HK 23: Invited Talks III

Time: Wednesday 11:00–12:30 Location: HSZ/0002

Invited Talk HK 23.1 Wed 11:00 HSZ/0002

High-Precision Laser Spectroscopy of C^{4+} for an All-Optical Determination of the Nuclear Charge Radius — •Phillip Imgram[1], Kristian König[1], Bernhard Maass[2], Patrick Müller[1], and Wilfried Nörtershäuser[1] — [1]Institut für Kernphysik, TU Darmstadt, Germany — [2]Argonne National Laboratory, Chicago, IL, USA

Nuclear charge radii of radioactive isotopes are typically referenced to a stable nucleus in the isotopic chain through an atomic isotope shift measurement. In some cases, this can limit the uncertainty of the obtained charge radii of radioactive nuclei to the uncertainty of the reference measurements from elastic electron scattering or muonic atom spectroscopy. To overcome this limit in light mass nuclei like ^{10,11}B, an all-optical approach for the charge radius determination purely from laser spectroscopy measurements and non-relativistic QED calculations was tested with the well-known nucleus of ^{12}C through laser excitation of helium-like $^{12}C^{4+}$ from the metastable $2\,^3S_1$ state with a lifetime of 21 ms to the $2\,^3P_J$ states. The high-precision collinear laser spectroscopy of $^{12}C^{4+}$ has been performed at the Collinear Apparatus for Laser Spectroscopy and Applied Physics (COALA) at the Institute of Nuclear Physics of TU Darmstadt. This contribution will give an overview of the project and present the measured transition frequencies along with the extracted all-optical nuclear charge radius of ^{12}C. This project is supported by DFG (Project-ID 279384907 - SFB 1245).

Invited Talk HK 23.2 Wed 11:30 HSZ/0002

ALICE determines the transparency of our galaxy to the passage of antihelium nuclei — •Laura Serksnyte for the ALICE Germany-Collaboration — Technical University of Munich

The measurements of the inelastic cross sections of antihelium-3 nuclei were performed by employing the ALICE detector material as a target. The antimatter-to-matter ratio and TOF-to-TPC matching methods were used in pp and Pb-Pb collisions, respectively. These, for the first time, measured inelastic cross sections have been implemented in the GALPROP propagation model to estimate the losses in the antihelium-3 cosmic ray fluxes due to inelastic interactions with the interstellar medium. Indeed, some dark matter candidates, such as the WIMPs, are expected to annihilate in our galaxy and produce, among other particles, light antinuclei, which can be observed as cosmic rays. However, the same antinuclei can also be produced in ordinary cosmic ray collisions with the interstellar gas. Thus, precise modelling of signal and background cosmic ray fluxes, including the inelastic losses in the interstellar medium, is required to draw conclusions from future antinuclei cosmic-ray measurements.

The results of this interdisciplinary study by ALICE allowed the determination of the transparency of our galaxy to the propagation of the antihelium-3 from dark matter annihilation and ordinary cosmic ray collisions, and to demonstrate that antihelium-3 nuclei are a promising probe for indirect dark matter searches. This research was funded by BMBF Verbundforschung (05P21WOCA1 ALICE) and the DFG under Germany's Excellence Strategy - EXC2094 - 390783311.

Invited Talk HK 23.3 Wed 12:00 HSZ/0002

The world of light and strange mesons: from spectroscopy puzzles to low energy QCD phenomena — •Stephan Paul for the COMPASS-Collaboration — Technical University of Munich, Physics Department, Garching, Germany — Max-Planck-Institute for Physics, Munich, Germany

After 20 years of data taking, the COMPASS experiment looks back on important contributions in the fields of nucleon spin-structure, light-hadron spectroscopy, and measurements related to very-low-energy QCD. Here, we report new insights into the mesonic excitation spectrum based on the world's largest data set, which provides access to all iso-vector mesons in a self-consistent manner using novel analysis techniques. In addition to excitations with high angular momentum, we have unraveled exotic mesons and discovered new mesonic structures even at low masses whose interpretation is still unclear. At very low energies, QCD can be described by effective interactions in the framework of chiral perturbation theory. We have challenged numerous precision calculations with high accuracy even in multidimensional analyses. COMPASS has proven to be a versatile precision instrument allowing for studies of QCD with high energy beams complementary to low energy facilities.