289 Darmstadt, Germany — [7]National Center for High-performance Computing, Hsinchu 30076, Taiwan

Dense astrophysical environments such as core-collapse supernovae are profuse sources of neutrinos. When the neutrino flux is sufficiently intense, those neutrinos can undergo collective flavor transition, the so-called fast flavor conversions (FFCs), which have been found to generally exist in supernovae. In this work, we present a comprehensive study of the FFCs by solving the multi-energy and multi-angle quantum kinetic equations based on a static and spherically symmetric CCSN matter background profile. We investigate the emergence and evolution of FFCs. We also assess their potential impacts on the neutrino heating mechanism and nucleosynthesis.

HK 37.3 Wed 18:15 SR 0.03 Erw. Physik

Microscopic description of beta-decay rates of r process nuclei — •Diana Alvear Terrero[1,2], Gabriel Martínez-Pinedo[1,2], Caroline E. P. Robin[1,3], Ante Ravlić[4], Thomas Neff[1], Max Pallàs[5], and Ariel Tarifeño-Saldivia[6,5] — [1]GSI Helmholtzzentrum für Schwerionenforschung, Germany — [2]Technische Universität Darmstadt, Germany — [3]Universität Bielefeld, Germany — [4]Michigan State University, USA — [5]Universitat Politècnica de Catalunya (UPC), Spain — [6]Instituto de Física Corpuscular (IFIC), Spain

Beta decay rates are fundamental to understanding r-process nucleosynthesis, which is responsible for producing roughly half of the heavy elements. Existing theoretical global calculations of the rates use either Skyrme or relativistic quasiparticle random phase approximation (QRPA). These models yield very different predictions and are limited due to their treatment of nuclear many-body correlations. Many-body correlations are known to determine the low-lying beta-decay strength and consequently the decay half-lives due to their strong sensitivity to phase space. In this talk, I address the inclusion of deformation and the coupling of quasiparticles to like-particle phonons within relativistic QRPA linear response theory. The impact on the beta strength and half-lives will be discussed together with the competition of Gamow-Teller and forbidden transitions.

This work is partly supported by the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (ERC Advanced Grant KILONOVA No.~885281)

HK 37.4 Wed 18:30 SR 0.03 Erw. Physik

Beta Spectroscopy Studies of Broad Energy Germanium (BEGe) Detectors and GEANT3 with ^{90}Sr — •Davud Sokolovic — Goethe Universität, Frankfurt am Main

Beta spectroscopy is a critical tool in nuclear astrophysics, particularly in the context of the activation method, as it allows the study of radioactive isotopes that decay predominantly or exclusively via beta decay, with minimal gamma emissions. Broad Energy Germanium (BEGe) detectors, which are primarily designed for gamma spectroscopy, offer precise energy resolution and low background noise, making them ideal for studying the beta spectrum of the isotope ^{90}Sr, which exclusively undergoes beta decay. However, to fully utilise these detectors in beta spectroscopy, a systematic characterisation of their response to beta radiation is required.

The primary objective of this research is to address discrepancies observed between experimental measurements and GEANT3 simulations. Therefore, a comprehensive study of energy loss mechanisms, including inelastic scattering and bremsstrahlung, is undertaken to refine simulation models and enhance our understanding of the interaction between beta particles and the detector material. In this talk, first results from this study are presented, providing insights into the potential of BEGe detectors for beta spectroscopy and the refinement of nuclear data.

HK 37.5 Wed 18:45 SR 0.03 Erw. Physik

Helium burning reactions: Results from Felsenkeller and future plans — •Eliana Masha[1], Simon Vincent[1,2], Aleksandra Skruch[1], Daniel Bemmerer[1], Axel Boeltzig[1], Peter Hempel[1,2], Konrad Schmidt[1], Anup Yadav[1,2], Jordan Marsh[3], and Kai Zuber[2] — [1]Helmholtz-Zentrum Dresden-Rossendorf (HZDR) — [2]TU-Dresden — [3]School of Physics and Astronomy, University of Edinburgh, United Kingdom

Helium burning is a crucial phase of stellar evolution, responsible for the synthesis of key elements such as carbon, oxygen, and fluorine, which significantly influence the chemical evolution of the Universe. Precise measurements of helium-burning reaction rate at astrophysical energies are essential to constrain stellar models and to understand nucleosynthesis pathways. At the Felsenkeller 5 MV accelerator lab in Dresden, we recently measured the $^{15}N(\alpha,\gamma)^{19}F$ reaction, which is one of the primary sources of fluorine production, an element whose origin remains a long-standing problem in nuclear astrophysics. Experimental details and results from resonances in the 0.8 - 2 MeV range, along with future plans to investigate other key helium-burning reactions, will be presented.

HK 38: yHEP Annual Meeting

Time: Wednesday 19:00–20:00 Location: HS 3 Physik

HK 38.1 Wed 19:00 HS 3 Physik

Annual Meeting of Young Scientists in High Energy Physics (yHEP) — •Farah Afzal[1], Meike Küssner[2], Michael Lupberger[2], Ruth Jacobs[3], Srijan Sehgal[4], Leonel Morejon[4], Dima El Khecken[5], and Felipe Peña[3,6] — [1]Ruhr University Bochum — [2]University of Bonn — [3]DESY — [4]University of Wuppertal — [5]Karlsruhe Institute of Technology — [6]University of Hamburg

We will present our activities from the last year, would like to discuss plans for the coming year with you and hear your ideas and thoughts. Topics of discussion are current and future developments in high and low energy physics, i.e. particle, astroparticle, hadron and nuclear physics, as well as accelerator physics, including topics of the situation of early-career researchers, environmental sustainability, networking and shaping the future of our fields.

All doctoral candidates, post-docs and scientists on temporary contracts are cordially invited.

Please register to our mailing list which can be found from yhep.desy.de to receive details on the meeting.

HK 39: Invited Talks II

Time: Thursday 11:00–12:30 Location: Kurt-Alder HS Chemie

Invited Talk HK 39.1 Thu 11:00 Kurt-Alder HS Chemie

Upgrade programme for the ALICE experiment at the LHC — •Andrea Dainese — INFN Padova, Italy

The main goal of the ALICE experiment is to determine the properties of the quark-gluon plasma (QGP), the deconfined state of strongly-interacting matter, and to discern how they arise from the underlying QCD interactions. During the second long shutdown of the LHC (LS2), the experiment has undergone a major upgrade, and a smaller-scale upgrade is in preparation for LS3 (upgrade of the inner tracking layers ITS3 and addition of a forward calorimeter FoCal).

The Collaboration has proposed a new apparatus, ALICE 3, for the LHC Runs 5-6. The detector consists of a large-acceptance pixel-based tracker, complemented by systems for hadron and lepton identification. ALICE 3 will enable novel QGP studies and open up important opportunities in other areas of QCD. The main new studies in the QGP sector focus on beauty hadrons, multi-charm baryons and charm-charm correlations, as well as on precise multi-differential measurements of dielectron emission to probe the mechanism of chiral-symmetry restoration and the time-evolution of the QGP temperature. ALICE 3 can uniquely contribute to hadronic physics, with femtoscopic studies of the interaction potentials between charm mesons and searches for nuclei with charm, and to fundamental physics, with tests of the Low theorem for ultra-soft photon emission.

The presentation covers the detector concept, the physics performance, and the status of R&D, for the LS3 upgrades and, more extensively, for ALICE 3.

Invited Talk HK 39.2 Thu 11:30 Kurt-Alder HS Chemie

Antiproton production measurement for indirect Dark Matter search at the AMBER experiment at CERN — •Davide Giordano — Torino Section of INFN, 10125 Turin, Italy

One of the indirect detection method of dark matter (DM) is based on the search of the products of DM annihilation or decay. They should appear as distortions in the gamma rays spectra and in the rare Cosmic Ray (CR) components, like antiprotons, positrons and antideuterons. In particular, the antiprotons in the Galaxy are mainly of secondary origin, produced by the scattering of cosmic proton and helium nuclei off the hydrogen and helium in the interstellar medium (ISM). In order to obtain a significant sensitivity to DM signals, accurate measurements of the antiproton production cross section in p-p and p-He collisions are crucial. The AMBER experiment at CERN collected in 2023 the first data ever in p+He collisions at a center of mass energies from 10 to 21 GeV. In addition, another poorly understood antiproton production method is the contribution from antineutrons decays, which remains experimentally unexplored. Unlike antiprotons, the yield of antineutrons in collisions is typically inferred based on theoretical principles, primarily relying on isospin symmetry. In 2024, the AMBER data collection was expanded to include p+H and p+D collisions to indirectly measure with unprecedented precision the possible antiproton production asymmetry in in p+n collisions.

Invited Talk HK 39.3 Thu 12:00 Kurt-Alder HS Chemie

New Constraints on the Nuclear Equation of State — •Melissa Mendes — Technische Universität Darmstadt, Department of Physics — ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — Max-Planck-Institut für Kernphysik, Heidelberg

Investigating the behavior of the nuclear equation of state (EOS) is an exciting interdisciplinary research area. In this endeavor, the exploration of neutron stars has been fruitful to probe the EOS against their predictions for neutron star properties, such as mass, radius and tidal deformability and test the high-density EOS behavior. Over the past years, substantial progress has been achieved on EOS calculations at nuclear densities based on chiral effective field theory interactions with reliable many-body techniques. In this talk, I will present new constraints on the neutron star EOS and mass-radius range based on new chiral EFT results for matter in beta equilibrium up to next-to-next-to-next-to-leading order as well as recent NICER observations and LIGO/VIRGO gravitational wave events.

*Funded by ERC Grant Agreement No. 101020842

HK 40: Structure and Dynamics of Nuclei X

Time: Thursday 14:00–15:30 Location: HS 2 Physik

Group Report HK 40.1 Thu 14:00 HS 2 Physik

Lifetime measurement in $N = 50$ isotones to investigate seniority conservation in the $\pi g_{9/2}$ orbital — •Mario Ley[1], Jan Jolie[1], Piet Van Isacker[2], Andrey Blazhev[1], Arwin Esmaylzadeh[1], Christoph Fransen[1], Lukas Knafla[1], Aaron Pfeil[1], and Jean-Marc Régis[1] — [1]Universität zu Köln, Institut für Kernphysik — [2]Grand Accélérateur National d'Ions Lourds, Caen, France

Excited states in the $N = 50$ semi-magic nuclei ^{92}Mo, ^{93}Tc, ^{94}Ru and ^{95}Rh were populated using fusion-evaporation reactions at the Cologne FN Tandem accelerator, and their lifetimes were measured with a hybrid setup of HPGe and LaBr detectors using the fast-timing method. The lifetime of the 4_1^+ state in ^{92}Mo was measured with high precision to derive state-dependent effective charges from the $B(E2)$ values of the yrast band [1]. In ^{94}Ru the lifetime of the 4_1^+ state was measured with high statistics [2]. The results were compared with theoretical predictions from semiempirical calculations in the single-j orbital for the protons and shell-model calculations using the SR88MHJM interaction in the $\pi(1p_{1/2}, 0g_{9/2})$ model space [2]. Preliminary results of lifetime measurements in ^{95}Rh will be presented.

Work supported by DFG Grant JO391/18-2

[1] Phys. Rev. C 108, 064313 (2023)
[2] Phys. Rev. C 110, 034320 (2024)

HK 40.2 Thu 14:30 HS 2 Physik

Probing a sudden drop of collectivity at ^{170,172}W — •K. E. Ide[1], V. Werner[1], R. Abels[2], U. Ahmed[1], D. Bittner[2], T. Biesenbach[2], A. Blazhev[2], A. Esmaylzadeh[2], C. Fransen[2], J. Jolie[2], H. Kleis[2], C. -D. Lakenbrink[2], M. Ley[2], H. Mayr[1], M. Müllenmeister[2], C. M. Nickel[1], R. Novak[2], A. Pfeil[2], N. Pietralla[1], J. Roob[2], F. von Spee[2], T. Stetz[1], T. Sültenfuss[2], and R. Zidarova[1] — [1]IKP, TU Darmstadt — [2]IKP, Uni Köln

Nuclear quadrupole collectivity is identified from enhanced $E2$ decay rates. The $E2$ decay strength of a state is inversely proportional to its lifetime. A sudden increase of the $E2$ strength of the $2_1^+ \rightarrow 0_1^+$ transition from N=96 (^{170}W) to N=98 (^{172}W) in the W isotopic chain is unexpected compared to the neighboring Hf isotopic chain. This discrepancy was previously investigated by lifetime measurements of yrast states of ^{170}W [1]. Therefore, in this work we investigate yrast $B(E2)$ values in ^{172}W to learn about the structural evolution of the yrast band in comparison to ^{170}W. The experiment was performed at the Cologne 10 MV FN-tandem accelerator facility and used the new CATHEDRAL spectrometer and a plunger device. The fast-timing method and the recoil distance Doppler-shift (RDDS) method are used complementary to determine the lifetimes of yrast states. First results will be presented and discussed together with the previous results on ^{170}W and will be compared to the confined β-soft (CBS) rotor model.

[1] K. E. Ide *et al.*, LNL report 2019 (2020).
*Supported by the BMBF under Grant No. 05P21RDCI2 and by DFG (GRK 2128, AccelencE).

HK 40.3 Thu 14:45 HS 2 Physik

Lifetime measurements in ^{198}Pt and ^{200}Pt — •Arwin Esmaylzadeh[1], Franziskus von Spee[1], Mario Ley[1], Christoph Fransen[1], Andrey Blazhev[1], Senuri Dantanarayana[1], Maximilian Droste[1], Julia Fischer[1], Jan Jolie[1], Lukas Knafla[1], Casper-David Lakenbrink[1], Richard Novak[1], Aaron Pfeil[1], and Kosuke Nomura[2,3] — [1]Universität zu Köln, Institut für Kernphysik — [2]Department of Physics, Hokkaido University, Sapporo 060-0810, Japan — [3]Nuclear Reaction Data Center, Hokkaido University, Sapporo 060-0810, Japan

Eight lifetimes of low-lying states in ^{198}Pt and ^{200}Pt were determined using the fast-timing and the recoil distance Doppler shift methods at the Cologne CATHEDRAL spectrometer. Low-lying states were populated in the ^{198}Pt(^{18}O, ^{18}O)^{198}Pt* inelastic scattering and in the ^{198}Pt(^{18}O, ^{16}O)^{200}Pt two-neutron transfer reaction,respectively. The beam was provided by the Cologne FN Tandem accelerator. In addition, four new candidates for states, five new transitions in ^{198}Pt and one new potential transition in ^{200}Pt could be observed and placed in the level scheme. The newly obtained results will be discussed in the context of the tungsten-osmium-platinum region around mass A≈ 190. This region is known to exhibit different phenomena like a prolate-to-oblate phase transitions, but also characteristics of γ-soft nuclei. The results will be compared to mapped interacting boson model with input from the microscopic self-consistent mean-field calculation using a Gogny interaction [1].
[1] K. Nomura et al., Phys. Rev. C 84, 054316 (2011)

HK 40.4 Thu 15:00 HS 2 Physik

Coulomb excitation in ^{185g,m}Hg — •Hannah Kleis[1], Peter Reiter[1], Liam Gaffney[2], Janne Pakarinen[3], and Katarzyna Wrzosek-Lipska[4] for the IS699-Collaboration — [1]IKP, University of Cologne, Germany — [2]University of Liverpool, UK — [3]University of Jyväskylä, Finland — [4]HIL, University of Warsaw, Poland

Shape coexistence in the neutron-deficient lead region around N≈104 has been discovered in different nuclei especially in the mercury isotopes, where a staggering effect was found between even- and odd-mass nuclei using charge radii measurements [1,2]. In addition the study of the even-even ^{182,184,186,188}Hg isotopes showed a mixing of weakly deformed oblate and more deformed prolate configurations which coexists at low excitation energies [3]. To investigate collective behavior of low-lying states on top of the $(1/2^-)$ ground-state in ^{185g}Hg and the $(13/2^+)$ isomeric state in ^{185m}Hg, a Coulomb excitation experiment was performed at HIE-ISOLDE. The ^{185g,m}Hg beams were accelerated onto ^{120}Sn and ^{48}Ti targets with an energy of 4 MeV/u. The emitted γ rays were detected utilizing the Miniball array in coincident to the scattered particles measured in the DSSSD detector. First results yield the discovery of the signature partner band of the ground-state band which was observed up to spin values of $25/2^-$. Supported by BMBF Projects 05P21KCI1, 05P24KCI1. This project has received funding from the European Union's Horizon Research and Innovation programme under Grant Agreement No. 101057511. [1] B. Marsh et al., Nature Physics 14, 1163 (2018) [2] J. Bonn et al., Z Phys A 276(3), 203 (1976) [3] K. Wrzosek-Lipska et al., EPJ A 55:130 (2019)

HK 40.5 Thu 15:15 HS 2 Physik

Lifetime measurements in ^{208}Po using the ORANGE-spectrometer and LaBr$_3$(Ce) detectors — •Dania Al Daas, Andrey Andrey, Jean-Marc Regis, Nigel Warr, and Jan Jolie — IKP, University of Cologne, Germany

The iron-free high-efficiency electron-spectrometer ORANGE at the IKP University of Cologne was updated recently [1]. Using the 10 MV FN-tandem accelerator, 208Po was produced with the reaction ^{209}Bi(p, 2nγ) to measure the lifetimes of the 2_1^+, 4_1^+ and 6_1^+ states using e^--γ and γ-γ coincidence measurements. The resulting lifetimes were compared to known values to ascertain the state of the updated spectrometer. For the mono-energetic electrons, the magnetic field of the ORANGE was varied to select different electron energies for detection by a plastic scintillator counter. The γ-rays were measured by a HPGe and four LaBr$_3$(Ce) detectors, the latter having a fast electronic response that allows for a precise determination of the lifetime of excited states. The resulting lifetimes of all three states have a higher precision than the known lifetimes, while agreeing within the error margin [2,3].

[1] A. Harter et al., Physical Review C, 106:024326, (2022) ;
[2] D. Kalaydjieva et al., Physical Review C, 104:024311, (2021) ;
[3] V. Rahkonen et al., Z. Phys. A 322, 333-348, (1985) .

HK 41: Hadron Structure and Spectroscopy V

Time: Thursday 14:00–15:30 Location: HS 3 Physik

HK 41.1 Thu 14:00 HS 3 Physik

Tetraquark Spectroscopy in Semileptonic *B* Decays at LHCb — •Piet Nogga — Helmholtz-Institut für Strahlen- und Kernphysik Nussallee 14-16 D-53115 Bonn

The last decade has seen a wealth of discoveries of new hadronic states with heavy quarks, many of which are outside of the scope of the naive quark model of conventional mesons and baryons. The LHCb experiment, designed to research heavy flavor hadrons in pp collisions, is especially well suited to investigate the nature of these states. An under-exploited source of hadronic resonances are semileptonic B decays. There are no published LHCb papers searching for exotic states in semileptonic decays but we expect significant exotic contributions since semileptonic decays comprise 10% of all B decays. Furthermore, the final state in semileptonic decays is relatively clean, since the hadronic system is produced in isolation, avoiding complicated final state interactions from crossed channels. On the other hand, the background contribution is large due to the missing energy in the system. This presentation will discuss tetraquark spectroscopy in $B_{(s)}^{0[-]} \to D^{0[+]}\pi^{+[-]}(K^+)\mu^-\bar{\nu}_\mu$ decays with an emphasis on their possible molecular nature.

HK 41.2 Thu 14:15 HS 3 Physik

A Study of DD^*K System — •Anuvind Asokan[1], Feng-Kun Guo[2,3,4], Christoph Hanhart[1], and Xu Zhang[2] — [1]Institute for Advanced Simulation 4, Forschungszentrum Jülich, D-52425 Jülich, Germany — [2]CAS Key Laboratory of Theoretical Physics, Institute of Theoretical Physics, Chinese Academy of Sciences, Beijing 100190, China — [3]School of Physical Sciences, University of Chinese Academy of Sciences, Beijing 100049, China — [4]Peng Huanwu Collaborative Center for Research and Education, Beihang University, Beijing 100191, China

We present our investigation of the DD^*K system. This three-body system is of particular interest due to the presence of a bound state in each of the two-body subsystems — $D_{s0}^*(2317)$ in DK, $D_{s1}(2460)$ in D^*K and $T_{cc}(3875)$ in DD^*, respectively. We employ a relativistic formalism using time ordered perturbation theory. We report the status of our calculations with special emphasis on poles location and width of the emerging three-body state.

HK 41.3 Thu 14:30 HS 3 Physik

Search for $\Lambda_b^0/\Xi_b^0 \to \Lambda\Lambda\bar{p}D_s^+$ with the LHCb experiment — •Ellinor Eckstein — Helmholtz-Institut für Strahlen- und Kernphysik (HISKP) Bonn

One of the most prominent questions in particle physics over the past decades is the nature of dark matter (DM). The sexaquark (S), a tightly bound state of $uuddss$ valence quark content, is a candidate for hadronic DM, proposed first by Glennys R. Farrar. The existence of such a state would furthermore have implications for the field of re- search regarding the substructure of exotic hadrons. At the LHCb experiment, the S, if it exists, is expected to occur in hadronic final states of b -baryon decays such as $\Lambda_b^0/\Xi_b^0 \to S\bar{p}D_s^+$. The decay $\Lambda_b^0/\Xi_b^0 \to \Lambda\Lambda\bar{p}D_s^+$, with the Λs escaping the detector, is one of the main backgrounds for S searches. At the same time, if the Λs can be reconstructed, it serves as a sensitivity check. With two long lived neutral particles in the final state and CKM suppression the first observation of this decay is a challenging task.

This talk will present the current status of the search for $\Lambda_b^0/\Xi_b^0 \to \Lambda\Lambda\bar{p}D_s^+$ in Run2 data of the LHCb experiment. Moreover, the potential of Run3 data, offering not only an increase in statistics, but a purely software based trigger with full track reconstruction in real time, resulting in an increase in trigger efficiency for hadronic decays, will be discussed.

HK 41.4 Thu 14:45 HS 3 Physik

Comparison of Sideband-Subtraction Methods for the Background Subtraction in η_c Decays — Tessa Bertelsmeier, Jans Böing, Anja Brüggemann, Lotta Frese, Nikolai in der Wiesche, Lois Kröger, •Hannah Neuwirth, Frederik Weidner, and Alfons Khoukaz for the BESIII Germany-Collaboration — Universität Münster, Germany

In particle physics, an accurate separation of signal and background events is essential to obtain reliable results. In particular, irreducible background contributions make it difficult to determine whether an event contributes to signal or background.

This study compares the strengths and limitations of two background subtraction methods: the single weight sideband subtraction and the Q-value method. The first method statistically removes background contributions from defined sideband regions, assuming similar properties of the background in sideband and signal regions. The second method calculates event-by-event probability-based weights by analysing local phase space neighbourhoods in a certain reference coordinate, allowing the separation of signal and background.

Using the world's largest J/ψ data set from the BESIII experiment, the methods are applied to Monte Carlo simulations and experimental data of the $J/\psi \to \gamma(\eta_c \to \eta' K^+K^-)$ decay to remove non-η' background, which is crucial for further analysis.

The current status of the analysis will be presented.

This work is supported by the German Research Foundation (DFG) under the project number 547123630 and the DFG GRK 2149/2.

HK 41.5 Thu 15:00 HS 3 Physik

Performance test of the KF Particle package for heavy-flavor hadron lifetime measurements with the ALICE detector — •Oleksii Lubynets for the ALICE Germany-Collaboration — Physikalisches Institut Universität Heidelberg

The lifetimes of heavy-flavor (HF) hadrons can be described using the heavy-quark expansion (HQE) method, which expresses the decay width as a series of $(1/m_Q)^n$, where m_Q is the mass of the HF quark. The predicted lifetimes can vary significantly depending on how higher-order terms in the expansion are handled. This makes lifetime measurements a valuable tool for refining and validating the most accurate approaches within the HQE framework. Recent measurements of the Ω_c^0 baryon lifetime by the LHCb and Belle II show significant deviations from previous results obtained at CERN and Fermilab. These discrepancies highlight the need for new precise measurements.

The HF hadrons decay within the ALICE detector volume and are reconstructed through their decay topology using methods of the Kalman Filter algorithm. To improve the resolution of decay parameters and increase the statistical significance of the measurements, a set of constraints is applied. These constraints take into account the production vertex of the HF hadron (topological constraint) and the expected mass of the decaying particles (mass constraint).

In this work, the KF Particle package was employed to reconstruct the $\Lambda_c \to pK\pi$ decay in pp collisions at $\sqrt{s} = 13.6$ TeV. The performance of the KF Particle package in measuring the Λ_c lifetime and the effect of the applied constraints are discussed.

HK 41.6 Thu 15:15 HS 3 Physik

Search for $\chi_{c1}(3872) \to p\bar{p}$ in $B^+ \to p\bar{p}K^+$ — •Kai Habermann, Sebastian Neubert, and Jascha Grabowski — HISKP, University of Bonn, Germany

We present and analysis, that aims to measure the branching ratio of the $\chi_{c1}(3871)$ decaying into the $(p\bar{p})$ final state using data collected by the LHCb experiment. The ultimate goal is to enable the observation and study of the $\chi_{c1}(3871)$ formed in $p\bar{p}$ collisions, paving the way for future experiments. The $\chi_{c1}(3871)$, commonly known as $X(3872)$, is an enigmatic state in the charmonium spectrum, widely studied due to its unconventional properties, including its proximity to the $D^0\bar{D}^{*0}$ threshold and its debated nature as a likely exotic state such as a tetraquark or hadronic molecule. This study utilizes the $B \to p\bar{p}K$ decay channel to extract the charmonium spectrum in the $p\bar{p}$ subsytem. In addition to the $\chi_{c1}(3871)$, this allows for precise measurements of the mass and width of the $\eta_c(1S)$ and $\eta_c(2S)$ states. Furthermore, a first measurement of the branching fraction of the $\psi(3770) \to p\bar{p}$.

HK 42: Heavy-Ion Collisions and QCD Phases VII

Time: Thursday 14:00–15:30 Location: HS 3 Chemie

Group Report HK 42.1 Thu 14:00 HS 3 Chemie

Universal critical dynamics in QCD — •Johannes Roth[1], Yunxin Ye[2], Sören Schlichting[2], and Lorenz von Smekal[1,3] — [1]Institut für Theoretische Physik, Justus-Liebig-Universität, 35392 Giessen, Germany — [2]Fakultät für Physik, Universität Bielefeld, 33615 Bielefeld, Germany — [3]Helmholtz Research Academy Hesse for FAIR (HFHF), Campus Giessen

In this group report, I will give an overview of the universal critical dynamics at the chiral phase transition of two-flavor QCD in the chiral limit. I will review the argument by Rajagopal and Wilczek of the associated dynamic universality class being 'Model G' from the Halperin-Hohenberg classification. To extract dynamic universal quantities, we use a novel formulation of the functional renormalization group for dynamical systems with 'reversible mode couplings'. I will show results for dynamic universal quantities such as the non-trivial value $z = d/2$ of the dynamic critical exponent at the 'strong-scaling' fixed point (where d is the number of spatial dimensions) and for dynamic universal scaling functions. Finally, I will outline how the same method can be used to study the universal dynamics at the QCD critical point, with the dynamic universality class being 'Model H' in this case.

HK 42.2 Thu 14:30 HS 3 Chemie

Critical dynamics of the chiral phase transition from a 1/N expansion — •Jonas Hirsch[1], Johannes Roth[1], and Lorentz von Smekal[1,2] — [1]Institut für Theoretische Physik, Justus-Liebig-Universität, 35392 Giessen, Germany — [2]Helmholtz Research Academy Hesse for FAIR (HFHF), Campus Giessen

The chiral phase transition of QCD in the limit of two massless quark flavors is widely believed to be of second order in the $O(4)$ universality class. Since the work of Rajagopal and Wilczek its *dynamic* universality class is then expected to be an extension of the original Model G by Halperin and Hohenberg. The characteristic feature of this dynamic model are the reversible mode couplings between the conserved iso-(axial-)vector charges and the chiral condensate as the order parameter field which all relax at equal rates due to *strong dynamic scaling*, as recently studied with the real-time FRG [1]. In this talk, I will consider a generalized version with an N-component order parameter field for large N. I will show that one can obtain exact solutions for the dynamic response functions with standard large-N counting rules from Dyson-Schwinger equations. In addition, I will discuss how the weak and strong-scaling fixed points are affected by the large-N limit.

[1] J.V. Roth, Y. Ye, S. Schlichting, L. von Smekal, *Dynamic critical behavior of the chiral phase transition from the real-time functional renormalization group*, JHEP, to be published, arXiv:2403.04573 [hep-ph].

