HK 29: Structure and Dynamics of Nuclei V

Time: Tuesday 16:00–17:30 Location: HK-H6

HK 29.1 Tue 16:00 HK-H6

Total Reaction Cross-Section Measurements in the S444 Commissioning Experiment for R^{3}B — •Lukas Ponnath[1], Roman Gernhäuser[1], Tobias Jenegger[1], Philipp Klenze[1], and Thomas Aumann[2] for the R3B-Collaboration — [1]Technische Universität München — [2]Technische Universität Darmstadt

The R^{3}B (Reactions with Relativistic Radioactive ion Beams) experiment at the research facility FAIR, currently under construction in Darmstadt, enables kinematically complete reaction studies for the most exotic nuclei.
The S444 commissioning experiment for R^{3}B, performed in the FAIR Phase-0 campaign in 2019, was the first operation of many new R^{3}B detectors in a common setup. With a stable ^{12}C beam and a set of different beam energies ranging from 400AMeV to 1AGeV we challengend this large installation around the GLAD magnet using the ^{12}C(p,2p)^{11}B benchmark reaction.
During this successful commissioning we could measure the energy dependence of total reaction cross-sections of a ^{12}C beam on a ^{12}C target, which is poorly known for energies above 400AMeV. This is an important input for current calculations based on the eikonal reaction theory.
In my Talk I will present the current status and preliminary results of the analysis and discuss the technique and evaluated error budget for the different steps.
(supported by BMBF 05P21WOFN1)

HK 29.2 Tue 16:15 HK-H6

Recent high-precision mass spectrometry of heavy and superheavy nuclides at SHIPTRAP — •Oliver Kaleja for the SHIPTRAP-Collaboration — University of Greifswald, Germany — GSI Darmstadt, Germany

Within the recent FAIR phase-0 program, the Penning-trap mass spectrometer SHIPTRAP at GSI in Darmstadt, Germany, was used to extend direct high-precision mass spectrometry to superheavy nuclides ($Z \geq 104$) in the vicinity of the $N = 152$ shell closure. Besides lowest production rates down to few atoms per hour, an improved efficiency, ion sensitivity and mass-resolving power of up to 11 000 000 allowed resolving metastable states with half-lives >200 ms, i.e, ^{251m,254m}No($Z = 102$), ^{254m,255m}Lr($Z = 103$), ^{257m}Rf($Z = 104$), and ^{258m}Db($Z = 105$) from their respective ground state. For the first time, isomer excitation energies in the range of ≈ 30 keV to 1.3 MeV were determined directly. In addition, multiple metastable states in a variety of heavy isotopes, many of which are close to the $Z = 82$, $N = 126$ shell closures, have been measured, e.g., for isotopes of Pb, Bi, Po, At, Rn, Fr ($Z = 82 - 87$), Th($Z = 90$), and Cf($Z = 98$). This allowed the direct determination of the excitation energies of long-lived isomeric states and therefore to contribute to the understanding of the level and decay schemes of these heavy nuclei, complementing the findings from decay and laser spectroscopy investigations. In this contribution an overview of the experimental challenges and results is given.

HK 29.3 Tue 16:30 HK-H6

Commissioning and status of a gas-jet apparatus for laser spectroscopy of the heaviest elements — •Jeremy Lantis for the GSI Gas Jet-Collaboration — Johannes Gutenberg University Mainz, 55099 Mainz, Germany — Helmholtz Institute Mainz, 55099 Mainz, Germany

Laser spectroscopy measurements can provide information about fundamental properties of both atomic and nuclear structure. These techniques are of particular importance for the heaviest actinides and superheavy elements, where atomic data are sparse. Recent resonance ionization spectroscopy experiments at GSI, Darmstadt have focused on in-gas-cell measurements using the RADRIS technique, with success measuring several nobelium and fermium isotopes. However, the limited resolution of these measurements hampers the precision in determining the nuclear moments and spin. To overcome these limitations, a new gas-jet apparatus has been constructed to perform laser spectroscopy of atoms in a hypersonic jet, providing an almost collision-free and reduced Doppler broadened environment, which improves the achievable resolution by an order of magnitude and provides substantially improved nuclear data of exotic nuclei. The reach and capabilities of the apparatus will be discussed, as well as planned online experiments involving the determination of the nuclear moments of ^{253,255}No and the definitive identification of the nucleonic configuration of the $K^\pi = 8^-$ isomer of ^{254m}No.

