HK 26: Structure and Dynamics of Nuclei VI

Time: Tuesday 17:30–19:00 Location: HBR 14: HS 4

Group Report HK 26.1 Tue 17:30 HBR 14: HS 4

Measurement of the Neutron-Decay Lifetime of the ^{26}O Ground State — •Sonja Storck-Dutine[1], Thomas Aumann[1,2], Christoph Caesar[2,3], Julian Kahlbow[1,3], Valerii Panin[2,3], and Dominic Rossi[1,2] for the SAMURAI20-Collaboration — [1]Institut für Kernphysik, TU Darmstadt, Germany — [2]GSI, Darmstadt, Germany — [3]RIKEN Nishina Center, Tokyo, Japan

The ground state of the neutron unbound nucleus ^{26}O is speculated to have a lifetime in the pico-second regime. In order to determine the neutron-decay lifetime of the ^{26}O ground state with high sensitivity and precision, a new method has been applied. The experiment was performed at the Superconducting Analyzer for MUlti-particle from RadioIsotope Beams (SAMURAI) at the Radioactive Isotope Beam Factory (RIBF) at RIKEN. A ^{27}F beam was produced in the fragment separator BigRIPS and impinged on a W/Pt target stack where ^{26}O was produced. The ratio of the number of decays occurring inside and outside of the target will change according to the lifetime. Thus, the velocity difference between the decay neutrons and the fragment ^{24}O delivers a characteristic spectrum from which the lifetime can be extracted. With this method, a new upper limit of the ^{26}O lifetime with reduced uncertainties was measured and will be presented in the report.

Supported by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) - Project-ID 279384907 - SFB 1245, the BMBF under contract number 05P21RDFN2 and the GSI-TU Darmstadt cooperation agreement.

HK 26.2 Tue 18:00 HBR 14: HS 4

Electron scattering off ^{10}B at a scattering angle of 180° — •M. Spall, J. Birkhan, I. Brandherm, M. L. Cortés, F. Gaffron, K. E. Ide, J. Isaak, I. Jurosevic, P. von Neumann-Cosel, F. Niederschuh, N. Pietralla, M. Singer, G. Steinhilber, and T. Stetz — Institut für Kernphysik, Technische Universität Darmstadt

Electron scattering experiments at a scattering angle of 180° are an excellent tool to study transversal form factors of magnetic excitations. This is based on 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. The ^{10}B(e, e') reaction was studied with the 180° system [1] at the S-DALINAC. It was the aim to investigate the $M3$ excitation of the 3^+ ground state of ^{10}B to its excited 0^+ state at 1.74 MeV. This is the isospin-analogue to the second-forbidden beta-decay of ^{10}Be. The measurement will extend data on the form factor towards lower momentum transfer. This improves the precision 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. The determined form factor of the investigated M3 transition of the ^{10}B(e,e') data will be presented.

*Supported by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) - Project-ID 279384907 - SFB 1245.

[1] C. Lüttge et al., Nucl. Instrum. Meth. A 366, 325*331 (1995).

HK 26.3 Tue 18:15 HBR 14: HS 4

Reaction Measurements on ^{12}C in Inverse Kinematics at R^{3}B — •Tobias Jenegger, Roman Gernhäuser, Philipp Klenze, and Lukas Ponnath — Technische Universität München, Germany

The R^{3}B Setup at GSI allows to fully reconstruct nuclear reactions of exotic nuclei in inverse kinematics. The commissioning of the CALIFA calorimeter for the S444 experiment in 2020 opened new doors to investigate the proton-induced-quasi-free one-nucleon knockout reactions.

The CALIFA calorimeter, with its 2528 CsI scintillator crystals in its final design, is a key detector for quasi-free-scattering experiments at R^{3}B. It allows to detect both gamma rays from nuclear de-exictation processes as well as light charged particles, as protons, from knockout reactions with high angular resolution and precise Doppler correction. This dedicated detector setup allowed to study single-particle structure of ^{12}C via the ^{12}C(p,2p)^{11}B quasi-free scattering channel as well as by measuring the charge changing and total reaction cross sections of ^{12}C beam on ^{12}C and plastic targets.

We present the analysis of the S444 experiment performed in the FAIR Phase-0 campaign with relativistic ^{12}C beams at beam energies from 400, 550, 650 and 800 AMeV and discuss the different techniques used for the analysis.

Supported by BMBF 05P21WOFN1 and Excellence Cluster Origins.

HK 26.4 Tue 18:30 HBR 14: HS 4

Measurements of interaction cross-section of carbon isotopes (^{10,11,12}C) at the FRS — •Rinku Prajapat for the BARB- and Super-FRS Experiment-Collaboration — GSI, Darmstadt, Germany — Saint Mary's University, Halifax, Canada

The advancement of production techniques to access unstable nuclei far from the stability line has resulted in the discovery of many exotic nuclei characterized by short half-lives and an unusual neutron-to-proton ratio. Such nuclei are of particular interest in fundamental and applied physics. For instance, measurement of interaction cross-section (σ_I) is essential for the deduction of the interaction radii and input in treatment planning programs for radiotherapy with heavy-ions such as ^{12}C. However, the case of positron emitters (^{10,11}C) is of special interest in ion beam therapy owing to their potential application in range verification in patients directly. Thus, an experiment has been performed at GSI Darmstadt to produce and separate the fragments (^{10,11}C) of interest using the in-flight fragment separator and spectrometer FRS. The aim of the experiment was to measure the interaction and charge-changing cross-sections of ^{10,11,12}C nuclei on a carbon interaction target at therapeutically relevant energies. The measurements were done with the transmission method, which means that the unreacted part of the beams is being analyzed using the FRS magnetic spectrometer. In this contribution, the experimental overview, data analysis, together with the preliminary results will be presented. This work is supported by ERC Advanced Grant 883425 (BARB) and performed within the Super-FRS Experiment Collaboration framework of the FAIR Phase-0.

HK 26.5 Tue 18:45 HBR 14: HS 4

Halo-EFT description of one-neutron halo nuclei with core excitation — •Live-Palm Kubushishi — Johannes Gutenberg-Universität Mainz, Germany

Halo nuclei are fascinating short-lived nuclear systems found near the driplines. In standard reaction models, halo nuclei are usually described as an inert core with one or two weakly bound nucleons. However, some breakup data suggest that the dynamics of the reaction is influenced by the excitation of the core to its excited states in a significant way. Halo-EFT has been shown to give a good description of halo nuclei within reaction models. Accordingly, we extend it to include core excitation considering a rigid-rotor model of the core. As a study case, we take the ^{11}Be which is a typical one-neutron halo nucleus. Its core deformation is then treated at the first order of perturbations to include effectively the 2^+ excited state of ^{10}Be in the description of ^{11}Be. We perform a coupled-channels study of the bound states of ^{11}Be where the low energy constants are fitted to reproduce an *ab initio* calculation. For the ground state, the inclusion of core excitation allows us to better reproduce the *ab initio* predictions (wavefunction and phaseshift). In contrast, for the first excited state, core excitation does not have much influence on the calculations, confirming that this is a shell model state. This simple few-body model will enable us to study the influence of core excitation in nuclear reactions. It will also provide a better understanding of the complicated *ab initio* results.