HK 7: Structure and Dynamics of Nuclei I

Time: Monday 14:00–15:30 Location: HK-H6

HK 7.1 Mon 14:00 HK-H6

Investigation of neutron-induced γ-rays from Ge-nuclides in the ROI of GERDA/LEGEND — •Marie Pichotta[1], Hans Hoffmann[1], Konrad Schmidt[2], Steffen Turkat[1], and Kai Zuber[1] — [1]Institut für Kern- und Teilchenphysik, TU Dresden, Dresden — [2]Helmholtz-Zentrum Dresden Rossendorf, Dresden

GERDA has been a pioneering experiment in the search for the still undetected neutrinoless double beta ($0\nu\beta\beta$)-decay of ^{76}Ge and this will also hold for the successor experiment LEGEND. The discovery of this extremely rare process would prove the Majorana character of neutrinos and consequently physics beyond the Standard Model. For an explicit identification of a signal caused by the $0\nu\beta\beta$-decay, which correspond to an energy of 2039 keV for ^{76}Ge, a precise understanding of all background contributions in the region of interest (ROI) is crucial.

Previous experiments indicated γ-lines, produced by neutron activation (n,p) and neutron scattering (n,n') processes on ^{76}Ge and ^{74}Ge but until now, no significant indications of their existence were found. In order to confirm the existence of the γ-lines in this ROI, an enriched Ge-sample was alternately irradiated by neutrons from a DT generator and measured by a HPGe detector. The γ-spectra of more than 40 irradiation cycles show two peaks in the ROI of GERDA/LEGEND. The experimental procedure and the analysis of the peaks will be presented. This project is supported by BMBF (05A17OD1).

HK 7.2 Mon 14:15 HK-H6

Neutrino-induced pion-production off the nucleon in chiral effective field theory — •Niklas Döpper and Norbert Kaiser — Physik-Department T39, Technische Universität München, D-85747 Garching, Germany

The current status of the analysis of neutrino-induced single pion production off the nucleon in the framework of manifestly Lorentz-invariant chiral perturbation theory is presented. The calculation of tree and one-loop diagrams is performed up to and including fourth chiral order with an explicit treatment of the $\Delta(1232)$ resonance. Terms that break the power counting between the loop and small momentum expansion are treated in the extended on-mass-shell scheme. This calculation aims to predict the total cross sections for the reactions of neutrino or antineutrino induced pion production off neutrons and protons at low energies. The present result has implications for the nuclear two-body axial exchange current as generated by one-pion exchange.

This work has been supported in part by DFG (Project-ID 196253076 - TRR 110) and NSFC.

HK 7.3 Mon 14:30 HK-H6

Reaction studies around the Ca isotopic chain in inverse kinematics with the R3B setup — •Christian Sürder for the R3B-Collaboration — Institut für Kernphysik, TU Darmstadt, Germany

In Feb. 2020 an experiment to study isotopes around the Ca isotopic chain, reaching from the proton-rich to the neutron-rich side, was performed with the versatile R3B setup at GSI, Darmstadt, Germany. The isotopes were produced through fragmentation of a primary beam of ^{86}Kr at a beam energy of 580MeV/A on a ^{9}Be target. The secondary cocktail beam included isotopes of Cr, V, Ti, Sc, Ca, K, Ar and Cl. This experiment, part of the R3B Phase 0 program at FAIR, allowed for exclusive studies in inverse kinematics, employing reactions like (p2p), (p2pn), etc. The knocked out particles were detected with CALIFA, a CsI detector with high granularity, situated around the target area. The talk focuses on CALIFA, showing the detector performance and presenting first results of the reaction studies.

This work is supported by BMBF under contract 05P19RDFN1 and 05P21RDFN1 and the Helmholtz Research Academy Hesse - HFHF.