HK 42.3 Thu 14:45 HS 3 Chemie

Critical dynamics with the analytically continued functional renormalization group — •Patrick Niekamp[1], Johannes Roth[1], and Lorenz von Smekal[1,2] — [1]Institut für Theoretische Physik, Justus-Liebig-Universität, 35392 Giessen, Germany — [2]Helmholtz Research Academy Hesse for FAIR (HFHF), Campus Giessen, 35392 Giessen, Germany

Euclidean approaches such as the functional renormalization group (FRG) have been abundantly and successfully used to study the universal static critical behavior of various physical systems near continuous phase transitions. For the study of critical dynamics, on the other hand, one usually relies on real-time methods. Our research aims to connect and relate the two approaches by comparing analytically continued (aRG) and real-time FRG on the closed time path. In particular, we investigate the dynamic critical behavior of a dissipative open quantum system near equilibrium in the spirit of the Caldeira-Leggett model with the aFRG and compare that with real-time results for the dynamic universality class of the corresponding Model A (according to the classification by Halperin and Hohenberg). The long-term goal of this project is to understand the merits and limitations of studying more complicated critical dynamics, including conservation laws and reversible mode couplings as relevant for QCD, with analytically continued Euclidean versus real-time approaches.

HK 42.4 Thu 15:00 HS 3 Chemie

Measurement of Net-Proton Fluctuations with ALICE — •Ilya Fokin for the ALICE Germany-Collaboration — Physikalisches Institut, Universität Heidelberg

Lattice QCD (LQCD) calculations predict that chiral symmetry is restored in a smooth crossover transition between a quark-gluon plasma and a hadron resonance gas (HRG) at vanishing net-baryon density, a condition realized in heavy-ion collisions at the LHC. In this regime, the net-baryon number cumulants computed using the HRG and LQCD partition functions are in good agreement up to third order. However, starting with the fourth-order cumulants, the LQCD results are significantly lower than the corresponding HRG results. This offers a unique opportunity to experimentally verify the full QCD partition function by measuring the fourth-order cumulants of the net-proton number distributions.

In this talk, the status of the measurement of net-proton cumulants up to fourth order in Pb–Pb collisions with ALICE is presented.

HK 42.5 Thu 15:15 HS 3 Chemie

Proton and light nuclei number fluctuations measured at HADES — •Marvin Nabroth for the HADES-Collaboration — Goethe University, Frankfurt, Germany

QCD matter under extreme densities and moderate temperatures can be studied experimentally by conducting low-energy heavy-ion collisions. The HADES (High-Acceptance Dielectron Spectrometer) experiment at SIS18/GSI is specifically designed to measure the reaction products of such collisions at kinetic beam energies in the 1 AGeV regime, thereby probing the freeze-out conditions at the highest baryon-chemical potentials. Net-baryon number fluctuations are a sensitive probe for investigating critical behavior expected near the conjectured first-order phase transition and the critical endpoint of the QCD phase diagram. This report presents an analysis of proton and light nuclei multiplicity fluctuations measured in Ag+Ag collisions at $\sqrt{s_{NN}} = 2.55$ GeV and Au+Au collisions at $\sqrt{s_{NN}} = 2.4$ GeV. Advanced techniques for correcting detector inefficiencies and incomplete particle identification are discussed, including unfolding methods based on fuzzy logic and machine learning algorithms. Additionally, the effects of volume fluctuations and the corresponding correction strategies are covered. Finally, we present the reconstructed cumulants of protons and light nuclei, along with their ratios, as functions of centrality and rapidity acceptance. This work has been supported by BMBF (05P21RFFC2, 05H24RF5), GSI and HGS-Hire.

HK 43: Instrumentation IX

Time: Thursday 14:00–15:30 Location: SR Exp1A Chemie

Group Report HK 43.1 Thu 14:00 SR Exp1A Chemie
Material budget imaging for mockup samples of the ALICE ITS3 with an electron beam — •Simon Gross-Bölting for the ALICE Germany-Collaboration — Physikalisches Institut, Heidelberg, Deutschland
During the Long Shutdown 3, ALICE will replace the inner barrel of its ITS2 detector with the ITS3, which features curved, ultra-thin silicon sensors supported by ultra-light carbon foam. The ITS3 aims for an average material budget of 0.09% in its first layer within a pseudorapidity range $|\eta| < 1$.

To study scattering caused by the carbon foam, a mockup was tested using an electron scattering telescope optimized for angular resolution. Scattering angle distributions were analyzed by fitting the inner 98% with a Gaussian, and the material budget was inferred using the Highland formula. Position-based momentum calculations, accounting for momentum gradients in the test beam, enhanced accuracy and eliminated the need for a scaling factor, enabling the creation of a two dimensional material budget map.

The measured material budget for the "half-ring" matched theoretical predictions, while deviations in the "longeron" were linked to excess glue, later confirmed by CT scans.

HK 43.2 Thu 14:30 SR Exp1A Chemie
Performance studies with the novel MIMOSIS-2.1 Sensor* — •Benedict Arnoldi-Meadows for the CBM-MVD-Collaboration — Goethe-Universität Frankfurt
The cmos Monolithic Active Pixel Sensor mimosis will be used as sensor technology for the Micro Vertex Detector (mvd) of the cbm experiment at fair in Darmstadt. It is currently in a R & D phase with mimosis-2.1 being its latest prototype, featuring likely fully depleted ac-coupled pixels with in total four sensing element designs, which were evaluated for their detection performance. These designs differ in the thickness of 25 μm and 50 μm and the doping in the epitaxy. The sensors under test feature numerous elements of the final sensor, *e.g.*, the full data rate capability of the final sensor by 8×320 MHz links with the mimosis data format which clusters neighboring fired pixels on the envisaged $\sim 4.25\,\mathrm{cm}^2$ large pixel matrix with 1024×504 pixels, each with an individual pitch of $\sim 27 \times 30\,\mu\mathrm{m}^2$.

The results of first sensor performance studies at dedicated test-beam facilities (desy, cern) will be presented.

*This work has been supported by bmbf (05P21RFFC2), gsi, Eurizon, hgs-hire, and hfhf.

HK 43.3 Thu 14:45 SR Exp1A Chemie
Status of the Readout of the CBM Micro Vertex Detector — •Benedikt Gutsche for the CBM-MVD-Collaboration — Goethe- Universität Frankfurt, Germany
The Compressed Baryonic Matter (CBM) Experiment will be one of the main experiments at the future FAIR facility. Its Micro Vertex Detector (MVD) will be composed of four sensor planes in vacuum and will be equipped with Monolithic Active Pixel Sensors (MIMOSIS). The sensor is being developed by IPHC Strasbourg and will run with a peak rate capability of 80 MHz/cm^2. The detector will be read out by GBTx's and PCIe based FPGA boards. The data is there to be processed and included into the common readout stream of the experiment. This contribution reports the progress regarding the GBTx configuration, HDL development, and lab testing. A smaller mini-MVD setup exists at GSI and results from the beam tests in Februray will be shown, as well as an outlook into the next steps and goals for the upcoming beam time in May/2025.

HK 43.4 Thu 15:00 SR Exp1A Chemie
Test-beam measurements with a babyMOSS beam telescope — •Alexander Rachev for the ALICE Germany-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn — Forschungs- und Technologiezentrum Detektorphysik, Universität Bonn
ALICE 3 is a novel, next-generation heavy-ion experiment at the LHC that is planned to be installed during the Long Shutdown 4. In the new detector, charged-particle tracking will be performed entirely by monolithic active pixel sensors (MAPS) based on 65nm CMOS technology. For the outer tracking alone an area of 45 m^2 needs to be covered, which requires extensive R&D on sensors, mechanics and cooling, as well as cooperation with industry.

In order to quantify the characteristics of new sensors, e.g. the spatial resolution, a reliable beam telescope is indispensible. A beam telescope is an arrangement of detectors used to track particles, providing a reference for the Device under Test (DUT) in a particle (test-)beam. Sensors that are currently being investigated for the upcoming inner tracker upgrade form the starting point for developments of the outer tracker. One of these sensors is the babyMOSS which is being used to construct a beam telescope for future characterizations and to understand the behavior of the newly developed MAPS.

In this talk I will present the setup of a babyMOSS beam telescope and show analysis results of testbeam data. Supported by BMBF.

HK 43.5 Thu 15:15 SR Exp1A Chemie
Impact of gap size modifications on the performance of a 65 nm CMOS technology Monolithic Stitched Sensor towards the future ALICE ITS3 — •Anouk Kaiser for the ALICE Germany-Collaboration — Physikalisches Institut, Ruprecht-Karls-Universität Heidelberg, Heidelberg, Germany
The Monolithic Stitched Sensor (MOSS) is a wafer-scale, pixel sensor prototype designed to investigate stitching techniques, evaluate achievable yield, and serve as a proof of concept for the ALICE Inner Tracking System 3 (ITS3) upgrade. The 50 μm thin sensor achieves full depletion at low reverse bias voltages through a deep n-type implant blanket extending beneath the collection diode. To improve charge collection efficiency at pixel boundaries, the design incorporates gaps of this implant between pixels in order to enhance lateral electric fields. The drift-based charge collection mechanism reduces the cluster size, making single-pixel hits the most common outcome.

This presentation will explain the analysis, using particles from a testbeam to determine performance parameters of the chip, namely the detection efficiency and the position resolution. It will examine the role of charge sharing at pixel boundaries, its effect on cluster size, and the resulting impact on position resolution. A key part of this study is comparing how two different gap sizes perform and understanding their role in shaping these results.

HK 44: Instrumentation X

Time: Thursday 14:00–15:30 Location: SR Exp1B Chemie

HK 44.1 Thu 14:00 SR Exp1B Chemie
The MAGIX Trigger Veto System — •Hannah Kessler for the MAGIX-Collaboration — Institute for Nuclear Physics, Johannes Gutenberg University Mainz, Germany
The MAGIX experiment, located at the new MESA accelerator at the University of Mainz, is designed for high-precision electron scattering studies. Its scientific goals include exploring dark sector particles, investigating the structure of hadrons and few-body systems, and studying reactions relevant to nuclear astrophysics. The experimental setup features a windowless scattering chamber with an internal gas jet target, two rotatable magnetic spectrometers, and advanced detector systems at their focal planes. A central component of these detectors is the MAGIX Trigger Veto System, which comprises plastic scintillators and passive lead absorbers. The veto part of the system is essential for particle identification and the trigger layer provides accurate timing information to support the tracking detector, a time projection chamber. To enhance the veto system's performance, various readout approaches have been investigated, including the use of readout cards and individual silicon photomultipliers. Laboratory tests with a Cobalt-60 source provided valuable insights into the signal processing capabilities. Further evaluations during a beam time at the Mainz Microtron (MAMI) allowed for a detailed comparison of the different readout methods under real experimental conditions.

In this presentation, I will introduce the MAGIX Trigger Veto System, outline the readout techniques explored, and share the results of the experimental investigation.

HK 44.2 Thu 14:15 SR Exp1B Chemie

Scintillating Fiber Hodoscopes for the Proton Radius Measurement at AMBER — •Karl Eichhorn, Jan Friedrich, Igor Konorov, Martin J. Losekamm, and Stephan Paul — School of Natural Sciences, Technical University of Munich, Garching, Germany

The AMBER collaboration aims to measure the proton-charge radius using elastic muon-proton scattering at the M2 beamline at CERN's Super Proton Synchrotron. The recoil of the proton will be measured in an active hydrogen target (TPC) while the scattering angle of the muon is reconstructed using novel Unified Tracking Stations (UTS). Each UTS contains ALPIDE pixel sensors and a Scintillating Fiber Hodoscope for timing. The SFH consists of four layers of scintillating fibers read out with silicon photomultipliers and provides precise timing information for reconstructing scattered muons. We present the detector design and results from a beam test with a detector prototype from 2024.

We acknowledge funding from BMBF, grant number 05P24WO1.

HK 44.3 Thu 14:30 SR Exp1B Chemie

Calibration Procedure of the START Detector for the HADES Experiment — •Henrik Flörsheimer[1], Ashish Bisht[4], Tetyana Galatyuk[1,2,3], Mladen Kis[2], Yevhen Kozymka[1], Wilhelm Krüger[1], Sergey Linev[2], Jan Michel[2], Jerzy Pietraszko[2], Christian Joachim Schmidt[2], Michael Träger[2], Michael Traxler[2], Felix Ulrich-Pur[2], and Matteo Centis Vignali[4] for the HADES-Collaboration — [1]Technische Universität Darmstadt — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH — [3]Helmholtz Forschungsakademie Hessen für FAIR — [4]Fondazione Bruno Kessler, Centre of Materials and Microsystems

HADES is a fixed-target experiment installed at SIS18 accelerator and addressing a very broad range of research topics based on studying reactions resulting from the interactions of pion, proton, and heavy ion beams with targets. A key component of particle identification is the time-of-flight measurement performed by the META detectors in combination with a reaction time detector (START). For the experiment with the proton beam, novel Low Gain Avalanche Detectors (LGAD) technology was used in HADES as a START detector. The detector consisted of two LGAD stations for high-precision start-time measurements with a precision below 100 ps and could be operated with rates of up to 10^8/s.

This talk will outline the START detector setup and the calibration steps needed to obtain the required performance. In addition, a possibility of improving the calibration procedure will be discussed.

HK 44.4 Thu 14:45 SR Exp1B Chemie

An overview of data calibration algorithms of NeuLAND in the R3B setup — •Yanzhao Wang[1], Paula Ulrich[1], Igor Gasparic[2], and Andreas Zilges[1] — [1]University of Cologne, Institute for Nuclear Physics, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung, Germany

The New Large-Area Neutron Detector NeuLAND, as part of the R^3B experiment at FAIR, aims at providing a high detection efficiency and spatial-temporal resolution of neutrons generated from a high-intensity radioactive beam[1]. Calibration processes of NeuLAND rely heavily on the reconstruction of local muon tracks from cosmic radiation. In this talk, we introduce the calibration algorithms that calculate the energy, time and position of particle interactions inside this detector based on the output data of TAMEX 3, a newly designed digitizer at GSI. Calibration results using the output of the cosmic radiation simulation will also be used to demonstrate the correctness of the algorithms.

Supported by the BMBF.

[1] K. Boretzky *et al.*, Nucl. Instrum. Methods Phys. Res. A1014 (2021) 165701

HK 44.5 Thu 15:00 SR Exp1B Chemie

Upgrade of the time readout of the Crystal Barrel detector — •Florian Taubert for the CBELSA/TAPS-Collaboration — University of Bonn

The CBELSA/TAPS experiment in Bonn conducts baryon spectroscopy utilizing linearly or circularly polarized photon beams impinging on a target, which can be polarized longitudinally or transversally. With this setup it is possible to obtain information on single and double polarization observables of photoproduction processes of single or multiple neutral mesons, e.g. $\gamma p \rightarrow p\pi^0$.

The main detector system consists of the Crystal Barrel (CB) and MiniTAPS calorimeters, combined with scintillators and scintillating fibers for charged particle detection. The Crystal Barrel is made up of 1320 CsI(Tl) crystals, which are arranged in a barrel shape around the target. Together with MiniTAPS covering the forward direction the system can cover a solid angle of almost 4π.

The readout of the CB detector consists of one energy and one timing branch. The time readout is incorporated on a VMEbus module with a Spartan6 FPGA and is done by a local VMEbus-CPU. To reduce deadtime and increase readout speed each module, 16 in total, was extended by a gigabit interface to overcome the limited transfer rate over VMEbus.

This talk presents details of the gigabit upgrade including implementation and achieved performance.

HK 44.6 Thu 15:15 SR Exp1B Chemie

Recent achievements with the FRS DAQ upgrade — •Nicolas Hubbard for the Super-FRS Experiment-Collaboration — GSI, Darmstadt, Germany

The FRS (FRagment Seperator) is a high-resolution magnetic spectrometer located at the GSI Helmhholtzzentrum fur Schwerionenforschung in Darmstadt, Germany. Using the FRS secondary beams of exotic nuclei can be produced by impinging high energy primary beams from the SIS-18 synchotron onto production targets. These secondary beams are identified with the FRS using the Brho-dE-TOF method, using a variety of particle detectors. As the desired nuclei get more and more exotic, one of the limiting factors in identification of produced particles is due to the data acquisition (DAQ), which necessarily takes some time to digitise and read-out detector signals (the so-called dead time). Recently the FRS DAQ system has been upgraded to use a new FPGA-based VME controller from Mesytec, MVLC, which enables faster detector read-out and lower latency processing, in addition to conversion time and related read-out optimizations. Last year test measurements were performed with beam to accurately measure the dead time and acquisition rate of the improved DAQ system under real conditions. This talk will discuss the results from these test measurements and the resulting improvements to the maximum acquisition rate of the FRS.

HK 45: Nuclear Astrophysics VI

Time: Thursday 14:00–15:15 Location: SR 0.03 Erw. Physik

HK 45.1 Thu 14:00 SR 0.03 Erw. Physik

Activation experiment for cross-section measurements of proton-induced reactions around A=110 — •Benedikt Machliner, Martin Müller, Darius Schneider, Svenja Wilden, and Andreas Zilges — University of Cologne, Institute for Nuclear Physics, Germany

Understanding the nucleosynthesis of stable isotopes on the proton-rich side of the valley of stability, the so called p-nuclei, is subject of current research. Most reactions relevant for the p-process take place far away from the valley of stability. Hence, theoretical calculations for cross sections and reaction rates are crucial. In order to adjust and verify theoretical models, a wide database of experimental results is needed [1]. In the context of p-nuclei, the Cd/Sn region (A≈110) is of particular interest, as it contains seven p-nuclei (^{102}Pd, ^{106}Cd, ^{108}Cd, ^{113}In, ^{112}Sn, ^{114}Sn and ^{115}Sn). To extend the experimental database in this mass region, the activation method is well suited. Using the University of Cologne's 10 MV FN Tandem accelerator and the Cologne Clover Counting setup [2], proton-induced reactions on four cadmium isotopes, ^{102}Pd, and ^{116}Sn were performed at astrophysically relevant energies. The cross section results will be presented and a method of analyzing reactions applicable to nuclei with long-lasting metastable states in the reaction product will be laid-out.

Supported by the DFG (ZI 510/12-1)

[1] M. Arnould and S. Goriely, Progr. in Part. and Nucl. Phys. **112**, (2020) 103766.

[2] F. Heim *et al.*, Nucl. Instrum. Methods A **966** (2020) 163854.

HK 45.2 Thu 14:15 SR 0.03 Erw. Physik

The ^{2}H(p,γ)^{3}He reaction studied at Felsenkeller underground lab — •Maria Lukyanova[1,2], Daniel Bemmerer[1], Axel Boeltzig[1], Antonio Caciolli[3,4], Peter Hempel[1,2], Eliana Masha[1], Konrad Schmidt[1], Anup Yadav[1,2], and Kai Zuber[2] — [1]Helmholtz-Zentrum Dresden-Rossendorf (HZDR) — [2]TU-Dresden — [3]INFN Sezione di Padova, Italy — [4]Università degli Studi di Padova, Italy

The ^{2}H(p,γ)^{3}He reaction is one of the primary processes responsible for deuterium destruction during Big Bang Nucleosynthesis (BBN), significantly impacting the primordial deuterium abundance (^{2}H). Previously, this reaction has been directly measured at BBN energies at LUNA using a gas target system. However, experimental data obtained at higher energies using solid targets suggest a 10% higher extrapolated cross-section. Recently, at the Felsenkeller 5 MV shallow-underground accelerator lab in Dresden, we measured the ^{2}H(p,γ)^{3}He reaction in the proton beam energy range 300-1200 keV providing partial overlap with both low-energy and high-energy datasets. The experimental setup and preliminary results, including γ-ray angular distributions, will be presented.

HK 45.3 Thu 14:30 SR 0.03 Erw. Physik

Constraining the ^{95}Zr(n,γ) cross section via the Oslo-method — •Tom Sittig[1], Anna Bohn[1], Devin Hymers[1], Abdallah Karaka[1], Markus Müllenmeister[1], Sarah Prill[1], Sebastian Schröder[1], Artemis Spyro[2], Michael Weinert[1], Gereon Weingarten[1], and Dennis Mücher[1] — [1]Institute of Nuclear Physics, University of Cologne, Cologne, Germany — [2]Facility for Rare Isotope Beams, Michigan State University, East Lansing, Michigan, USA

Using the Oslo method we aim to constrain the neutron capture cross section of ^{95}Zr via the ^{96}Zr(p,p') reaction. This cross section is of pivotal understanding for the slow neutron capture process (s-process) as the long-lived ^{95}Zr isotope is a branching point at which β-decay is in competition with the production of ^{96}Zr. But thus far its stellar neutron capture cross section is not experimentally known.

Measurements were performed at the 10 MV FN-Tandem accelerator of the Institute for Nuclear Physics at the University of Cologne using the SONIC@HORUS detector array [1]. For the main experiment a high purity ^{96}Zr target was irradiated with 15 MeV protons. Additionally, ^{90}Zr, ^{28}Si and ^{12}C foils were irradiated to perform background subtractions as well as calibrating the detector response for the statistical Oslo-type analysis. The preliminary results of these first measurements will be presented, along with a discussion of the impact of the achieved precision on our understanding of the s-process.

[1] Pickstone et al, 2017, 10.1016/j.nima.2017.09.016

HK 45.4 Thu 14:45 SR 0.03 Erw. Physik

Beam characterization of a DT neutron generator for Big Bang Nucleosynthesis studies — •Max Osswald[1,2], Daniel Bemmerer[2], Björn Lehnert[1], Steffen Turkat[1], and Kai Zuber[1] — [1]TU Dresden — [2]Helmholtz-Zentrum Dresden-Rossendorf (HZDR)

The intense DT neutron generator of TU Dresden is based on a duoplasmatron ion source, which can extract a deuteron beam with energies up to 350 keV. With beam currents of several milliamperes, it is an exceptional facility in Europe and can generate 14 MeV neutrons with up to 10^{12} n/s for fusion research. This contribution focuses on the characterization of the accelerator, including the calibration of beam energy, energy spread, and long-term stability, which are pivotal for precision studies of Big Bang Nucleosynthesis reactions. Additional key parameters such as beam spot size and position stability will also be reported enabling high-precision cross-section measurements.

Based on this characterization, the ^{2}H(d, p)^{3}H and ^{2}H(d, n)^{3}He reactions will be investigated at a new ASTRO beam line, which is currently being designed. These reactions currently limit our understanding of the primordial deuterium abundance in BBN modelings. Together with D/H precision data based on astronomical observations, these measurements will allow us to determine the cosmic baryon density $\Omega_b h^2$ with the same precision as obtained by the CMB survey of the PLANCK satellite. This independent determination of one of cosmology's most fundamental parameters will provide a cross-check between astronomy, cosmology & nuclear astrophysics, offering deeper insights into the early universe and the origin of our chemical elements.

HK 45.5 Thu 15:00 SR 0.03 Erw. Physik

Astrophysical and Nuclear Uncertainties of the r-Process — •Jan Kuske[1], Almudena Arcones[1,2,3], Takayuki Miyagi[4], Moritz Reichert[5], and Achim Schwenk[1,3] — [1]IKP, TU Darmstadt (DEU) — [2]GSI, Darmstadt (DEU) — [3]MPIK, Heidelberg (DEU) — [4]CCS, U. Tsukuba (JPN) — [5]Dep. Astronomia i Astrofisica, U. Valencia (ESP)

The rapid neutron capture (r-) process produced half of the elements heavier than iron in the Universe. Significant uncertainties remain in understanding the astrophysical environments capable of generating the necessary intense neutron fluxes. Detailed simulations of proposed astrophysical scenarios (e.g. binary neutron star mergers, magneto-hydrodynamical supernovae, and collapsars) are computationally intensive and subject to various uncertainties.

To address these challenges, we adopt an alternative approach that is instead based on a site-independent density profile. Our nuclear network calculations explore a wide range of initial electron fractions, entropies, and expansion timescales. The results align well with those of simulations and extend beyond conditions currently found in them.

Another important source of uncertainties arises from poorly constrained nuclear properties: Most nuclei along the r-process path are currently not experimentally accessible, making theoretical predictions essential, e.g. for nuclear masses, reaction rates, and fission properties. Here we show the impact of nuclear masses on r-process predictions and compare the results to observational data.

HK 46: Computing II

Time: Thursday 14:00–14:30 Location: SR 0.01 Erw. Physik

HK 46.1 Thu 14:00 SR 0.01 Erw. Physik

Variational Quantum Eigensolver for (2+1)-Dimensional QED at Finite Density — •Emil Rosanowski[1], Lena Funcke[1], Karl Jansen[2], Paulo Itaborai[2], Arianna Crippa[2], and Stefan Kühn[2] — [1]Universität Bonn — [2]DESY Zeuthen

In this talk, we present an implementation of multiple fermion flavors in both the Kogut-Susskind and Wilson formulations for quantum simulations of (2+1)-dimensional Quantum Electrodynamics (QED). Our first results show a particular type of level crossing with one flavor of fermions at zero density, as expected from analytical Chern number calculations. Moving forward, we explore the multi-flavor system at finite density by including a chemical potential. Finally, we present results from inference runs executed on real quantum hardware.

HK 46.2 Thu 14:15 SR 0.01 Erw. Physik

Machine Learning Enhanced Optimization of Variational Quantum Eigensolvers — •Luca Johannes Wagner, Kim Nicoli, and Lena Funcke — Helmholz Institut für Strahlen- und Kernphysik, Bonn, Germany

Variational Quantum Eigensolvers (VQEs) are a powerful class of hybrid quantum-classical algorithms designed to approximate the ground state of a quantum system described by its Hamiltonian. VQEs hold promise for various applications, including lattice field theory and quantum chemistry. However, the inherent noise present in Noisy Intermediate-Scale Quantum (NISQ) devices poses a significant challenge for running VQEs. These algorithms are particularly susceptible to noise, such as measurement shot noise and hardware noise.

Within this work, we propose to enhance VQEs using Gaussian Processes and Bayesian Optimization. These established machine-learning techniques excel at learning from noisy data, making them ideal candidates for improving VQEs. The contributions of this work are twofold. First, we introduce a "VQE-kernel", a custom kernel function specifically designed to incorporate valuable prior physics information in the Gaussian Process by design. Second, we propose a physics-informed acquisition function for Bayesian Optimization termed "Expected Maximum Improvement over Confident Regions" (EMICoRe).

Extensive numerical experiments demonstrate that our approach outperforms state-of-the-art baselines.

HK 47: Fundamental Symmetries I

Time: Thursday 14:30–15:30 Location: SR 0.01 Erw. Physik

Group Report HK 47.1 Thu 14:30 SR 0.01 Erw. Physik

Latest update from the Muon g-2 experiment — •René Reimann and Martin Fertl for the Muon g–2-Collaboration — Institute of Physics and Excellence Cluster PRISMA+, Johannes Gutenberg University Mainz, 55099 Mainz, Germany

The magnetic moment anomaly of the muon, that relates the cyclotron and spin precession frequency, provides one of the most stringent tests of the Standard Model of Particle Physics since it is measured and theoretically predicted to very high precision. The Fermilab Muon g-2 collaboration ended data taking in summer 2023 after reaching its design goal in terms of recorded statistics. The final result of the Fermilab Muon g-2 experiment will be a long-standing reference for theory calculations in the next decades. Analysis of the last three years of data is wrapping up and will improve the 200ppb uncertainty from measurement campaigns 1-3. In this talk we will update on the latest progress towards the final result of the muon g-2 experiment.

Group Report HK 47.2 Thu 15:00 SR 0.01 Erw. Physik

Search for Charged Lepton Flavor Violation with the Mu2e experiment at Fermilab — •Anna Ferrari, Stefan E. Mueller, Oliver Knodel, and Reuven Rachamin for the Mu2e-Collaboration — Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany

The Mu2e experiment, which is currently entering the final construction phase at the Fermi National Accelerator Laboratory in USA, will search for the charged-lepton flavor violating neutrino-less conversion of negative muons into electrons in the field of an aluminum nucleus. A conversion signal would require physics beyond the Standard Model, and the aim of Mu2e is to reach a single-event sensitivity four order of magnitude better than previous experiments. This can be achieved through an efficient production and transport of the muon beam, a rigorous control of all backgrounds that could mimic the monoenergetic conversion electrons, and an accurate normalization of the signal events. The design and present status of the Mu2e experiment will be presented, while the muon beamline and the detector sub-systems are going towards the construction completion.

