Nuclear Masses in Astrophysics for the Next 25 Years

Reporte der Beiträge

Beitrag ID: **1** Typ: **Poster**

Nuclear mass predictions based on deep neural network and finite-range droplet model (2012)

Mittwoch, 20. August 2025 15:30 (1 h 30m)

A neural network with two hidden layers is developed for nuclear mass prediction, based on the finite-range droplet model (FRDM12). Different hyperparameters, including the number of hidden units, the choice of activation functions, the initializers, and the learning rates, are adjusted explicitly and systematically.
The resulting mass predictions are achieved by averaging the predictions given by several different sets of hyperparameters with different regularizers and seed numbers.
The overall root-mean-square deviations of nuclear mass have been reduced from 0.603 MeV for the FRDM12 model to 0.200 MeV and 0.232 MeV for the training set and validation set, respectively.

Autor: YIU, To Chung Martin (The University of Hong Kong)

Co-Autoren: Prof. LIANG, Haozhao (The University of Tokyo); Prof. LEE, Jenny Hiu Ching (The University of Hong Kong)

Vortragende(r): YIU, To Chung Martin (The University of Hong Kong)

Sitzung Einordnung: Poster Session

Beitrag ID: **2** Typ: **Talk Main Workshop**

Machine Learning Techniques Used To Determine Accurate Binding Energies

Donnerstag, 21. August 2025 13:30 (30 Minuten)

Machine Learning has become a powerful tool in science. Various machine learning approaches including Neural Networks, Support Vector Machines, Gaussian Process Regression, and Ensemble of Trees have been used to either model binding energies directly or to improve binding energy predictions from existing models. This talk will discuss the successes, benefits, and disadvantages of various approaches. Rules will be proposed with the goal of helping to advance the applicability of Machine Learning based binding energy models. Additionally, a composite model called the Four Model Tree Ensemble will be discussed which fits the Atomic Mass Evaluation 2020 data with a standard deviation of 76 keV and an independent compilation including 33 more recent measurements with a standard deviation of 376 keV. A discussion of extrapolations approaching the neutron dripline will also be included.

Autor: BENTLEY, Ian (Florida Polytechnic University)

Vortragende(r): BENTLEY, Ian (Florida Polytechnic University)

Beitrag ID: **3** Typ: **Talk Early Career**

Precision Mass Measurements Of Neutron-Rich Rare-Earth Isotopes And Fission Fragments

Montag, 18. August 2025 10:00 (30 Minuten)

Penning trap mass spectrometry provides the most precise technique for direct measurement of the mass of single nuclides. The determination with high-precision of this fundamental nuclear property, and the related nuclear binding energy, gives information on the evolution of nuclear structure away from stability. It also produces valuable inputs for the theoretical models describing the stellar nucleosynthesis processes such as the rapid neutron capture (r) process, responsible for the origin of more than half of the elements heavier than iron. These astrophysical calculations were shown to be very sensitive to masses, with the improved precision on their value directly impacting the model predictions. In the recent years at the JYFL Accelerator Laboratory, the use of the JYFLTRAP and the Phase-Imaging Ion Cyclotron-Resonance technique, combined with the fast and universal IGISOL production method, led to the determination of more than a 100 nuclear masses across the nuclide chart, including around 40 long-lived isomeric states. This presentation aims at giving an overview of the latest high-precision mass measurements of neutron-rich rare-earth isotopes around $A = 160$ and fission fragments in the ^{132}Sn region performed with the JYFLTRAP, and discussing their implications for the r process modeling.

Autor: JARIES, Arthur (University of Jyväskylä/Max Planck Institute for Nuclear Physics)

Vortragende(r): JARIES, Arthur (University of Jyväskylä/Max Planck Institute for Nuclear Physics)

Beitrag ID: **4** Typ: **Poster**

Precision Mass and Decay Lifetime Measurements at the HIAF-SRing facility

Mittwoch, 20. August 2025 15:30 (1 h 30m)

The established storage ring mass spectrometry at the current operational HIRFL-CSR facility in Lanzhou has demonstrated its efficacy in accurately measuring the masses of short-lived nuclei that are far from beta stability. With the advent of the High Intensity heavy-ion Accelerator Facility (HIAF), the beam intensity is anticipated to be three orders of magnitude higher than what can currently be provided by the HIRFL. Consequently, a dedicated and versatile Spectrometer Ring (SRing) will be constructed at the high-energy end of the HIAF facility.

It is planned to extend the successful mass and lifetime measurement program to the future HIAF-SRing facility in Huizhou, China. The primary focus will be on measuring the unknown masses and exotic decay modes of highly-charged ions of heavy neutron-rich nuclei. To achieve this objective, two time-of-flight (TOF) detectors as well as two sets of position-sensitive Schottky detectors are currently under construction for the HIAF-SRing. Additionally, high-order magnets are being considered to ensure precise control over the ion-optics of the SRing.

This poster will present the detailed plan and instrumentation for the HIAF-SRing mass spectrometry project.

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Vortragende(r): YAN, Xinliang (IMPCAS, China)

Sitzung Einordnung: Poster Session

Beitrag ID: **5** Typ: **Talk Main Workshop**

Impact Of Experimental Mass Of ^{70}Kr On The ^{68}Se Waiting-Point In Rp-Process

Donnerstag, 21. August 2025 16:20 (20 Minuten)

The recent mass measurement of ^{70}Kr using the $B\rho$-defined isochronous mass spectrometry yields a mass excess of $-41320(140)$ keV, indicating a 220-keV increase in binding energy compared to the AME2020 prediction. We utilize this experimental mass to probe its impact on the potential waiting point ^{68}Se in rp-process and quantitatively constrain the $2p$-capture reaction flow that can bypass this waiting point. Our investigation shows that the more tightly bound nature of ^{70}Kr enhances this $2p$-capture reaction flow up to a factor of four. While this enhancement reduces the effective half-life of ^{68}Se, the nucleus remains a waiting point. The dominate uncertainty in determining the effective half-life of and reaction flow around ^{68}Se originates from the large experimental error in the ^{70}Kr mass. A more precise ^{70}Kr mass measurement is highly desired.

