HK 1: Invited Talks I

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

Invited Talk HK 1.1 Mon 11:00 HSZ/0002

Nucleosynthesis of heavy nuclei – moving a supernova into the laboratory — •Felix Heim — University of Cologne, Institute for Nuclear Physics

Stars do not only produce visible light and energy via nuclear fusion reactions but are also responsible for the creation of heavy elements. Since its birth over 60 years ago, the field of nuclear astrophysics strives to describe the complex nuclear processes and astrophysical conditions that drive elemental nucleosynthesis. While many facets of this topic are well-understood, others do still remain a great puzzle. Many heavy isotopes are produced within explosive stellar scenarios such as supernova explosions or neutron-star merger events. The procedure and the outcome of these events is heavily affected by nuclear reactions and the rates at which they occur. Therefore, it is essential to study the relevant nuclear reactions in the laboratory and mimic the stellar conditions. Furthermore, theoretical models have to be employed in many cases, where no experimental data are yet available. Therefore systematic investigation and testing of the underlying nuclear physics parameters is essential.

This contribution will discuss some experimental techniques to study nuclear reactions under astrophysical conditions using ion beam accelerators. In addition, current experimental results will be put into context of modern theoretical models using statistical methods. Supported by the DFG (ZI 510/8-2).

Invited Talk HK 1.2 Mon 11:30 HSZ/0002

Exploring the 3D nucleon structure with CLAS and CLAS12 at JLAB — •Stefan Diehl for the CLAS-Collaboration — Justus Liebig Universität Gießen and University of Connecticut

Exploring the 3 dimensional structure of the nucleon can help to understand several fundamental questions of nature, such as the origin of the nucleon spin and the charge and density distributions inside the nucleon. In QCD, the 3-dimensional structure of the nucleon is described by Wigner functions. However, experimentally momentum and coordinate space have to be assessed independently. The momentum distribution can be accessed by transverse momentum dependent distribution functions (TMDs) measured in semi-inclusive deep inelastic scattering (SIDIS) or Drell-Yan processes. The distribution in transverse coordinate and longitudinal momentum space is described by generalized parton distributions (GPDs) which can be accessed for example by deeply virtual Compton scattering (DVCS) and hard exclusive meson production (DVMP). Based on the high quality data of CLAS and the recently upgraded CLAS12 detector at Jefferson Laboratory (JLAB), a detailed study of these distribution functions is being performed. With the new CLAS12 data, multidimensional, high precision studies in an extended kinematic range become possible for the first time. The talk will present the results of recent SIDIS, DVCS and DVMP studies with CLAS and CLAS12, as well as perspectives for 3D nucleon structure measurements with PANDA at FAIR and their impact on the understanding of the 3D nucleon structure.

*The work is supported by DFG (project number: 508107918) and BMBF.

Invited Talk HK 1.3 Mon 12:00 HSZ/0002

Lattice simulations with chiral effective field theory at N3LO — •Serdar Elhatisari — Faculty of Natural Sciences and Engineering, Gaziantep Islam Science and Technology University, Gaziantep, Turkey — Helmholtz-Institut fuer Strahlen-und Kernphysik, Universitaet Bonn, Bonn, Germany

In this talk I present a new approach called wave function matching for solving quantum many-body systems and recent results for ab initio calculations of nuclear structure. The method is applied to lattice Monte Carlo simulations of light nuclei, medium-mass nuclei, neutron matter, and nuclear matter. The goal of method is to ensure that the perturbative corrections used in the lattice calculations converge quickly. We use interactions at next-to-next-to-next-to-leading order in the framework of chiral effective field theory and we find that the method is producing good results for the binding energies and charge radii of light and medium mass nuclei as well as the equation of state for pure neutron matter and symmetric nuclear matter saturation. Also, these results are accompanied by new insights on the nuclear interactions that may help to resolve long-standing challenges in accurately reproducing nuclear binding energies, charge radii, and nuclear matter saturation in ab initio calculations.