HK 48: Structure and Dynamics of Nuclei XI

Time: Thursday 15:45–17:15 Location: HS 2 Physik

HK 48.1 Thu 15:45 HS 2 Physik

Constraining Double Beta Decay: Detailed Spectroscopy of ^{136}Ba — •Jelena Bardak[1,2], Giacomo Colombi[3], Corinna Henrich[4], Ilja Homm[4], Nikola Jovancevic[2], Ulli Koester[5], Thorsten Kroell[4], Caterina Michelagnoli[5], Erin Peters[6], Matthias Rudigier[4], Marcus Scheck[7], Kathrin Wimmer[1], and S. W. Yates[8] — [1]GSI Helmholtzzentrum für Schwerionenforschung — [2]Department of Physics, University of Novi Sad — [3]University of Guelph — [4]IKP TU Darmstadt — [5]Institut Laue-Langevin, Grenoble — [6]Department of Chemistry, University of Kentucky — [7]School of Engineering, UWS, Paisley — [8]Department of Physics and Astronomy, Lexington

Neutrinoless double beta decay ($0\nu\beta\beta$) is a rare process predicted by theories beyond the Standard Model, offering insights into neutrinos as Majorana particles with non-zero mass. The decay of ^{136}Xe to ^{136}Ba is a key candidate for $0\nu\beta\beta$ studies. Nuclear matrix elements (NMEs) are crucial for extracting neutrino properties from decay rates, but their values vary between theoretical models.This study investigates the nuclear structure of ^{136}Ba through spectroscopy with the FIPPS detector at ILL. Coincidence analysis will refine the level scheme, and gamma-ray angular correlations will assign spins, parities, and mixing ratios. Lifetimes will be measured to reduce uncertainties and provide new data. The vibrational and mixed-symmetry properties of ^{136}Ba will also be explored, enhancing understanding of its collective dynamics. These results aim to reduce NME uncertainties, advance knowledge of $0\nu\beta\beta$, and contribute to broader nuclear structure studies.

HK 48.2 Thu 16:00 HS 2 Physik

Electron-Nucleus Cross-Section Measurements at MAMI for Neutrino Physics — •Luca Wilhelm, Maximilian Littich, and Luca Doria — Institute for Nuclear Physics, Johannes Gutenberg-University Mainz, Germany

Electron scattering experiments are powerful tools for studying problems in nuclear physics. Recently, theoretical *ab-initio* methods extended their reach to medium-mass nuclei opening up new opportunities for precise electron scattering experiments. Such experiments can elucidate the role of different effects in the nuclear dynamics, ranging from excited states to collective phenomena and nucleon resonances in the nuclear medium. Furthermore, neutrino physics needs precise nuclear physics input for reaching the ambitious goals set by next-generation long-baseline experiments. Due to the similarity between electrons and neutrinos, theoretical models and neutrino generators can be tested and improved through the comparison to precise electron scattering experiments. At the MAMI accelerator, we performed and inclusive cross-section measurements on different nuclei relevant for neutrino physics: ^{12}C, ^{16}O, ^{40}Ar. The collected data will be used to test the predictions of different theoretical calculations and generators.

HK 48.3 Thu 16:15 HS 2 Physik

Measurement of the ^{71}Ge half-life using a silicon drift detector — •Hans F. R. Hoffmann, Jonas Koch, Björn Lehnert, and Kai Zuber — Technische Universität Dresden, Germany

In the search for possible explanations for the discrepancy between the measured and expected neutrino flux in gallium-based radiochemical neutrino detectors, known as the gallium anomaly, the half-life of ^{71}Ge plays a crucial role. While new theories in neutrino physics are being explored, variations in the ^{71}Ge half-life could also influence this discrepancy and its statistical significance. To evaluate the current literature value, a disc-shaped sample of germanium with natural isotope abundance was measured. The germanium disc was irradiated with thermal neutrons at the TRIGA reactor at Johannes Gutenberg University in Mainz. The actvated sample was brought to Dresden where K_α and K_β X-rays from the decay of ^{71}Ge were measured over several months using a silicon drift detector. The resulting count rate was fitted with an exponential decay curve, from which the half-life was determined. The result is compared to other ^{71}Ge half-life measurements and placed in the context of the gallium anomaly.

HK 48.4 Thu 16:30 HS 2 Physik

The low-lying dipole response of ^{62}Ni — •Tanja Schüttler[1], Florian Kluwig[1], Miriam Müscher[1], Deniz Savran[2], Ronald Schwengner[3], and Andreas Zilges[1] — [1]University of Cologne, Institute for Nuclear Physics, Germany — [2]GSI, Research Division, Darmstadt, Germany — [3]Helmholtz-Zentrum Dresden-Rossendorf, Germany

Systematic studies along isotopic and isotonic chains are fundamental for investigating the properties of the low-lying dipole response of atomic nuclei, and can shed light on, e.g., the effects of shell structure and neutron excess on dipole strength. The semi-magic nickel (Z=28) isotopic chain is ideally suited for a systematic study, because of its four stable, even-even isotopes covering a wide range of N/Z ratios. The dipole response of ^{58}Ni, ^{60}Ni, and ^{64}Ni has already been studied in (γ, γ') experiments [1-4], making the investigation of ^{62}Ni one of the last missing steps to complete the systematics. Therefore, a (γ, γ') bremsstrahlung experiment on ^{62}Ni up to a maximum photon energy of E_{max} = 8.7 MeV was performed at the γELBE facility at the Helmholtz-Zentrum Dresden-Rossendorf [5]. First results of this experiment will be presented. This work has been supported by the BMBF (05P21PKEN9).

[1] F. Bauwens *et al.*, Phys. Rev. C **62** (2000) 024302.
[2] M. Scheck *et al.*, Phys. Rev. C **88** (2013) 044304.
[3] M. Scheck *et al.*, Phys. Rev. C **87** (2013) 051304(R).
[4] M. Müscher *et al.*, Physical Review C **109** (2024) 044318.
[5] R. Schwengner *et al.*, Nucl. Instr. and Meth. A **555** (2005) 211.

HK 48.5 Thu 16:45 HS 2 Physik

Deviations from the Porter-Thomas distribution due to non-statistical gamma decay — •Johann Isaak[1], Oliver Papst[1], Volker Werner[1], Deniz Savran[2], Norbert Pietralla[1], Maike Beuschlein[1], Sean Finch[3], Robert Janssens[3,4], Jörn Kleemann[1], Miriam Müscher[5], Werner Tornow[3], and Andreas Zilges[5] — [1]TU Darmstadt, IKP, Darmstadt, Germany — [2]GSI, Darmstadt, Germany — [3]TUNL, Durham, USA — [4]UNC, Chapel Hill, USA — [5]Universität zu Köln, IKP, Köln, Germany

Fluctuations of partial transition widths in nuclear reactions are usually considered following the so-called Porter-Thomas (PT) distribution [1]. While fluctuations have been studied extensively for thermal neutron resonances, partly with inconclusive results, the region below particle thresholds is untouched so far [2].

In this contribution, we introduce a new method for the study of fluctuations of partial transition widths based on nuclear resonance fluorescence experiments with quasimonochromatic linearly-polarized photon beams below particle separation thresholds.

Results for ^{150}Nd will be presented and discussed. The data suggest deviations from the PT distribution, which can be explained by non-statistical effects in the γ-decay channel.

*Supported by the DFG Project-ID 499256822 - GRK 2891 and Project-ID 279384907 - SFB 1245.

[1] Porter and Thomas, PR 104, 483 (1956).
[2] Weidenmüller and Mitchell, RMP 81, 539 (2009).

HK 48.6 Thu 17:00 HS 2 Physik

First temperature-dependent relative self-absorption measurement at the S-DALINAC — •K. Prifti[1], V. Werner[1], N. Pietralla[1], U. Ahmed[1], M. Baumann[1], M. Beuschlein[1], J. Bormans[1,2], I. Brandherm[1], M. L. Cortes[1], B. Götz[1], A. Gupta[1], J. Hauf[1], B. Hesbacher[1], M. Heumüller[1], K. E. Ide[1], J. Isaak[1], I. Jurosevic[1], J. Kleemann[1], P. Koseoglou[1], J. Lu[1], H. Mayr[1], A. R. Netto[1], C. M. Nickel[1], O. Papst[1], T. Ramaker[1], M. Rech[1], D. M. Richter[1], T. M. Sebe[3,4], T. Stetz[1], and R. Zidarova[1] — [1]IKP, TU Darmstadt — [2]GSI, Darmstadt — [3]ELI-NP, IFIN-HH, Romania — [4]Politehnica Bucharest, Romania

The temperature-dependent relative self-absorption (TRSA) technique enables the disentanglement of the Doppler broadening contribution to the total width of the self-absorption line from that of the zero-point motion of atoms in the target material. The first TRSA measurement was conducted at the Darmstadt High-Intensity Photon Setup (DHIPS) at the superconducting Darmstadt linear electron accelerator (S-DALINAC) on the nucleus ^{27}Al using a bremsstrahlung photon beam with an endpoint energy of 5.5 MeV. The present work aims at measuring the level width of the 3957 keV level with high precision and simultaneously determine the Debye temperature of the target material. Measurements were performed with and without the absorbing target at three different temperatures, 77 K, 320 K, and 600 K. The data, their analysis and first results will be presented and discussed. This work is supported by the DFG under Project-ID 279384907-SFB 1245 and Project-ID No. 499256822-GRK 2891 "Nuclear Photonics".

HK 49: Hadron Structure and Spectroscopy VI

Time: Thursday 15:45–17:00 Location: HS 3 Physik

Group Report HK 49.1 Thu 15:45 HS 3 Physik

The ePIC experiment at the Electron-Ion Collider: Exploring the mysteries of the building blocks of matter — •Stefan Diehl for the ePIC-Collaboration — Justus Liebig Universität Gießen and University of Connecticut

The Electron-Ion Collider (EIC) is an advanced, new accelerator facility under development at Brookhaven National Laboratory (USA), expected to start operation in the early 2030s. It will collide polarized electrons with high-energy beams, ranging from heavy ions to polarized light ions and protons, at a center-of-mass energy between 20 and 140 GeV and peak luminosities up to $10^{34}\mathrm{cm}^{-2}\mathrm{s}^{-1}$. These unique characteristics provide the basis for answering fundamental questions about the strong force and how it holds matter together, by taking three-dimensional precision snapshots of the inner structure of protons and atomic nuclei. It is expected to make important contributions to the proton spin puzzle, the understanding of quark- and gluon-confinement, the origin of the nucleon mass, the behavior of quarks and gluons in nuclei, and many more aspects. To achieve these physics goals, up to two detectors will be built. One such detector, which is in an advanced design phase, is the Electron-Proton and Ion Collider detector (ePIC). It applies a compact detector concept able to achieve fine track reconstruction resolution, combined with high-performance electromagnetic and hadronic calorimetry and particle identification over a wide kinematic range. This talk will present an overview of the EIC, the ePIC detector concept, and its physics program, with a special focus on the discovery potentials in the field of nucleon structure.

HK 49.2 Thu 16:15 HS 3 Physik

A new formalism for calculating CP asymmetries in nonleptonic multibody B decays — •Leon Heuser[1], Bastian Kubis[1], Christoph Hanhart[2], José R. Peláez[3], Alba R. Torrecilla[3], and Patrícia Magalhães[4] — [1]HISKP Universität Bonn, Bonn, Germany — [2]FSZ Jülich, Jülich, Germany — [3]Departamento de Física Teórica, Universidad Complutense de Madrid, Madrid, SPAIN — [4]IFGW Universidade Estadual de Campinas, Sao Paulo, Brazil

We present a new method to construct the amplitude for hadronic multibody B decays that exploits the universality of pairwise hadronic final state interactions for small invariant masses between two of the final-state particles. This allows us to import the very accurate knowledge of such two-particle systems at low energies into the description of kinematic distributions for bottom hadrons in specific kinematic regions. We demonstrate the validity of this method by computing the CP asymmetry distributions and comparing to data.

HK 49.3 Thu 16:30 HS 3 Physik

Precision Tests of the Chiral Anomaly at the COMPASS Experiment — •Andrii Maltsev — Technische Universität München

Quantum chromodynamics (QCD) has been extremely successful in describing hadron interactions at high energies. At low energies, it becomes challenging to obtain quantitative predictions from first principles. However, one can exploit the chiral symmetry, a fundamental property of QCD, to build phenomenological models, such as the chiral perturbation theory, which give a perturbative framework for describing low-energy processes. Verification of the predictions of these models is crucial for understanding the low-energy interactions of hadrons.

This talk will give an overview of the processes that can be predicted using chiral perturbation theory, such as the $\pi\gamma \to \pi\pi$, $\pi\gamma \to \pi\eta$, $\mathrm{K}\gamma \to \mathrm{K}\pi$ processes, with special emphasis on the status of the measurement of the $\pi\gamma \to \pi\pi$ coupling constant, $F_{3\pi}$.

HK 49.4 Thu 16:45 HS 3 Physik

Measurement of the π^0 transition form factor at MAMI — •Luigi Capozza[1,2], Frank Maas[1,2,3], Oliver Noll[1,2], Christoph Rosner[1,2], Paul Schöner[1,2], and Sahra Wolff[1,2] — [1]Helmholtz-Institut Mainz, Mainz, Germany — [2]Institute of Nuclear Physics, Mainz, Germany — [3]PRISMA Cluster of Excellence, Mainz, Germany

An important uncertainty on the hadronic corrections to the anomalous magnetic moment of the muon comes from the so-called "light-by- light scattering" contributions. To estimate such contributions in data driven approaches, measurements of the π^0 electromagnetic transition form factor, parametrising the effective coupling of the neutral pion to the electromagnetic field, are needed. One way to access this form factor is measuring the π^0 electroproduction cross section in the Primakoff kinematical regime. Such a measurement has been set up at MAMI featuring a modified version of the PANDA backward calorimeter, installed at forward angles in the A1 electron scattering facility. A status report on this experiment will be presented.

HK 50: Heavy-Ion Collisions and QCD Phases VIII

Time: Thursday 15:45–17:15 Location: HS 3 Chemie

HK 50.1 Thu 15:45 HS 3 Chemie

Measurement of elliptic flow v_2 of neutral mesons in Pb–Pb collisions at $\sqrt{s_{\mathrm{NN}}}$ = 5.36 TeV with the ALICE EMCal — •Marvin Hemmer — Institut für Kernphysik, Goethe-Universität Frankfurt

The simultaneous description of the elliptic flow and production rate of direct photons in ultra-relativistic heavy-ion collisions, known as the "direct-photon puzzle", remains a key theoretical challenge. Distinguishing the elliptic flow of direct photons from that of decay photons, primarily from π^0 mesons, requires a precise estimate of π^0 flow. Additionally, studying the flow of various baryons and mesons sheds light on the underlying production mechanisms.

During LHC Run 3, the ALICE experiment recorded 100 times more Pb–Pb collisions than in Run 2, enabling more detailed studies of these phenomena. In ALICE, π^0 mesons can be reconstructed e.g. by detecting their decay photons with the electromagnetic calorimeter (EMCal). In this talk, the first π^0 elliptic flow measurements in Pb–Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 5.36$ TeV will be presented.

HK 50.2 Thu 16:00 HS 3 Chemie

First Look at Dilepton Flow in Au+Au collisions at $\sqrt{s_{NN}}$ = 2.23 GeV with HADES* — •Sukyung Kim — Bergische Universität Wuppertal, Wuppertal, Germany

Dileptons are excellent probes for studying the hot, dense hadronic matter created in heavy-ion collisions. Unlike strongly interacting particles, they traverse the medium without interaction, preserving information from all stages of the fireball evolution.

In this contribution, we study the anisotropic flow of dielectrons produced in Au+Au collisions at $\sqrt{s_{NN}} = 2.23$ GeV, recorded by the High Acceptance DiElectron Spectrometer (HADES) at GSI Darmstadt in March 2024. Recent advances in the calibration of the Ring-Imaging Cherenkov (RICH) detector, leveraging its excellent timing precision, have significantly improved electron purity and enabled more accurate reconstruction of dilepton flow.

This talk will focus on the status and first steps towards deriving the elliptic flow coefficient (v_2) for dielectrons.

*Work supported by “Netzwerke 2021”, an initiative of the Ministry of Culture and Science of the State of Northrhine Westphalia and BMBF (05P24PX1).

HK 50.3 Thu 16:15 HS 3 Chemie

Strangeness fluctuations in the HADES experiment* — •Athira Sreejith — Bergische Universität Wuppertal, Wuppertal, Deutschland

The QCD phase diagram has been actively studied over the years in the experimental, and theoretical domains using e.g. lattice QCD. The fluctuations of conserved charges like electric charge, baryon number, and strangeness are useful probes to study the QCD phase diagram. The experimental study of higher order cumulants provides insights into potential critical behaviour, and is being analysed at different experiments. This work focuses on the analysis of strangeness fluctuations in Ag-Ag collision data at 1.58 AGeV collected with the High Acceptance DiElectron Spectrometer (HADES). HADES is a fixed target experiment at GSI, Darmstadt that investigates the properties of dense baryonic matter at lower energy regimes.

This study aims to extract strangeness fluctuations by means of charged kaons. The low particle yield at the studied low energies presents challenges, necessitating robust methods to address particle misidentification. One such approach is the Identity method, in which the particle identification is based on probabilities rather than hard cuts. This method is implemented in the TIdentity module developed by M. Arslandok and A. Rustamov. This software module is used to conduct a feasibility study which will be the focus of this contribution.

*This work is supported by “Netzwerke 2021”, an initiative of the Ministry of Culture and Science of the State of Northrhine Westphalia and BMBF (05P24PX1).

HK 50.4 Thu 16:30 HS 3 Chemie

Investigating dense nuclear matter - resent collective flow results from HADES — •Behruz Kardan for the HADES-Collaboration — Goethe-Universität, Frankfurt am Main

The study of strongly interacting matter under extreme conditions is one of the most important topics in the exploration of Quantum Chromodynamics (QCD).

In this talk, we highlight new measurements by HADES, the *High-Acceptance Dielectron Spectrometer* located at the SIS18 at GSI in Darmstadt, which is currently the only experimental setup with the unique ability to measure rare and penetrating probes at the high-μ_B frontier of the QCD phase diagram.

We discuss recent high statistics results on collective flow phenomena in Au+Au and Ag+Ag collisions. Moreover, flow coefficients v_n up to the 6th order are investigated for the first time in this energy regime. Their combined information allows to construct for the first time a full 3D picture of the angular particle emission in momentum space. The multi-differential results for protons and light nuclei will be shown in different centrality classes over a large region of phase space. Furthermore, flow fluctuations, stemming from variations of the emission pattern, are investigated by an event-by-event correlation of flow coefficients.

The data provide essential constraints for theoretical transport models utilised in the determination of the properties of dense baryonic matter, such as its *viscosity* and *equation-of-state* (EOS).

Supported by the Helmholtz Forschungsakademie HFHF and the BMBF grant 05P24RF2.

HK 50.5 Thu 16:45 HS 3 Chemie

Equation of state at finite density from functional methods — •Omar Perez-Figueroa[1], Theo F. Motta[1,2], and Christian S. Fischer[1,3] — [1]Institut für Theoretische Physik, Justus-Liebig-Universität Gießen, 35392 Gießen, Germany. — [2]Technische Universität Darmstadt, Fachbereich Physik, Institut für Kernphysik, Theoriezentrum, Schlossgartenstr. 2 D-64289 Darmstadt, Germany. — [3]Helmholtz Forschungsakademie Hessen für FAIR (HFHF), GSI Helmholtzzentrum für Schwerionenforschung, Campus Gießen, 35392 Gießen, Germany.

In this short talk, we present first results for a state of the art calculation to obtain the quark-gluon matter pressure at finite chemical potential. To this end we employ Dyson-Schwinger equations (DSE) in a 2+1 flavor scenario that has been tested successfully elsewhere in the QCD phase diagram. The equation of state for quark-gluon matter can be used as input for the hydrostatic equilibrium equation of cold neutron stars. Two paths were explored for the calculations. First, employing an effective action expansion derived by functional methods, the pressure at finite and zero chemical potential can be compared or, second, the number density can be calculated and further integrated to yield the pressure. The latter option has already been proved useful in computing quark and baryon number fluctuations at finite temperature. Both methods are compared and some physical consequences are discussed.

HK 50.6 Thu 17:00 HS 3 Chemie

Determining the Reaction Volume with CBM — •Beatriz Artur — IKF, Goethe-Universität

The main goal of the Compressed Baryonic Matter (CBM) Experiment at FAIR is to probe the QCD phase diagram at high net-baryon densities and moderate temperatures with nucleus-nucleus collisions, in order to locate the possible first order phase transition from hadronic to partonic matter and its critical end point (CEP). The higher moments (cumulants) of conserved quantities, such as baryon number, strangeness and electrical charge, are suggested to be sensitive to the proximity of the CEP. In order to assess the behavior of these cumulants, it is crucial to determine the reaction volume. Indeed, different procedures for centrality selection, based on participant multiplicity with the STS detector or on spectator multiplicity with the new FSD detector, allow us to study reaction volume fluctuations and their impact on net-baryon cumulants. In this work, we explore these different procedures using the hadronic transport models SMASH and PHQMD.

HK 51: Instrumentation XI

Time: Thursday 15:45–17:15 Location: SR Exp1A Chemie

Group Report HK 51.1 Thu 15:45 SR Exp1A Chemie

The Outer Tracker Barrel of ALICE3 — •Laszlo Varga for the ALICE Germany-Collaboration — Technische Universitaet Muenchen, Munich, Germany

The large area Outer Tracker (OT) of ALICE3 will be fully based on Monolithic Active Pixel Sensor technology. Its four barrel layers follow a cylindrical geometry, with a support structure segmented into independent staves populated by interconnected detector modules. The whole concept, the layout of a stave and the implementation of the infrastructure is based on the cooling of the detectors.

We will discuss the different cooling options and the corresponding mechanical implementations and compare them to simulations carried out using the COMSOL Multiphysics finite element tool. In parallel the prototype development has already started and we will present detailed measurements on the heat dissipation, mechanical precision and flow induced vibrations, which will significantly influence the performance of a system designed for high precision tracking on the micrometer scale.

This research was supported by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) under Germany's Excellence Strategy-EXC-2094-390783311 and Bundesministerium für Bildung und Forschung, BMBF-05P24WO4 ALICE.

HK 51.2 Thu 16:15 SR Exp1A Chemie

Front-end pixel grouping for the ALICE 3 Outer Tracker — •Johannes Hensler for the ALICE Germany-Collaboration — Physikalisches Institut, Ruprecht-Karls-Universität Heidelberg, Heidelberg, Germany

The ALICE collaboration is advancing plans for a novel detector with outstanding pointing resolution, excellent tracking, and particle identification over a large pseudorapidity range using cutting-edge silicon detector technology. This detector, called ALICE 3, is intended to replace the current experimental setup and start operation in 2036.

Central to ALICE 3 is a fully silicon-based monolithic active pixel sensor (MAPS) tracking detector built using a 65 nm technology node. The tracking system includes a Vertex Detector, Middle Layers, and an Outer Tracker, covering a total of 60 m^2 of active sensor area.

This large-area tracking device poses significant challenges in sensor design. Achieving the required intrinsic position resolution of 10 μm is essential for accurate pointing and momentum measurements. For the Outer Tracker, a pixel pitch of O(50 μm) was chosen to balance resolution, power, and channel counts. However, larger pixel pitches have been found to reduce efficiency, especially at pixel corners.

To address these challenges, the potential of grouping the response of multiple pixels is being explored. This work presents input capacitance measurements on the CE65 chiplet as a starting point, along with initial tests of pixel grouping implemented directly in the analog front-end.

HK 51.3 Thu 16:30 SR Exp1A Chemie

Timing resolution of the Analogue Pixel Test Structure — •Lars Döpper for the ALICE Germany-Collaboration — Helmholtz-Institut für Strahlen- und Kernpyhsik — Forschungs- und Technologiezentrum Detektorphysik

The ALICE collaboration plans a complete overhaul of its detector for Long Shutdown 4 of the LHC titled ALICE 3. This new detector will utilize a fully MAPS-based detector for charged particle tracking. To achieve the envisioned time binning of 500 ns, a timing resolution of 100 ns is required for the sensor.

The Analogue Pixel Test Structure (APTS), a prototype sensor developed in the scope of the Inner Tracking System 3 project, offers direct access to the analogue waveforms of the sensor diodes. As the 65 nm production process used for APTS will also be used for the final sensor of ALICE 3, testing the timing resolution of APTS offers insight into the performance of sensors fabricated in this production process. In this talk I present a novel approach to measure the timing resolution of APTS without the need for any external time reference.

This work is supported by BMBF.

HK 51.4 Thu 16:45 SR Exp1A Chemie

Status of Sensor and Detector Integration of the CBM MVD* — •Franz Matejcek for the CBM-MVD-Collaboration — Goethe-Universität Frankfurt

The Micro Vertex Detector (MVD) of the Compressed Baryonic Matter Experiment (CBM) will consist of four planar stations, each built of four independent quadrants, that will be equipped with dedicated CMOS pixel sensors (MIMOSIS) and will operate in vacuum. Each detector plane will feature a material budget x/X_0 ranging between 0.3 and 0.5 %. The sensors will be glued onto 380 μm thick TPG (Thermal Pyrolytic Graphite) carriers and then wire-bonded to dedicated flex cables connecting the front end electronics which will be mounted on a heat sink sitting outside the acceptance. The integration is mechanically challenging as the sensors have to be glued and bonded on both sides of the carrier to maximize the acceptance.

This contribution will present the current status of the integration activities with a focus on sensor mass qualification and the finalized engineering design which is currently validated in a full-scale mechanical mock-up to prepare for detector pre-production.

*This work has been supported by BMBF (05P21RFFC2, 05H24RF5), HGS-HIRe, HFHF, GSI and Eurizon.

HK 51.5 Thu 17:00 SR Exp1A Chemie

Ladder production and characterization of the Silicon Tracking System for the CBM experiment — •Lady Maryann Collazo Sánchez for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany

The Silicon Tracking System (STS) for the CBM experiment is designed to handle a 10 MHz interaction rate. A specialized integration approach, where the readout electronics are located outside the sensitive volume, minimizes the material budget to 2 - 8% X_0 while ensuring high granularity, precision, and timing accuracy. Each detector module features a double-sided silicon strip sensor connected to two Front-End Boards (FEBs) with eight custom-designed STS-XYTER ASICs via microcables.

After assembly, rigorous quality control procedures are performed, including time and amplitude calibration of all module ASICs and thermal stress tests to ensure reliable operation and precise data analysis. After testing, the modules are attached to low-mass carbon fiber ladders, each with up to 10 modules. The three first-of-series ladders have undergone further evaluation to confirm consistent functionality, including IV measurements, functional tests, simultaneous noise (ENC) characterization, long-run stability, and radioactive source irradiation measurements.

This study presents the current status of module and ladder testing results during the STS detector's series production. It offers key insights into the detector's development and performance, with detailed studies on noise levels and signal response.

HK 52: Instrumentation XII

Time: Thursday 15:45–17:00 Location: SR Exp1B Chemie

HK 52.1 Thu 15:45 SR Exp1B Chemie

Current Iteration of Prototype Tests of the Front-End and Readout Electronics Systems for the PANDA Barrel EMC* — •Aniko Tim Falk[1], Kai-Thomas Brinkmann[1], Simon Glennemeier-Marke[1], Simon Habermehl[1], Phil Ionkov[1], Marvin Peter[1], Hans-Georg Zaunick[1], Oliver Noll[2,3], and Luigi Capozza[2,3] for the PANDA-Collaboration — [1]II. Physics Institute, Justus Liebig University, Gießen — [2]Institute of Nuclear Physics, Johannes Gutenberg University, Mainz — [3]Helmholtz Institute, Mainz

The barrel section of the electromagnetic calorimeter (EMC) in the PANDA experiment, which is one of the largest installations at the upcoming FAIR accelerator facility, aims to deliver superior photon energy resolution across a broad dynamic range. To achieve this high level of precision, the operation and calibration of the calorimeter's various subsystems, particularly the readout and front-end electronics, must be meticulously fine-tuned. This demands a thorough series of functional tests and calibration procedures, especially concerning the front-end electronics, to ensure that the system operates optimally. This contribution will present the current prototype setup, along with results from beam tests and laboratory measurements conducted over the past year. *supported by the BMBF, GSI and HFHF.

