HK 27: Structure and Dynamics of Nuclei VI

Zeit: Dienstag 16:30–18:15 Raum: S1/01 A03

Gruppenbericht HK 27.1 Di 16:30 S1/01 A03

Results of the latest EXL campaign — •Mirko von Schmid for the EXL E105-Collaboration — Institut für Kernphysik, TU Darmstadt

EXL (**EX**otic nuclei studied in **L**ight-ion induced reactions at storage rings) is a project within NUSTAR at FAIR. It aims for the investigation of light-ion induced direct reactions in inverse kinematics with radioactive ions in storage rings at the future FAIR facility.

The existing ESR at GSI, together with its internal gas-jet target, provides the unique opportunity to perform this kind of experiments on a smaller scale already today. With a detector setup developed specifically for this experiment, we successfully investigated nuclear reactions with a stored radioactive beam for the very first time. As a part of the first EXL campaign we investigated the reaction ^{56}Ni(p, p)^{56}Ni in order to measure the differential cross section for elastic proton scattering and deduce the nuclear matter distribution and the radius of ^{56}Ni. Furthermore, as a feasibility study, we excited the GMR of ^{58}Ni by utilizing the ^{58}Ni(α, α')^{58}Ni reaction.

The results of this campaign and the current status of the project will be presented in this contribution.

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Gruppenbericht HK 27.2 Di 17:00 S1/01 A03

Status and Outlook of the FRS Ion Catcher at GSI — •Jens Ebert — Justus-Liebig-Universität Gießen

Exotic nuclei are produced in stellar processes like the p- and r-process and are essential for our understanding of nucleosynthesis beyond iron. They have an unusual ratio of neutrons to protons and short half-lives in common. Important production methods for exotic nuclei in the laboratory are projectile fragmentation and fission of heavy ions. Nuclei produced this way have energies up to several GeV/u and must be slowed down and separated from other beam products and contaminants for high-accuracy low-energy experiments with traps and lasers. This is tested by the FRS Ion Catcher, which is a test bench for the low energy branch of the Super-FRS at FAIR. There, the nuclei are separated in-flight, range-bunched, slowed-down in the fragment separator and subsequently thermalized in a cryogenic stopping cell. The ions extracted from the stopping cell will be transported to a multiple-reflection time-of-flight mass spectrometer for high accuracy mass measurements, decay spectroscopy or separation and preparation for further experiments.
A novel technical method allows mass measurements of nuclides with half-lifes of about 1ms such as ^{215}Po. From our online campaign in 2014 almost background-free α-spectroscopy, mass selected decay spectroscopy and measurements of excitation energies and isomeric ratios will be presented together with instrumental advances.

HK 27.3 Di 17:30 S1/01 A03

Twenty-five New Mass Values from Measurements Performed with Isochronous Mass Spectrometry — •Marcel Diwisch[1], Ronja Knöbel[1,2], Zygmunt Patyk[3], Hans Geissel[1,2], Wolfgang R. Plass[1,2], Christoph Scheidenberger[1,2], and Helmut Weick[2] for the FRS-ESR-Collaboration — [1]Justus-Liebig-Universität Gießen, Germany — [2]GSI, Darmstadt, Germany — [3]National Centre for Nuclear Research - NCBJ Swierk, Warszawa, Poland

Masses of uranium fission fragments have been measured with the FRS-ESR facility at GSI. In order to increase the mass resolving power and particle identification for non-isochronous particles, $B\rho$-tagging was applied in one out of two experiments. A new method of data analysis, using a correlation matrix for the combined data set from the two experiments, has provided reliable experimental mass values for 25 different neutron-rich isotopes for the first time. The new masses were obtained for nuclides in the element range from Ge to Ce. The results have been compared with theoretical predictions. At the neutron shell N=82 the comparison of experimental data for tin and cadmium isotopes show both strong shell effects in agreement with spectroscopy experiments and modern shell-model calculations.

HK 27.4 Di 17:45 S1/01 A03

Isotope shift measurements in the D2-transition of neutron-rich Ca-isotopes using the ROC technique at COLLAPS — •Christian Gorges for the COLLAPS-Collaboration — Institut für Kernphysik, TU Darmstadt, Germany

Calcium isotopes have been of great interest in nuclear physics for decades because of its two stable doubly magic nuclei within the isotopic chain. Recently, this has been revived by experiments revealing possible new shell closures at $N = 32$ and $N = 34$ [1]. The $4s\ ^2S_{1/2} \rightarrow 4p\ ^2P_{3/2}$ transition (D2) is sensitive to the quadrupole moments of the odd isotopes and is therefore the preferred transition for studies of short-lived isotopes as they were recently reported up to $^{52}Ca^+$ [2] using optical fluorescence detection. To extend the investigations further towards ^{54}Ca a more sensitive approach is required. Hence, we have adapted the COLLAPS collinear laser beamline at ISOLDE for the application of β-decay detection after optical pumping and state-selective neutralization (ROC) [3].

[1] D. Steppenbeck et al., Nature 502, 207 (2013)
[2] R. F. Garcia Ruiz et al., Phys. Rev. C 91, 041304(R) (2015)
[3] L. Vermeeren et al., Phys. Rev. Lett 68, 1679 (1992)

HK 27.5 Di 18:00 S1/01 A03

Measurements of isomers at the FRS Ion Catcher — •Christine Hornung for the FRS Ion Catcher-Collaboration — Justus-Liebig Universität Gießen, Germany

Projectile fragmentation and fission reactions at in-flight facilities are important production mechanisms to access short-lived exotic nuclei. It is a challenge to describe the angular momentum distribution after the collision of relativistic nuclei. This can be experimentally accessed by measuring the population of isomeric states.
Isomeric ratios and excitation energies of isomers of short-lived exotic nuclei can be determined at the FRS Ion Catcher at GSI. At the FRS, projectile and fission fragments are produced at relativistic energies, separated in-flight and range-focused. They are slowed down and thermalized in a cryogenic stopping cell. In a multi-purpose RFQ beamline alpha spectroscopy can be performed. Alternatively the ions can be transported to a multiple-reflection time-of-flight mass spectrometer (MR-TOF-MS), where masses of the ground and isomeric states can be measured simultaneously with high resolving power. The MR-TOF-MS can also be used to spatially separate the ions in order to provide isomerically clean ion beams.
During a recent experiment isomer-to-ground state ratios and excitation energies of uranium projectile and fission fragments produced at 1 GeV/u were measured. The ratios, measured with the MR-TOF-MS, were verified by alpha spectroscopy. Furthermore the ratios were compared to calculations based on an abrasion-ablation model of fragmentation.