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Vortragende(r): XU, Xing (Institute of Modern Physics, CAS)

Beitrag ID: **6** Typ: **Talk Main Workshop**

The Crust Of Accreting Neutron Stars: Role Of Nuclear Binding Energies

Mittwoch, 20. August 2025 11:50 (20 Minuten)

The crust of neutron stars in soft X-ray transients is heated up by nuclear reactions induced by hydrostatic compression during periods of active accretion. These periods alternate with quiescent phases, during which X-ray telescopes in space have monitored a gradual decrease in the thermal emission from the surface of a dozen neutron stars [1]. The exact location of heating sources and the crustal composition represent crucial parameters for the detailed modeling of the neutron star crust cooling and the correct interpretation of observational data [2]. They depend on the nuclear reaction flows which extend up to the neutron-drip line and beyond and are mainly governed by the binding energies of extremely neutron-rich nuclei. A large part of these nuclides is not yet accessible to terrestrial nuclear facilities. Hence, the reaction networks are forced to rely on theoretical predictions for nuclear masses. In this talk, I will show to what extent the nuclear evolution is sensitive to the applied nuclear mass model [3-5] and identify the key neutron-rich isotopes that are of particular interest for future laboratory measurements. In addition, I will present our latest efforts in building nuclear mass tables along with the relevant nuclear physics input for the wide range of astrophysical applications.

References

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3. Shchechilin N. N., Gusakov M. E. & Chugunov A. I., MNRAS, 507, 3860–3870 (2021).
4. Shchechilin N. N. & Chugunov A. I., MNRAS, 490, 3454–3463 (2019).
5. Fantina A. F., Zdunik J. L., Chamel N., Pearson J. M., Haensel P. & Goriely S., A&A 620, A105 (2018).

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Vortragende(r): SHCHECHILIN, Nikolai (Universite Libre de Bruxelles)

Beitrag ID: **7** Typ: **Talk Main Workshop**

Mass Measurements Of N-Z Nuclei

Donnerstag, 21. August 2025 16:00 (20 Minuten)

Nuclear masses of neutron-deficient N∼Z nuclei are pivotal for modeling astrophysical processes, such as the rapid proton-capture (rp) and νp processes, which drive nucleosynthesis in X-ray bursts and proton-rich supernova ejecta. These masses determine proton separation energies, reaction Q-values, and waiting points, directly influencing reaction flows, light curves, and p-nuclei abundances. This talk presents recent advances in high-precision mass measurements at the Ion Guide Isotope Separator On-Line (IGISOL) facility in Finland and the Rare-RI Ring at RIKEN, Japan, focusing on their technical innovations and astrophysical impacts. At IGISOL, the JYFLTRAP double Penning trap, coupled with an inductively heated hot-cavity catcher laser ion source, has enabled mass measurements of exotic nuclides, like $^{95-97}$Ag, with ∼1 keV/c^2 precision, using time-of-flight ion-cyclotron resonance (TOF-ICR) and phase-imaging ion-cyclotron resonance (PI-ICR) techniques to achieve a relative precision of 10^{-8}. These measurements, particularly of ^{95}Ag and the ^{96}Ag isomers, have refined reaction rates for the rp-process, impacting X-ray burst modeling, and confirmed the robustness of the N=50 shell closure. Additionally, the Multi-Reflection Time-of-Flight Mass Spectrometer (MR-TOF-MS) at IGISOL has targeted the A∼84 region, addressing the Zr-Nb cycle's role in limiting rp-process flows (although some masses in this region have been measured at RIKEN with MR-TOF-MS). At RIKEN, the Rare-RI Ring employs isochronous mass spectrometry (IMS) and Bρ-TOF methods to access heavy N∼Z nuclei (A=70–100), achieving a relative precision of 10^{-6}–10^{-7} for exotic nuclei with half-lives of 100 ns to 1 ms. Approved experiments using a ^{124}Xe beam aim to measure masses near ^{100}Sn, critical for rp- and νp-process termination cycles, like Sn-Sb-Te. Technical advances, including isochronous optics and high-efficiency ion extraction, enhance measurement precision to ∼10–100 keV. These results will provide critical inputs for modeling waiting points and p-nuclei production in the future.
The talk will highlight achievements, such as resolving the ^{96}Ag astromer and incorporating measured masses of $^{95-96}$Ag to refine reaction rates, technical advances in all modern mass measurement techniques (existing and proposed, using Penning Trap, MR-TOF MS, IMS and Bρ-TOF methods with storage ring and beam line) for the A∼70–100 region, and outline future plans to measure N∼Z nuclei, resolving nuclear structure puzzles and refining astrophysical models. Collaborative efforts with facilities, like the FRS/SuperFRS Ion Catcher at GSI/FAIR, will further extend the reach of these techniques, paving the way for the next 25 years of nuclear mass spectrometry in astrophysics.

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Vortragende(r): GE, Zhuang (University of Jyväskylä)

Beitrag ID: **9** Typ: **Talk Early Career**

R-Process Calculations Using Ab Initio Masses From VS-IMSRG

Montag, 18. August 2025 14:00 (30 Minuten)

The rapid neutron capture (r-) process is responsible for producing half of the elements heavier than iron in the Universe. Most of the exotic neutron-rich 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 employ ab initio masses for nuclei around the N=82 shell closure that were calculated with the Valence Space In-Medium Similarity Renormalization Group (VS-IMSRG) method. We show how these state-of-the-art mass calculations can be used to refine r-process predictions compared to purely phenomenological mass models.

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Vortragende(r): KUSKE, Jan (TU Darmstadt)

Beitrag ID: **10** Typ: **Talk Main Workshop**

Recent Precision Mass Measurements At ISOLTRAP

Mittwoch, 20. August 2025 09:35 (30 Minuten)

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 atomic 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.
This contribution will highlight recent mass measurements at ISOLTRAP with a focus on the neutron-deficient $^{97,98}\mathrm{Cd}$ ground states in vicinity of the self-conjugate doubly-magic $^{100}\mathrm{Sn}$ and the high-lying 25/2+ isomer $^{97n}\mathrm{Cd}$ as well as the first mass measurements of the neutron-rich $^{209,210,212}\mathrm{Hg}$.
In addition, recent technical developments at ISOLTRAP, such as the first online experiments using a linear Paul trap for mass-selective re-trapping [2] and a temperature stabilization system for the multi-reflection time-of-flight mass spectrometer will be presented, which pave the way for mass measurements of more exotic nuclides at ISOLDE.
[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)

Autor: SCHWEIGER, Christoph (Max-Planck-Institute for Nuclear Physics/CERN)

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Beitrag ID: **11** Typ: **Talk Early Career**

Advancing Frib's Science Program With A High-Voltage Mr-Tof Mass Spectrometer And Separator

Montag, 18. August 2025 15:30 (30 Minuten)

To further expand the science program at the Facility of Rare Isotope Beams (FRIB), we are developing a high-voltage Multi-Reflection Time-of-Flight (MR-ToF) device at FRIB. It is foreseen to increase the reach of FRIB's high-precision mass measurement program, to deliver isobaric and isomeric purified ion beams to experimental stations within FRIB's stopped and reaccelerated beam areas and to improve beam diagnostics and identification.

