HK 42: Structure and Dynamics of Nuclei VIII

Time: Wednesday 15:45–17:15 Location: SCH/A215

Group Report HK 42.1 Wed 15:45 SCH/A215

Nuclear structure studies far from stability with the FRS Ion Catcher — •Christine Hornung for the FRS Ion Catcher-Collaboration — GSI, Darmstadt, Germany,

At the FRS Ion Catcher at GSI, projectile and fission fragments are produced at relativistic energies at the FRS, separated in-flight, range-focused, slowed-down and thermalized in a cryogenic stopping cell and transmitted to a Multiple-Reflection Time-of-Flight Mass Spectrometer (MR-TOF-MS) for high-accuracy (down to $\Delta m/m \sim 10^{-8}$) direct mass measurements. Mass measurements of projectile fragments in the vicinity of ^{100}Sn were performed, including the first direct mass measurement of the ^{98}Cd ground state and the discovery of isomeric states. The measured excitation energies are compared with large-scale shell model calculations; they indicate the importance of core excitation around ^{100}Sn. Light neutron-deficient lanthanides were investigated. In this measurement the potential to perform surveys covering a large region on the chart of nuclei using an MR-TOF-MS was shown. Additionally, mass measurements of neutron-rich nuclei revealed evidence for shape transitions in the $N \approx 90$, Z=56-63 region. These results, recent technical upgrades at the FRS-IC, news from the next-generation CSC for the Super-FRS at FAIR and an outlook to plans for future experiments will be presented.

HK 42.2 Wed 16:15 SCH/A215

Fragmentation cross-sections of 1 GeV/u ^{208}Pb on ^{9}Be measured at the FRS — •Suraj K. Singh for the S450-Collaboration — GSI, Darmstadt, Germany — Justus-Liebig-Universität Gießen, Germany

Studies of nuclei far from the valley of stability, where extreme proton-to-neutron ratios appear, are particularly interesting because they provide insight into the nuclear structure and astrophysical nucleosynthesis processes. The nuclei are important for studies of the nuclear-existence limit, and for the understanding of nuclear reaction mechanisms. For such studies of the exotic isotopes, production cross-section measurements are the basic step of any research. The knowledge of accurate production cross-sections is essential for further development of reaction models and every new experiment based on a certain reaction. In this contribution, the evaluation of production cross-sections of exotic nuclei close to N=126, produced in fragmentation of a 1 GeV/u ^{208}Pb beam on a ^{9}Be target and separated in-flight at fragment separator FRS at GSI will be presented.

HK 42.3 Wed 16:30 SCH/A215

^{12}C(p,2p)^{11}B Quasi-Free-Scattering in Inverse Kinematics at R^{3}B — •Tobias Jenegger, Philipp Klenze, Lukas Ponnath, and Roman Gernhaeuser — Technische Universität München, Germany

The advanced R^{3}B setup at GSI allows to investigate proton-induced-quasi-free one-nucleon knockout reactions of exotic nuclei in inverse kinematics. This technique gives direct access to the momentum distributions of the scattered off protons in the nucleus before as well as the recoil momentum of the remaining spectator nucleus. In addition to the correlated gamma spectrum it is a powerful tool to unveil individual states populated in the reaction. The CALIFA calorimeter, with its 2528 CsI scintillation crystals in its final design, is a key detector in quasi-free-scattering experiments at R^{3}B. It allows to detect both the two coincident protons from the quasi-free-scattering process and emitted γ-rays from de-excitation of the remaining nucleus with high angular resolution and precise Doppler correction.
For the heavy residues unique particle identification was performed with multi-sampling ionisation chambers and a high resolution tracking system before and after the GLAD magnet, resulting in a relative mass resolution of less than 0.5 percent.
We present the analysis of the S444 experiment performed in the FAIR Phase-0 campaign with relativistic ^{12}C beams at various energies focusing on the quasi-free-scattering process, and the reconstruction of the associated gamma ray spectra.

HK 42.4 Wed 16:45 SCH/A215

Search for near-threshold multi-neutron resonances in (p,2p) reactions with neutron-rich nuclei at R^{3}B — •Nikhil Mozumdar[1,3], Thomas Aumann[1,2,3], Olivier Sorlin[4], and Valerii Panin[2] for the R3B-Collaboration — [1]Technische Universität Darmstadt — [2]GSI Helmholtz-Zentrum für Schwerionenforschung — [3]Helmholtz Forschungsakademie Hessen für FAIR — [4]Grand Accélérateur National d'Ions Lourds

In order to constrain the largely unknown multi-neutron interactions, it is necessary to measure the relevant observables sensitive to them. In the current work we plan to investigate multi-neutron resonances close to the corresponding neutron removal thresholds in neutron-rich light nuclei. The objective is to search for and characterize the systematic appearance of narrow resonances related to multi-neutron cluster structures and correlations near the respective cluster thresholds, similar to the popular alpha cluster resonant states. For this purpose an experiment has been recently concluded at the R^{3}B Setup in GSI. The $(p, 2p)$ reactions are studied in inverse kinematics where a radioactive ion "cocktail" beam is impinged on a 5cm LH_2 target. The resulting reaction products are measured using a large combination of detector systems providing information of the full reaction kinematics. Of particular interest is the neutron detector NeuLAND, which thanks to its high resolution and granularity provides access to the detailed study of multi-neutron resonances aimed for in this work.
Supported by HFHF, the GSI-TU Darmstadt cooperation and the BMBF project 05P21RDFN2

HK 42.5 Wed 17:00 SCH/A215

Correlation Experiments in Photofission* — •Vincent Wende[1], Dimiter Balabanski[4], Joachim Enders[1], Sean W. Finch[2], Alf Göök[3], Calvin R. Howell[2], Ronald C. Malone[6], Maximilian Meier[1], Andreas Oberstedt[4], Stephan Oberstedt[5], Marius Peck[1], Norbert Pietralla[1], 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

Mass, total kinetic energy and polar as well as azimuthal angular distributions of fission fragments were measured simultaneously using a position-sensitive twin Frisch-grid ionization chamber [1]. We present results of a pioneering ^{238}U(γ,f) experiment at the High-Intensity γ-Ray Source (HIγS) facility at Triangle Universities Nuclear Laboratory (TUNL) at an excitation energy of 11.2 MeV [2] as well as the first data from follow-up ^{234}U(γ,f) and ^{232}Th(γ,f) experiments with excitation energies near the fission barrier.
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[1] A. Göök et al., Nucl. Instrum. Methods A 830, 366 (2016); M.Peck et al., EPJ Web of Conferences 239, 05011 (2020).
[2] M. Peck, PhD Dissertation, TU Darmstadt (2020).