HK 52.2 Thu 16:00 SR Exp1B Chemie

Stability analyses of a cryogenic hydrogen filament target — •Eva-Maria Hausch, Jost Froning, Christian Mannweiler, Simon Obszerninks, and Alfons Khoukaz — Institut für Kernphysik, Universität Münster, 48149 Münster, Germany

Internal targets such as hydrogen cluster-jet and pellet/droplet targets are widely applied in accelerator experiments in nuclear and particle physics. For example, the future $\overline{\text{P}}$ANDA experiment at FAIR will make use of both target types. Another option for internal target experiments is to use filament targets.

The MDT-H is a droplet target which is currently operated in Münster as a filament target. The hydrogen is cooled down to liquid conditions, leaves the target through an aperture nozzle with a diameter of 10 microns into the interaction chamber and freezes out due to the low vacuum pressure, resulting in a solid hydrogen beam. For operation in accelerator experiments, it is important that the target beam exhibits minimal fluctuations, for vertex reconstruction. Stability analyses provide information about these fluctuations and form a basis for optimising the target.

In this talk, the setup of the MDT-H will be presented and the results of various stability measurements will be shown.

The research project was supported by EU Horizon 2020 programme (824093), BMBF (05P21PMFP1) and NRW Netzwerke (NW21-024-E).

HK 52.3 Thu 16:15 SR Exp1B Chemie

Cryobending: Deflection of frozen hydrogen filaments — •Jost Froning, Eva-Maria Hausch, Christian Mannweiler, Simon Obszerninks, and Alfons Khoukaz — Institut für Kernphysik, Universität Münster, 48149 Münster, Germany

For the use of cryogenic fibre or droplet/pellet targets at accelerator experiments in nuclear and particle physics, a way to adjust the position of the target beam at the interaction point without mechanical movement of the target components is desirable. For this purpose, a novel strategy, named cryobending, is developed and presented in this talk for a frozen hydrogen filament in vacuum. The produced hydrogen target beam is deflected by helium gas emerging from correction nozzles. A comparison between measured and expected deflection angles is shown in this talk.

Funding was received from GSI F&E (MSKHOU2023), EU Horizon 2020 programme (824093), BMBF (05P21PMFP1) and NRW Netzwerke (NW21-024-E).

HK 52.4 Thu 16:30 SR Exp1B Chemie

Construction of the crystal Zero Degree Detector for BESIII — •Frederic Stieler, Achim Denig, Peter Drexler, Werner Lauth, Jan Muskalla, Saskia Plura, Christoph Florian Redmer, and Yasemin Schelhaas for the BESIII Germany-Collaboration — Institute for Nuclear Physics, Johannes Gutenberg University, Germany

The crystal Zero Degree Detector (cZDD) is a proposed addition to the BESIII experiment in China. In order to measure hadronic cross sections with the Initial State Radiation (ISR) method, for a more precise calculation of the hadronic vacuum polarization contribution to the anomalous magnetic moment of the muon, ISR photons have to be detected. Since these photons are mostly emitted at small angles relative to the colliding particles, the cZDD will measure these photons at angles of about 1.5 mrad to 10.4 mrad, that are not covered yet by the already existing detectors at BESIII. Additionally, the cZDD will replace the Luminsoity monitors of BEPCII. Balancing both tasks of the cZDD is a challenge for the design of the readout.

This presentation discusses the design of the first prototype of the cZDD and the development of an online feature extraction based on FPGAs.

HK 52.5 Thu 16:45 SR Exp1B Chemie

Results from the Digital Calorimeter Prototype EPICAL-2 — •Johannes Keul — Institut für Kernphysik Frankfurt

A prototype of a novel digital electromagnetic calorimeter, EPICAL-2, has been developed. The R&D is performed in the context of the ALICE-FoCal and is strongly related to studies of imaging in proton CT. Digital calorimetry also proves promising for future collider projects like EIC, ILC, CLIC, or FCC.

Based on proof of principle with a first prototype, EPICAL-2 has been constructed as an advanced second prototype. EPICAL-2 consists of 24 layers with alternating tungsten absorbers and ALPIDE MAPS. The design features an active area of approximately 30 x 30 mm^2 and a depth of 20 radiation lengths, totaling over 25 million pixels.

EPICAL-2 test-beam measurements were performed at DESY in February 2020 and CERN-SPS in September 2021. The DESY test-beam campaign results have been published in [1], showing good energy resolution and linearity.

This contribution will report on energy resolution and linearity measurements for different definitions of the detector response in the EPICAL-2 and compare it to a detailed MC simulation. Furthermore, shower shape studies will be presented and studies of the Molière radius in the EPICAL-2 will be shown.

[1] J.Alme et al 2023 JINST 18 P01038

Supported by BMBF and the Helmholtz Association.

HK 53: Nuclear Astrophysics VII

Time: Thursday 15:45–17:00 Location: SR 0.03 Erw. Physik

Group Report HK 53.1 Thu 15:45 SR 0.03 Erw. Physik

Activation experiments for nuclear astrophysics — •Martin Müller, Benedikt Machliner, Darius Schneider, Svenja Wilden, and Andreas Zilges — University of Cologne

Nuclear astrophysics is a highly interdisciplinary field and the modelling of nucleosynthesis processes requires input from all of its constituents. On the nuclear physics site, reaction rates and cross sections rank among the most important inputs, especially for p-process calculations. This is primarily due to the fact, that in the vast reaction networks that make up the γ process, different reaction channels can compete with each other at many different branching or deflection points. In order to improve the underlying models used to calculate cross sections - typically within the Hauser-Feshbach statistical model - even for nuclei far away from stability, a large experimental database is needed to test and adjust theoretical models. One of the most effective techniques in building these

databases throughout the last decades has been the activation method. In this work, recent experiments performed using the activation method as well as the stacked target technique to determine cross sections for both α- and p-induced reactions will be presented. These will include ^{170,172}Yb(α,γ), ^{170,172}Yb(p,γ), ^{55}Mn$(\alpha,(2)n)$, ^{58}Fe(p,n), ^{nat}Dy(p,γ), and ^{nat}Dy(α,γ).
Supported by the DFG (ZI 510/12-1).

HK 53.2 Thu 16:15 SR 0.03 Erw. Physik

Measurement of ^{87}Rb$(p,\gamma)^{88}$Sr total reaction cross sections — •Svenja Wilden, Benedikt Machliner, Martin Müller, and Andreas Zilges — University of Cologne, Institute for Nuclear Physics, Germany

The origin of the p nuclei - a group of stable proton-rich nuclei - cannot be attributed to neutron - capture processes [1]. Instead, their synthesis involves a network of photodisintegration reactions, known as the γ process. Statistical model calculations are essential for predicting reaction rates and cross sections for reactions involved in this process.

An in-beam experiment was conducted to study the ^{87}Rb$(p,\gamma)^{88}$Sr reaction using the high-efficiency HPGe γ-ray spectrometer HORUS at the University of Cologne. Proton beams with energies between $E_p = 2$ and 5 MeV were supplied by a 10 MV FN Tandem accelerator. Cross-section values were determined for six proton-beam energies. These measurements provide the first experimental cross sections for the ^{87}Rb$(p,\gamma)^{88}$Sr reaction, offering constraints on nuclear physics inputs for statistical model calculations.

[1] M. Arnould and S. Gorieley, Prog. Part. Nucl. Phys. **112** (2020) 103766.

Supported by the DFG (ZI 510/8-2).

HK 53.3 Thu 16:30 SR 0.03 Erw. Physik

Sensitivity study of μ and τ neutrino on νr-process — •Heamin Ko[1], Zewei Xiong[2], and Gabriel Martínez-Pinedo[1,2] — [1]Institut für Kernphysik, Fachbereich Physik, TU Darmstadt, Darmstadt, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany

In neutron-rich environments, large neutron fluxes can be absorbed by nuclei, which means that neutron-nucleus reactions can push matter beyond the stability line through charge-current reactions and produce p-nuclei. This new process is called the νr-process. In this work, we study the sensitivity of the heavier neutrinos (μ and τ neutrinos). In this talk, we will show the contribution of the heavier neutrinos to the neutral current reaction by varying the parameters of the heavier neutrinos, such as flux and temperature.

This work is supported by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) through Project - ID 279384907 - SFB 1245.

HK 53.4 Thu 16:45 SR 0.03 Erw. Physik

Neutron capture cross section, (n,γ), of natural Krypton in the s-process — •Jan Butz — Goethe Universität, Frankfurt am Main, Germany

An important step in understanding the origin of life is to study stellar nucleosynthesis. The abundance of elements up to iron is produced almost exclusively through nuclear fusion, whereas most heavy elements are formed via neutron capture in the s- and r-processes. The s-process occurs inside the shell burning of massive stars, while the r-process, however, requires extreme conditions, like type II supernovae or neutron star mergers.

Krypton plays a vital role in the s-process due to the branching points of ^{81}Kr and ^{85}Kr. These branching points are nuclei where the decay rate is in the order of the neutron capture rate, $r_\beta \approx r_n$. To gain insight into these points, it is crucial to study the (n,γ)-reaction and the behavior of these nuclei under stellar conditions. Using the activation method, the neutron capture cross section for natural krypton was determined at stellar temperatures for the corresponding s-process components.

HK 54: Fundamental Symmetries II

Time: Thursday 15:45–17:15 Location: SR 0.01 Erw. Physik

Group Report HK 54.1 Thu 15:45 SR 0.01 Erw. Physik

Achieving and measuring ultra-low magnetic field gradients for measurements of the 129Xe-EDM- — •Felix Grüner — Physikalisches Institut, Uni Heidelberg

In the Standard Model, the electric dipole moment (EDM) of ^{129}Xe arises solely from the CP violation of the weak interaction. Additional sources of CP violation beyond the SM, as needed to explain e.g. baryon asymmetry, should cause a larger xenon EDM. The method used to measure smallest EDMs, comagnetometry, requires exceptionally homogeneous magnetic fields with field gradients of the order of pT/cm. Achieving this requirement necessitates advanced magnetic shielding.

The goal of the Helium-Xenon Experiment is to set a new upper limit on the xenon EDM. For this purpose, a Magnetically Shielded Room (MSR) was constructed at the Physikalisches Institut at Heidelberg University. This talk focuses on how the MSR achieves those low field gradients by active and passive shielding, as well as the determination of magnetic field gradients within the MSR of the order of pT/cm by measuring spin relaxation time constants.

Group Report HK 54.2 Thu 16:15 SR 0.01 Erw. Physik

Ultra-cold neutron storage and lifetime measurement in the fully magnetic trap τSPECT — •Sylvain Vanneste for the tauSPECT-Collaboration — Institut für Physik , Johannes Gutenberg University, Mainz, Germany

The accurate determination of the free neutron lifetime is of particular interest in modern precision physics. Its value is closely linked to the mixing of up and down quarks, as well as the abundance of primordial elements formed during Big Bang nucleosynthesis. Currently, two distinct measurement techniques yield results that are inconsistent, giving rise to the so-called neutron lifetime puzzle.

To minimize experimental systematic uncertainties caused by neutron losses on material walls, the experiment τSPECT employs a fully magnetic trap for Ultra-Cold Neutrons (UCNs). This work presents the latest commissioning results of τSPECT at the Paul Scherrer Institute (PSI) in Switzerland, including UCN loading optimization, systematic studies, comparisons with simulations, neutron lifetime measurements, and proposed future improvements.

HK 54.3 Thu 16:45 SR 0.01 Erw. Physik

Status of the neutron decay facility PERC and its main detector — •Lilli Löbell for the PERC-Collaboration — School of Natural Sciences, Technische Universität München, Germany

The decay of free neutrons is a powerful tool for precision tests of the Standard Model of particle physics. By determining decay correlation coefficients such as the beta asymmetry A, one can test the unitarity of the CKM matrix and search for physics beyond the Standard Model via new effective couplings.

The neutron decay spectrometer PERC (Proton Electron Radiation Channel), which is currently set up at the FRM II research reactor in Garching, aims to improve the accuracy of several correlation coefficients by one order of magnitude. PERC consists of a 12 m long superconducting magnet system, in which the neutron beam is contained by a non-depolarizing neutron guide. Electrons and protons produced in the neutron decay are guided by the magnetic field towards the main detector, which will initially be a scintillation detector with photomultiplier tube readout.

The talk will present the design of the main detector as well as the current status of the installation of PERC.

HK 54.4 Thu 17:00 SR 0.01 Erw. Physik

Proton Transport from the Antimatter Factory of CERN — •Marcel Leonhardt[1,2], Daniel Schweitzer[1,3], Fatma Abbass[1,3], Satoshi Endo[2,4], and Christian Smorra[1] for the BASE-Collaboration — [1]Institut für Experimentalphysik, Heinrich-Heine-Universität, Düsseldorf, Germany — [2]RIKEN, Ulmer Fundamental Symmetries Laboratory, Wako, Saitama, Japan — [3]Institut für Physik, Johannes Gutenberg-Universität, Mainz, Germany — [4]Graduate School of Arts and Sciences, University of Tokyo, Tokyo, Japan

The most precise CPT invariance tests in the baryon sector are currently conducted at CERN's world-unique antimatter factory. Within this program, the BASE collaboration compares the fundamental properties of antiprotons and protons using state-of-the-art cryogenic Penning-trap systems. To push the limits of our measurements to higher fractional accuracy, we built the autonomous, open, transportable Penning-trap system BASE-STEP to transport antiprotons to our dedicated high-precision offline laboratory currently under construction at Heinrich Heine University Düsseldorf, Germany. I will present the most critical milestone in realizing antiproton transport: The successful demonstration of all essential techniques required for its implementation using protons. Specifically, we achieved lossless transport of 100 trapped protons via truck across the CERN Campus and continued seamless operation of the system after transport. Our demonstration validates the feasibility of the concept, paving the way for future offline antiproton precision studies.

HK 55: Structure and Dynamics of Nuclei XII

Time: Thursday 17:30–18:45 Location: HS 2 Physik

Group Report HK 55.1 Thu 17:30 HS 2 Physik

Overview of recent production cross-section measurements at the FRagment Separator FRS — •Suraj Kumar Singh for the Super-FRS Experiment-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — Justus-Liebig-Universität Gießen, Germany

Studies of nuclei far from the valley of stability are of interest because they provide insight into their sometimes new or unexpected properties, nuclear reactions and nuclear structure relevant for various fields of physics ranging from fundamental physics, nuclear astrophysics up to applications. Therefore, it is important to produce and study such exotic nuclides at the edges of stability. The possible rate and yield of the exotic isotopes, which are essential for each proposal for new experiments, are determined by their production cross-sections and require an accurate knowledge. As precise calculations of the production cross-section are difficult, the cross-section measurements are the first step towards research with isotopes far away from the valley of stability. The measured cross-sections shed light on production mechanisms and offer improved benchmarks for theoretical models, too. In this contribution, recent developments of the analysis and first results from the evaluation of production cross-sections of relativistic U, Er, Mo and Pb beams at the FRS at GSI will be presented.

HK 55.2 Thu 18:00 HS 2 Physik

Proton range calibration for the R^3B-CALIFA calorimeter — •Mrunmoy Jena, Roman Gernhäuser, and Tobias Jenegger for the R3B-Collaboration — Technische Universität München, Munich, Germany

The CALIFA (CALorimeter for In-Flight detection of gamma rays and high energy charged pArticles) is one of the most important detectors in the R^3B (Reactions with Relativistic Radioactive ion Beams) experiment. Being highly segmented and having almost full polar angle coverage ($7^o < \theta < 143^o$), this detector provides spectroscopic information for gamma rays and charged particle energies varying from 100 keV to about 300 MeV. The MPRB-32 charge sensitive preamplifiers coupled to the detection units can be operated in a low gain (gamma range) or a high gain mode (proton range), enabling a high dynamic range for the energy determination.

This presentation introduces a user-friendly, computer-controlled procedure that carries out an automatic calibration of the entire CALIFA calorimeter over the full dynamic range. The calibration is carried out using a combination of a ^{22}Na radioactive source and electronic pulser signals of known amplitudes.

Supported by BMBF 05P24WO2.

HK 55.3 Thu 18:15 HS 2 Physik

Investigation of nuclear surface structure of exotic Xe isotopes with the PUMA apparatus — •Clara Klink[1,2], Lukas Nies[2], Alexandre Obertelli[1], Frank Wienholtz[1], Jonas Fischer[1], and Moritz Schlaich[1] — [1]TU Darmstadt — [2]CERN

PUMA (antiProton Unstable Matter Annihilation) is a new experiment at CERN since 2021. It aims to use antiprotons' unique properties to probe the nucleonic structure of both stable and exotic nuclei. After formation of antiprotonic atoms with the isotope of interest, antiprotons will annihilate on the nucleus's surface. This process yields annihilation products whose total electric charge allows to reconstruct the neutron-to-proton ratio on the surface of an isotope. These insights can provide a new perspective for investigating quantum phenomena such as nuclear halos and neutron skins. In order to trap antiprotons with exotic nuclei, PUMA aims to transport up to one billion antiprotons from the AD (Antiproton Decelerator) to the ISOLDE (Isotope Separator On-Line Device) facility.

In this talk, the current status and future plans for the experimental campaign of PUMA at ISOLDE is outlined. PUMA aims to measure before the LS3 the neutron-to-proton annihilation ratio of captured antiprotons in antiprotonic 115-144 Xe to extract a quantitative understanding of how the increasing number of neutrons in the isotopic chain changes neutron skin thickness. For this, a new transfer beamline is currently under construction at ISOLDE. Additionally, other exotic candidates for measurements with the PUMA setup are discussed and the transport of antiprotons from AD to ISOLDE detailed.

HK 55.4 Thu 18:30 HS 2 Physik

Probing the surface of stable nuclei with antiprotons - the first phase of the PUMA experiment — •Moritz Schlaich[1], Alexandre Obertelli[1], Frank Wienholtz[1], Clara Klink[2], Jonas Fischer[1], and Lukas Nies[2] — [1]Technische Universität Darmstadt, Institut für Kernphysik, Darmstadt, Germany — [2]CERN, Genf, Schweiz

PUMA (antiProton Unstable Matter Annihilation) is a new experiment at the Antimatter Factory at CERN since 2021 [1]. It aims to use low-energy antiprotons as a probe for the nucleonic composition on the surface of both stable and exotic nuclei. For this, antiprotons are trapped together with the ions of interest to form antiprotonic atoms. As a result, the antiprotons will annihilate with a proton or a neutron in the tail of the nuclear density distribution. This process yields annihilation products dominated by pions whose total electric charge allows the reconstruction of the isospin distribution and thus provides access to a new observable: the neutron-to-proton annihilation ratio. These insights offer a new perspective for the investigation of quantum phenomena such as nuclear halos and neutron skins.

In the first phase of the experiment, the experimental technique will be applied to stable ions provided by a versatile offline ion source setup. This contribution provides an overview of the current status of the PUMA experiment at the Antimatter Factory and discusses the latest results of the PUMA offline ion source setup.

[1] T. Aumann et al., Eur. Phys. J. A (2022) 58:88
[2] D. Adhikari et al., PREX, Phys. Rev. Lett. 126 (2021) 172502

HK 56: Hadron Structure and Spectroscopy VII

Time: Thursday 17:30–18:45 Location: HS 3 Physik

Group Report HK 56.1 Thu 17:30 HS 3 Physik

Evidence of pentaquark-like states in strangeness photoproduction at the BGOOD experiment — •Antonio Joao Clara Figueiredo for the BGOOD-Collaboration — Physikalisches Institut, Universität Bonn

Exotic multi-quark states have been confirmed in the heavy quark sectors and equivalent structures may be evidenced in the light, uds sector as well.

The BGOOD experiment at the ELSA facility is ideal for the study of strangeness photoproduction in the region of low momentum exchange to the hyperon. BGOOD is comprised of a central calorimeter for neutral meson momentum reconstruction and complemented by a magnetic spectrometer in forward directions for charged particle identification.

Our published results in the strangeness sector suggest a dominant role of meson-baryon dynamics which has an equivalence to the P_C states in the charmed sector. This includes structure in $K^0\Sigma^0$ and $K^+(\Lambda(1405) \rightarrow \pi^0\Sigma^0)$ photoproduction at the K^*Y threshold. Additionally, the differential cross section for $K^+\Sigma^0$ photoproduction at forward angles shows a peak-like structure at the $K^+\Sigma(1385)$ threshold, potentially indicating the formation of a bound molecular state. This is further supported by a peak in $K^+\Sigma(1385)$ exactly at threshold, which is consistent with model calculations of on-shell production of the constituents of molecular states.

Supported by DFG projects 388979758/405882627 and the European Union's Horizon 2020 programme, grant 824093.

HK 56.2 Thu 18:00 HS 3 Physik

Novel constraints for the multi-strange meson-baryon interaction using correlation measurements with ALICE — •Valentina Mantovani Sarti for the ALICE Germany-Collaboration — TUM Department of Physics, Garching, Germany

We present unprecedented correlation measurements involving Λ, Ξ, kaons and pions measured by ALICE in pp collisions at 13 TeV.

Several measurements are presented for the first time, constituting new experimental constraints on the strangeness S=-1,-2 meson-baryon interactions and the nature of exotic states.

The strong interactions involving mesons and baryons with strangeness content delivers a rather broad spectrum of interesting states, arising from the rich interplay between the elastic and inelastic QCD dynamics. The Λ(1405) in the S=-1 sector is an example of such molecular state, but in order to build a solid description of its inner structure more data are needed particularly below the antiKN energy threshold.

Much less experimental data are currently available on another potential molecular state, the Ξ(1620), predicted and observed in the S=-2 meson-baryon sector.

The correlation data we present here constitute new constraints on these sectors and delivers a better understanding on such states. Funded by the Deutsche Forschungsgemeinschaft (DFG) through the grant MA 8660/1 * 1.

HK 56.3 Thu 18:15 HS 3 Physik

Studying the strong nuclear force in the strangeness $S = -1$ sector via $\Lambda\pi$ femtoscopy — •Daniel Battistini for the ALICE Germany-Collaboration — Technical University of Munich, Munich, Germany

Due to its non-perturbative nature at low energies, a deep understanding of the strong force still represents a challenge for the physics community. From the theoretical side, the study of low-energy QCD is typically conducted employing effective field theories (EFT) which are based on low-energy constraints to be anchored to the experimental measurements. Understanding the strangeness $S = -1$ meson-baryon systems is particularly relevant because they are characterised by a rich coupled-channel structure and feature the emergence of dynamically generated states. At present, EFT calculations have been well constrained by experimental data for energies above the K-N threshold. At lower energies, there are tensions among models due to the limited amount of measurements. The study of $\Lambda\pi^+$ and $\Lambda\pi^-$ interactions is so relevant because it allows accessing the K-N sub-threshold energies, leading to new experimental inputs to EFTs. In this contribution, the $\Lambda\pi$ strong interaction is measured using the femtoscopy technique applied to high-multiplicity proton-proton collisions at $\sqrt{s} = 13$ TeV recorded by the ALICE collaboration. Funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) under Germany's Excellence Strategy – EXC-2094 – 390783311.

HK 56.4 Thu 18:30 HS 3 Physik

Hyperon-production in proton-proton collisions at $\sqrt{s}$ = 3.5 GeV with HADES — •Snehankit Pattnaik[1,2], Johan Messchendorp[1], and James Ritman[1,2,3] for the HADES-Collaboration — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH — [2]Ruhr-Universität Bochum — [3]Institut für Kernphysik (IKP) - Forschungszentrum Jülich

This work presents a preliminary analysis of the $\Lambda + K^0_S + p + \pi^+$ final state in proton-proton scattering using data collected at $\sqrt{s} = 3.46$ GeV with HADES at GSI in Darmstadt, Germany. Proton-induced hyperon production studies offer valuable insights into baryon spectroscopy, in particular to understand the coupling strengths of intermediate baryons to hyperon final states and to search for new baryon resonances. Hyperon production provides information about the role of N^* resonances in strangeness production in NN interactions and in elementary reactions as a reference for understanding many-body systems.

In this talk we will present some of the data-driven analysis procedures, including the use of a kinematic fitter to efficiently select the signal for this exclusive state. Additionally, we discuss the results from an analysis that explores the role of intermediate baryons such as Δ^{++}, $\Sigma^*(1385)$ and mesonic excitations, K^* (892). Preliminary results include total and differential cross sections and hints of N^* resonances at this energy, building on earlier studies in related channels.

HK 57: Heavy-Ion Collisions and QCD Phases IX

Time: Thursday 17:30–19:00 Location: HS 3 Chemie

Group Report HK 57.1 Thu 17:30 HS 3 Chemie

Measurement of radius dependent jet suppression and jet-hadron correlations in Pb–Pb collisions at 5.02 TeV with a novel mixed-event approach — •Nadine Alice Grünwald for the ALICE Germany-Collaboration — Heidelberg University, Heidelberg, Germany

The Quark-Gluon Plasma (QGP) is produced in heavy-ion collisions collisions where quarks and gluons are deconfined and new physics phenomena emerge. The ALICE experiment measures heavy-ion collisions at the LHC where the QGP can be studied using jets from partons, which are produced in the early stage of the collisions.

In this talk mixed events as a new approach to describe the uncorrelated background in jet measurements in heavy-ion collisions in ALICE are presented. The resulting charged-particle jet R_{AA} measurements have high precision over a broad kinematic range, reaching significantly lower jet p_T values as compared to the traditional analyses. Various jet resolution parameters are studied to measure the radius dependence of the jet energy loss and thereby the redistribution of the lost energy to the surrounding QGP medium.

We also present measurements of the event plane dependent jet-hadron correlations. Angular correlations of jets are analyzed to obtain information about the energy loss of jets in the medium. The study of these correlation functions for different orientations of the jet to the event plane allows for a measurement of the energy loss which is sensitive to the in-medium path-length of the parton.

HK 57.2 Thu 18:00 HS 3 Chemie

Semi-inclusive hadron-jet momentum distributions using mixed events with ALICE — •Nicola Wilson for the ALICE Germany-Collaboration — Physikalisches Institut, Ruprecht-Karls-Universitaet Heidelberg, Germany

The ALICE experiment at CERN studies the Quark Gluon Plasma (QGP), a state of matter formed at extreme temperatures/densities with partonic degrees of freedom produced in heavy-ion collisions. Jets, generated in the initial hard scatterings, are valuable for probing QGP properties. As they transverse the QGP, their energy and structure are modified by medium interactions.

This work focuses on jets recoiling from high p_T trigger hadrons (h-jets) in central PbPb collisions at $\sqrt{s} = 5.02$ TeV, with different p_T^{trig} intervals analyzed. Jet measurements are challenging due to the large uncorrelated background, particularly at low p_T. To address this, a novel mixed-event technique is applied, where artificial events with uncorrelated tracks are constructed from real events. Jet reconstruction is performed using the anti-k_T algorithm with varying jet radii for both real and mixed events. The mixed event jet p_T distribution is used to correct the background yield in real event jet spectra. Finally, unfolding procedures correct detector and background effects.

We present first results of hadron triggered recoil jet transverse momentum spectra using the mixed-event technique.

HK 57.3 Thu 18:15 HS 3 Chemie

Sexaquark Search in ALICE — •Andrés Bórquez for the ALICE Germany-Collaboration — Heidelberg University

In 2017, G. Farrar proposed the sexaquark, a hypothetical six-quark state with the quark content $uuddss$. This particle is characterised by being neutral, compactly bound, and cosmologically stable within certain mass limits; unique properties that make it a compelling dark matter candidate.

Despite its elusive nature, several experimental collaborations have been searching for evidence of its existence. In particular, this contribution presents an update on its ongoing search within the ALICE experiment at the LHC. The strategy focuses on identifying displaced strangeness production caused by the annihilation of anti-sexaquarks with detector material, following their potential production in heavy-ion collisions (Pb-Pb) during LHC Run 2.

HK 57.4 Thu 18:30 HS 3 Chemie

Event-by-event multiharmonic correlations in Run 3 heavy-ion collisions with ALICE — •Ante Bilandzic for the ALICE Germany-Collaboration — Technical University of Munich

In ultrarelativistic heavy-ion collisions, several nontrivial physics phenomena can lead to persistent event-by-event azimuthal anisotropies in particle distributions, which are traditionally quantified with Fourier harmonics. Besides the standard measurements of individual vn harmonics, further independent information about different stages in heavy-ion collisions can be extracted from multiharmonic correlations, using recently developed Symmetric Cumulants (SC) and Asymmetric Cumulants (AC). These novel observables are particularly suitable for Bayesian studies, after it was demonstrated that they exhibit a better sensitivity to model parameters than the previously used observables. This contribution presents the first differential measurements of SC and AC observables in Run 3 Pb-Pb collisions as a function of kinematic variables.