Uniquely, FRIB's MR-ToF device will store ions at an unprecedented beam energy of 30 keV. Simulations based on the work by the MIRACLS collaboration at ISOLDE/CERN [1,2] show that the ion throughput can be enhanced by 2 orders of magnitude when increasing the kinetic energy of the stored ions and when improving the MR-ToF design leading to a higher beam intensity of the purified ion beam. Furthermore, the raised beam energy also results in a larger energy spread tolerance enabling a higher mass resolving power in even shorter processing times [1,3] as required to access nuclei with extremely short half-lives.

This contribution presents the design concept, development status, and the planned first science cases of FRIB's MR-ToF system. The primary focus are high-precision mass measurements of the most exotic nuclei in close proximity to the driplines and the delivery of high-purity isomeric beams for decay spectroscopy studies critical to nuclear structure and astrophysics. Of particular interest is the study of astromers, nuclear isomeric states that can influence elemental abundances in astrophysical environments. Understanding the population and depopulation of these isomeric states is essential for modeling nucleosynthesis pathways.

[1] F.M.Maier et al, NIMA 1056, 168545 (2023)
[2] F.M.Maier et al, NIMA 1075, 170365 (2025)
[3] M.I. Yavor et al, IJMS 426, 1-11 (2018)

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Beitrag ID: **12** Typ: **Talk Early Career**

MR-ToF-MS At IGISOL

Dienstag, 19. August 2025 16:00 (30 Minuten)

A Multi-Reflection Time-of-Flight Mass-Spectrometer (MR-ToF-MS) [1], a device that rapidly separates ions based on their mass-over-charge ratios, has been incorporated to the Ion-Guide Isotope-Separator On-Line (IGISOL) facility [2]. At IGISOL, a variety of radioactive beams can be produced via fusion-evaporation, fission or multinucleon-transfer reactions. The continuous ion beam is accelerated to 30 kV, and mass-separated with a dipole magnet before it is injected to a radio-frequency quadrupole cooler and buncher (RFQ-CB). To facilitate narrow ion bunches for the MR-ToF-MS measurements, a miniaturized radiofrequency quadrupole cooler-buncher was recently commissioned at IGISOL [3]. It delivers ion bunches with small longitudinal emittance to the MR-ToF-MS, which consists of a stack of mirror and lens electrodes on both sides of the trap. The MR-ToF-MS is operated utilizing a pulsed drift tube to trap ions on closed paths between the mirror electrodes, where ion masses disperse over time-of-flight. In this overview, the IGISOL MR-ToF-MS, and the recent on-line measurement results, such as the mass measurements of the isomeric states of the N= Z nucleus 94Ag, are presented.

References

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[2] I. Moore et al., “Towards commissioning the new IGISOL-4 facility”, Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms, vol. 317, pp. 208–213, 2013. doi: 10.1016/j.nimb.2013.06.036.

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Beitrag ID: **13** Typ: **Talk Early Career**

Precision Mass Measurements Of Neutron-rich Isomers For The R-Process

Dienstag, 19. August 2025 11:30 (30 Minuten)

Approximately half of the nuclei heavier than iron are produced by the rapid neutron capture process (r process). [1] The r process can be simulated with nuclear reaction network codes for which nuclear input data is essential. Particularly neutron capture reaction rates and β-decay Q values are important, both of which are dependent on nuclear masses. However, many neutron-rich nuclei have measured masses with rather large uncertainties, and the isomeric states might be even lesser known. [2] Improving the accuracy of the measured masses for these nuclei also leads to more precise reaction rates which in turn lead to reduced uncertainties in the r-process simulations. The improved masses also affect the beta decay Q values which are important for the heating rate of the r process.

JYFLTRAP, a double Penning trap mass spectrometer [3], at the IGISOL facility has been utilised to accurately measure the masses of several neutron-rich isotopes. Combined with the phase-imaging ion cyclotron resonance (PI-ICR) technique [4], several low-lying isomeric states have been successfully resolved [5,6]. While currently not widely used in astrophysical simulations, isomeric states can have substantial effect on the r-process outcome. [7] In my presentation, example cases of measured isomeric states are presented with updated reaction rates and their effects on the r-process abundances and heating rate.

References:
[1] Cowan, J., et al. "Origin of the heaviest elements: The rapid neutron-capture process," in Reviews of Modern Physics, vol. 93, no. 1, pp. 015002, 2021.
[2] Kondev, F., et al. "The NUBASE2020 evaluation of nuclear physics properties," in Chinese Physics C, vol. 45, no. 3, pp. 030001, 2021.
[3] Eronen, T., et al. "JYFLTRAP: A Penning trap for precision mass spectroscopy and isobaric purification," in The European Physical Journal A, vol. 48, 2012.
[4] Nesterenko, D., et al. "Phase-Imaging Ion-Cyclotron-Resonance technique at the JYFLTRAP double Penning trap mass spectrometer," in Eur. Phys. J. A, vol. 54, no. 9, pp. 154, 2018.
[5] J. Ruotsalainen et al., "High-precision mass measurements of the ground and isomeric states in 124,125Ag,"Phys. Rev. C, vol. 111, no. 4, p. 044314, Apr. 2025, doi: 10.1103/PhysRevC.111.044314.
[6] Jaries, A., et al. "Isomeric states of fission fragments explored via Penning trap mass spectrometry at IGISOL," in Phys. Rev. C, vol. 110, pp. 034326, 2024.
[7] Misch, G., et al. "Astromers: Nuclear Isomers in Astrophysics*," in The Astrophysical Journal Supplement Series, vol. 252, no. 1, pp. 2, 2020.

