03.05. - Theory

Nuclear forces and electroweak currents from chiral effective field theory

Chiral effective field theory enables a systematic derivation of nuclear forces and the coupling of electromagnetic and weak interactions to nucleons. This talk will discuss the basic concepts of chiral effective field theory and its predictions for nuclear forces from two- to many-nucleon interactions. In addition, the talk will introduce at a basic level the implications for the coupling of electroweak probes to nuclei.

17.05. - Experiment

Precision spectroscopy of light nuclei: The nuclear charge radius of ^{11}Li

Some neutron-rich isotopes of light elements exhibit extended nuclear matter distributions, they are much larger than one would expect according to the $A^{1/3}$ rule of thumb. This is due to loosely bound neutrons that form a dilute halo around a core of standard nuclear matter density. Nuclear charge radii of such nuclei are accessible for about a decade using high precision laser spectroscopy. From the experimental point of view, spectroscopy on such systems with very short lifetime and small production rates is extremely challenging. How this task was accomplished in the case of ^{11}Li, the most prominent halo nucleus, and which conclusions were drawn about the nuclear structure are to be discussed.

24.05. - Theory

Precision Calculations of Light Nuclei

The solution of the nuclear many-body problem with controlled theoretical uncertainties is one of the major challenges in modern nuclear structure theory. For light nuclei, typically up into the middle of the p-shell, we have powerful ab initio many-body methods available, e.g., the No-Core Shell Model or Quantum Monte Carlo Methods. These calculations can access a range of nuclear observables from energies to radii, electromagnetic moments, and transition strengths. This contribution will discuss the basic many-body methods available for light nuclei and illustrate the difficulties in precision calculations for non-energy observables, such as charge radii, with quantified theoretical uncertainties.

07.06. - Theory

Neutron skins and the nuclear equation of state

The nuclear equation of state governs the dynamics of supernova explosions, the merger of compact objects and the properties of neutron stars. The behavior of nuclear matter as a function of neutron excess is dominated by the symmetry energy. In recent years, it has been shown that neutron skins and other related observables are sensitive to the properties of the symmetry energy. This talk will give an introduction to the nuclear equation of state and its connections and correlations with neutron skins and other observables.

14.06. - Experiment

Neutron skins in stable and radioactive nuclei

Nuclei with an excess of neutrons tend to develop at their surface an excess of neutrons, called « neutron skin ». The thickness of a neutron skin strongly depends on the interaction among nucleons and is therefore a stringent test for our understand of the nuclear many-body problem. It has a strong connection to the nuclear equation of state, in particular to the physics of neutron stars. On the experimental side, the neutron skin phenomenon is difficult to quantify precisely since it requires the determination of observables related to the neutron density distribution, which are more difficult to access than charge-density related observables. This contribution will focus on the experimental methods to characterise neutron skins and the associated uncertainties. Particular attention will be given to methods and new experimental programs applied to short lived nuclei in which thick neutron skins are predicted to develop with the addition of neutrons beyond stability.

21.06. - Theory

Electromagnetic Observables in the In-Medium Similarity Renormalization Group

For a long time, the ab initio description of electromagnetic properties of ground and excited states, such as magnetic dipole and electric quadrupole moments and transition matrix elements, was limited to light nuclei. Over the past few years, several methods have been proposed that enable ab initio calculations for medium-mass nuclei. One family of methods is based on the In-Medium Similarity Renormalization Group (IM-SRG). This contribution will discuss different ways in which the IM-SRG can be utilized and which additional theory developments are necessary to address excitation spectra and electromagnetic properties of closed- and open-shell nuclei.

28.06. - Experiment

Laser spectroscopic determination of nuclear moments: Simple structure of complex nuclei

Laser spectroscopy does not only allow for the determination of nuclear charge radii but can also be used to measure spins and moments of nuclear ground states and long-lived isomeric states. Collinear laser spectroscopy is the workhorse for such investigations. It has recently been applied on cadmium isotopes and provided a wealth of data along a chain of 31 isotopes and several isomers. Especially the electric quadrupole moments delivered exciting results since they seem to almost perfectly reproduce an expectation from the "simple" nuclear shell model and at the same time contradict it in other aspects. The technique of collinear laser spectroscopy, the extraction of nuclear spins and moments from optical spectra and the related nuclear physics concepts are to be discussed.

12.07. - Theory

Ab Initio Theory for Hypernuclei

Given the dramatic advance in the ab initio description of nuclei over the past decade, one might ask the question: can we do the same for hypernuclei? Based on an established ab initio method for conventional nuclei, the No-Core Shell Model, this contribution will discuss the new physics aspects and the difficulties that emerge in the description of hypernuclei, i.e., self-bound systems of nucleons and hyperons. These new physics aspects have direct implication not only for the structure of hypernuclei, but also for the physics hyperons in dense matter and the structure of neutron stars.

12.07. - Experiment

Short-range correlations in nuclei

Recent experiments have exhibited very interesting features in the high-momentum knockout of nucleon-nucleon pairs from nuclei, which can be interpreted as a feature of short-range correlations in nuclei. This talk will discuss the general theoretical challenges of such quantities, which come with inherent model dependencies for nuclear interactions. This can be illustrated nicely for the case of the deuteron, and we then discuss new developments beyond A=2.