HK 7.4 Mon 14:45 HK-H6

Investigation of 220<A<230 Po-Fr nuclei in the south-east frontier of the A-225 island of octupole deformation — •Nicolas Hubbard[1,2], Marta Polletini[3,4], Helena Albers[2], Giovanna Benzoni[4], Julgen Pellumaj[5,6], and Jose Javier Valiente-Dobon[5] for the DESPEC-S460-Collaboration — [1]Technische Universitaet Darmstadt, Darmstadt, Germany — [2]GSI Helmholtzzentrum fuer Schwerionenforschung, Darmstadt, Germany — [3]Universita degli Studi di Milano, Italy — [4]INFN Senzione di Milano, Italy — [5]INFN, Laboratori Nazionali di Legnaro, Italty — [6]Universita di Ferrara, Italy

The Ra-Th (Z=88-90) actinide nuclei around mass number A~225 delimit the region of the nuclear chart where the strongest octupole correlations manifest. In general, there is a dearth of experimental information on the structure of nuclei in this region. An experiment was performed at GSI in April 2021 utilising the FRS+DESPEC setup to directly measure beta-decay half-lives, alpha-branching ratios and lifetimes of excited nuclear states. These results can be used to study the interplay between quadrupole and octupole correlations at the far end of the isle-of-deformation, to obtain beta-decay information beyond N=126 to better model the rapid neutron-capture (r-)process and to study shape isomers in 220,220Po where super-deformed and hyper-deformed structures at low excitation energies are expected. Furthermore, a calibration of the FRS+DESPEC setup using the alpha-emitting Rn and Fr isotopes was employed, providing a high-efficiency ion-decay correlation test as well as refining alpha-decay information.

HK 7.5 Mon 15:00 HK-H6

Branching-ratio of the mixed-symmetry 2^+-state of ^{132}Te* — •R. Mayer[1], T. Stetz[1], T. Beck[1], V. Werner[1], R. Zidarova[1], P. Koseoglou[1], N. Pietralla[1], R.-E. Mihai[2], R. Borcea[2], S. Calinescu[2], C. Costache[2], I. Dinescu[2], A. Ionescu[2], N. Margineanu[2], C. Mihai[2], C.-R. Nita[2], S. Pascu[2], L. Stan[2], and S. Toma[2] — [1]IKP, TU Darmstadt — [2]IFIN-HH, Bucharest

^{132}Te is two protons and two neutron holes away from the doubly-magic ^{132}Sn. Its second 2^+ state has been found [1] to be a mixed-symmetry state which mostly decays by a strong M1 transition to the first 2^+ state. The transition to the 0^+ ground state occurs with a small branching ratio of 1.0(5)%. The large relative uncertainty of this ground-state decay branch prevented a precise determination of the $2_2^+ \rightarrow 2_1^+$ M1 strength from Coulomb-excitation data [1]. In a recent experiment, populating the 2_2^+ state of ^{132}Te via the two-neutron transfer reaction ^{130}Te(^{18}O,^{16}O)^{132}Te in an experiment at IFIN-HH, we employed the ROSPHERE HPGe array for a Doppler-shift attenuation measurement aimed at the determination of the 2_2^+ lifetime. While that analysis is ongoing, we sought to use the significant background reduction due to the use of the particle detection system SORCERER [2] to obtain a new value for the ground-state decay branch of the 2_2^+ state.

[1] M. Danchev et al., Phys. Rev. C 84, 061306(R) (2011)
[2] T. Beck et al., Nucl. Inst. Meth. Phys. A 951 (2020) 163090
*Supported by the BMBF under the Grants No. 05P19RDFN1 and 05P21RDFN1.

HK 7.6 Mon 15:15 HK-H6

HYDRA: HYpernuclei Decay at R3B Apparatus — •Simone Velardita, Liancheng Ji, Alexandre Obertelli, and Yelei Sun for the R3B-Collaboration — Technische Universität Darmstadt

HYDRA is a physics program within the R^{3}B collaboration at the decay spectroscopy of hypernuclei produced from heavy-ion collisions at GSI/FAIR. The program aims at measuring with high resolution the in-flight pionic decay of light and medium mass hypernuclei. The pion tracker is conceived as a time projection chamber inside the GLAD magnet of the R^{3}B setup.

As a first step, a prototype TPC was built to implement all the technologies proposed for the full TPC. The prototype covers an active area of 256 x 88 mm^2 decomposed into 5632 pads. In the drift region in which the drift length is 300 mm, a homogeneous electric field is held up by a two-layer wire field cage. A compact metal-core Micromegas pad plane is used to amplify and collect drift electrons. The prototype was tested at TU Darmstadt. The first results will be presented in the poster.

The full experimental setup has been simulated within the R3BROOT framework. Simulations were used to optimise the geometry and to define conditions for a forthcoming experiment at GSI/FAIR. Results will be detailed. The first experiment to be proposed with the HYDRA prototype, aiming at the mass radius of hypernuclei such as the hypertriton, expected to be halo, from interaction cross section measurement will be detailed in the poster.