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Beitrag ID: **14** Typ: **Talk Early Career**

Offline Commissioning Of The Double Penning Trap PIPERADE

Montag, 18. August 2025 11:00 (30 Minuten)

Of the approximately 7,000 nuclei predicted by nuclear models, fewer than half have had their mass measured experimentally. Many of the remaining nuclei are highly unstable and difficult to produce. Precise mass measurements play a crucial role in nuclear structure studies and nucleosynthesis modelling, and require advanced instrumentation to reach the most exotic isotopes.
At the DESIR facility at GANIL, radioactive nuclei will be provided both by the S3 low-energy branch, delivering heavy, neutron-deficient nuclei via fusion-evaporation reactions, and by SPIRAL1, producing light, neutron-rich isotopes through fragmentation. The Exotic Nuclei group at LP2iB is developing PIPERADE, a double Penning trap dedicated to isobaric purification and precise mass measurements of exotic nuclei.
I will present the current status of PIPERADE, which is currently undergoing offline commissioning at LP2iB in Bordeaux. While the Time-of-Flight Ion-Cyclotron Resonance (ToF-ICR) technique is already well established and has yielded promising results, current efforts are focused on the implementation and optimization of the Phase-Imaging Ion-Cyclotron Resonance (PI-ICR) method. The current level of precision achieved will be presented. Although PI-ICR is a well-established technique, its deployment at PIPERADE requires careful tuning of the trap configuration and beamline parameters to meet performance expectations. Some of the encountered and resolved issues will also be discussed during the presentation.
The setup is scheduled to be relocated to the DESIR facility in 2027, with first on-line experiments planned for 2028. These developments will pave the way for precise mass measurements at DESIR, extending the accessible range of exotic nuclei and contributing to the facility's scientific programme.

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Beitrag ID: **15** Typ: **Talk Main Workshop**

Nuclear Masses And Astrophysics In The NuPECC Long Range Plan 2024

Donnerstag, 21. August 2025 09:30 (30 Minuten)

The Nuclear Physics European Collaboration Committee (NuPECC) recently published its Long Range Plan (LRP) 2024 for European Nuclear Physics [1]. The document is a result of a large community effort, involving researchers in various meetings, workshops and thematical working groups. Nuclear masses and their importance for nuclear astrophysics is highlighted throughout the document, from the fundamental questions regarding the origins of elements to the recently developed methods opening new opportunities, yielding recommendations concerning methods, radioactive beam facilities as well as theoretical, computational and collaborative aspects in nuclear astrophysics. In this contribution, I will give a brief overview on the highlighted nuclear astrophysics themes and the role of nuclear masses in the NuPECC LRP2024, together with its relevant recommendations.

[1] NuPECC Long Range Plan 2025, arXiv:2503.15575 [nucl-ex] https://nupecc.org/lrp2024/Documents/nupecc_lrp2024_web

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Beitrag ID: **16** Typ: **Talk Early Career**

Ion traps for the study of stellar nucleosynthesis

There is an astute idea of the different processes that assemble heavy elements (Z > 26) in our universe, but the production sites of some of them remain unclear. The processes that generate the most exotic nuclei such as r-process, for rapid neutron capture, and rp-process, for rapid proton capture are difficult to thoroughly describe because of the lack of experimental nuclear properties of those regions. Indeed, said properties are key inputs to calculate nucleosynthesis processes. Regarding nuclear masses, we have on one hand sensitivity studies using theoretical input that show higher effects on the r-process around N = 82 region of the nuclear chart [1]. On another hand, we know that the region around 100Sn is a key area for the rp-process, as it is called the "end point"of the rapid proton capture process [2]. During this talk, I will be presenting the part of my Phd work that revolves around the development of a new data acquisition system for the ISOLTRAP mass spectrometer at ISOLDE, CERN. Which will improve measurements of difficult cases with very low yields. Additionally, I aim to study the effect of new measured masses on the nucleosynthesis processes that are planned this year with the ISOLTAP experiment along with previously measured masses in these regions. Such nuclei are 96-98Cd [3] for rp-process, and 126-129Ag [4] for r-process.
[1] M. R. Mumpower et al., 10.1103/PhysRevC.92.035807 (2015)
[2] H. Schatz et al., 10.1103/PhysRevLett.86.3471(2001)
[3] M. Mougeot et al. INTC-P-682 (2023)
[4] P. F. Giesel , M. Benhatchi et al., INTC-P-742 (2025)

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Vortragende(r): BENHATCHI, Maroua (IJCLab/in2p3/CNRS)

Beitrag ID: **17** Typ: **Talk Main Workshop**

Mass Measurements For Explosive Nuclear Astrophysics And Exploration Beyond The Sn-132 And Pb-208 Diagonal

Donnerstag, 21. August 2025 10:00 (20 Minuten)

High precision mass measurement using ion traps continue to play an important role in shaping our understanding of the nucleus. State-of-the-art spectrometers nowadays can reach far into the neutron-rich terra incognita, away from the valley of stability, where new structure phenomena including e.g. weakening or disappearance of classical nuclear shells or rapid shape transitions can be observed and studied via their signatures in the mass surface. At the same time, rapid changes in the mass surface directedly impact the rapid neutron-capture process pathway and thus our understanding of the origin of heavy elements.
In this talk we will discuss technical aspects of high precision mass measurements using ion traps tailored for ISOL and In-Flight facilities, particularly drawing from TRIUMF's Ion Trap for Atomic and Nuclear science (TITAN) [1] located at the ISAC (TRIUMF, Vancouver) ISOL type facility and the FRS Ion Catcher experiment [2] located at the GSI/FAIR (Darmstadt, Germany) In-Flight facility. Among others, we will highlight recent results of mass measurements of neutron-rich isotopes e.g. investigating the evolution of neutron-rich tin and gallium isotopes and their impact on r-process network calculations but also discuss the emergence of features in the mass surface beyond N = 116 in ytterbium. Finally, we will give an outlook towards future mass measurement campaigns pushing the limits of known masses beyond the Sn-132 and Pb-208 diagonal and discuss links between mass measurements reveling nuclear structure and astrophysical implications.

Autor: REITER, Moritz Pascal (University of Edinburgh)

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Vortragende(r): REITER, Moritz Pascal (University of Edinburgh)

Beitrag ID: **18** Typ: **Talk Early Career**

Precision Mass Measurements With The Canadian Penning Trap For Nuclear Astrophysics

Montag, 18. August 2025 11:30 (30 Minuten)

Understanding the reaction rates of nuclei relevant to nucleosynthesis processes relies in part on nuclear masses, often far from the valley of stability. The Canadian Penning Trap (CPT) has long measured such masses, and has recently concluded a decade-long campaign at the CARIBU facility, measuring over 200 nuclei produced through the spontaneous fission of ^{252}Cf. One focus of these measurements was masses of interest to understanding the formation of the rare-earth peak in the astrophysical r-process [1,2,3], and another was on measurement of the ground and isomeric states of "astromers" or astrophysically-relevant isomers in neutron-rich nuclei along both the r- and s-process paths [4,5]. The future of the CPT's studies for nuclear astrophysics will occur at the currently-commissioning N=126 Factory, where multi-nucleon transfer reactions will produce nuclei further from stability at rates that make Penning trap mass measurements possible. Measurements at the N=126 Factory will begin with masses of interest for the formation of the heaviest $A \sim 195$ r process abundance peak, but will also extend the CPT's rare earth peak campaign farther from stability.