HK 29.4 Tue 16:45 HK-H6

Perturbative inclusion of core excitation in a structure model of one-neutron halo nuclei — •Live-Palm Kubushishi and Pierre Capel — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz, 55099 Mainz, Germany

Halo nuclei are exotic nuclear structures found near the dripline and thus short-lived. In standard reaction models, halo nuclei are described as simple two or three-body systems: an inert core with one or two weakly bound neutrons. However, some breakup data suggest that the structure of the core, and in particular its excitation to its excited states, can play a role in the dynamics of the reaction [1]. In this talk, we propose a simple structure model to account for that effect. Here we consider the example of the one-neutron halo nucleus ^{11}Be. To improve our description of the ^{10}Be core without resorting to a purely microscopic model, we use a collective one: the rigid rotor. We assume the core to be weakly deformed, which we treat at the first order of perturbations to couple it to its 2^+ first excited state, and we add this degree of freedom to the halo effective field theory description of ^{11}Be [2]. Our calculations were performed using the R-matrix method on a Lagrange mesh. In this context, we have been able to reproduce with a good agreement, the coupled-channels results [3] and improve the halo-EFT model [2] with respect to *ab initio* results [4].
[1] R. de Diego, et al., *Phys. Rev. C* 95, 044611 (2017).
[2] P. Capel, et al., *Phys. Rev. C* 98, 034610 (2018).
[3] F.M. Nunes, et al., *Nucl. Phys. A* 596, 171 (1996).
[4] A. Calci, et al., *Phys. Rev. Lett.* 117, 242501 (2016).

HK 29.5 Tue 17:00 HK-H6

Investigation of fission in quasi-free-scattering experiments at R^{3}B — •Tobias Jenegger, Philipp Klenze, Lukas Ponnath, and Roman Gernhäuser — Technische Universität München, Germany

The advanced R^{3}B Setup at GSI allows to investigate fission of exotic nuclei in inverse kinematics via the (p,2pf) reaction. Fission via quasi-free-scattering is a new method to directly determine the excitation energy of the fissile nucleus and its fission barrier. This can only be achieved by kinematically complete measurement of all reaction products. Hence the CALIFA calorimeter, covering a polar angular acceptance from 22° up to 89° in the laboratory system around the target, plays a crucial role. It enables the detection of γ-rays with energies from 100 keV up to 30 MeV as well as protons and other light charged particles with energies up to 700 MeV, hence giving the opportunity to detect both the two coincident protons from the quasi-free-scattering process and emitted γ-rays from deexcitation of the fission products.
We present first analysis steps from a pilot experiment performed in the FAIR Phase-0 campaign in March 2021 with a relativistic ^{238}U beam and a LH2 target focussing on the identification of the fission products and the kinematic analysis of the (p,2pf) reaction.
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HK 29.6 Tue 17:15 HK-H6

Electron scattering off ^{10}B under 180° — •Maximilian Spall, Maxim Singer, Jonny Birkhan, Isabelle Brandherm, Martha Liliana Cortés, Florian Gaffron, Katharina E. Ide, Johann Isaak, Igor Jurosevic, Peter von Neumann-Cosel, Florian Niederschuh, Norbert Pietralla, Gerhart Steinhilber, and Tim Stetz — Institut für Kernphysik, Technische Universität Darmstadt

Electron scattering experiments under 180° are an excellent tool to study transversal form factors of magnetic excitations due to the suppression of longitudinal excitations by several order of magnitudes with respect to the transversal excitations and the associated radiative tail background from elastic scattering at this angle. A measurement was performed with the 180° system at the S-DALINAC [1], in order to investigate the M3 transition of the 3^+ ground state to the excited 0^+ state at 1.74 MeV in ^{10}B which is the analogue to the second-forbidden beta-decay of ^{10}Be. The measurement will extend existing data towards lower momentum transfer allowing to improve the preci-

sion of the determined transition strength. The combined information from electron scattering and beta-decay will serve as a precision test of the unified description of electroweak observables in ab-initio models. First results of the new ^{10}B(e,e') data will be presented and a novel approach for the scattering angle calibration will be discussed.
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[1] C. Lüttge et al., Nucl. Instrum. Meth. A 366, 325*331 (1995).