HK 57.5 Thu 18:45 HS 3 Chemie

Angular Correlations in Jets — •Lars Jörgensen for the ALICE Germany-Collaboration — Technische Universität München

Antinuclei in cosmic rays could be an indicator for dark matter decay. In order to correctly interpret any future measurement of the flux of antinuclei in our galaxy, the formation mechanism of antinuclei must be understood. The coalescence model aims to describe the formation process on a microscopic level by assuming that nucleons close in phase space are likely to form a bound state. A powerful tool to test coalescence is the study of nuclear production in jets since their emission is highly collimated, and therefore the coalescence condition is likely to be fulfilled. In this contribution, a first measurement of angular correlations between (anti)nucleons inside jets will be presented. Further, the yields of (anti)nucleons and (anti)nuclei in jets will be shown. With these ingredients it is possible to make a prediction on (anti)nuclei production in jets using a coalescence model such as ToMCCA. This model shows the expected enhancement of the coalescence parameter B_2 in jets previously observed in other analyses. With this extension to the ToMCCA model it is possible to study nuclei production in point-like systems similar to $e^+–e^-$, which is expected to closely resemble dark matter annihilation. This work was funded by the BMBF 05P24W04 ALICE.

HK 58: Instrumentation XIII

Time: Thursday 17:30–19:00 Location: SR Exp1A Chemie

Group Report HK 58.1 Thu 17:30 SR Exp1A Chemie

The Silicon Tracking System of the CBM experiment: recent progress of the series production and performance in beam experiments — •Dairon Rodriguez Garces for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany

The Compressed Baryonic Matter (CBM) experiment, cornerstone of the Facility for Antiproton and Ion Research (FAIR), focuses on exploring the properties of dense matter under extreme conditions. A key component of CBM is the Silicon Tracking System (STS), the central detector for tracking and momentum measurement of charged particles, designed to measure up to 1000 charged particles in nucleus-nucleus collisions at interaction rate up to 10 MHz, with a free streaming readout. It consists of 8 tracking stations equipped with 876 double sided silicon sensor modules mounted on low-mass carbon fiber ladders.

This report provides an overview of the recent progress in view of the realization of the STS detector: series module and ladder production, including detailed test and characterization of all individual components. It presents insights from beam operation with prototypes installed in the mini-CBM detector at SIS18 and in the E16 experiment at J-PARC, highlighting the capabilities of the detector under realistic conditions.

HK 58.2 Thu 18:00 SR Exp1A Chemie

Performance of hit, track, and vertex reconstruction of the Silicon Tracking System of the CBM experiment — •Dario Alberto Ramirez Zaldivar for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

The Compressed Baryonic Matter (CBM) experiment is one of the experimental pillars at the Facility for Antiproton and Ion Research (FAIR). The Silicon Tracking System (STS) is the core detector for track reconstruction and momentum measurement. It comprises approximately 900 double-sided silicon strip sensors with 1024 strips per side, arranged in 8 tracking stations in a magnetic field of 1 Tm.

The mCBM setup at SIS18/GSI (mCBM@SIS18) is a small-scale precursor of the full CBM experiment. It consists of pre-series productions of all major detector subsystems, aiming to verify CBM's free-streaming readout electronics, data transport, and online reconstruction. The mini-STS (mSTS) setup consists of 12 sensors arranged in 3 stations and no magnetic field.

Heavy ion collisions in the $1-2\ AGeV/c$ range were measured with an average collision rate $of 500\ kHz$. The primary and secondary vertexes are reconstructed. Hit reconstruction efficiency is estimated using correlations with downstream detectors. This contribution will present the performance of hit, track, and vertex reconstruction from measurements of heavy ion collisions.

HK 58.3 Thu 18:15 SR Exp1A Chemie

LGAD Technology for Precise Reaction Time Measurement in Heavy-Ion Experiments, Medical Applications and Detector Diagnostics — •Yevhen Kozymka[3], Thomas Bergauer[2], Tetyana Galatyuk[1,3,4], Albert Hirtl[5], Matthias Kausel[5,6], Mladen Kis[1], Barbara Knäusl[7], Wilhelm Krüger[3], Sergey Linev[1], Jan Michel[1], Jerzy Pietraszko[1], Christian Joachim Schmidt[1], Michael Träger[1], Michael Traxler[1], Felix Ulrich-Pur[1], Matteo Centis Vignali[8], and Ashish Bisht[8] — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH — [2]Austrian Academy of Sciences, Institute of High Energy Physics — [3]Technische Universität Darmstadt — [4]Helmholtz Forschungsakademie Hessen für FAIR — [5]TU Wien, Atominstitut — [6]EBG MedAustron — [7]Medical University of Vienna, Department of Radiation Oncology — [8]Fondazione Bruno Kessler, Centre of Materials and Microsystems

The development of LGAD technology for charged particle detection is currently experiencing significant growth and demonstrating great performance in applications such as reaction time measurement, beam monitoring and ion CT thanks to its excellent timing properties. Preliminary measurements conducted with He and C ions have shown very promising results and great potential for heavy ion applications.

This presentation will focus on the results achieved using LGAD detectors for measuring the time-of-flight of protons as well as He and C ions conducted at the MedAustron institute, and will also showcase an example of using these sensors to diagnose radiation damage in a pcCVD diamond sensor.

HK 58.4 Thu 18:30 SR Exp1A Chemie

Commissioning of a telescope with babyMOSS reference layers for the testing of MAPS chips for ALICE — •Georgios Mantzaridis for the ALICE Germany-Collaboration — Technische Universität München, München, Germany

Monolithic Active Pixel Sensors (MAPS) provide the basis for the next generation of tracking and vertex detectors for the ALICE experiment at CERN. Both the next upgrade of the inner tracking system, ITS3, and the upcoming Outer Tracker for the planned ALICE3 detector will employ this technology. For that, the ALICE Collaboration is developing new sensor prototypes for which an extensive R&D program is conducted to assess the performance and operating parameters. For this purpose, we constructed a testbeam telescope at TUM. It uses six babyMOSS chips as reference planes in addition to the device under test (DUT). This contribution presents the commissioning of the telescope using the 3.2 GeV/c electron beam of the ELSA facility in Bonn. An analogue prototype test structure (APTS) is used as the DUT of which the spatial resolution and efficiency have been measured. This testbeam serves also as a preparation for testing larger pitch APTS, which are prototype sensors for the ALICE3 Outer Tracker and will be available next summer.

This research was supported by the Excellence Cluster ORIGINS funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) under Germany's Excellence Strategy EXC-2094-390783311 and the DFG through the Grant SFB 1258 "Neutrinos and Dark Matter in Astro and Particle Physics".

HK 58.5 Thu 18:45 SR Exp1A Chemie

Readout and Slow Control for Test Detectors — •Tim Molzberger — Physikalisches Institut Albert-Ludwigs Universität, Freiburg im Breisgau

We present the latest developments for the readout and the slow control for test detectors. The readout features silicon photomultipliers for photodetection, coupled with application-specific integrated circuits (ASICs) for signal processing. The ASICs amplify and shape the signals, outputting a digital signal for each channel, along with two sums of the analog signals at different gain levels. A set of sampling ADCs digitizes the summed signals, while a separate set of threshold ADCs extracts timing information from the digital signals. The slow control system configures and monitors both the ADCs and ASICs through a group of controller boards. These boards also supply power to the readout system and maintain consistent gain across all photodetectors over a wide temperature range by employing a feedback loop.

HK 59: Instrumentation XIV

Time: Thursday 17:30–18:45 Location: SR Exp1B Chemie

HK 59.1 Thu 17:30 SR Exp1B Chemie

The New Jet and Static Gas Target System at the Felsenkeller Underground Laboratory — •Anup Yadav[1,2], Konrad Schmidt[1], and Daniel Bemmerer[1] — [1]Helmholtz-Zentrum Dresden-Rossendorf — [2]Technische Universität Dresden

A newly developed windowless gas-target system, tailored to meet the precision measurement demands of modern nuclear astrophysics, has recently been installed at the Felsenkeller underground ion accelerator laboratory. The system can be operated either in jet or static modes. Real-time monitoring of the jet is facilitated by laser interferometry validated by alpha-energy-loss measurements. Areal jet densities of up to 3×10^{18} atoms/cm^2 have been determined. Continuing optimization of the jet-nozzle geometry involves comprehensive computational fluid dynamics simulations. For the extended static gas target setup, pressure and temperature profiles have been measured to construct the density profile. A beam calorimeter is used to measure the beam intensity. The setup has undergone development and testing at the HZDR Rossendorf campus and now is in the commissioning phase at the Felsenkeller underground ion accelerator laboratory.

HK 59.2 Thu 17:45 SR Exp1B Chemie

Commissioning of the First Gas System Line for the CBM-TRD — •Felix Fidorra for the CBM-Collaboration — Institut für Kernphysik Münster, Münster, Deutschland

The Compressed Baryonic Matter (CBM) experiment is a fixed target heavy-ion experiment which is currently under construction at FAIR in Darmstadt. It will explore the QCD phase diagram at high net-baryon densities. The Transition Radiation Detector (TRD) of the CBM experiment will be based on Multi Wire Proportional Chambers (MWPCs) filled with Xe/CO2 85:15 as detector gas. This talk reports on the commissioning of the first regulated line of the future gas system for the CBM-TRD. During operation, the gas flow through the chambers has to be regulated such that the relative pressure in the detector volume stays within -0/+1 mbar. A part of the gas system, as, e.g., the main regulation valves, the circulation pump and the PLC layer will be located in a service level above the experiment. The first gas line, including already the final tube lengths and the PLC controls, has been set up in the laboratories in Münster and test runs of the system have been successfully performed. This work was supported by BMB through ErUM-Pro FSP-T06.

HK 59.3 Thu 18:00 SR Exp1B Chemie

Analysis of the hydrogen cluster sizes using shadowgraphy measurements — •Clara Fischer, Hanna Eick, and Alfons Khoukaz — Institute for Nuclear Physics, University of Münster

The $\overline{\text{P}}$ANDA cluster-jet target will be installed at the High Energy Storage Ring at FAIR and will provide a target thickness of more than 10^{15} atoms/cm^2 at the interaction point, which is more than 2 meters away from the origin.

To study the properties of the cluster beam and the cluster themselves, one can use shadowgraphy measurements. This method is based on the illumination of a cluster beam using a pulsed laser in e.g., the nanosecond regime. By the analysis of the shadowgraphy images, one can determine the cluster sizes, size distribution and investigate the dependency of the clusters on target parameters. This information is of special interest for both the later data analysis and simulation of storage ring data.

Initial shadowgraphy measurements carried out with a Münster cluster-jet target have already demonstrated the feasibility of this method and provided important initial information on cluster sizes. Based on this, more refined and comprehensive measurements will now be carried out to determine the granularity and size distribution of the cluster jets as well as the trajectories of the individual target particles.

This talk gives an overview of the planning and initial realisation of the shadowgraphy measurements in Münster. This research project was supported by the EU Horizon 2020 programme (824093), BMBF (05P21PMFP1) and NRW Netzwerke (NW21-024-E).

HK 59.4 Thu 18:15 SR Exp1B Chemie

Nozzle production and vacuum simulations for the $\overline{\text{P}}$ANDA cluster-jet target — •Michael Weide, Philipp Brand, Sophia Vestrick, Hanna Eick, and Alfons Khoukaz — Institut für Kernphysik, Universität Münster, 48149 Münster, Germany

In antiproton-proton annihilation experiments such as the upcoming $\overline{\text{P}}$ANDA experiment at FAIR, internal targets have a key role as they allow the accelerator beam to be utilized for multiple interactions with the target. Initially, this target will be realized by a cluster-jet target (CJT) operated with H_2, that produces clusters of sizes ≤ 10 microns in diameter.

A challenge of such an experiment is minimizing background reactions due to the costly production of antiprotons, thus good vacuum conditions are mandatory. To study the effect of various residual gas sources such as flash evaporation and beam induced evaporation, vacuum simulations are performed and compared with experimental data.

The core piece of a CJT is a copper Laval nozzle, which was previously produced at CERN. In order to be able to influence the geometry and shape of the nozzle, a manufacturing process is currently being developed at the Institute of Nuclear Physics at the University of Münster. The current status of the process and the first very promising results will be presented.

The research project was supported by EU Horizon 2020 program (824093), BMBF (05P21PMFP1) and NRW Netzwerke (NW21-024-E).

HK 59.5 Thu 18:30 SR Exp1B Chemie

The windowless gas jet target for e-p scattering experiments at MAGIX at MESA: Development and optimization — •Liridon Deda, Philipp Brand, Jost Froning, and Alfons Khoukaz for the MAGIX-Collaboration — Institut für Kernphysik, Universität Münster, 48149 Münster, Germany

The future MAGIX experiment will use the MESA energy-recovering beam in combination with a windowless gas jet target. With this innovative target, a next phase of high-precision measurements with a reduced background compared to previous e-p scattering experiments is possible. The MAGIX gas jet target delivers a thickness of more than 10^{18} atoms/cm^2 at the interaction point when using hydrogen as target material. Providing such a target thickness requires a high gas flow rate at a cryogenic temperature, which is then pressed through a convergent-divergent nozzle. The geometry of the nozzle defines how the target expands, thus influencing the jet target's shape and temperature. Therefore, for further target optimization, numerical simulations of the jet's formation and propagation are necessary to refine the stagnation conditions and nozzle geometry. Additionally, a new approach—the generation of a filament jet structure with the MAGIX gas jet target—to reach even a higher thickness with better vacuum conditions is under development. The setup, performance, and development of the MAGIX gas jet target will be presented and discussed.

This project has received funding from CRC1660 (project number 514321794).

HK 60: Astroparticle Physics VIII

Time: Thursday 17:30–18:30 Location: SR 0.03 Erw. Physik

Group Report HK 60.1 Thu 17:30 SR 0.03 Erw. Physik

First result of the CONUS+ experiment — •Nicola Ackermann for the Conus-Collaboration — Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg

With the CONUS+ reactor antineutrino experiment, the coherent elastic neutrino nucleus scattering (CEνNS) on germanium nuclei is currently studied at the nuclear power plant in Leibstadt, Switzerland. Very low energy thresholds down to 160 eV were achieved in four 1 kg point contact germanium detectors equipped with electric cryocooling. The setup is positioned at a distance of about 20 m from the center of the reactor core. The detector performances and first CONUS+ results after few months of data taking will be presented. In November 2024 three detectors were replaced by newer models with higher Ge crystal masses of 2.4 kg each to further improve the sensitivity of the experiment.

HK 60.2 Thu 18:00 SR 0.03 Erw. Physik

Generating ultra-compact neutron stars with bosonic dark matter — •Sarah Louisa Pitz and Jürgen Schaffner-Bielich — Max-von-Laue Straße 1, D-60438 Frankfurt am Main

Neutron stars with admixed dark matter enable new possibilities in the description of unusal mass and radius measurements, such as e.g. HESS J1731-347. We are including bosonic, self-interacting dark matter with a sufficiently stiff self-interaction potential in the form of $V \propto \phi^n$ and find that these neutron stars become ultra-compact ($C \geq 1/3$). They are compact enough to have a stable photon orbit at their surface or even above, a property that is otherwise exclusively attributed to black holes or hypothetical boson stars. These ultra-compact neutron stars are characterized by small radii of the ordinary matter ($R < 7$ km) and masses of approximately 1.5 $M_\odot$. We furthermore study the stability of these configurations by investigating the onset of unstable radial modes.

HK 60.3 Thu 18:15 SR 0.03 Erw. Physik

Determination of the absolute nuclear transition energies of ^{83m}Kr using the gaseous krypton source of KATRIN — •Matthias Böttcher and Benedikt Bieringer — Institut für Kernphysik, Universität Münster

The KATRIN experiment aims to measure the electron neutrino mass m_ν with 0.3 eV/c^2 (90% C.L.) sensitivity after 1000 measurement days in 2025, by measuring the T_2 β spectrum near its endpoint E_0, and performing a fit including parameters E_0 and m_ν^2. Since these are highly correlated, systematic effects influencing the obtained m_ν will also manifest in E_0 and the derived T_2 Q value. Comparing this with the T–^{3}He mass difference from Penning-trap measurements is therefore valuable for cross checks of our experimental procedure. Determining the KATRIN Q value with high precision requires calibration of the experimental energy scale with ^{83m}Kr conversion electrons. This is limited by knowledge of ^{83m}Kr nuclear transition energies, being known to 0.3 eV precision in the literature. The excited nucleus of ^{83m}Kr decays via a two-step cascade of 32.2 keV and 9.4 keV highly converted γ transitions, and a weak direct transition. With a gaseous Kr source, a measurement of conversion electrons from all three transitions was performed in 2023 at KATRIN. Following the method described in ref. EPJ C 82 (2022) 700 the nuclear transition energies can be determined, which can allow for a reduction of the T_2 Q value uncertainty to 0.1 eV. In this talk, we present the analysis of the measurement. This work is supported by Helmholtz Association and BMBF (grant numbers ErUM-Pro 05A23PMA, 05A23PX2, 05A23VK2, and 05A23WO6).

HK 61: Members' Assembly

Time: Thursday 19:00–20:30 Location: HS 2 Physik

All members of the Hadronic and Nuclear Physics Division are invited to participate.

HK 62: Invited Talks III

Time: Friday 11:00–12:30 Location: Kurt-Alder HS Chemie

Invited Talk HK 62.1 Fri 11:00 Kurt-Alder HS Chemie

New insights into the QCD phase diagram — •Fabian Rennecke — Institut für Theoretische Physik, Justus-Liebig-Universität Giessen

The phase diagram of quantum chromodynamics (QCD) is of paramount importance for nuclear and particle physics. It tells us how nuclear matter emerged from the quark-gluon plasma of the hot early universe and how the dense interior of neutron stars looks like. Through collisions of heavy ions at relativistic energies and multi-messenger signals from neutron stars and their mergers, we can get a glimpse of the QCD phase diagram and, hence, also a glimpse into the inner workings of strongly interacting matter. The region of the phase diagram relevant for the description of the cores of neutron stars and upcoming heavy-ion collision experiments, such as the Compressed Baryonic Matter experiment at FAIR, is largely unknown. However, a lot of progress has been made in recent years in understanding this region. I will discuss some of the latest developments, with a focus on the ongoing search for the critical endpoint of the chiral phase transition, the possibility for crystalline phases in hot and dense QCD matter, and their experimental signatures.

Invited Talk HK 62.2 Fri 11:30 Kurt-Alder HS Chemie

Overview of the BGOOD experiment at ELSA, Bonn — •Rachele Di Salvo for the BGOOD-Collaboration — I.N.F.N., Sezione di Roma Tor Vergata

The BGOOD experiment at the ELSA facility combines a forward spectrometer and a large solid angle central calorimeter, thus providing a hermetic coverage and a unique tool for the detection of both charged and neutral particles. The experiment, complementary to other setups working in the same physics sector, allows a systematic investigation of the nucleon excitation spectrum and the search for the so-called missing resonances, via strange and non-strange meson photoproduction. In the last years focus has been put also on the investigation of unconventional multi-quark states in the (hidden-)strange sector, in analogy to what happens in the (hidden-)charm one, where states interpreted as penta- and tetraquarks have been found. For the investigation of such loosely bound meson-baryon molecular systems, the opportunity (provided by the BGOOD apparatus) to access the low momentum transfer region, where the meson is detected at very forward angles, is crucial. I will give a short overview of the main results obtained at this experiment in the recent years.

Invited Talk HK 62.3 Fri 12:00 Kurt-Alder HS Chemie

Precision experiments with undressed radioactive atoms — •Yury Litvinov — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

Storage of freshly produced secondary particles in a storage ring is a straightforward way to achieve the most efficient use of the rare species as it allows for using the same precious secondary ion multiple times. Employing storage rings for precision physics experiments with highly-charged ions (HCI) at the intersection of atomic, nuclear, plasma and astrophysics is a rapidly developing field of research. The number of physics cases is enormous. In the focus of this presentation will be the most recent results obtained at the heavy-ion rings at GSI in Germany, at IMP in China, and at RIKEN in Japan.

Apart from routinely conducted precision mass measurements of short-lived rare nuclei, storage rings are utilized for investigations of radioactive decays of mass-resolved HCIs. Decay properties of HCIs can be very different from the ones known in neutral atoms: Specific decay channels can be blocked or new ones can become open. Furthermore, in-ring nuclear reaction studies profit from the beam cooling combined with internal ultra-thin ultra-pure windowless gas targets, thereby achieving high angular and energy resolution.

The experiments performed at the operating storage rings will be put in the context of the research programs in a worldwide context, where, thanks to fascinating results obtained, a number of new projects is planned.

Mass Spectrometry Division
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Overview of Invited Talks and Sessions

(Lecture hall HS 2 Chemie; Poster Foyer Physik)

Invited Talks

MS 1.1	Mon	15:00–15:30	HS 2 Chemie	**Recent technical developments and precision mass measurements at Isoltrap** — •Christoph Schweiger
MS 2.1	Mon	16:45–17:15	HS 2 Chemie	**Non destructive mass and lifetime measurement of unstable nuclear states in heavy ion storage rings** — •Shahab Sanjari
MS 4.1	Tue	15:45–16:15	HS 2 Chemie	**A big scale to measure the tiniest mass - closing in on the neutrino mass with the KATRIN experiment** — •Alexander Marsteller
MS 6.1	Thu	11:00–11:30	HS 2 Chemie	**Isobar analysis in the actinide range and the characterization of an isotopic Np spike** — •Andreas Wiederin, Martin Martschini, Aya Sakaguchi, Peter Steier, Karin Hain
MS 8.1	Thu	15:45–16:15	HS 2 Chemie	**LABEC, the INFN-university of florence laboratory of nuclear techniques (IBA and AMS) for environment and cultural heritage** — •Franco Lucarelli
MS 9.1	Thu	17:30–18:00	HS 2 Chemie	**Development of chemical ionization methods based on plasma driven reactant ion production** — •Thorsten Benter, Hendrik Kersten, Walter Wissdorf
MS 10.1	Fri	11:00–11:30	HS 2 Chemie	**Rare-RI Ring facility: tool of precision mass spectrometry of short-lived nuclei** — •Takayuki Yamaguchi

Invited Talks of the joint Symposium Mass matters: Prospects of Bridging Nuclear Physics, Mass Spectrometry, and Astrophysics (SYMM)

See SYMM for the full program of the symposium.

SYMM 1.1	Tue	11:00–11:30	Kurt-Alder HS Chemie	**Mass measurements with RIBs** — •Guy Savard
SYMM 1.2	Tue	11:30–12:00	Kurt-Alder HS Chemie	**LUNA -Experimental challenges in Underground Nuclear Astrophysics Laboratory** — •Alba Formicola
SYMM 1.3	Tue	12:00–12:30	Kurt-Alder HS Chemie	**The r-process: connecting astrophysics and nuclear physics** — •Almudena Arcones

Invited Talks of the joint Symposium Precision Measurements at the Intersection of Atomic and Nuclear Physics (SYPM)

See SYPM at the SAMOP meeting in Bonn for the full program of the symposium

SYPM 1.1	Wed	14:30–15:00	HS 1+2	**Probing new bosons and nuclear structure with ytterbium isotope shifts** — •Tanja Mehlstäubler, Chih-Han Yeh, Henning Fürst, Laura Dreissen
SYPM 1.2	Wed	15:00–15:30	HS 1+2	**Probing the stars: Nuclear astrophysics with stable and radioactive ion beams** — •Ragandeep Singh Sidhu
SYPM 1.3	Wed	15:30–16:00	HS 1+2	**Precision measurements and metrology applications at the borderline between atomic and nuclear physics** — •Adriana Pálffy
SYPM 1.4	Wed	16:00–16:30	HS 1+2	**Atomic parity violation: the seventh decade** — •Dmitry Budker

Sessions

MS 1.1–1.5	Mon	15:00–16:30	HS 2 Chemie	**Heavy and Superheavy Elements**
MS 2.1–2.5	Mon	16:45–18:15	HS 2 Chemie	**New Methods, Technical Development I**
MS 3	Tue	13:00–14:00	HS 2 Chemie	**Members' Assembly**
MS 4.1–4.5	Tue	15:45–17:15	HS 2 Chemie	**Application to Astrophysics**
MS 5.1–5.9	Tue	17:30–19:00	Foyer Physik	**Poster**
MS 6.1–6.5	Thu	11:00–12:30	HS 2 Chemie	**Isobar Suppression Techniques**
MS 7.1–7.3	Thu	14:45–15:30	HS 2 Chemie	**New Methods, Technical Development II**
MS 8.1–8.5	Thu	15:45–17:15	HS 2 Chemie	**Accelerator Mass Spectrometry I**
MS 9.1–9.5	Thu	17:30–19:00	HS 2 Chemie	**Actinide Analysis**
MS 10.1–10.5	Fri	11:00–12:30	HS 2 Chemie	**Accelerator Mass Spectrometry II**

Members' Assembly of the Mass Spectrometry Division

Tuesday 13:00–14:00 HS 2 Chemie

- Report
- Miscellaneous

Sessions

– Invited Talks, Contributed Talks, and Posters –

MS 1: Heavy and Superheavy Elements

Time: Monday 15:00–16:30 Location: HS 2 Chemie

Invited Talk MS 1.1 Mon 15:00 HS 2 Chemie

Recent technical developments and precision mass measurements at Isoltrap — •Christoph Schweiger for the ISOLTRAP-Collaboration — Max-Planck-Institut for Nuclear Physics, Heidelberg, Germany — CERN, Geneva, Switzerland

The Isoltrap experiment [1] is a multi-ion-trap mass spectrometer located at ISOLDE/CERN for high-precision mass measurements of artificially produced, short-lived, exotic radionuclides far from stability. Experimentally, Isoltrap uses multi-reflection time-of-flight and Penning-trap mass spectrometry for absolute and relative mass measurements. Following Einstein's famous mass-energy equivalence, $E = mc^2$, the measured masses can be related to nuclear binding energies which reflect the underlying interactions and structure in the nucleus. Knowledge of the binding energies therefore allows the study of nuclear structure and nuclear astrophysics while precise mass measurements have also applications in fundamental physics such as neutrino or weak interaction studies.

In this contribution, the experimental setup, recent technical developments such as the commissioning of a linear Paul trap for mass-selective re-trapping [2], as well as selected results from recent beamtimes will be presented. These include the neutron-deficient ^{97,98}Cd ground states in vicinity of the self-conjugate doubly-magic ^{100}Sn and the high-lying 25/2+ isomer ^{97n}Cd as well as the first mass measurements of the neutron-rich ^{209,210,212}Hg.

[1] Lunney, D. et al., J. Phys. G: Nucl. Part. Phys. 44, 064008 (2017)
[2] Dickel, T. et al., J. Am. Soc. Mass Spectrom. 28, 1079 (2017)

MS 1.2 Mon 15:30 HS 2 Chemie

Mass Measurements of Actinides at TRIGA-Trap — •Tanvir Sayed[1], Klaus Blaum[1], Michael Block[2,3], Burcu Cakirli[1], Stanislav Chenmarev[1], Christoph Düllmann[2,3], Szilard Nagy[1], and Dennis Renisch[2,3] — [1]Max-Planck-Institut für Kernphysik, Heidelberg, DE — [2]Helmholtz-Institut Mainz, DE — [3]Department Chemie - Standort TRIGA, Mainz, DE

TRIGA-Trap is a high-precision, double Penning-trap mass spectrometer. Masses of actinides including ^{244}Pu, ^{241}Am, ^{243}Am, ^{248}Cm, and ^{249}Cf have been measured using the Phase-Imaging Ion-Cyclotron-Resonance (PI-ICR) technique with parts-per-billion precision [1]. The precise mass measurements allow to explore nuclear structure through trends in mass filters, such as S_{2n} (two-neutron separation energies) and $\delta V_{p,n}$ (average p-n interaction of the most loosely-bound two nucleons), as well as their differentials. Measurements of nuclei in the neutron-deficient Pu isotopic chain – ^{238}Pu, ^{239}Pu, ^{240}Pu, and ^{242}Pu – are in preparation to enhance the current dataset and complement ongoing nuclear structure studies. In particular, the shell evolution with increase in neutron number N towards the N=152 sub-shell closure for proton number Z=94 can be investigated, and the predictive capabilities of nuclear shell models for heavy, deformed nuclei can be assessed. In this talk, an overview of the current status of the experiment, as well as future directions, will be discussed.

References: [1] S. Chenmarev, K. Blaum, M. Block et al. Masses of transuranium nuclides measured with the PI-ICR technique at TRIGA-Trap. Eur. Phys. J. A 60, 204 (2024).