This work is supported in part by the U.S. Department of Energy, Office of Nuclear Physics, under Contract No. DE-AC02-06CH11357; by the National Science Foundation under Grant No. PHY-2310059; by the University of Notre Dame; and with resources of ANL's ATLAS facility, an Office of Science User Facility.

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Autoren: VALVERDE, Adrian (Argonne National Laboratory); BRODEUR, Maxime (University of Notre Dame); CLARK, Jason (Argonne National Laboratory); HOFF, D.E.M. (Lawrence Livermore National Laboratory); HOUFF, Alicen M. (University of Notre Dame); JACOBS, Andrew (Argonne National Laboratory); KOLOS, Karolina (Lawrence Livermore National Laboratory); KONDEV, Filip; LIU, Biying (University of Notre Dame); MARTIN, Matthew (Argonne National Laboratory); MCLAUGHLIN, Gail (???); MUMPOWER, Matthew (Los Alamos National Laboratory); ORFORD, Rodney (Lawrence Berkeley National Laboratory); PORTER, Sam (University of Notre Dame, USA); RAY, Dwaipayan (TRIUMF); RIVERO, Fabio (University of Notre Dame); SAVARD, Guy (Argonne National Laboratory/University of Chicago); SURMAN, Rebecca (University of Notre Dame); SHARMA, Kumar S. (University of Manitoba); VASSH, Nicole (TRIUMF)

Vortragende(r): VALVERDE, Adrian (Argonne National Laboratory)

Beitrag ID: **19** Typ: **Talk Early Career**

Mass Measurements Of Actinides At The High-Precision Penning-Trap Mass Spectrometer Triga-Trap

Montag, 18. August 2025 16:30 (30 Minuten)

Atomic masses are indispensable in nuclear structure and astrophysics research, and Penning traps enable the most precise mass measurements achievable to date [1]. TRIGA-Trap is a high-precision, double Penning-trap mass spectrometer located in the reactor hall of the TRIGA (Training, Research, Isotopes, General Atomic) research reactor in Mainz, Germany [2]. At TRIGA-Trap, mass measurements of heavy radioactive nuclides — particularly actinides — are performed with the PI-ICR (Phase-Imaging Ion-Cyclotron Resonance) technique [3]. This method offers high sensitivity, resolving power and accuracy, while requiring relatively short measurement times [3].
Latest mass measurements of actinides, including ^{244}Pu, ^{241}Am, ^{243}Am, ^{248}Cm, and ^{249}Cf have achieved uncertainties at the parts-per-billion (ppb) level and will be included in the next AME (Atomic Mass Evaluation) dataset [4,5]. Precise mass values of actinides are crucial inputs to nucleosynthesis calculations of r-process pathways. In addition, such measurements allow the exploration of 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 [4]. Furthermore, the predictive capabilities of various nuclear shell models for heavy and deformed nuclei can be assessed. Recently, mass measurements in the Pu isotopic chain — including ^{238}Pu, ^{239}Pu, ^{240}Pu, and ^{242}Pu — have been performed. This will enhance the current dataset and help contribute to ongoing nuclear structure and astrophysical studies.
This presentation will provide an overview of the current status of the TRIGA-Trap experiment, highlight recent results, and outline future prospects.

References

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[5] W. Huang, M. Wang, F.G. Kondev, et al. Chin. Phys. C **45**(3):030002 (2021).

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Vortragende(r): SAYED, Tanvir (Max-Planck-Institut für Kernphysik)

Beitrag ID: **20** Typ: **Talk Main Workshop**

A TITAN Journey Towards The R-Process

Mittwoch, 20. August 2025 10:50 (30 Minuten)

In the quest to measure the masses of the most exotic species available at TRIUMF, the TITAN facility has transitioned from a Penning-trap to a Multi-Reflection Time-Of-Flight (MR-TOF) mass spectrometer. The latter has permitted measurements of yields with species less than 0.01 particles per second as well as half-life determinations. With an extraordinary dynamic range, TITAN has tackled both sides of the valley of stability, moving closer to the driplines. For studies of the rapid-proton-capture process, measurements of Ga-60 and Sr-74 have been performed. More recent collaborations with beam development have permitted measurements within the r-process pathway like Zn-83 and Sn-138. A selection of recent developments, results, and their impact will be shown.

Autoren: KWIATKOWSKI, Anna A. (TRIUMF); WALLS, Coulter (TRIUMF)

Co-Autor: TITAN COLLABORATION, The (TRIUMF)

Vortragende: KWIATKOWSKI, Anna A. (TRIUMF); WALLS, Coulter (TRIUMF)

Beitrag ID: **21** Typ: **Talk Main Workshop**

Opportunities For Mass Measurements At NuCARIBU

Mittwoch, 20. August 2025 09:05 (30 Minuten)

The CARIBU facility just conpleted an upgrade to nuCARIBU where the fission products are now obtained from neutron-induced fission of 235U instead of the spontaneous fission of 252Cf used previously. This new source is more intense and should provide access to even more exotic nuclides and allow extending the mass measurement campaigns on very neutron-rich isotopes that were performed at CARIBU over the last decade. This new campaign will use an MR-TOF spectrometer instead of the Penning trap mass spectrometer used previously, sacrificing the utmost accuracy for higher sensitivity for the shortest-lived isotopes. The novel facility and its expected reach will be presented.

This work is supported by the U.S. Department of Energy, Office of Nuclear Physics, under contract No. DE-AC02-06CH11357, and uses resources from ANL's ATLAS facility, an Office of Science National User Facility.

