HK 15: Structure and Dynamics of Nuclei IV

Time: Tuesday 15:45–17:15 Location: HBR 14: HS 4

Group Report HK 15.1 Tue 15:45 HBR 14: HS 4

Experiments with exotic nuclei at the FRS Ion Catcher — •Jianwei Zhao for the FRS Ion Catcher-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

At the FRS Ion Catcher, projectile and fission fragments are produced at relativistic energies, separated in-flight, energy-bunched, slowed down, and thermalized in a gas-filled cryogenic stopping cell (CSC). Subsequently, they are extracted and their masses are measured by using a Multiple-Reflection Time-Of-Flight Mass-Spectrometer (MR-TOF-MS). The MR-TOF-MS features mass resolving powers of up to one million and relative mass measurement accuracies of down to 2x10^{-8} with measurement times of merely a few tens of milliseconds.

Recently, direct mass measurements of neutron-deficient nuclides around the $N = 50$ shell closure below ^{100}Sn, including the first direct mass measurements of ^{98}Cd and ^{97}Rh, shed light on the nuclear structure in this region and on the "^{100}Sn mass riddle". Additionally, broadband mass measurements of fission fragments from a ^{252}Cf spontaneous fission source reveal evidence for shape transitions in the $N \sim 90$, $Z = 56$-63 region, and provide direct determination of independent isotopic fission yields.

An overview of the setup, recent experimental highlights, technical advances including the higher rate capability of CSC, upcoming experiments in FAIR Phase-0, including studies of multi-nucleon transfer reactions inside the CSC and direct mass measurements of neutron-rich nuclides along the $N = 126$ line below ^{208}Pb, will be reported.

HK 15.2 Tue 16:15 HBR 14: HS 4

Search for near-threshold multi-neutron resonances in $(p, 2p)$ reactions with neutron-rich nuclei at R^{3}B — •Nikhil Mozumdar[1,2], Antoine Barriere[4], Martina Feijoo-Fontán[5], Thomas Aumann[1,2,3], and Olivier Sorlin[4] for the R3B-Collaboration — [1]Technische Universität Darmstadt — [2]Helmholtz Forschungsakademie Hessen für FAIR — [3]GSI Helmholtz-Zentrum für Schwerionenforschung — [4]Grand Accélérateur National d'Ions Lourds — [5]University of 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. Towards this end an experiment was performed at the state-of-the-art R^{3}B 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 5cm LH_2 target. Complete kinematic information of resulting reactions is provided by the large combination of detectors in the setup. In this communication, the first 2-neutron reconstruction procedure in the neutron detector NeuLAND will be discussed along with preliminary results.

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HK 15.3 Tue 16:30 HBR 14: HS 4

Mass measurements of neutron-deficient nuclides below ^{100}Sn at the FRS Ion Catcher, GSI — •Gabriella Kripkó-Koncz for the FRS Ion Catcher-Collaboration — Justus-Liebig-Universität Gießen, Gießen, Germany

The heavy $N = Z$ nuclei and the nuclei in their vicinity are highly interesting to study; they can provide important insights about nuclear structure, symmetries and interactions and have a high impact in modelling nuclear astrophysics processes (rp-process, νp-process). A few examples of the striking phenomena are the formation of high-spin isomeric states, the direct and/or β-delayed proton emission from ground or excited states and the strong resonances in Gamow-Teller transitions close to the proton dripline. The FRS Ion Catcher (FRS-IC) experiment at the in-flight fragment separator FRS at GSI enables highly accurate direct mass measurements ($\delta m/m \sim 10^{-8}$) with thermalized projectile and fission fragments by combining a cryogenic stopping cell and a multiple-reflection time-of-flight mass spectrometer. Supported by mass measurements at the FRS-IC within FAIR Phase-0, the evolution of Gamow-Teller transition strengths for even-even $N = 50$ isotones was studied [1]. Besides this, the riddle surrounding the exotic decay modes of the (21^+) high-spin isomer of ^{94}Ag was further unraveled. These results will be presented together with intricacies of the data analysis when analyzing data obtained synchronously by FRS and FRS-IC.

[1] A. Mollaebrahimi et al., Phys. Lett. B 839, 137833 (2023).

HK 15.4 Tue 16:45 HBR 14: HS 4

Measurements of the reaction cross sections of neutron-rich Sn isotopes at the R^{3}B setup. — •Eleonora Kudaibergenova[1], Ivana Lihtar[2], Martina Feijoo-Fontán[3], Thomas Aumann[1,4,5], Igor Gašparić[2], Andrea Horvat[1,2], Valerii Panin[4], José Luis Rodríguez-Sánchez[6], and Dominic Rossi[1,4] for the R3B-Collaboration — [1]Institut für Kernphysik, TU Darmstadt, Germany — [2]RBI, Zagreb, Croatia — [3]IGFAE, Universidad de Santiago de Compostela, Spain — [4]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — [5]Helmholtz Forschungsakademie HFHF — [6]CITENI, Universidade da Coruña, Spain

Constraining the parameters of the nuclear Equation of State (EoS) is one of the central issues in nuclear physics, especially since the slope parameter L has not yet been constrained well experimentally. It has been identified that a precise determination of the neutron-removal cross section in neutron-rich nuclei, which correlates with the neutron-skin thickness, would provide a more precise constraint on L. To this end, an experiment was performed at the R^{3}B setup at GSI as a part of the FAIR Phase-0 program. The reactions are studied in inverse kinematics with neutron-rich tin isotopes in the mass range A=124–134 on carbon targets of different thicknesses. In this communication the charge-changing and charge-exchange analysis of ^{124}Sn+^{12}C at 900 MeV/u is presented.

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HK 15.5 Tue 17:00 HBR 14: HS 4

^{12,16}C(p,2p) Quasi-free scattering in inverse kinematics at R^{3}B/GSI — •Enis Lorenz[1], Thomas Aumann[1,2,3], and Meytal Duer[1] for the R3B-Collaboration — [1]Technische Universität Darmstadt — [2]GSI Helmholtz Zentrum für Schwerionenforschung — [3]Helmholtz Forschungsakademie Hessen für FAIR

Quasi-free scattering (QFS) has proven a potent tool to study the single-particle structures of nuclei, clustering, as well as probing short-range correlated nucleon pairs in nuclei. Recently, a fully exclusive QFS measurement has been performed at the R^{3}B setup at GSI as part of the FAIR Phase-0 experimental program with radioactive-ion beam. At relativistic energy of 1.25 GeV/nucleon both ^{16}C and ^{12}C nuclei are studied by employing complete and inverse kinematics on a liquid-hydrogen target. The exclusive measurement of the two outgoing protons in coincidence with fragments and neutrons provides background-free identification of the reaction channel. In particular, both bound and unbound states, populated by knockout of deeply bound protons can be probed via the invariant mass. In this talk I will present the status of the data analysis, including preliminary results for ^{12}C. This work is supported by the State of Hesse within the Research Cluster ELEMENTS (Project ID 500/10.006), the German Federal Ministry of Education and Research - BMBF project number 05P21RDFN2, and the GSI-TU Darmstadt cooperation agreement.