MS 1.3 Mon 15:45 HS 2 Chemie

Analysis and quantification of a transcurium breeding solution after intense neutron irradiation at ORNL via RIMS — •Sebastian Berndt[1], Christoph E. Düllmann[1,2,3], Raphael Hasse[1], Andrea T. Loria Basto[1,2], Christoph Mokry[1,2], Thorben Niemeyer[1], Sebastian Raeder[2,3], Dennis Renisch[1,2], Jörg Runke[1,3], Samantha K. Schrell[4], Matou Stemmler[1], and Klaus Wendt[1] — [1]Johannes Gutenberg University Mainz, Mainz, Germany — [2]Helmholtz-Institut Mainz, Mainz, Germany — [3]GSI, Darmstadt, Germany — [4]Oak Ridge National Laboratory, Oak Ridge, TN, USA

The High Flux Isotope Reactor at Oak Ridge National Laboratory produces trans-Cm samples through intense neutron irradiation. The expected isotope yields are modeled, but these models require experimental benchmark data. In this context, a trans-Cm sample was characterized using α- and γ-spectrometry as well as Resonance Ionization Mass Spectrometry (RIMS) for an isotopically resolved determination of the Np, Pu, Am, Cm and Cf content. Such a characterization of the isotopic composition of a mixed actinide solution by α- and γ-spectrometry can be difficult due to large differences in the half-lives of the individual nuclides ranging from a few up to 10^7 years. In addition, the individual α- or γ-lines of several nuclides overlap. In contrast, RIMS is an efficient and, due to the ionization process, element-selective technique with the capability of resolving the elemental and isotopic composition avoiding such disadvantages. The results of the combined approach of classical radioanalytics and RIMS will be presented.

MS 1.4 Mon 16:00 HS 2 Chemie

Status and prospects for laser spectroscopy with RADRIS — •Kenneth van Beek for the SHE Laser-Collaboration — TU Darmstadt — GSI Helmholtzzentrum für Schwerionenforschung GmbH

The experimental determination of atomic and nuclear properties such as atomic energy levels, ionization potentials, electromagnetic moments, trends in mean-square charge radii, and isotope shifts for nuclei in the region of heavy actinides ($Z \geq 100$) remains limited. The main challenges are low production rates in accelerator facilities and the short half-life of the fusion products. This necessitates the use of highly efficient and selective laser spectroscopy techniques. At GSI-FAIR in Darmstadt, Germany, the **RA**diation **D**etected **R**esonance **I**onization **S**pectroscopy (RADRIS) apparatus has been succesfully used to study aforementioned properties in $^{245,246,248-250,254}$Fm and $^{252-255}$No.

This contribution deals with the latest results with RADRIS, which include laser spectroscopy of $^{152-154}$Tm and, for the first time, of ^{152}Tm. Here, the isotope shift was measured in three different optical transitions. These results are discussed in particular with regard to a planned search for atomic levels in the chemical element Md (Z=101), for which Tm is the chemical homolog.

MS 1.5 Mon 16:15 HS 2 Chemie

High precision laser ionisation spectroscopy with JetRIS at GSI — •Alexandre Brizard for the SHE Laser-Collaboration — GANIL, CEA/DRF-CNRS/IN2P3, Caen, France

Resonance Ionization Spectroscopy (RIS) probes the atomic structure through multi-step laser ionization of neutralised atoms. When performed in a hypersonic gas jet, the technique's precision is enhanced by minimizing Doppler and pressure broadening [1].

At the SHIP velocity filter at GSI, JetRIS utilizes ion guiding and filament neutralization to inject the fusion products into the gas jet [2]. The photoions are studied using an alpha detector for efficient detection with low background. Future upgrades include an MR-ToF-MS, enabling mass-selected ion detection and access to long-lived as well as beta-decaying nuclides.

Following online commissioning in 2022, which revealed a transport efficiency of about 0.2% [3], significant effort has been put in improving the extraction and neutralisation of ions from the stopping gas cell. This work is being carried out in collaboration with KU Leuven.

Here we present the latest developments on the setup in preparation for the beamtime in February 2025.

[1] R. Ferrer et al., Nat Commun, 8, 14520 (2017)
[2] S. Raeder et al., NIMB, 463, 272-276 (2020)
[3] J. Lantis et al., Phys. Rev. Research 6, 023318 (2024)

MS 2: New Methods, Technical Development I

Time: Monday 16:45–18:15 Location: HS 2 Chemie

Invited Talk MS 2.1 Mon 16:45 HS 2 Chemie

Non destructive mass and lifetime measurement of unstable nuclear states in heavy ion storage rings — •Shahab Sanjari — GSI Darmstadt

Storage rings provide a unique experimental environment for non-destructive measurements of the mass and lifetimes of unstable nuclei and/or their isomeric states. With their high resolution, cavity-based Schottky detectors provide the speed and sensitivity required for such measurements. In order to increase the measurement accuracy, the velocity spread of the particles must be addressed. In the past, the electron cooler was used for this purpose. However, since the cooling time is on the order of seconds, efforts have been made to perform measurements of shorter-lived states by tuning the lattice of the storage ring to the isochronous ion-optical mode. During the last beam times, the isochronous mode was successfully used in combination with sensitive and fast non-destructive Schottky detectors (S+IMS method), thus combining the measurement of short lifetimes with high frequency resolution. In order to further improve the accuracy of mass measurements using non-destructive Schottky cavities, the effect of velocity outside the isochronous window needs to be addressed. For this purpose, a novel position sensitive detector structure was simulated, designed and constructed at GSI for use in the R3 storage ring at RIKEN. In this work we describe the successful application of the new combined Schottky and isochronous mass (and lifetime) spectroscopy (S+IMS) method. The experimental setup, used detectors and methods are described and future perspectives are discussed.

MS 2.2 Mon 17:15 HS 2 Chemie

Setup for Technical Development of Resonance Ionization Spectroscopy in Buffer Gases — •Tim van de Vendel[1,2], Michael Block[2,3,4], Julia Even[1], and Sebastian Raeder[2,4] — [1]University of Groningen, The Netherlands — [2]GSI Helmholtzzentrum für Schwerionenforschung, Germany — [3]Johannes Gutenberg University, Mainz, Germany — [4]Helmholtz-Institut Mainz, Germany

A new offline development setup is being established in the laser spectroscopy group of the Superheavy Physics-department at GSI. While the existing RADRIS [1] and JetRIS [2] setups provide efficient, high-precision online measurements, they offer limited flexibility for off-line development studies.

This new setup solves this problem by constructing a novel three-cell design, where atoms are ionized in a pressurized cell and guided into a second cell. Here, a compact RFQ design directs the ions to a detector cell. The setup allows pressures in the first two cells to be easily varied, and the construction simplifies exchange of components.

This setup can be used for a variety of studies including pressure broadening effects in different gases, the extraction efficiency of various electrode designs, and other preparatory studies for online experiments.

An overview of the current status of the setup and future applications are discussed.

[1] F. Lautenschläger et al., NIMB, 383, (2016) 115-122
[2] R. Ferrer et al., Nat Commun, 8, 14520 (2017)

MS 2.3 Mon 17:30 HS 2 Chemie

Recent beam line and vacuum line upgrades at the FRS Ion Catcher — •Leonard Welde[1] and Jiajun Yu[2,3] for the FRS Ion Catcher-Collaboration — [1]Justus-Liebig-Universität Gießen, Gießen, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — [3]Institute of Modern Physics, Chinese Academy of Sciences, Lanzhou, China

At the FRS Ion Catcher, located at GSI, experiments with exotic nuclei are conducted. Exotic nuclei produced and separated at the Fragment Separator (FRS) are stopped in a gas-filled cryogenic stopping cell (CSC), transported via a radio frequency quadrupole (RFQ) beam line, which contains mass filters, to a multiple-reflection time-of-flight mass spectrometer (MR-TOF-MS).
Experiments targeting exotic nuclei with detection rates down to less than one ion per hour demand an as high as achievable transport efficiency from the CSC to the MR-TOF-MS, to be able to get sufficient statistics in a reasonable time frame. Simulations of the RFQ beam line were done, indicating possibilities to improve the transport efficiency by changing the positioning and/or the geometry of different apertures inside the beam line. In addition an upgrade of the pre-vacuum lines was done to be able to achieve higher areal densities in the CSC for future experiments. The results of these recent technical upgrades will be reported in this contribution.

MS 2.4 Mon 17:45 HS 2 Chemie

Simulations of ion transport at the high-density RF Carpet for the Cryogenic Stopping Cell of the Super-FRS — •Nils Steinbrenner[1], Daler Amanbayev[1,2], Timo Dickel[1,2], and Wolfgang R. Plass[1,2] — [1]II. Physikalisches Institut, Justus-Liebig Universität, Gießen, Deutschland — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Deutschland

In the context of the Super-FRS at FAIR, the Cryogenic Stopping Cell (CSC) is responsible for decelerating and stopping exotic ion beams produced at relativistic energies. The CSC's design is constrained by the need to achieve exceptionally high areal gas densities, up to 40 mg/cm^2, which presents significant challenges in ion extraction. The RF carpet, a critical component in this process, experiences decreased efficiency in ion capture and transport at high gas densities. To optimize the RF carpet's performance, detailed ion trajectory simulations were conducted. This contribution presents recent investigations into various RF-carpet geometries and explores the influence of the gap-to-electrode ratio on ion transport efficiency, with the ultimate goal of enhancing the RF carpets functionality for future CSC configurations.

MS 2.5 Mon 18:00 HS 2 Chemie

Comparing a Conventional and an Improved Faraday Cup in an Element-Specific Analysis for Ion Beam Current Measurements — •Sarah Oehler[1], Sebastian Berndt[1], Vadim Gadelshin[1], Raphael Hasse[1], Christoph E. Düllmann[1,2,3], Tom Kieck[2,3], Nina Kneip[1], and Klaus Wendt[1] — [1]Johannes Gutenberg-Universität, Mainz — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt — [3]Helmholtz-Institut, Mainz

Faraday cups are crucial tools for ion beam current measurements in mass spectrometry, at accelerators or storage rings. Comparative measurements at the RISIKO mass separator facility in Mainz using γ-spectroscopy indicated a systematic underestimation of the ion beam current, leading to the implementation of a new Faraday cup design. This new design provides an optimized geometry and an adapted material composition for significantly improved suppression of any charged secondary particles. Within the experiment, primary ions of various elements along the Periodic Table were measured on both a conventional and the improved Faraday cup. The results show that for non-alkali and non-alkaline earth metals, the improved Faraday cup reduces loss of sputtered particles by an average of 24.8% compared to the conventional design at 200 V repeller voltage. Further, for alkali and alkaline earth metals the corrections were observed to reach above 50% with respect to the conventional design.

MS 3: Members' Assembly

Time: Tuesday 13:00–14:00 Location: HS 2 Chemie

All members of the Mass Spectrometry Division are invited to participate.

MS 4: Application to Astrophysics

Time: Tuesday 15:45–17:15 Location: HS 2 Chemie

Invited Talk MS 4.1 Tue 15:45 HS 2 Chemie

A big scale to measure the tiniest mass - closing in on the neutrino mass with the KATRIN experiment — •Alexander Marsteller for the KATRIN-Collaboration — Karlsruher Institut für Technologie, Karlsruhe, Deutschland

The neutrino mass is a fundamental parameter with profound implications for cosmology, shaping structure formation in the universe, and offering a gateway to physics beyond the Standard Model. The kinematics of weak decays provide the only model-independent laboratory approach to determine the absolute neutrino mass scale.

The KArlsruhe TRItium Neutrino experiment (KATRIN) aims to measure the mass of the electron anti-neutrino via high-precision beta-decay spectroscopy of tritium. KATRIN combines a high-luminosity, windowless gaseous molecular tritium source with an electrostatic spectrometer employing magnetic adiabatic collimation. This setup achieves eV-scale energy resolution while maintaining a large accepted solid angle. Since commencing measurements in 2019, KATRIN has achieved stable and precise operation, recently establishing the most stringent direct upper limit of 0.45 eV (90% C.L.) for the neutrino mass.

This presentation will highlight results from the most recent data release and gives an overview of current and future KATRIN activities beyond the neutrino-mass measurement. The talk will conclude with an outlook on KATRIN's remaining path to its 0.3 eV sensitivity goal, and long-term perspectives for pushing neutrino mass measurements in the laboratory by at least another order of magnitude in sensitivity.

MS 4.2 Tue 16:15 HS 2 Chemie

Using metastable C^- ions to infer limits on room temperature radiation in the Cryogenic Storage Ring — •Mira Newe, Manfred Grieser, Florian Grussie, Oldřich Novotný, Viviane C. Schmidt, Aigars Znotiņš, and Holger Kreckel — Max-Planck-Institut für Kernphysik, Heidelberg, Germany

In order to investigate molecular processes of astrophysical relevance the Cryogenic Storage Ring (CSR) is operated at very low temperatures (~ 4 K). In this low black-body radiation field molecules can cool to their lowest rotational states. Nevertheless, small radiation leaks, as e.g. by laser viewports or beamline ports, lead to a slightly elevated radiation field with a small room temperature component [1]. For future experiments and new detector developments it is important to quantify this room temperature component. To probe the room temperature contribution we measured the lifetime of metastable C^- anions in the highly excited ^2D states, which can be photodetached by room temperature radiation. Using the method of laser probing we measured the radiation-limited lifetime of the metastable ions at cryogenic temperatures. Corresponding measurements were also made at room temperature (without laser probing) to verify previous results [2]. The results and implications will be presented and discussed.

[1] C. Meyer *et al.*, Phys. Rev. Lett. 119, 02320 (2017)
[2]T. Takao *et al.*, J. Phys. Conf. Ser. 88, 012044, (2007)

MS 4.3 Tue 16:30 HS 2 Chemie

Interstellar ^{60}Fe in Antarctic Ice Tracing the Local Interstellar Cloud — •Annabel Rolofs[1], Dominik Koll[1,2,3], Florian Adolphi[4], Sebastian Fichter[1], Maria Hörhold[4], Johannes Lachner[1], Stefan Pavetich[2], Georg Rugel[1], Stephen Tims[2], Sebastian Zwickel[1,3], and Anton Wallner[1,2,3] — [1]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany — [2]Australian National University, Canberra, Australia — [3]TUD Dresden University of Technology, Dresden, Germany — [4]Alfred-Wegener-Institut, Bremerhaven, Germany

^{60}Fe ($t_{1/2}$=2.6 Myr) is formed in massive stars and can be transported to Earth if embedded into interstellar dust grains. Previous studies found ^{60}Fe in million-year-old marine archives and on the Moon. A recent influx of interstellar ^{60}Fe was discovered in Antarctic surface snow and with sediment data it was shown that this recent influx extends back to at least 33 kyr ago. The solar system entered a denser substructure of the otherwise thin Local Bubble about 40 kyr ago, the Local Interstellar Cloud (LIC).
To investigate a connection between the entry into the LIC and an interstellar ^{60}Fe influx, 295 kg of continuous flow analysis water from the EDML ice core in Antarctica, spanning 40 - 80 kyr BP, were analysed. A suite of cosmogenic radionuclides, ^{10}Be, ^{26}Al, ^{41}Ca and ^{53}Mn, was measured by accelerator mass spectrometry to assess any potential losses of interstellar ^{60}Fe. The cosmogenic radionuclide abundance as well as the amount of interstellar ^{60}Fe deposited into Antarctic ice will be discussed and a connection to the LIC will be drawn.

MS 4.4 Tue 16:45 HS 2 Chemie

Interstellar Radionucildes in Lunar Regolith Tracing Supernova and *r*-Process Events — •Sebastian Zwickel[1,2], Sebastian Fichter[1], Michael Hotchkis[3], Dominik Koll[2], Johannes Lachner[1], Marc Norman[4], Stefan Pavetich[4], Georg Rugel[1], Konstanze Stübner[1], Stephen Tims[4], and Anton Wallner[1,2] — [1]HZDR, Dresden, Germany — [2]TU Dresden, Germany — [3]ANSTO, Sydney, Australia — [4]ANU, Canberra, Australia

The search for live interstellar radionuclides on Earth and the Moon via accelerator mass spectrometry provides valuable insights into the history and dynamics of our galaxy. The detection of ^{60}Fe in deep-sea archives has shown that two supernova explosions occurred in the solar neighbourhood during the last 10 Myr. While lunar regolith lacks time resolution, it offers an integral measurement of interstellar radionuclide deposition over the last few to several hundred million years. Interstellar ^{60}Fe in lunar regolith already provided a clearer understanding of the total amount of ^{60}Fe arriving on Earth and the Moon. Further insight into the evolution of the solar neighbourhood could be realised using ^{244}Pu as a probe. This radionuclide provides a signal essentially only derived from *r*-process events that occurred in the last few hundred million years, and could shed light on the heavily disputed astrophysical sites of the *r*-process. This project aims to simultaneously measure ^{60}Fe and ^{244}Pu in lunar regolith, with the goal of linking them to nearby supernova and *r*-process nucleosynthesis events. I will show the importance of cosmogenic radionuclides for this research and present new preliminary results on ^{60}Fe in lunar regolith.

MS 4.5 Tue 17:00 HS 2 Chemie

Challenges in the extraction of ^{182}Hf from geological archives — •Sebastian Fichter[1], Dominik Koll[1], Sebastian Zwickel[1], Martin Martschini[2], Silke Merchel[2], Laurenz Widermann[2], Robin Golser[2], and Anton Wallner[1] — [1]HZDR, Dresden, Germany — [2]University of Vienna, Faculty of Physics, Austria

The identification and measurement of the astrophysically relevant radionuclide ^{182}Hf ($t_{1/2}$ = 8.9 * 10^6 yr) in different geological archives would significantly advance our understanding of potential *r*-process sites, especially when its abundance is compared to other nucleosynthesis radionuclides such as ^{60}Fe and ^{244}Pu over time. In this work, we present our recent efforts to develop a suitable chemical protocol to extract ^{182}Hf from various sample matrices including deep-sea ferromanganese crusts. The main objective of this work is to maintain a high chemical yield while separating other elements as much as possible. Special attention is paid to the suppression of the stable isobar ^{182}W, which is yet one of the limiting factors preventing the actual measurement of live ^{182}Hf using Accelerator Mass Spectrometry (AMS). This work is partly funded by ChETEC-INFRA.

MS 5: Poster

Time: Tuesday 17:30–19:00 Location: Foyer Physik

MS 5.1 Tue 17:30 Foyer Physik

An experimental setup to study collisions of molecular ions using the 4k-pixel microcalorimeter detector MOCCA and follow-up integration into the Cryogenic Storage Ring CSR — •Selina Gaisser[1], Christian Enss[2], Andreas Fleischmann[2], Lisa Gamer[1], Oded Heber[3], Daniel Hengstler[2], Christopher Jakob[3], Daniel Kreuzberger[2], Ansgar Lowack[2], Abdullah Özkara[2], Micheal Rappaport[3], Andreas Reifenberger[2], Dennis Schulz[2], Abhishek Shahi[3], Yoni Toker[4], Andreas Wolf[1], and Oldřich Novotný[1] — [1]MPIK Heidelberg — [2]KIP Heidelberg University — [3]Weizmann Institute of Science, Rehovot, Israel — [4]Bar-Ilan University, Ramat Gan, Israel

One key process for the formation of over 300 molecular species detected in the InterStellar Medium (ISM) is Dissociative Recombination (DR). For a better understanding of this reaction, experimental studies under conditions similar to those in the ISM are necessary. A facility capable of such conditions and measurements is the electrostatic Cryogenic Storage Ring (CSR) at the Max Planck Institute for Nuclear Physics in Heidelberg. To obtain precise data, a detector which collects neutral DR products with high energy, time and position resolution is essential. Therefore, the 4k-pixel MOleCule Camera Array (MOCCA) based on Metallic Magnetic Calorimeters was designed and fabricated at the Kirchhoff Institute for Physics in Heidelberg. MOCCA will first be implemented in a CSR-independent standalone setup, where collisions between ions and a gas jet will be studied. The current status of the project will be presented.

MS 5.2 Tue 17:30 Foyer Physik

Recent technical developments and measurements at ISOLTRAP — •Paul Florian Giesel for the ISOLTRAP-Collaboration — Universität Greifswald, Institut für Physik, Greifswald, Deutschland

The ISOLTRAP setup at ISOLDE/CERN is a high-precision mass spectrometer designed to measure the masses of short-lived, exotic radionuclides far from the valley of stability. Utilizing both multi-reflection time-of-flight (MR-ToF) and Penning-trap mass spectrometry, ISOLTRAP performs precise absolute and relative mass measurements. Converting these measured masses into nuclear binding energies (via the mass-energy equivalence) provides critical insights into the underlying nuclear forces and structures.

This contribution will present the current status of ISOLTRAP and highlight recent technical developments, such as the implementation of a second linear Paul trap to rebunch mass-selected ion beams and the addition of a temperature-stabilization system for the MR-ToF mass spectrometer. Recent beamtime results will also be shown, focusing on the neutron-deficient ^{97,98}Cd ground states in the vicinity of the doubly-magic ^{100}Sn and the ^{97m}Cd isomeric state, as well as the first mass measurements of the neutron-rich ^{209,210,212}Hg.

MS 5.3 Tue 17:30 Foyer Physik

Investigation of a New Control Loop for the Stability of the Cologne 10 MV AMS System — •Marcus Sickmöller, Markus Schiffer, Gereon Weingarten, and Dennis Mücher — Institute for Nuclear Physics, University of Cologne

This work focuses on improving the voltage stability of the 10 MV tandem accelerator at the University of Cologne for improved Accelerator Mass Spectrometry (AMS) measurements. AMS requires pulsed ion beams with highly stable beam energies for precise isotopic ratio measurements, such as Fe-60 and Mn-53. Until now, the slit control mode, which offers superior long-term voltage stability (50-100 V/MV compared to 500-1000 V/MV in the Generating Voltmeter (GV) mode), could not be utilized due to the pulsed nature of AMS beams.

In this research project, modifications to the accelerator enabled the slit control mode to be applied for the first time with pulsed beams. A comparative analysis showed that the slit control mode significantly reduces beam instability caused by voltage fluctuations, enhancing measurement precision. However, challenges were observed during extended non-active pulse times, indicating areas for further optimization.

This work provides a starting point for improving terminal voltage stability in pulsed beam operation, making it comparable to that of non-pulsed beams.

MS 5.4 Tue 17:30 Foyer Physik

Ion-optical and optical measurements of the Anion Laser Isobar Separator - ALIS — •Derin Schmidt[1], Stefan Heinze[1], Oscar Marchhart[1,2,3], Dennis Mücher[1], and Markus Schiffer[1] — [1]University of Cologne, Institute for Nuclear Physics, Germany — [2]University of Vienna, Faculty of Physics, Isotope Physics, Austria — [3]University of Vienna, Vienna Doctoral School in Physics, Vienna, Austria

As the detection of trace amounts of certain nuclides via Accelera- tor Mass Spectrometry (AMS) is highly dependent on the suppression of isobars, the Anion Laser Isobar Separator (ALIS) was installed at the University of Cologne for element-selective photo-detachment and buffer-gas reactions. The ion-optical system of the ion source and the injector magnet was characterized by beam profile measurements, and the results were compared to simulations. The ion source efficiency was measured for ^{12}C, ^{27}AlO, $^{88}SrF_3$, and ^{35}Cl. An 18W continuous-wave 532 nm laser was installed, and transmission tests were conducted with the optical system to prepare for its future application in element- selective photo-detachment.

MS 5.5 Tue 17:30 Foyer Physik

Advancing AMS-based techniques for ultra-trace detection of ^{99}Tc — •Stephanie Adler[1,2], Martin Martschini[1], Dennis Mücher[3], Erik Strub[3], Thomas C. Meisel[4], and Karin Hain[1] — [1]University of Vienna, Faculty of Physics, Austria — [2]University of Vienna, Vienna Doctoral School in Physics, Austria — [3]University of Cologne, Institute for Nuclear Physics, Germany — [4]Montanuniversität Leoben, Austria

Determination of absolute concentrations of the anthropogenic radionuclide ^{99}Tc ($t_{1/2}$=2.1×10^5 yr) in environmental samples by accelerator mass spectrometry (AMS) requires the suppression of the stable isobaric background of ^{99}Ru and a reliable normalisation method. Classical AMS of ^{99}Tc at the Vienna Environmental Research Accelerator (VERA) yielded a reproducibility of 15% for normalisation to $^{93}Nb^{4+}$. We achieved a detection limit of 2×10^9 atoms ^{99}Tc when correcting for the ^{99}Ru background by monitoring ^{101}Ru. With the addition of the Ion-Laser InterAction Mass Spectrometry (ILIAMS) setup, a better $^{99}RuF_5^-$ suppression of up to 10^5 can be achieved. Previously, this method showed poor reproducibility, but we have finally improved the reproducibility from 50% to 15% by optimisation of ion source parameters. At the Montanuniversität Leoben, isobar suppression was tested using a thermal ionisation source. By extracting $^{99}TcO_4^-$ ions, a ^{99}Ru suppression factor of 10^6 was achieved. The feasibility of normalisation with a ^{97}Tc spike is investigated. To produce the spike, a Nb foil was irradiated with a $^7Li^{3+}$ beam at the Institute for Nuclear Physics in Cologne yielding > 5×10^{12} atoms of ^{97}Tc.

MS 5.6 Tue 17:30 Foyer Physik

AMS-detection of ^{182}Hf: Characterization of new low-level reference materials and cross-contamination experiments — •Laurenz Widermann[1], Martin Martschini[1], Silke Merchel[1], Sebastian Fichter[2], Dominik Koll[2,3], Johannes Lachner[2], Johannes H. Sterba[4], Anton Wallner[2], and Robin Golser[1] — [1]University of Vienna, Faculty of Physics, Austria — [2]HZDR, Dresden, Germany — [3]TUD Dresden University of Technology, Dresden, Germany — [4]TRIGA Center Atominstitut, TU Wien, Vienna, Austria

To detect the potentially supernova-produced radionuclide ^{182}Hf ($t_{1/2}$ = 8.9·10^6 yr) as low as 2.2 · 10^4 atoms per ferromanganese crust sample with Accelerator Mass Spectrometry (AMS), the stable isobar ^{182}W needs to be suppressed by six orders of magnitude.

Ion-Laser InterAction Mass Spectrometry (ILIAMS) in Vienna allows suppression of $^{182}WF_5^-$ by a factor of 10^5. New low-level reference materials prepared from a known activity of ^{182}Hf, with ^{182}Hf/^{180}Hf ratios between 10^{-13}–10^{-11}, were characterized and cross-checked against ViennaHf-10 and ViennaHf-11. These previously used materials have too high ^{182}Hf/^{180}Hf ratios (> 10^{-10}) to allow measurements at the 10^{-14} level expected from crust samples.

New isobar spikes for correcting A = 182 counts for residual ^{182}W were investigated at the AMS-facilities in Vienna and Dresden. Sputtering targets spiked with varying amounts of tungsten revealed both short-term cross-contamination and long-term memory effects.

This work is supported by ChETEC-INFRA (H2020 #101008324).

MS 5.7 Tue 17:30 Foyer Physik

Multi-Actinide Analysis on Air Filters Collected in Different Environmental Settings — •Mihails Pavlenko, Helinä Poutamo, Nathalie Schuster-Bourgin, and Karin Hain — University of Vienna, Faculty of Physics, Austria

The earth's surface was labelled with human-produced long-lived actinides deposited as nuclear weapons fallout in the 1950s and 1960s, and, more locally restricted, by emission from the nuclear industry and major nuclear accidents. Until today, they take part in redistribution processes and are re-mobilized in the form of aerosols. The signals of the anthropogenic actinides ^{233,236}U, ^{237}Np,^{239,240,241}Pu, and ^{241}Am have been studied in air filters using Accelerator Mass Spectrometry (AMS) at the Vienna Environmental Research Accelerator (VERA). Samples provided by Deutscher Wetterdienst had been collected at various locations in Germany which suggest a different aerosol composition.

In this context, a chemical procedure preparing U, Pu and Np together in the same AMS target is being developed. First results e.g. on the chemical recovery, were compared to our routine preparation protocol of separating U from Pu and Np, respectively. The parallel analysis of Pu and U is within reach thanks to the efficient suppression of neighbouring masses in the actinide region at VERA.