Autor: SAVARD, Guy (Argonne National Laboratory)

Co-Autoren: VALVERDE, Adrian (Argonne National Laboratory); JACOBS, Andrew (Argonne National Laboratory); CLARK, Jason (Argonne National Laboratory); BRODEUR, Maxime (University of Notre Dame); PORTER, Sam (University of Notre Dame, USA)

Vortragende(r): SAVARD, Guy (Argonne National Laboratory)

Beitrag ID: **22** Typ: **Talk Main Workshop**

Mass Measurements For Nuclear Structure Using The CPT

Mittwoch, 20. August 2025 14:30 (20 Minuten)

The synthesis of elements via the rapid-neutron capture process depends sensitively on the one-neutron separation energy, which in turns is influenced by nuclear structure effects such as shell closure and deformation. It has already been demonstrated for the light isotopes that standard magic numbers such as 20, 28 vanish while new ones emerge as nuclei gets more neutron rich. Such situation can be expected for the N = 82 and 126 shell closures relevant for the r-process. In between shells, the nucleus is also observed to get deformed, which affect the pathway of the r-process. In this talk I will present mass measurements, using the Canadian Penning Trap (CPT) at the former CARIBU facility, of neutron-rich Rh isotopes, which lie in a region of rapid shape transitions. I will also discuss planned measurements using the CPT at the N=126 Factory aimed at studying changes in the N = 126 shell closure.

Autor: BRODEUR, Maxime (University of Notre Dame)

Co-Autoren: CLARK, Jason (Argonne National Laboratory); SAVARD, Guy (Argonne National Laboratory); VALVERDE, Adrian (Argonne National Laboratory); HOUFF, Alicen M. (University of Notre Dame); PORTER, Sam (University of Notre Dame)

Vortragende(r): BRODEUR, Maxime (University of Notre Dame)

Beitrag ID: **23** Typ: **Talk Early Career**

Nuclear Two-Photon Decay Investigation Of 98mo At The ESR Heavy Ion Storage Ring

Dienstag, 19. August 2025 10:00 (30 Minuten)

The nuclear two-photon or double gamma (2γ) decay is a rare second-order electromagnetic process in which an excited nucleus emits two gamma rays simultaneously [1]. Its branching ratio is significantly lower than that of competing first-order processes such as internal conversion, pair creation, or single-photon emission, making its experimental observation extremely challenging. However, in the Experimental Storage Ring (ESR) at GSI, these competing decay modes can be suppressed by storing fully stripped ions and selecting a $0^+ \rightarrow 0^+$ transition with excitation energy below the electron-positron pair creation threshold (1022 keV) [2, 3]. Under these conditions, the two-photon decay becomes the only available decay channel.

In this talk, we will report on the current status of the analysis of an experiment investigating the 2γ decay of ^{98}Mo, which has a first excited 0^+ state at 734.75 keV. The experiment was performed at the GSI facility in Darmstadt, employing the unique conditions in the Experimental Storage Ring. Fully stripped ^{98}Mo ions were produced using the projectile fragmentation of ^{100}Mo primary beam on a ^{9}Be target in the transfer line to the ESR. These ions were then transported and stored in the ESR, which was operated in the isochronous mode. To monitor and detect the revolving ions, two non-destructive Schottky detectors [4] were used at different operation frequencies (245 and 410 Hz). These detectors allow for precision measurement of the ions'revolution frequencies, enabling extraction of both the nuclear half-life and mass. In addition, the revolution frequency provides particle identification via the ions'mass-to-charge ratios. The preliminary results indicate that the measured half-life of ^{98}Mo is consistent with the expected theoretica estimates based on extrapolation from previously studied $0^+ \rightarrow 0^+$ nuclear transitions [1].

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4) M. S. Sanjari et al., Phys. Scr. 2013, 014088 (2013).

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Vortragende(r): FORCONI, Carlo (GSI Helmholtzzentrum für Schwerionenforschung GmbH(GSI))

Beitrag ID: **24** Typ: **Talk Early Career**

Present And Future Of The Rare-RI Ring

Montag, 18. August 2025 15:00 (30 Minuten)

Vortragende(r): NAGAE, Daisuke (Saitama University)

Beitrag ID: **25** Typ: **Talk Early Career**

Unlocking Rare Isotope Masses: The Reach Of TOF-Bρ Measurements

Dienstag, 19. August 2025 16:30 (30 Minuten)

Vortragende(r): SULTANA, Irin (Central Michigan University)

Beitrag ID: **27** Typ: **nicht angegeben**

Thermal Evolution Of Accreting Neutron Stars

Dienstag, 19. August 2025 15:00 (30 Minuten)

Vortragende(r): NAVA CALLEJAS, Martin Javier (Université Libre de Bruxelles)

Beitrag ID: **28** Typ: **Talk Early Career**

High-Precision Penning-Trap Mass Measurements Of Light Nuclei And Beyond

Dienstag, 19. August 2025 15:30 (30 Minuten)

Vortragende(r): HEISSE, Fabian (Max Planck Institute for Nuclear Physics)

Beitrag ID: **29** Typ: **Talk Main Workshop**

Status Of NUSTAR At FAIR

Mittwoch, 20. August 2025 10:05 (20 Minuten)

Vortragende(r): PODOLYAK, Zsolt (???)

Beitrag ID: **30** Typ: **Talk Main Workshop**

Recent Progress In Isochronous Mass Measurement Experiment

Mittwoch, 20. August 2025 11:20 (30 Minuten)

Vortragende(r): Dr. CHEN, Riu-jiu (IMP CAS)

Beitrag ID: **31** Typ: **nicht angegeben**

Microscopic Mean-Field Mass Models For Astrophysics Applications

Mittwoch, 20. August 2025 13:30 (30 Minuten)

Vortragende(r): GONZÁLEZ MIRET ZARAGOZA, Luis (Université libre de Bruxelles)

Beitrag ID: **32** Typ: **nicht angegeben**

Rare-RI Ring Facility At RIBF–Present Status

Mittwoch, 20. August 2025 14:00 (30 Minuten)

Vortragende(r): YAMAGUCHI, Takayuki (Saitama Univ.)

