HK 66: Plenary VIII

Time: Thursday 11:00–13:00 Location: Audi-Max

Invited Talk HK 66.1 Th 11:00 Audi-Max

Precision experiments with cold and ultracold neutrons — •Klaus Kirch — Paul Scherrer Institut, Villigen PSI, Switzerland

The neutron is a composite particle, but a rather fundamental one. It is the experimentally easiest accessible, electrically neutral spin-1/2 particle. Neutrons take part in all known interactions: They are massive, have magnetic moments, interact strongly and decay weakly. Thermal and cold ("slow") neutrons can be guided to experiments because they are totally reflected from suitable material surfaces under grazing angles of incidence. Critical angles for total reflection depend on neutron velocity. Sufficiently slow neutrons are called ultracold when they are totally reflected under all angles of incidence.

Slow neutrons are particularly useful to test the fundamental interactions and symmetries of nature. They allow for long observation times and are relatively easy to polarize. Most neutron decay correlation studies make use of cold neutron beams which provide large decay statistics and today allow for almost complete neutron polarization. Other experiments, like the measurement of the neutron beta-decay lifetime or the search for an electric dipole moment of the neutron benefit from using stored, ultracold neutrons. Especially in these experiments, considerable progress can be expected due to increasing the available ultracold neutron intensity. To that end, the Paul Scherrer Institut in Switzerland, but also various other projects around the world, aim at providing larger intensities and densities of ultracold neutrons.

Invited Talk HK 66.2 Th 11:30 Audi-Max

Spectroscopy with Belle, BaBar, BES, PANDA. — •Diego Bettoni — INFN, Sezione di Ferrara, Ferrara, Italy

The study of hadron spectroscopy is of fundamental importance for a better, quantitative understanding of QCD. Precision measurements are needed to distinguish between the different theoretical approaches and identify the relevant degrees of freedom. Experimental studies of hadron spectroscopy can be performed in e^+e^- and $\overline{p}p$ annihilations. In e^+e^- direct formation is only possible for states with the quantum numbers of the photon, while all states can be reached by means of other production mechanisms. In $\overline{p}p$ all non-exotic quantum numbers can be formed directly, whereas exotic and non-exotic states can be studied in production. Both experimental techniques have proven very successful. The potential of the e^+e^- experiments is illustrated by the recent discovery by Belle and BaBar of many new states, whose nature is still unclear and for which a conventional interpretation as quark-antiquark bound states as well as more exotic possibilities (hybrids, multiquarks, molecules) are being considered. On the other hand the capability of $\overline{p}p$ experiments to carry out high-precision spectroscopy has been shown by the E760 and E835 experiments at Fermilab and will be exploited by the PANDA experiment at the future FAIR facility in Darmstadt. In this talk we will present an overview of the most significant results achieved by the Belle, BaBar and BES experiments and we will discuss the physics prospects of PANDA.

Invited Talk HK 66.3 Th 12:00 Audi-Max

Density Functionals in Nuclear Structure Physics — •Dario Vretenar — Physics Department, University of Zagreb, Croatia

Among the microscopic approaches to the nuclear many-body problem, energy density functionals (EDF) provide the most complete and accurate description of ground states and collective excitations over the whole nuclide chart. One of the principal objectives of modern nuclear structure theory is to develop a universal EDF framework, in the sense that the same functional is used for all nuclei, with a universal set of parameters determined from low-energy data or, eventually, from two-nucleon and three-nucleon interactions. The current generation of EDFs, with parameters adjusted to empirical properties of nuclear matter and bulk properties of finite nuclei, has achieved a high level of accuracy in the description of ground states and properties of excited states in arbitrarily heavy nuclei, exotic nuclei far from beta-stability, and in systems at the nucleon drip-lines.

In addition to recent advances, future challenges for nuclear EDFs will be discussed. Arguably the most important is a fully microscopic, low-energy QCD-based foundation of the EDF framework. When considering applications, equally important is to develop EDF-based structure models that go beyond the lowest order approximation - the static nuclear mean field. Excitation spectra and transition rates can only be calculated by including dynamical correlations through restoration of broken symmetries, and configuration mixing of symmetry-breaking mean-field states.

Invited Talk HK 66.4 Th 12:30 Audi-Max

Two-proton radioactivity as a tool of nuclear structure — •Bertram Blank — CEN Bordeaux-Gradignan, Chemin du Solarium, F-33175 Gradignan Cedex, France

Two-proton radioactivity is the latest nuclear decay mode discovered. It consists of the emission of a pair of protons from a nuclear ground state.

In pioneering experiments at GANIL and GSI, this new radioactivity was discovered in 2002 [1,2] and meanwhile 45Fe and 54Zn [3] are established 2p emitters, with a possible third nucleus, 48Ni [4]. These results allowed a detailed comparison with the theoretical models.

The latest step in the investigation of 2p radioactivity was the use of time-projection chambers to study the decay dynamics via measurements of the individual proton energies and the relative proton-proton emission angle. A first experiment at GANIL [5] and an experiment performed at MSU [6] allowed to gain first insights into the decay characteristics.

The talk will review the experimental results on ground-state two-proton radioactivity and compare these results with theoretical predictions. Future studies with 2p emitters will be discussed as well.

[1] J. Giovinazzo et al., Phys. Rev. Lett. 89 (2002) 102501
[2] M. Pfützner et al., Eur. Phys. J. A14 (2002) 279
[3] B. Blank et al., Phys. Rev. Lett. 94 (2005) 232501
[4] C. Dossat et al., Phys. Rev. C72 (2005) 054315
[5] J. Giovinazzo et al., Phys. Rev. Lett. 99 (2007) 102501
[6] K. Miernik et al., Phys. Rev. Lett. 99 (2007) 192501