MS 5.8 Tue 17:30 Foyer Physik

AMS for long-lived cosmogenic radionuclides in stony meteorites - Now without chemical preparation — •Silke Merchel, Oscar Marchhart, Martin Martschini, Alexander Wieser, and Robin Golser — University of Vienna, Faculty of Physics, Austria

Long-lived radionuclides in meteorites are a result of the interaction with cosmic rays. These cosmogenic nuclides (CNs) record the history of extraterrestrial matter. Reconstruction parameters of interest are: 1. pre-atmospheric size and shielding depth of the body in space (meteoroid); 2. irradiation time in space; 3. identification of complex exposure, i.e., repeated collisions or inherited CNs from pre-exposure at the surface of the meteoroid's parent body (asteroid, Moon, Mars); 4. residence time on Earth (terrestrial age). Accelerator mass spectrometry (AMS) is the preferred method for the detection of CNs such as ^{10}Be, ^{14}C, ^{26}Al, ^{36}Cl, and ^{41}Ca ($t_{1/2}$ = 6 ka – 1.4 Ma). However, tedious radiochemical separation to deplete matrices and isobars has been essential for AMS preventing rapid analysis until recently. Now, the unique Ion-Laser InterAction Mass Spectrometry (ILIAMS) system at the Vienna Environmental Research Accelerator provides isobar suppression of up to 14 orders of magnitude. Thus, ILIAMS-assisted AMS, allows the direct detection of ^{26}Al/^{27}Al (~10^{-10}) and ^{41}Ca/^{40}Ca (~10^{-11}) in stony meteorites containing intrinsic ~1% Al and Ca. Isobars of the naturally-abundant elements (~15% Mg, ~0.1% K) do not interfere, making radiochemical separation redundant. Recent examples are the German and Austrian meteorite falls of Elmshorn, Ribbeck (Bischoff et al., *MAPS* 2024a/b) and Kindberg.

MS 5.9 Tue 17:30 Foyer Physik

Recurring Routine Measurements at DREAMS - Status and Challenges — •Georg Rugel, Toralf Döring, Sebastian Fichter, Klemens Kirsch, Dominik Koll, Johannes Lachner, Annabel Rolofs, Konstanze Stübner, Alexander Wieser, Stella Winkler, Janis Wolf, René Ziegenrücker, Sebastian Zwickel, and Anton Wallner — Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany

DREAMS, the DREsden AMS-facility in operation since 2011 is based on a 6 MV tandetron (manufactured by High Voltage Engineering Europa) and shared with other research groups at the Helmholtz-Zentrum Dresden-Rossendorf (HZDR). DREAMS has been used primarily for the measurement of the cosmogenic isotopes ^{10}Be and ^{26}Al. Over the years, we have improved the AMS facility in various aspects for increased performance, particularly for these two isotopes. In this poster we will give details on the performance of our routine measurements over the past 13 years of operation with a focus on the impact of methodological developments since 2021. We will present our recent investigations and improvements on the performance of ^{10}Be and ^{26}Al measurements, highlight remaining key challenges, and point to potential future optimisations. Finally, we will show a comparison of our in-house standards material for ^{26}Al with the standards provided by Nishiizumi (KNSTD) demonstrating the compatibility of our analytical results with exposure-age calculators such as CRONUS-Earth.

MS 6: Isobar Suppression Techniques

Time: Thursday 11:00–12:30 Location: HS 2 Chemie

Invited Talk MS 6.1 Thu 11:00 HS 2 Chemie

Isobar analysis in the actinide range and the characterization of an isotopic Np spike — •Andreas Wiederin[1,2,3], Martin Martschini[1], Aya Sakaguchi[4], Peter Steier[1], and Karin Hain[1] — [1]University of Vienna, Faculty of Physics, Isotope Physics Austria — [2]University of Vienna, Vienna Doctoral School in Physics, Austria — [3]Austrian Academy of Sciences, Austria — [4]University of Tsukuba, Institute of Pure and Applied Sciences, Japan

^{237}Np is the second most abundant anthropogenic actinide in the environment and has great potential as an environmental tracer. An isotopic Np spike would solve the problem of normalization for mass spectrometric ^{237}Np measurements in a robust and reliable manner. Such a material has been produced via the ^{232}Th(^{7}Li,3n)^{236g}Np reaction at the Nishina AVF cyclotron (<10^{10}at ^{236g}Np). The co-production of the isobars ^{236}U, ^{236}Pu presented a challenge for the spike characterization since no AMS facility could distinguish isobars in this high mass range. An approach that combines AMS (Accelerator Mass Spectrometry), AFIA (Anion Formation Isobar Analysis) and the first non-chemical isobar separation in the actinide range in AMS using ILIAMS (Ion Laser InterAction Mass Spectrometry) has been developed to characterize a Np spike candidate. This pilot spike has been applied to a selection of environmental samples to analyze ^{237}Np. This work was funded by the Austrian Science Fund (FWF): [I-4803-N], a Dimitrov Fellowship of the Austrian Academy of Sciences, and supported by the Vienna Doctoral School in Physics, the Japanese Society for the Promotion of Sciences, and the ERAN network.

MS 6.2 Thu 11:30 HS 2 Chemie

Investigations on ILIAMS isobar suppression for non-routine AMS isotopes — •Martin Martschini[1], Denis Ibrahimovic[1], David Krebs[1], Oscar Marchhart[1], Silke Merchel[1], Thorben Niemeyer[2], Raphael Haase[2], Klaus Wendt[2], and Karin Hain[1] — [1]University of Vienna, Faculty of Physics - Isotope Physics, Austria — [2]Johannes Gutenberg-University, Mainz, Germany

The Ion-Laser InterAction Mass Spectrometry (ILIAMS) setup at Vienna offers unique opportunities for atomic isobar suppression in AMS via element-selective laser photodetachment. Over the past years, several studies on the ILIAMS performance for rather exotic AMS isotopes like ^{32}Si, ^{44}Ti, ^{59}Ni, ^{60}Fe, and ^{107}Pd ($t_{1/2} = 60 - 7\times10^6$ yr) were carried out, fueled by interest in these isotopes from nuclear astrophysics and environmental sciences. First, screening campaigns of oxide and fluoride molecular anions to identify systems suited for suppression of S, Ca, Co, Ni and Ag, respectively, were conducted using our fixed-frequency lasers of typically 10 – 20 W output power. Subsequently, negative ion yields of several of these anions in a Cs-sputter ion source were investigated. Additionally, measurement campaigns with tunable Ti:Sa and OPO lasers have recently been started to pin down unknown detachment energies of further promising systems. This work was partly supported by ChETEC-INFRA (EU H2020 #101008324).

MS 6.3 Thu 11:45 HS 2 Chemie

New light in Cologne: low-energy isobar suppression for trace isotopes — •Markus Schiffer[1], Oscar Marchhart[1,2,3], Derin Schmidt[1], Ferhat Altun[1], Stefan Heinze[1], Natasha Kalanke[1], Martin Martschini[2], Timm-Florian Pabst[1], Peter Steier[2], Gereon Weingarten[1], Erik Strub[4], Robin Golser[2], Tibor Dunai[5], and Dennis Mücher[1] — [1]University of Cologne, Institute for Nuclear Physics, Germany — [2]University of Vienna, Faculty of Physics, Isotope Physics, Austria — [3]University of Vienna, Vienna Doctoral School in Physics, Vienna, Austria — [4]University of Cologne, Institute for Nuclear Chemistry, Germany — [5]University of Cologne, Institute for Geology and Mineralogy, Germany

CologneAMS has successfully implemented a new low-energy isobar suppression unit, the Anion Laser Isobar Separator (ALIS), to improve and expand the detection of trace amounts of isotopes for scientists that apply the AMS technique for their geologic, environmental, archaeological, nuclear chemical, and nuclear astrophysical research. The new infrastructure ALIS consists of four major sections: anion beam formation and mass selection, anion cooling and isobar suppression, ion-beam transport to the 6 MV AMS system and finally an 18 W 532 nm continuous wave laser. We will report on the detailed design and the status of ALIS. First beams are transmitted through ALIS and we will show initial physics cases, with a focus on geological and environmental aspects, that are feasible with the achieved transmissions and characteristics of the setup.

MS 6.4 Thu 12:00 HS 2 Chemie

Installation and characterization of the new ion cooler beamline at the 1 MV AMS facility in Dresden — •Johannes Lachner[1], Alexander Wieser[1,2], Robin Golser[2], Stefan Findeisen[1], Thilo Hauser[3], Timo Kirschke[1], Markus Meyer[1], Allan O'Connor[3], Carlos Vivo-Vilches[1,2], Nicole Wagner[1], Gerald Wedel[1], Stella Winkler[1], and Anton Wallner[1] — [1]Helmholtz-Zentrum Dresden-Rossendorf — [2]Universität Wien, Fakultät für Physik — [3]National Electrostatics Corp.

The AMS system HAMSTER (Helmholtz Accelerator Mass Spectrometer Tracing Environmental Radionuclides) will be installed at HZDR in 2025. This 1 MV facility includes an additional injection line for the purpose of isobar suppression with an ion cooler, the so-called Ion Linear Trap for Isobar Suppression (ILTIS). The beamline was installed in 2024 and its operation with the new ion cooler has started. The design of the ion cooler follows the system used for Ion-Laser InterAction Mass Spectrometry (ILIAMS) at the University of Vienna. An important update is the segmentation of the electrodes inside the cooler. This modular design allows the ion cooler to be operated as a single system or split into multiple radiofrequency quadrupole (RFQ) sections, which gives us more control of the ion energy. Within the RF circuit, the additional inductivity can be continuously adjusted. This simplifies the trap's adaptation for different frequencies.

Our presentation will cover a description of the new injection line and results from first experiments with the cooled ion beam and the characterization of the Paul trap using ion beams of Cl^- and Cu^-.

MS 6.5 Thu 12:15 HS 2 Chemie

Photodetachment measurements of negatively charged molecules and element separation at VERA — •T. Niemeyer[1], S. Berndt[1], Ch. E. Düllmann[1,2,3], O. Forstner[4,5], K. Hain[6], R. Hasse[1], K. Hens[7], M. Martschini[6], S. Merchel[6], M. Stemmler[8], and K. Wendt[1] — [1]Johannes Gutenberg-Universität Mainz — [2]Helmholtz-Institut Mainz — [3]GSI Darmstadt — [4]Friedrich-Schiller-Universität Jena — [5]Helmholtz-Institut Jena — [6]Universität Wien — [7]Hübner GmbH & Co. KG, Division HÜBNER Photonics, Kassel — [8]Institut für Radioökologie und Strahlenschutz (IRS), Leibniz Universität Hannover

Detection limits of 16 orders of magnitude in isotope ratios and isobaric suppression make Acccelerator Mass Spectrometry (AMS) the method of choice for ultra-sensitive trace analysis in various fields such as radiometric dating, nuclear astrophysics and geology. However, isobaric interferences still challenge ultrarare isotope measurements, e.g., of Mn-53 which is used for long-term geological and extraterrestrial dating or Fe-60 as an indication of supernovae remains found on Earth.

To suppress interfering isobar anions such as CrO on mass 53, tunable light sources, based on Ti:Sa and OPO technology, were used for the first time at the ILIAMS cooler at the low-energy side of the VERA AMS facility at the University of Vienna. Here we report on measurement of laser photodetachment curves for various oxide anions such as FeO, NiO, MnO, CrO and TiO, delivering useful molecular physics data as well as predictions on the expected isobaric suppression of e.g. MnO against CrO for AMS applications.

MS 7: New Methods, Technical Development II

Time: Thursday 14:45–15:30 Location: HS 2 Chemie

MS 7.1 Thu 14:45 HS 2 Chemie

Optimizing ToF-SIMS Analysis Conditions for Detecting Antibiotics in Frozen Hydrated Samples — •Michael Bäumer, Thorsten Adolphs, Richard Erling Peterson, Bonnie June Tyler, and Heinrich Franz Arlinghaus — University of Münster, Münster, Germany

In order for most biological specimens to be analyzed with ToF-SIMS, either the water must be removed via a process such as freeze-drying or the samples must be frozen and analyzed under cryogenic conditions. Cryogenic preparation and analysis of biological samples preserves the 3-dimensional structure of tissues and biofilms and can prevent migration artifacts that occur during freeze-drying. However, ToF-SIMS analysis of frozen aqueous sample systems results in a spectrum of pure and non-pure water ice cluster ions, extending to high masses, which can interfere with detection of biomolecules. Furthermore, metastable decay of the cluster ions in the time-of-flight analyzer can lead to a high background that raises the detection limit for target analytes. In this study, we have investigated the influence of a range of analytical parameters, including primary ion species, cluster size, analysis temperature and analyzer voltages, on the spectrum of water ice mixed with typical biological sample preparation additives such as dextran, ammonium formate, acetic acid and the antibiotic ciprofloxacin. The aim of this work is to optimize analysis conditions in order to improve the detection limit for antibiotic compounds. We also provide an outlook on further reduction of background signals by the destruction of water ice clusters using a 157 nm excimer laser.

MS 7.2 Thu 15:00 HS 2 Chemie

Status of the MR-ToF MS for JetRIS for laser spectroscopy of heavy actinides at GSI/HIM — •J. Weyrich[1,2,3], M. Block[1,2,3], A. Brizard[4], C. Helmel[2,3], D. Münzberg[1,2,3], P. Fischer[5], S. Raeder[1,2], D. Rodríguez[7], M. Schlaich[6], L. Schweikhard[5], K. Wendt[3], and F. Wienholtz[6] — [1]GSI, Darmstadt, DE — [2]Helmholtz-Institut, Mainz, DE — [3]JGU, Mainz, DE — [4]GANIL, Caen, France — [5]Universität Greifswald, Greifswald, DE — [6]Technische Universität, Darmstadt, DE — [7]Universidad de Granada

Research on heavy and superheavy elements enhances our understanding of the nuclear structure, as these elements exist just due to nuclear shell effects. These elements are radioactive, with short half-lives, and produced only in limited quantities. As a result, techniques like Resonant Ionization Spectroscopy (RIS) play a crucial role in studying atomic spectra to determine atomic and nuclear properties. The in-gas Jet Resonant Ionization Spectroscopy (JetRIS) experiment at GSI in Darmstadt, Germany, allows spectroscopy of heavy elements on minute amounts and with a spectral resolution of down to 260 MHz. JetRIS currently utilizes α-decay detection to selectively measure isotopes achieving low to zero background. However, this method is not suitable for long-lived isotopes or those without an α-decay branch. Thus, a Multi-Reflection Time-of-Flight Mass Spectrometer (MR-ToF MS) [DOI: 10.1016/j.ijms.2023.117166] will be integrated into the JetRIS setup enabling ion detection through mass-to-charge ratio separation. This contribution will discuss the MR-ToF MS setup, its commissioning status, and the latest experimental results.

MS 7.3 Thu 15:15 HS 2 Chemie

TOFControl, a data acquisition and analysis software system for multiple-reflection time-of-flight mass spectrometry (MR-TOF-MS) — •Makar Simonov and Julian Bergmann for the FRS Ion Catcher-Collaboration — Justus-Liebig-Universität Gießen, Gießen, Germany

TOFControl is a software system that was developed to perform high-accuracy measurements utilizing MR-TOF-MS techniques in analytical chemistry at the Justus-Liebig University (JLU), Giessen, Germany and in accelerator-based physics research centers at GSI, Darmstadt, Germany and TRIUMF, Vancouver, Canada. The software allows to control timing settings and data acquisition hardware, monitor and optimise measurement performance. In addition, it is equipped with various tools for the interpretation and evaluation of mass spectra including data adjustment, peak detection, and recognition procedures.

In this talk, an overview of the TOFControl functionality for the acquisition and analysis of mass spectrometry data will be given. Several examples illustrating the software's capabilities to perform filtering, identification, and mass measurement of atomic and molecular ions will be provided.

MS 8: Accelerator Mass Spectrometry I

Time: Thursday 15:45–17:15 Location: HS 2 Chemie

Invited Talk MS 8.1 Thu 15:45 HS 2 Chemie

LABEC, the INFN-university of florence laboratory of nuclear techniques (IBA and AMS) for environment and cultural heritage — •Franco Lucarelli — Department of Physics and Astronomy and INFN, Firenze, Italy

The LABEC laboratory, located in the Scientific and Technological Campus of the University of Florence, is the joint INFN-University of Florence laboratory of nuclear techniques (mainly Ion Beam Analysis (IBA) and Accelerator Mass Spectrometry (AMS)) for environment and cultural heritage. Although those techniques are well-established, a strong effort is put on their upgrade, making them suitable for more and more applications. The laboratory is based on a 3 MV Tandetron accelerator. There are many beam lines; in particular one is devoted to IBA application to Cultural Heritage, one to IBA applications for the study of atmospheric aerosol composition, one to AMS applications, mainly 14C dating with the graphite sample masses down to a few tens of μg of carbon (also for modern art objects). Switching between IBA and AMS operation is very easy and fast, which gives high flexibility in programming the activities. The facilities presently available at the LABEC laboratory, their technical features and some success stories of recent applications will be presented.

MS 8.2 Thu 16:15 HS 2 Chemie

Sample size series for CO_2 measurements with an EA-IRMS-GIS-AMS system at CologeAMS — •Martina Gwozdz[1], Stefan Heinze[1], Janet Rethemeyer[2], Markus Schiffer[1], and Dennis Mücher[1] — [1]University of Cologne, Institute for Nuclear Physics, Cologne, Germany — [2]University of Cologne, Institute for Geology and Mineralogy, Cologne, Germany

CO_2 sample materials such as soil samples or wood samples measured with AMS can be very versatile and often only little material is available. At CologneAMS we want to measure precise ^{14}C data in the ranges of approximately 5-100 μg of carbon. Most importantly, ultra-small samples containing approximately 2-20μg of carbon, need to be measured reliably and with a constantly low background. At CologneAMS we established a connection between an elemental analyser (EA), an isotope ratio mass spectrometer (IRMS) and the 6MV AMS system of CologneAMS as well as an existing gas interface (GIS) to measure these small CO2 samples. This setup provides a fully automated, online-analysis of ^{14}C/^{12}C, and it delivers precise values for δ^{13}C. We will present the first CO_2 sample size series of Ox-II standard measured with this system. Additionally, with the collaboration of the Dendrochronology laboratory in Cologne we want to use this system to establish a routine process for radiocarbon dating of pine trees, with the goal to improve dendrochronological archives in the ages of 13.000 years.

MS 8.3 Thu 16:30 HS 2 Chemie

Exposure dating using AMS of ^{36}Cl isotopes in $CaSO_4$ -containing sediments and evaporites — •Natasha Goaba Kalanke[1], Markus Schiffer[2], Erik Strub[3], Gregory Campbell Hillhouse[1], Michael Staubwasser[4], Steven Binnie[4], and Dennis Muecher[2] — [1]Department of Physics and Astronomy, Botswana International University of Science and Technology — [2]Institute of Nuclear Physics, University of Cologne — [3]Institute of Nuclear Chemistry, University of Cologne — [4]Institute of Geology and Mineralogy, University of Cologne

The cosmogenic nuclide ^{36}Cl is valuable for exposure dating due to its long half-life of 3.013E5 years, enabling accurate geochronological timelines. This study measures isotopic ratios of ^{36}Cl, ^{35}Cl and ^{37}Cl focusing on under-utilized gypsum ($CaSO_4$.2H2O) due to overlapping isotopic mass interference from ^{36}S. We are developing a novel chemical preparation method to suppress isobaric ^{36}S and enhance chlorine yield as AgCl(~80-90%), validated by Inductively Coupled Plasma-Optical Emission Spectroscopy (ICP-OES). The Anion Laser Isobar Separator (ALIS), employs laser photo-detachment principles for isobar suppression and ^{36}Cl transmission. Furthermore, ions are cooled within an advanced radiofrequency quadrupole (RFQ) system with a high-power 532 nm continuous-wave laser (>10 W). Initial ALIS transmission measurements with chemically optimized samples will be presented, along with the chemical protocol, and integration of ALIS to a 6 MV Tandem accelerator for improved ion beam emittance and superior isobar suppression.

MS 8.4 Thu 16:45 HS 2 Chemie

Advanced chemical sample preparation of soil and concrete for AMS measurements of ^{90}Sr — •Oscar Marchhart[1,2,3], Markus Schiffer[3], Martin Martschini[1], Silke Merchel[1], Melisa Maslo[3], Erik Strub[3], Laura Frost[4], Tibor Dunai[3], Dennis Mücher[3], and Robin Golser[1] — [1]University of Vienna, Faculty of Physics, Austria — [2]University of Vienna, Vienna Doctoral School in Physics, Austria — [3]University of Cologne, Faculty of Mathematics and Natural Sciences, Germany — [4]JEN Jülicher Entsorgungsgesellschaft für Nuklearanlagen mbH, Germany

An advanced sample preparation method for measuring ^{90}Sr ($T_{1/2}$ = 28.91 a) by Accelerator Mass Spectrometry (AMS) in soil and concrete samples has been developed. Based in general on published recipes, it increases the AMS measurement efficiency of ^{90}Sr for soil samples by 50% within the first hour of sputtering time. As earlier and newly prepared SrF_2 have the same chemical yield, we interpret the higher ion source output as less CaF_2 and other contaminations in SrF_2. For the first time concrete samples have been processed with chemical yields of SrF_2 >90% for AMS measurements. These were performed using the unique Ion-Laser InterAction Mass Spectrometry (ILIAMS) setup at the Vienna Environmental Research Accelerator (VERA), which achieves an isobar suppression of >10^{12} for ^{90}Zr. The sample preparation and AMS measurements were validated using IAEA reference materials for soil, and with known LSC results for concrete. Within 1-sigma the AMS results are in good agreement and yield results for samples below the LSC limit due to the low detection limit of <0.1 mBq.

MS 8.5 Thu 17:00 HS 2 Chemie

Actinide work at MILEA during 2024 — •Habacuc Pérez-Tribouillier[1], Marcus Christl[1], Nuria Casacuberta[2,1], and Chrisrof Vockenhuber[1] — [1]Laboratory of Ion Beam Physics, ETH Zürich, Switzerland — [2]Department of Environmenta Systems Sciences, ETH Zürich, Switzerland

Among the main applications of the Multi-Isotope Low-Energy AMS (MILEA) system is the precise measurement of various elements within the actinide group. This work provides a comprehensive overview of studies conducted in 2024 that utilized actinide measurements performed at MILEA, with a particular emphasis on their contributions to Environmental Sciences. These studies address a broad spectrum of topics, ranging from the analysis of oceanographic processes to the assessment of direct and long-term environmental impacts of nuclear incidents. The versatility, extremely low background, and excellent sensitivity of MILEA enable ultra-low-level determinations, providing valuable insights into the transfer of actinides among different environmental compartments.

MS 9: Actinide Analysis

Time: Thursday 17:30–19:00 Location: HS 2 Chemie

Invited Talk MS 9.1 Thu 17:30 HS 2 Chemie
Development of chemical ionization methods based on plasma driven reactant ion production — •Thorsten Benter, Hendrik Kersten, and Walter Wissdorf — University of Wuppertal, Wuppertal, Germany

Earlier this year, the DPG/professional association mass spectrometry (MS), and the German Society for Mass Spectrometry (DGMS) have reinitiated a collaboration initiative with the goal of fostering current and future research efforts regarding MS, particularly at research institutions, and providing a larger platform for the communication of related results. One tool in this collaboration is the mutual invitation of keynote speeches at the annual conferences of both societies; this contribution is the first in a hopefully long line of future DPG/DGMS interactions.

This talk begins with a brief outline of the current research efforts at the institute for pure and applied mass spectrometry (ipaMS) and the Physical and Theoretical chemistry (PTC) at the university of Wuppertal. We will then discuss selected applications of low to medium pressure, low power plasmas in recently developed chemical ionization (CI) methods used in MS. Some of these methods are tailored towards operation in highly specialized environments, e.g., atmospheric chemistry or semiconductor production research, whereas others have been commercialized, e.g., in the ecTOF of the Swiss company TOFWerk. The latter approach is discussed in more depth, as electron and chemical ionization is (uniquely) running in parallel, providing correlated molecular (CI) and structural (EI) mass spectrometric data.

MS 9.2 Thu 18:00 HS 2 Chemie
Resonant Laser Ionisation Mass Spectrometry on hot particles from the Thule area — •Paul Hanemann[1], Tobias Weissenborn[1], Aaron Lehnert[1], Jixin Qiao[2], Sven Nilsen[2], and Clemens Walther[1] — [1]Leibniz University Hannover, IRS — [2]Technical University of Denmark

In resonant Laser-ionisation Secondary Neutral Mass Spectrometry (rL-SNMS) a set of lasers is used to selectively ionize atoms of a specific element for ToF-MS analysis. This method combines sub-micron spatial resolution with excellent elemental selectivity while keeping the sample structurally intact. In previous work [1-3], rL-SNMS was used for the characterisation of individual nuclear fuel fragments from the Chornobyl Exclusion Zone. To prove the versatility of rL-SNMS we applied this method to samples from the Thule area in Greenland, where a bomber carrying four thermonuclear bombs crashed in 1968. Individual hot particles were isolated from soil samples. In traditional SIMS analysis of Thule hot particles by Ranebo et al. [4] isobaric interferences posed a significant challenge. In this work isobaric interference free rL-SNMS measurements were performed successfully on multiple particles. The particles contain both weapons grade plutonium (240Pu/239Pu > 0.05) as well as highly enriched uranium (235U/238U > 1.0). The adaption of rL-SNMS from fragments of nuclear fuel to hot particles from nuclear weapon material shows the versatility of this method and its applications for nuclear forensics.

[1] DOI: 10.1126/sciadv.abj1175
[2] DOI: 10.1016/j.sab.2022.106377
[3] DOI: 10.1016/j.jhazmat.2023.131338
[4] DOI: 10.1017/S1431927607070353

MS 9.3 Thu 18:15 HS 2 Chemie
Nuclear Forensic Analysis of a single Chornobyl Hot Particl via Advanced Mass Spectrometry Techniques — •Laura Leifermann[1], Greg Balco[2], Autumn Roberts[2], Paul Hanemann[1], Tobias Weissenborn[1], Wolfgang Schulz[1], Manuel Raiwa[2], Martina Klinkenberg[3], Felix Brandt[3], Michael Savina[2], Brett Isselhardt[2], and Clemens Walther[1] — [1]Leibniz University Hannover, Hannover, Germany — [2]LLNL, Livermore, USA — [3]Forschungszentrum Jülich, Jülich, Germany

In the field of nuclear forensics, clarifying the origin and age of an unknown sample is the central question and common practice. Nuclear fuel samples rise to a number of new questions regarding burn-up, degree of enrichment, and operational conditions during the service life. The resonant-laser-SNMS method is ideally suited for this purpose. Actinides, fission and breeding products can be analyzed isotope and element selective. If this is combined with noble-gas-MS, many insights can be gained about a fuel sample. This provides a complete picture of the age, burn-up, neutron flux densities during reactor operation and source of a sample. The ratio of U-235/U-238 of a special particle from Chornobyl is 1,22% which indicates a relative low burn-up and matches the Xe-136(131+132) isotope ratios. This is in contrast to the Xe-134(131+132) ratio which indicates a high Pu-fission. This work addresses a unique particle that has raised questions that can be solved by a synthesis of different mass spectrometric analysis techniques.

MS 9.4 Thu 18:30 HS 2 Chemie
Isotopic purification of trans-uranium tracers using RIMS at RISIKO and their characterization with AMS (I) — •Raphael Hasse[1], Sebastian Berndt[1], Christoph E. Duellmann[1,2,3], Sebastian Raeder[2], and Klaus Wendt[1] — [1]Johannes Gutenberg-Universität Mainz, Mainz, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — [3]Helmholtz-Institut Mainz, Mainz, Germany

Ultra-sensitive accelerator mass spectrometry is regularly used to quantify low levels of actinide concentrations as well as isotopic ratios in environmental samples. Actinide quantification relies on a relative measurement to an added mono-isotopic spike of the respective element. Standard solutions are available at the required purity (up to 10^{-7}) for elements such as U, Pu and Am. However, no corresponding commercial high-purity spike solution exists so far for the trans-uranium elements Np and Cm. In this project, we establish a novel isotopic purification and characterization of isotopic spikes using a combination of RIMS and AMS starting with ^{248}Cm and later extending it to ^{236}Np.

Here, we present this novel isotopic purification approach, carried out at the RISIKO laser mass separator facility in Mainz, using element and isotope selective resonance ionization by two tuneable Ti:Sa lasers. For suitable isotopic purification of a ^{248}Cm spike, an efficient two step ionization scheme was developed. In this way, an overall efficiency well above 10% with a suppression of the neighbouring isotope ^{247}Cm by about 300 was achieved.