Beitrag ID: **33** Typ: **nicht angegeben**

Mass Measurements Of Neutron-Rich A≈90 Nuclei Constrain Element Abundances

Donnerstag, 21. August 2025 11:50 (20 Minuten)

Vortragende(r): XIAN, Wenduo

Beitrag ID: **34** Typ: **Talk Main Workshop**

Nuclear Structure Studies of the Heaviest Elements with the SHIPTrap Mass Spectrometer @GSI

Mittwoch, 20. August 2025 14:50 (20 Minuten)

Vortragende(r): GIACOPPO, Francesca (GSI Helmholtzzentrum für Schwerionenforschung GmbH(GSI))

Beitrag ID: **35** Typ: **Talk Main Workshop**

Current Status Of Mass Measurements In CSRe/Lanzhou

Donnerstag, 21. August 2025 09:00 (30 Minuten)

Vortragende(r): ZHANG, Yuhu (Institute of Modern Physics, Chinese Academy of Sciences)

Beitrag ID: **36** Typ: **Talk Main Workshop**

Broadband And High-Precision Mass Measurements Of Thermalized Exotic Nuclei At GSI/FAIR

Freitag, 22. August 2025 09:00 (30 Minuten)

Vortragende(r): DICKEL, Timo (GSI Helmholtzzentrum für Schwerionenforschung GmbH(GSI))

Beitrag ID: **37** Typ: **Talk Main Workshop**

Nuclear Masses For Heavy Element Nucleosynthesis

Donnerstag, 21. August 2025 10:50 (30 Minuten)

Vortragende(r): MARTINEZ PINEDO, Gabriel (GSI Helmholtzzentrum für Schwerionenforschung GmbH(GSI))

Beitrag ID: **38** Typ: **Talk Main Workshop**

Developments Of Penning Trap Mass Spectrometry At LEBIT For Measurements Of Astrophysical Interest

Donnerstag, 21. August 2025 11:20 (30 Minuten)

Vortragende(r): RINGLE, Ryan (FRIB/Michigan State University)

Beitrag ID: **39** Typ: **Talk Main Workshop**

Tof-Bρ Mass Measurements With The S800 Spectrometer

Donnerstag, 21. August 2025 14:00 (20 Minuten)

Co-Autor: PEREIRA, Jorge (National Superconducting Cyclotron Laboratory)

Vortragende(r): ESTRADE, Alfredo (CMU)

Beitrag ID: **40** Typ: **Talk Main Workshop**

Mass Measurements Of Neutron Rich Nuclei Along The R-Process Path Using The ToF-Bρ Method At FRIB

Donnerstag, 21. August 2025 14:20 (20 Minuten)

Vortragende(r): KORKULU, Zeren (CENS, IBS)

Beitrag ID: **41** Typ: **Talk Main Workshop**

How Well Do We Know The Basic Properties Of Nuclei: Updates On The AME And NUBASE Nuclear Data Libraries

Donnerstag, 21. August 2025 14:40 (20 Minuten)

Vortragende(r): KONDEV, Filip

Beitrag ID: **42** Typ: **Talk Main Workshop**

Accelerating Mass Modeling With Scientific Machine Learning

Donnerstag, 21. August 2025 15:30 (30 Minuten)

(talk will be held remotely)

Vortragende(r): MUMPOWER, Matthew (Los Alamos National Laboratory)

Beitrag ID: **43** Typ: **Talk Main Workshop**

Opportunities For Mass Measurements At Argonne's N=126 Factory

Freitag, 22. August 2025 10:00 (20 Minuten)

Vortragende(r): CLARK, Jason (Argonne National Laboratory)

Beitrag ID: **44** Typ: **Talk Main Workshop**

The Nuclear Two-Photon Decay

Freitag, 22. August 2025 09:30 (30 Minuten)

Vortragende(r): KORTEN, Wolfram (CEA Paris-Saclay)

Beitrag ID: **45** Typ: **Talk Early Career**

Bound-State Beta Decay Studies at ESR: Recent Results and Upcoming Experiments

Dienstag, 19. August 2025 14:00 (30 Minuten)

Bound-state beta decay is an exotic nuclear process in which the emitted electron is created directly into a vacant atomic orbital rather than being released into the continuum. This rare decay mode becomes significantly more probable in highly charged ions and requires long-duration storage measurements, conditions that are uniquely achievable at storage ring facilities. To date, all experimental studies of bound-state beta decay have been conducted at the Experimental Storage Ring (ESR) at the GSI Helmholtz Centre for Heavy Ion Research in Darmstadt, Germany.

In this talk, I will present recent results from the FAIR Phase-0 program at the ESR, with a focus on the first-ever direct measurement of bound-state beta decay in fully ionized thallium ($^{205}Tl^{81+}$). The experimentally determined half-life deviates significantly from theoretical estimates, with potential implications for our understanding of elemental abundances in the early universe [1] and solar neutrinos [2]. I will also discuss the next planned experiment at the ESR: a measurement of both the continuum and bound-state beta decay of ^{134}Cs, a key waiting-point nucleus along the *s*-process nucleosynthesis path.

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Co-Autor: FOR THE E121 AND G-24-00271 COLLABORATIONS

Vortragende(r): SIDHU, Ragandeep Singh (University of Surrey)

Beitrag ID: **46** Typ: **Talk Early Career**

Precision Mass Measurements Of Neutron-Rich Sn Isotopes And Its Impact On Stellar Nucleosynthesis

Dienstag, 19. August 2025 11:00 (30 Minuten)

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 at TITAN. The recent results include first-time mass measurement of neutron-rich $^{136-138}$Sn isotopes near $N = 82$ and their implications for studying the 2^{nd} abundance peak in the rapid neutron capture process (*r*-process) [1].

[1] A. Mollaebrahimi et al., Physical Review Letters 134 (2025), 232701

Autor: MOLLAEBRAHIMI, Ali (Facility for Antiproton and Ion Research in Europe GmbH(FAIR))

Vortragende(r): MOLLAEBRAHIMI, Ali (Facility for Antiproton and Ion Research in Europe GmbH(FAIR))

Beitrag ID: **47** Typ: **Talk Early Career**

Study Of Nucleosynthesis Processes With ISOLTRAP

Montag, 18. August 2025 16:00 (30 Minuten)

There is an astute idea of the different processes that assemble heavy elements (Z > 26) in our universe, but the production sites of some of them remain unclear. The processes that generate the most exotic nuclei such as r-process, for rapid neutron capture, and rp-process, for rapid proton capture are difficult to thoroughly describe because of the lack of experimental nuclear properties of those regions. Indeed, said properties are key inputs to calculate nucleosynthesis processes.
During this talk, I will be presenting the work that revolves around nuclear mass measurements with the ISOLTRAP experiment [1] at CERN. I will focus on astrophysical motivations for mass measurements in two extremes of the nuclear chart near the magic proton number Z = 50. On the neutron-rich side, there are masses relevant to the r-process around the neutron magic number N = 82 as shown in sensitivity studies of different models [2]. On the neutron-deficient side, the region around 100Sn is a key area for the rp-process, as it is considered the "end point"of the process [3] with the Sn-Sb-Te cycle. In this context, I will be looking at the recently evaluated masses in the region including, the ones measured by ISOLTRAP, and their effect on the rp-process.
Then, I will present the measurement method at ISOLTRAP and its challenges. As we are going for more exotic nuclei over time, the current techniques of production and measurements are reaching their limits. That is why we are working on technical developments to overcome some of these issues, mainly contaminations, and low yield cases. These advances are/will be used during next measurements of some interesting nuclei for the mentioned nucleosynthesis processes, such as, 96-98Cd [4] and 126-129Ag [5].

