HK 1: Invited Talks I

Time: Monday 11:00–12:30 Location: HK-H1

Invited Talk HK 1.1 Mon 11:00 HK-H1

A supernova in the lab - Astrophysics with stored, radioactive ions — •Jan Glorius for the E127-Collaboration — GSI Helmholtzzentrum, Darmstadt, Germany

Stars are giant nuclear reactors responsible for the synthesis of every element beyond hydrogen and helium. They generate vast amounts of material through nuclear conversions acting over millions of years or in the blink of an eye, e.g., in quiescent stellar burning or in violent star explosions, respectively. Simulations of the internal stellar processes can reproduce the main features of the solar inventory, however the production of many naturally occurring nuclei is still a mystery. This applies in particular to the so-called p-nuclei arising from stellar explosions, for which the models suffer from large nuclear uncertainties.

This contribution will introduce a novel experimental approach to shed light on such eluding cases by providing data on nuclear key reactions to produce strong constraints for explosive nucleosynthesis. The experimental campaign focuses on proton-capture reactions and is based on the production of radioactive ion beams at GSI, which are subsequently accumulated, cooled and decelerated in the heavy ion storage ring ESR. After years of development with stable beams, the first successful measurement has been conducted recently with a radioactive beam, namely ^{118}Te. The talk will discuss the experimental technique in detail, as well as the status and results of the recent and precursor experiments. Furthermore, the plans for an extension of the campaign to the new CRYRING facility at GSI will be presented.

Invited Talk HK 1.2 Mon 11:30 HK-H1

Exotic quark-made formations — •Mikhail Mikhasenko — ORIGINS Excellence Cluster, Munich, Germany — Ludwig Maximilian University of Munich

Conventional hadrons incorporate three-quark baryons like proton and neutron, and quark-antiquatk mesons, as e.g. pion, kaon, and J/ψ. Recent discoveries in particle-physics experiments around the world change our understanding of the quark-made formations. The tetraquarks of the XYZ family, narrow pentaquarks, and long-lived double-heavy-flavor tetraquarks do exists and heat the scientific debates on their microscopic nature. The talk will review the most amazing findings of hadron spectroscopists that paved the way to the rich world of the exotic states what we know of now. I will focus on the newest observation of the doubly charmed tetraquark T_{cc}^{+} using data collected by the LHCb experiment at the Large Hadron Collider.

Invited Talk HK 1.3 Mon 12:00 HK-H1

Nuclear ab-initio theory for neutrino oscillations — •Joanna Sobczyk[1], Sonia Bacca[1], and Bijaya Acharya[2] — [1]Johannes Gutenberg-Universitat, Mainz, Germany — [2]Oak Ridge National Laboratory, Oak Ridge, USA

We are entering an era of high-precision neutrino oscillation experiments (T2HK, DUNE), which potentially hold answers to some of the most exciting questions in particle physics. Their scientific program requires a precise knowledge of neutrino-nucleus interactions coming from fundamental nuclear studies. Ab initio many-body theory has made great advances in the last years and is able to give relevant predictions for medium-mass nuclei.

In my talk I will give an overview of the recent progress that has been made in describing neutrino-nucleus scattering within the ab-initio coupled-cluster framework, combined with the Lorentz integral transform. These techniques open the door to obtaining nuclear responses (and consequently cross-sections) for medium-mass nuclei starting from first principles. A series of steps has been made in this direction. Firstly, the nuclear 1- and 2-body currents have been rederived and checked for the case of neutrino-deuteron scattering. Afterwards, the Coulomb sum rule of 16O has been calculated, introducing a new technique to remove the center-of-mass contamination. This allowed us to calculate for the first time the longitudinal response of 40Ca. Recently, we obtained spectral functions which enabled us to extend our calculations to the relativistic regime within the impulse approximation.