MS 9.5 Thu 18:45 HS 2 Chemie
Isotopic purification of trans-uranium tracers using RIMS at RISIKO and their characterization with AMS (II) — •Dominik Koll[1,2], Sebastian Fichter[2], Michael Hotchkis[3], and Anton Wallner[1,2] — [1]TUD Dresden University of Technology, Dresden, Germany — [2]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany — [3]Australian Nuclear Science and Technology Organisation, Lucas Heights, Australia

Ultra-sensitive accelerator mass spectrometry is regularly used to quantify low levels of actinide concentrations as well as isotopic ratios in environmental samples. Actinide quantification relies on a relative measurement to an added mono-isotopic spike of the respective element. Standard solutions are available at the required purity (up to 10^{-7}) for elements such as U, Pu and Am. However, no corresponding commercial high-purity spike solution exists so far for the trans-uranium elements Np and Cm. In this project, we establish a novel isotopic purification and characterization of isotopic spikes using a combination of RIMS and AMS starting with ^{248}Cm and later extending it to ^{236}Np.

Here, we present the characterization of an isotopically purified ^{248}Cm spike using AMS. A dilution series of purified ^{248}Cm with the initial ^{248}Cm solution containing certified amounts of Cm isotopes was measured for isotopic ratios to quantify the purified ^{248}Cm amount. High-sensitivity measurements of the purified spike were carried out for A=244,247 isotopes to assess the isotopic purity. A suppression factor of about 300 for the neighbouring isotope ^{247}Cm was achieved.

MS 10: Accelerator Mass Spectrometry II

Time: Friday 11:00–12:30 Location: HS 2 Chemie

Invited Talk MS 10.1 Fri 11:00 HS 2 Chemie
Rare-RI Ring facility: tool of precision mass spectrometry of short-lived nuclei — •Takayuki Yamaguchi — Saitama University, Saitama 338-8570, Japan

Today challenge is to precisely measure atomic masses of short-lived exotic nuclei, which contribute to the understanding of nuclear structure evolution, various interactions and symmetries, and astrophysical observations. The Rare-RI Ring (R3) facility is a unique storage ring facility coupled with the cyclotron complex through the high-energy fragment separator BigRIPS at the RIKEN RI beam factory [1]. Ions of interest are in-flight selected and are individually injected in the storage ring where the precision isochronous condition is realized. The event-by-event data processing is performed with information from auxiliary detectors at the BigRIPS. Thus obtained revolution times of stored ions provide the mass-to-charge ratios. Since successful developments of the related devices, several commissioning and physics runs have been conducted; a highlight is the masses in the vicinity of the r-process nucleosynthesis [2]. In this talk, I will overview the BigRIPS-R3 facility and physics programs and will discuss possible extensions and collaborations in the future.

[1] D. Nagae et al., Phys. Rev. C 110, 014310 (2024).
[2] H.F. Li et al., Phys. Rev. Lett. 128, 152701 (2022).

MS 10.2 Fri 11:30 HS 2 Chemie

Upgraded LE side of the 6 MV Tandem Accelerator — •Christof Vockenhuber, Matthias Schlomberg, Thorben Wulff, Urs Ramsberger, Lukas Wacker, and Marcus Christl — Laboratory of Ion Beam Physics, ETH Zürich, Switzerland

At ETH, six AMS facilities are in operation, spanning terminal voltages from as low as 50 kV up to 6 MV. In the past decades, the focus of the instrumental development at the laboratory had been on the small, compact AMS system with the aim of making AMS measurements easier, more affordable and more precise. Yet, a few radionuclides still need larger accelerators for sufficient isobar separation, such as Cl-36 or Si-32. Some of the developments at the small AMS systems can be beneficial for the larger machines. Based on these experience we have rebuilt the LE side of the 60-year-old 6 MV EN Tandem accelerator over the past two years. A key part is the MICADAS-type ion source with some refinements for the need of the radionuclides measured at this accelerator. Especially the target design and the target position system were improved. The upgraded system will be presented and the performance, in particular the ion source output and cross talk, for the key-radionuclide Cl-36 discussed.

MS 10.3 Fri 11:45 HS 2 Chemie

Detecting Environmental ^{231}Pa Using Accelerator Mass Spectrometry — •Janis Wolf[1], Marcus Christl[2], Sebastian Fichter[1], Habacuc Perez Tribouillier[2], Stella Winkler[1], and Anton Wallner[1] — [1]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany — [2]ETH Zürich, Laboratory of Ion Beam Physics (LIP), Zürich, Switzerland

While many actinides (e.g., ^{236}U, ^{239}Pu, ^{241}Am) are routinely measured in environmental samples using accelerator mass spectrometry (AMS), the naturally occurring radionuclide ^{231}Pa ($t_{1/2}$ = $3.28 \cdot 10^4 a$) is not among them, even though it has been shown that its AMS detection limit is in the lower femtogram range[1]. Challenges in the measurement of ^{231}Pa include the complicated sample preparation and the lack of a long-lived isotope that one could use for normalization.

We developed chemical sample preparation procedures for environmental water and sediment samples, proven successful by our first beam time using MILEA at ETH Zürich. We could achieve a great abundance sensitivity on the mass 231, with no significant background contriburion of ^{232}Th. We also investigated complications caused by the short-lived ^{233}Pa ($t_{1/2}$ = 26.98 days), used for normalization. The ingrowth of ^{233}U in our samples causes a lower ^{231}Pa/^{233}X ratio to be measured, as UO^- has up to 10 times higher negative ion formation efficiency than PaO^- in the ion source. This needs to be accounted for by measurement of standards.

[1] M. Christl et al., Nucl. Instrum. Methods Phys. Res., B 262 (2007) 379

MS 10.4 Fri 12:00 HS 2 Chemie

ILIAMS assisted AMS measurements of long-lived radionuclides produced in fusion environment — •Carlos Vivo-Vilches[1], Esad Hrnjic[1], Martin Martschini[1], Lee W. Packer[2], Silke Merchel[1], Johannes H. Sterba[3], Karin Hain[1], and Robin Golser[1] — [1]University of Vienna, Faculty of Physics, Vienna, Austria — [2]UKAEA, Culham Campus, Abingdon, United Kingdom — [3]Center for Labelling and Isotope Production, TRIGA Center Atominstitut, TU Wien, Austria

To reliably assess the radionuclide inventories of future nuclear fusion reactors, foils of different materials were irradiated with deuterium-tritium neutrons in the Joint European Torus (JET) reactor, followed by γ-measurements of short-lived radionuclides. The activities of long-lived radionuclides are too low for radiometric techniques. At the Vienna Environmental Research Accelerator (VERA), the potential of AMS for the detection of ^{91}Nb ($T_{1/2} = 680$ a), ^{94}Nb ($T_{1/2} = 20300$ a) and ^{93}Mo ($T_{1/2} = 4839$ a) is investigated. These three radionuclides are produced in Mo-containing materials, e.g. stainless steel SS316. Their measurement requires the use of VERA's Ion-Laser InterAction Mass Spectrometry (ILIAMS) setup for laser photodetachment to suppress their respective stable isobars: ^{91}Zr, ^{94}Zr and ^{94}Mo, and ^{93}Nb. For ^{91,94}Nb, NbO_3^- is selected for ILIAMS. Suppression of $^{91,94}ZrO_3^-$ is observed just by collisions with the He buffer gas. This suppression is enhanced by photons from a 355 nm laser, which also suppress $^{94}MoO_3^-$ by a factor 3900. For ^{93}Mo, MoO_2^- is selected, while isobaric $^{93}NbO_2^-$ is suppressed a factor $>10^6$ by our new 637 nm laser.

MS 10.5 Fri 12:15 HS 2 Chemie

Developments towards detection of ^{26}Al at ALIS — •Ferhat Altun, Markus Schiffer, Stefan Heinze, Timm-Florian Pabst, Gereon Weingarten, and Dennis Muecher — Institute for Nuclear Physics, University of Cologne, Germany

To expand the list of measurable isotopes for AMS, the Anion Laser Isobar Separator (ALIS) was installed at CologneAMS. The system uses element-selective photo-detachment for the suppression of the high abundant isobars. The process of laser isobar interaction requires the superposition of a high intense laser with the anion beam. For the decoupling of the laser and the anion beam, an electrostatic deflector with a hole in the outer electrode is used. Holes in electrodes of electrostatic devices lead to unwanted field inhomogeneities. Therefore, we developed an additional correction electrode for electrostatic deflectors, that is able to correct the inhomogeneity and hence ensures a precise energy filtering. In this talk, the electric field measurements of the electrostatic deflector will be presented including our newly developed measurement technique. The main focus of the ALIS setup is the measurement of environmental (^{90}Sr, ^{135}Cs), and cosmogenic isotopes (^{26}Al, ^{41}Ca). For the benchmark test of the new setup, we measured the efficiency and level of detection of an isotope that is routinely measured at CologneAMS, which can be improved for the users of the facility. Therefore, we aim to measure ^{26}Al with ALIS by use of the prolific molecular injection (AlO^-) where the suppression of ^{26}MgO is required. The measured ionization efficiencies of the ion beams will be discussed during the talk.

Working Group "Young DPG"
Arbeitskreis junge DPG (AKjDPG)

Simon Neuhaus
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Overview of Tutorials, Invited Talks, and Sessions

(Lecture halls HS 2 Physik and HS 3 Physik)

Tutorials

AKjDPG 1.1	Mon	9:00–10:00	HS 3 Physik	**Overview talk on hadron and nuclear physics for young scientists** — •Jana N. Guenther
AKjDPG 1.2	Mon	10:00–11:00	HS 3 Physik	**Overview of nuclear astrophysics** — •Artemis Spyrou
AKjDPG 1.3	Mon	11:00–12:00	HS 3 Physik	**Massenspektrometrie und Radioaktivität: Eine Erfolgsstory!** — •Clemens Walther

Physicists Beyond Academia

AKjDPG 2.1	Tue	19:00–19:25	HS 2 Physik	**Von Teilchen zu Raketen** — •Steffen Schaepe
AKjDPG 2.2	Tue	19:25–19:50	HS 2 Physik	**Of course we can do that: Working as a data science consultant and software developer in mechanical engineering** — •Lena Linhoff
AKjDPG 2.3	Tue	19:50–20:15	HS 2 Physik	**Leaving Academia: A Failure? Or the Best Decision I Ever Made?** — •Edoardo Mornacchi

Sessions

AKjDPG 1.1–1.3	Mon	9:00–12:00	HS 3 Physik	**jDPG Tutorials**
AKjDPG 2.1–2.3	Tue	19:00–21:30	HS 2 Physik	**Physicists Beyond Academia**

Sessions

– Invited and Contributed Talks –

AKjDPG 1: jDPG Tutorials

Time: Monday 9:00–12:00 Location: HS 3 Physik

Tutorial AKjDPG 1.1 Mon 9:00 HS 3 Physik

Overview talk on hadron and nuclear physics for young scientists — •Jana N. Guenther — University of Wuppertal, Germany

An introduction to selected topics in the fields of hadron and nuclear physics is provided, offering insights through the perspective of a researcher specializing in heavy-ion physics with lattice QCD. This overview is particularly designed for early-career scientists, including MSc and PhD students, to support their exploration of key concepts and help them to navigate the various sessions at the DGP meeting.

Tutorial AKjDPG 1.2 Mon 10:00 HS 3 Physik

Overview of nuclear astrophysics — •Artemis Spyrou — Michigan State University, East Lansing, MI, USA

This talk will serve as an introductory overview of the field of nuclear astrophysics. The field addresses questions associated with the life and death of stars, the extreme conditions found in stellar cores and the synthesis of the chemical elements we see around us. To address these questions, a multidisciplinary approach is needed, which combines astronomical observations, astrophysical models, nuclear experiment and nuclear theory. I will discuss the interplay between the different sub-disciplines and focus, in particular, on the contributions of experimental nuclear physics. How do we identify the nuclear properties that have an impact on a particular astrophysical process? How accurate should these properties be measured? What can we do if a direct measurement is not currently feasible? These and other questions will be discussed in this overview talk, preparing junior researchers for a week of an exciting immersion into current research in nuclear astrophysics (and more).

Tutorial AKjDPG 1.3 Mon 11:00 HS 3 Physik

Massenspektrometrie und Radioaktivität: Eine Erfolgsstory! — •Clemens Walther — Leibniz Universität Hannover, Institut für Radioökologie und Strahlenschutz

Was fällt einem so bei Radioaktiviät ein? Schreckliche Dinge wie Unfälle, Bomben, Ätommüll"? Oder eher positive Anwendungen in der medizinischen Diagnose und Therapie, den Materialwissenschaften, physiklaischer Grundlagenforschung und nicht zuletzt CO2 arme Stromerzeugung? In allen genannten Themen spielt Massenspektrometrie eine kaum wegzudenkende Rolle. In diesem Tutorial geht es von Spurenanalytik z.B. zur Untersuchung von Meeresströmungen, über Aufnahme von Radionukliden in Pflanzen und die Nahrung bis zur nuklearen Forensik - und alles im Rahmen aktueller Forschung!

AKjDPG 2: Physicists Beyond Academia

Time: Tuesday 19:00–21:30 Location: HS 2 Physik

Invited Talk AKjDPG 2.1 Tue 19:00 HS 2 Physik

Von Teilchen zu Raketen — •Steffen Schaepe — Deutsche Raumfahrtagentur im DLR

Die Deutsche Raumfahrtagentur im DLR nimmt für die Bundesregierung hoheitliche Aufgaben auf dem Gebiet der Raumfahrt eigenverantwortlich wahr. Dazu gehört die Durchführung eigener Missionen, die Förderung von Forschung und Entwicklung in Industrie und Wissenschaft sowie die Vertretung der Bundesrepublik in internationalen Raumfahrtgremien (ESA, EU, etc.).

Die Abteilung ”Raumtransportsysteme” kümmert sich insbesondere um alle Belange, die mit Trägerraketen im weitesten Sinne zu tun haben. Insbesondere ist die Abteilung auch für die deutschen Beteiligungen an den europäischen Trägerprogrammen (Ariane, Vega, etc.) verantwortlich.

In meinem Vortrag werde ich kurz die Raumfahrtagentur vorstellen, ein Wenig zu den aktuellen Themen und Schwerpunkten im Bereich der Trägerraketen in Europa erzählen, sowie die Frage beantworten, wie und wieso ich als Teilchenphysiker in diesem Umfeld gelandet bin.

Invited Talk AKjDPG 2.2 Tue 19:25 HS 2 Physik

Of course we can do that: Working as a data science consultant and software developer in mechanical engineering — •Lena Linhoff — Point 8 GmbH, Dortmund, Germany

I studied physics at TU Dortmund, where I also got my PhD in astroparticle physics. During my PhD and postdoc, I worked mostly in the context of large experiments (MAGIC, CTA, SKA, LoFAR) in radio and gamma astronomy, focused on data analysis and software development. In 2023, I left academia for good to work on more ground-based problems. Since then, I work as data scientist and software developer at Point 8 GmbH, which was founded as a startup company in 2016 by physicists also from TU Dortmund. We are mainly engaged in the field of mechanical engineering in Germany, bringing data experience and AI knowledge into industry. I will give some insights in my daily work, what qualifies me to work on industry-related topics with a background in studying far-away galaxies, and challenges I'm confronted with in times of ChatGPT.

Invited Talk AKjDPG 2.3 Tue 19:50 HS 2 Physik

Leaving Academia: A Failure? Or the Best Decision I Ever Made? — •Edoardo Mornacchi — Swabian Instruments GmbH, Stuttgart, Germany

As physicists, we dedicate years in academia, often wondering: *What happens if I step away? Is leaving academia a failure? Should I give up physics and research for a stable job? And honestly, who's going to hire someone with my expertise in hadron physics?*

Here's the thing: leaving academia isn't a failure. There are plenty of companies doing groundbreaking, high-tech research, actively seeking skilled physicists like you. And this can be the start of something new and, for someone, even better.

In this talk, I'll share my journey from nuclear/hadron physics to my current role at Swabian Instruments, where I get to keep my love for science alive while also enjoying work outside the lab. Whether you're considering a move yourself or just curious about what's out there, I hope to provide some insights and inspiration to help you carve your own path beyond academia.

Discussion with the speakers

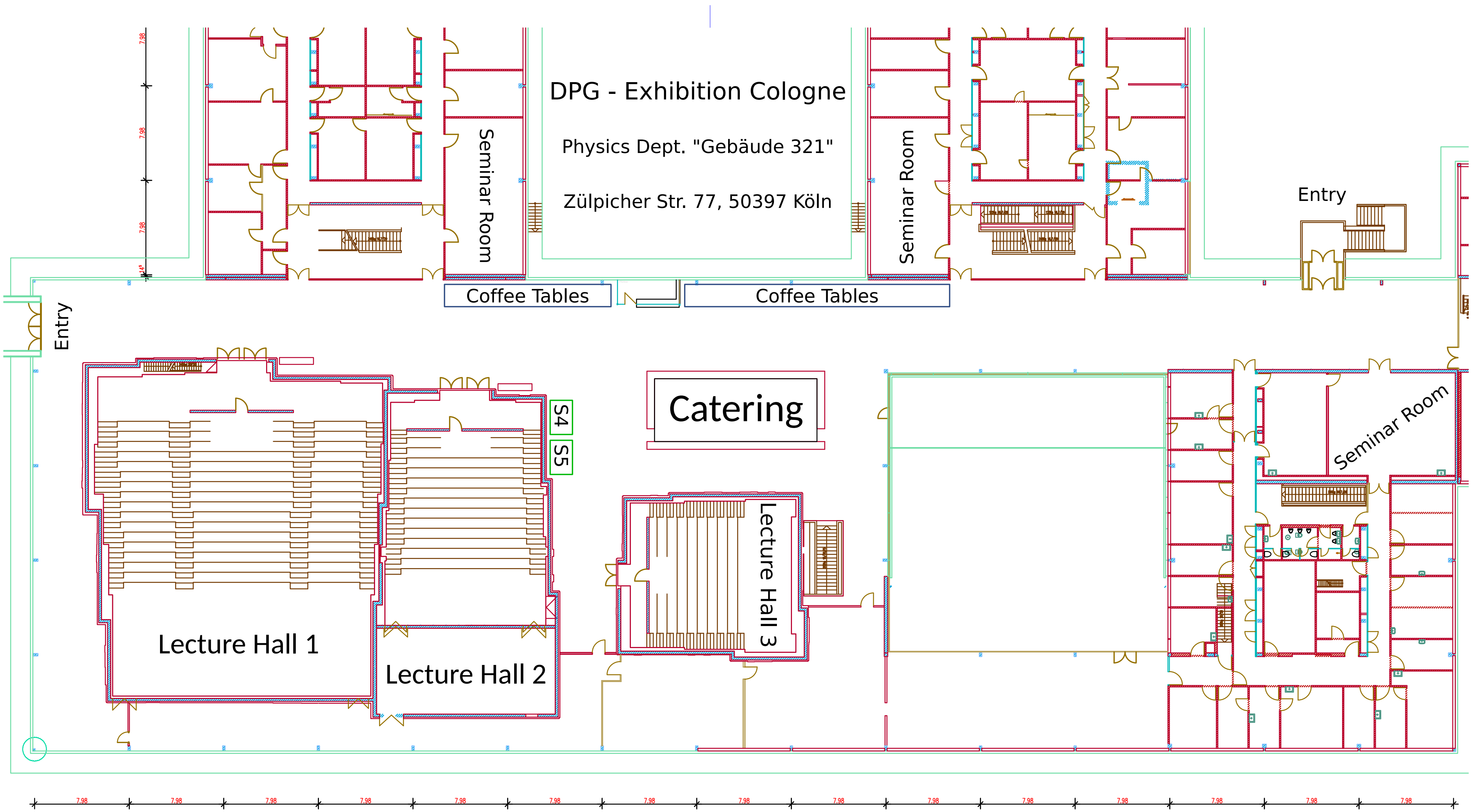
Index of Exhibitors Köln 2025

Exhibition venue
Physics Department (Bldg. 321)
FOYER
Zülpicher Str. 77
50397 Köln

Exhibition opening hours

Tuesday, March 10	10:30 - 18:00
Wednesday, March 11	10:30 - 18:00
Thursday, March 12	10:30 - 18:00

	Stand No.
CAEN GmbH Klingenstraße 108, 42651 Solingen *Analog- und Digitalelektronik für Teilchendetektoren, HV/LV Stromversorgungen*	S05
Hamamatsu Photonics Deutschland GmbH Arzbergerstraße 10, 82211 Herrsching *To improve life through photonic technologies, we continuously develop new products for the generation and measurement of a broad spectrum of wavelengths from x-rays, UV light, visible and infrared.*	S04
LHC ErUM-FSP Office / Georg-August-Universität Göttingen Friedrich-Hund Platz 1, 37077 Göttingen *Das LHC ErUM-FSP-Büro ist das gemeinsame Projektbüro für Öffentlichkeitsarbeit und der deutschen Community an den LHC Experimenten.*	S04



DPG - Exhibition Cologne
Physics Dept. "Gebäude 321"
Zülpicher Str. 77, 50397 Köln
Entry
Seminar Room
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Coffee Tables
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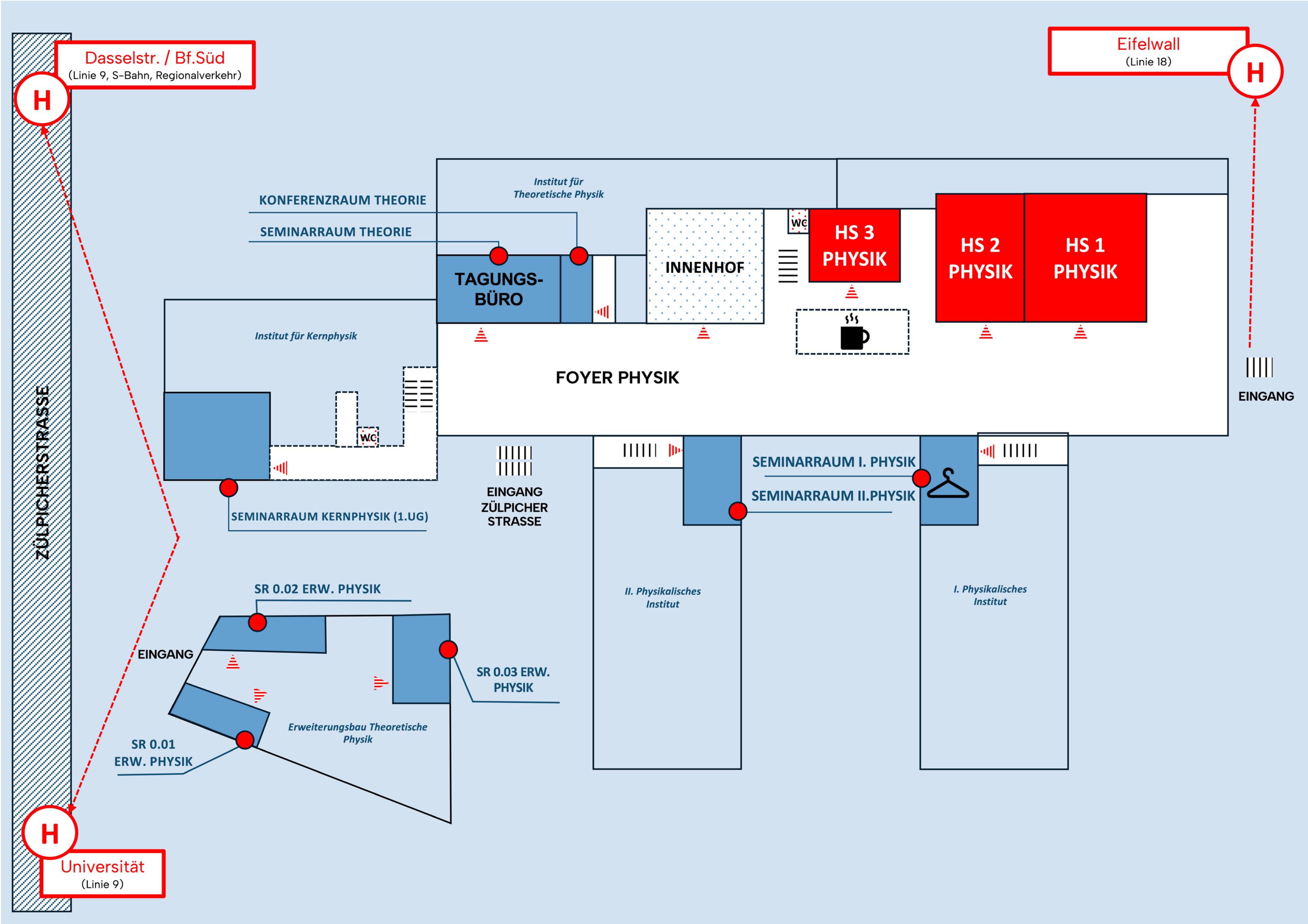
Lecture Hall 1
Lecture Hall 2
S4
S5
Catering
Lecture Hall 3
Seminar Room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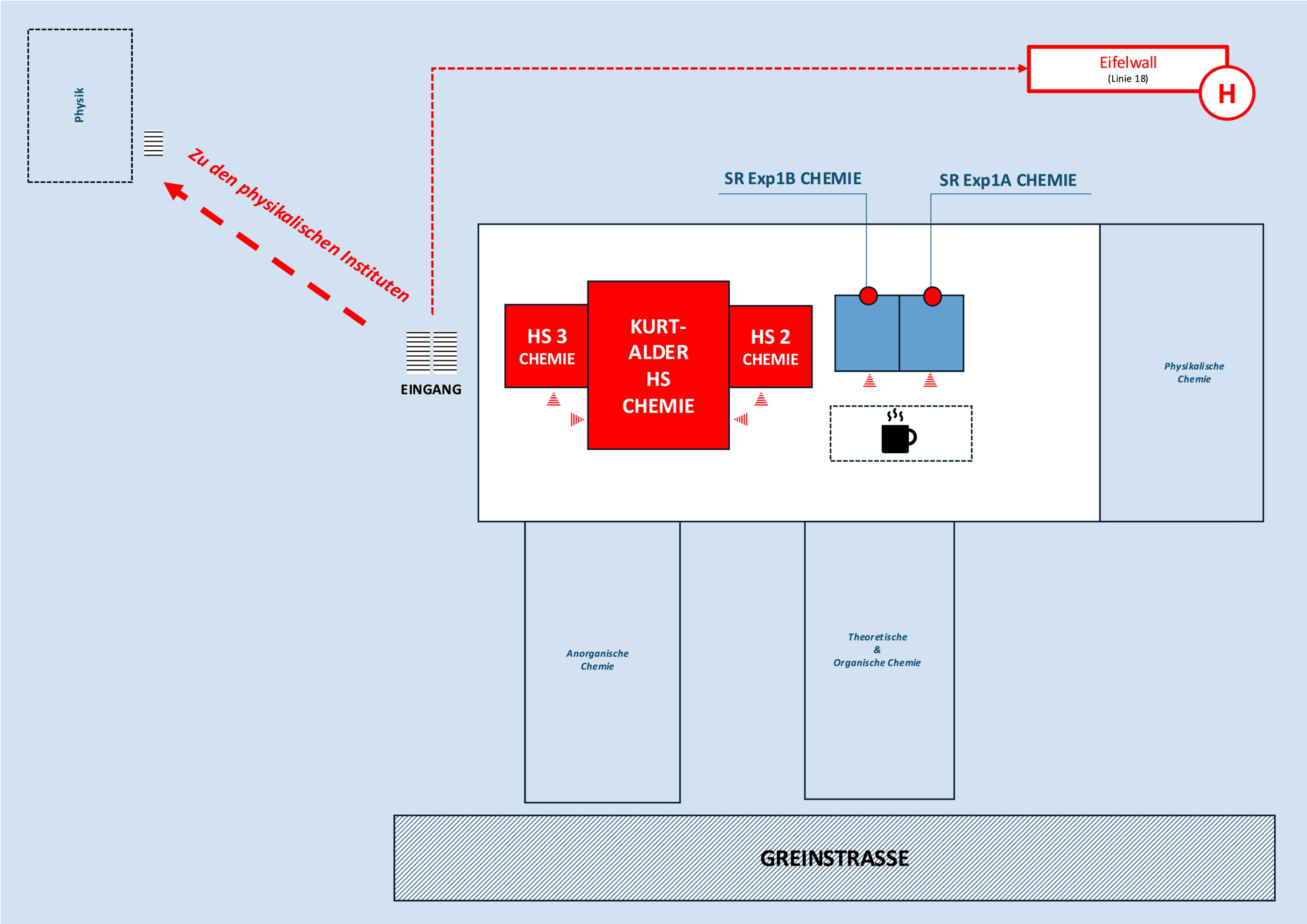
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&
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