HK 55: Structure and Dynamics of Nuclei XII

Time: Thursday 17:30–18:45 Location: HS 2 Physik

Group Report HK 55.1 Thu 17:30 HS 2 Physik

Overview of recent production cross-section measurements at the FRagment Separator FRS — •Suraj Kumar Singh for the Super-FRS Experiment-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — Justus-Liebig-Universität Gießen, Germany

Studies of nuclei far from the valley of stability are of interest because they provide insight into their sometimes new or unexpected properties, nuclear reactions and nuclear structure relevant for various fields of physics ranging from fundamental physics, nuclear astrophysics up to applications. Therefore, it is important to produce and study such exotic nuclides at the edges of stability. The possible rate and yield of the exotic isotopes, which are essential for each proposal for new experiments, are determined by their production cross-sections and require an accurate knowledge. As precise calculations of the production cross-section are difficult, the cross-section measurements are the first step towards research with isotopes far away from the valley of stability. The measured cross-sections shed light on production mechanisms and offer improved benchmarks for theoretical models, too. In this contribution, recent developments of the analysis and first results from the evaluation of production cross-sections of relativistic U, Er, Mo and Pb beams at the FRS at GSI will be presented.

HK 55.2 Thu 18:00 HS 2 Physik

Proton range calibration for the R^3B-CALIFA calorimeter — •Mrunmoy Jena, Roman Gernhäuser, and Tobias Jenegger for the R3B-Collaboration — Technische Universität München, Munich, Germany

The CALIFA (CALorimeter for In-Flight detection of gamma rays and high energy charged pArticles) is one of the most important detectors in the R^3B (Reactions with Relativistic Radioactive ion Beams) experiment. Being highly segmented and having almost full polar angle coverage ($7^o < \theta < 143^o$), this detector provides spectroscopic information for gamma rays and charged particle energies varying from 100 keV to about 300 MeV. The MPRB-32 charge sensitive preamplifiers coupled to the detection units can be operated in a low gain (gamma range) or a high gain mode (proton range), enabling a high dynamic range for the energy determination.

This presentation introduces a user-friendly, computer-controlled procedure that carries out an automatic calibration of the entire CALIFA calorimeter over the full dynamic range. The calibration is carried out using a combination of a ^{22}Na radioactive source and electronic pulser signals of known amplitudes.

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HK 55.3 Thu 18:15 HS 2 Physik

Investigation of nuclear surface structure of exotic Xe isotopes with the PUMA aparatus — •Clara Klink[1,2], Lukas Nies[2], Alexandre Obertelli[1], Frank Wienholtz[1], Jonas Fischer[1], and Moritz Schlaich[1] — [1]TU Darmstadt — [2]CERN

PUMA (antiProton Unstable Matter Annihilation) is a new experiment at CERN since 2021. It aims to use antiprotons' unique properties to probe the nucleonic structure of both stable and exotic nuclei. After formation of antiprotonic atoms with the isotope of interest, antiprotons will annihilate on the nucleus's surface. This process yields annihilation products whose total electric charge allows to reconstruct the neutron-to-proton ratio on the surface of an isotope. These insights can provide a new perspective for investigating quantum phenomena such as nuclear halos and neutron skins. In order to trap antiprotons with exotic nuclei, PUMA aims to transport up to one billion antiprotons from the AD (Antiproton Decelerator) to the ISOLDE (Isotope Separator On-Line Device) facility.

In this talk, the current status and future plans for the experimental campaign of PUMA at ISOLDE is outlined. PUMA aims to measure before the LS3 the neutron-to-proton annihilation ratio of captured antiprotons in antiprotonic 115-144 Xe to extract a quantitative understanding of how the increasing number of neutrons in the isotopic chain changes neutron skin thickness. For this, a new transfer beamline is currently under construction at ISOLDE. Additionally, other exotic candidates for measurements with the PUMA setup are discussed and the transport of antiprotons from AD to ISOLDE detailed.

HK 55.4 Thu 18:30 HS 2 Physik

Probing the surface of stable nuclei with antiprotons - the first phase of the PUMA experiment — •Moritz Schlaich[1], Alexandre Obertelli[1], Frank Wienholtz[1], Clara Klink[2], Jonas Fischer[1], and Lukas Nies[2] — [1]Technische Universität Darmstadt, Institut für Kernphysik, Darmstadt, Germany — [2]CERN, Genf, Schweiz

PUMA (antiProton Unstable Matter Annihilation) is a new experiment at the Antimatter Factory at CERN since 2021 [1]. It aims to use low-energy antiprotons as a probe for the nucleonic composition on the surface of both stable and exotic nuclei. For this, antiprotons are trapped together with the ions of interest to form antiprotonic atoms. As a result, the antiprotons will annihilate with a proton or a neutron in the tail of the nuclear density distribution. This process yields annihilation products dominated by pions whose total electric charge allows the reconstruction of the isospin distribution and thus provides access to a new observable: the neutron-to-proton annihilation ratio. These insights offer a new perspective for the investigation of quantum phenomena such as nuclear halos and neutron skins.

In the first phase of the experiment, the experimental technique will be applied to stable ions provided by a versatile offline ion source setup. This contribution provides an overview of the current status of the PUMA experiment at the Antimatter Factory and discusses the latest results of the PUMA offline ion source setup.

[1] T. Aumann et al., Eur. Phys. J. A (2022) 58:88
[2] D. Adhikari et al., PREX, Phys. Rev. Lett. 126 (2021) 172502