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[4] M. Mougeot et al. INTC-P-682 (2023)
[5] P. F. Giesel , M. Benhatchi et al., INTC-P-742 (2025)

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Vortragende(r): BENHATCHI, Maroua (IJCLab/in2p3/CNRS)

Beitrag ID: **48** Typ: **Poster**

Simulation of ion beam transport in the FRIB beam line for time-of-flight mass measurements

Mittwoch, 20. August 2025 15:30 (1 h 30m)

The time-of-flight magnetic rigidity (TOF-Bρ) technique is an effective method for determining the mass of unstable nuclides that have lifetimes of the order of 10s of ms. This method uses the motion of an ion in a magnetic field to determine its mass. With sufficiently precise time-of-flight measurements, around 10 ps uncertainty, the resulting mass resolution is of the order of $m/\delta m = 10,000$. In order to increase measurement accuracy and optimize the setup for TOF-Bρ experiments at the Facility for Rare Isotope Beams (FRIB) we simulate the ARIS fragment separator and S800 mass spectrometer using LISE++. We used the Monte-Carlo simulation procedure in LISE++ to track the trajectory and properties of ions throughout the beam line. The objective of this work is to determine the effect of the beam line optics on the resulting time-of-flight measurements and the ability to correct for these effects, which would result in greater accuracy and precision for the resulting mass measurement.

Autoren: ESTRADE, Alfredo (CMU); PLACIDO, Justin (Central Michigan University)

Vortragende(r): PLACIDO, Justin (Central Michigan University)

Sitzung Einordnung: Poster Session

Beitrag ID: **49** Typ: **Poster**

Mass Measurements of Actinides at the High-Precision Penning-Trap Mass Spectrometer TRIGA-Trap

Mittwoch, 20. August 2025 15:30 (1 h 30m)

Atomic masses are indispensable in nuclear structure and astrophysics research, and Penning traps enable the most precise mass measurements achievable to date [1]. TRIGA-Trap is a high-precision, double Penning-trap mass spectrometer located in the reactor hall of the TRIGA (Training, Research, Isotopes, General Atomic) research reactor in Mainz, Germany [2]. At TRIGA-Trap, mass measurements of heavy radioactive nuclides particularly actinides are performed with the PI-ICR (Phase-Imaging Ion-Cyclotron Resonance) technique [3]. This method offers high sensitivity, resolving power and accuracy, while requiring relatively short measurement times [3].

Latest mass measurements of actinides, including ^{244}Pu, ^{241}Am, ^{243}Am, ^{248}Cm, and ^{249}Cf have achieved uncertainties at the parts-per-billion (ppb) level and will be included in the next AME (Atomic Mass Evaluation) dataset [4,5]. Precise mass values of actinides are crucial inputs to nucleosynthesis calculations of r-process pathways. In addition, such measurements allow the exploration of nuclear structure through trends in mass filters, such as (two-neutron separation energies) and (average - interaction of the most loosely-bound two nucleons), as well as their differentials [4]. Furthermore, the predictive capabilities of various nuclear shell models for heavy and deformed nuclei can be assessed. Recently, mass measurements in the Pu isotopic chain including ^{238}Pu, ^{239}Pu, ^{240}Pu, and ^{242}Pu have been performed. This will enhance the current dataset and help contribute to ongoing nuclear structure and astrophysical studies.

This poster presentation will provide an overview of the current status of the TRIGA-Trap experiment, highlight recent results, and outline future prospects.

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Vortragende(r): SAYED, Tanvir (Max-Planck-Institut für Kernphysik)

Sitzung Einordnung: Poster Session

Beitrag ID: **50** Typ: **Poster**

Study of nucleosynthesis processes with ISOLTRAP

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In this poster, I will present the work that revolves around nuclear mass measurements methods of exotic nuclei with the ISOLTRAP experiment at CERN. You will find the astrophysical motivations for mass measurements in two extremes of the nuclear chart near the magic proton number Z = 50. To reach these areas, there are some technical challenges that we have to face. In this context, I will additionally present the different ongoing developments made to overcome some of these issues, mainly contaminations, and low yield cases.

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Sitzung Einordnung: Poster Session

Beitrag ID: **51** Typ: **Poster**

Schottky & Isochronous Mass Spectroscopy

Mittwoch, 20. August 2025 15:30 (1 h 30m)

More details to my talk “Schottky & Isochronous Mass Spectroscopy”

Autor: MENZ, Esther Babette (GSI Helmholtzzentrum für Schwerionenforschung GmbH(GSI))

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Sitzung Einordnung: Poster Session

Beitrag ID: **52** Typ: **Poster**

Precision Mass Measurements of Neutron-rich Isomers for the r-process

Mittwoch, 20. August 2025 15:30 (1 h 30m)

Approximately half of the nuclei heavier than iron are produced by the rapid neutron capture process (r process). [1] The r process can be simulated with nuclear reaction network codes for which nuclear input data is essential. Particularly neutron capture reaction rates and β-decay Q values are important, both of which are dependent on nuclear masses. However, many neutron-rich nuclei have measured masses with rather large uncertainties, and the isomeric states might be even lesser known. [2] Improving the accuracy of the measured masses for these nuclei also leads to more precise reaction rates which in turn lead to reduced uncertainties in the r-process simulations. The improved masses also affect the beta decay Q values which are important for the heating rate of the r process.

JYFLTRAP, a double Penning trap mass spectrometer [3], at the IGISOL facility has been utilised to accurately measure the masses of several neutron-rich isotopes. Combined with the phase-imaging ion cyclotron resonance (PI-ICR) technique [4], several low-lying isomeric states have been successfully resolved [5,6]. While currently not widely used in astrophysical simulations, isomeric states can have substantial effect on the r-process outcome. [7] In my presentation, example cases of measured isomeric states are presented with updated reaction rates and their effects on the r-process abundances and heating rate.

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Sitzung Einordnung: Poster Session

Beitrag ID: **53** Typ: **Poster**

Time-of-flight mass measurement of exotic nuclei near N=28 shell closure around sulfur

Mittwoch, 20. August 2025 15:30 (1 h 30m)

Time-of-flight mass measurement of exotic nuclei near N=28 shell closure around sulfur

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Sitzung Einordnung: Poster Session