HK 27: Structure and Dynamics of Nuclei VI

Time: Wednesday 14:00–16:00 Location: J-HS H

Group Report HK 27.1 Wed 14:00 J-HS H

Effective field theory for nuclear wobbling motion — •Qibo Chen[1], Norbert Kaiser[1], and Ulf-G. Meissner[2,3,4] — [1]Physik-Department, Technische Universität München, D-85747 Garching, Germany — [2]Helmholtz-Institut für Strahlen- und Kernphysik and Bethe Center for Theoretical Physics, Universität Bonn, D-53115 Bonn, Germany — [3]Institute for Advanced Simulation, Institut für Kernphysik, Jülich Center for Hadron Physics and JARA-HPC, Forschungszentrum Jülich, D-52425 Jülich, Germany — [4]Ivane Javakhishvili Tbilisi State University, 0186 Tbilisi, Georgia

In recent years, effective field theory (EFT) has achieved many successes in hadronic and low-energy nuclear physics, and the investigation of wobbling motion of triaxially deformed nuclei has become one of hottest topics in nuclear structure physics. In our previous work [1, 2], the EFT has been extended successfully to investigate the rotational and vibrational motions of triaxially deformed even-even nuclei. In this work, the EFT is further extended to investigate the collective motion of triaxial odd-mass nuclei. This extension requires a systematic treatment of the coupling between the single-particle motion and the collective rotational motion. The applicability of the obtained EFT is examined to study the wobbling motion in Lu isotopes.

*Supported by DFG and NSFC (CRC 110).

[1] Q. B. Chen, N. Kaiser, Ulf-G. Meißner, J. Meng, Eur. Phys. J. A 53, 204 (2017).

[2] Q. B. Chen, N. Kaiser, Ulf-G. Meißner, J. Meng, Phys. Rev. C 97, 064320 (2018)

HK 27.2 Wed 14:30 J-HS H

Mass measurements of neutron-deficient Yb isotopes around the N=82 shell closure, close to the proton dripline — •Beck Sönke for the TITAN-Collaboration — Justus-Liebig Universität, Giessen — GSI, Darmstadt

The nuclear mass reflects the binding energy of a nucleus and provides key information for nuclear structure, nuclear reactions and related fields like nuclear astrophysics. Mass measurements of exotic nuclei provide insight into the limits of nuclear existence and changes of the nuclear structure far from stability.

At TRIUMF's Ion Trap for Atomic and Nuclear science (TITAN), masses of neutron-deficient lanthanides have been measured. The ions were produced by a proton beam impinging on a Ta target. The yield of Yb isotopes was enhanced by laser ionization. Mass measurements of the exotic nuclei were performed with TITAN's Multiple-Reflection Time-of-Flight Mass Spectrometer (MR-TOF-MS). For the first time, the MR-TOF-MS was used as its own isobar separator by re-trapping the ions of interest and measuring their masses consecutively. This reduced isobaric background and more exotic nuclei could be measured.

Several masses were measured for the first time. This allows studying the evolution of the $N = 82$ shell closure farthest away from stability. One measured mass is an anchor point of an α decay chain and as such determines the mass values of several heavier isotopes. Mass uncertainties of more than 10 isotopes are reduced by this measurement. The determination of their masses helps in pinning down the exact position of the drip line and finding possible p- and 2p-emitters.

HK 27.3 Wed 14:45 J-HS H

Sub-nanosecon K-isomers in ^{178}W — •M. Rudigier[1,2], P.M. Walker[1], R.L. Canavan[1,3], Zs. Podolyak[1], P.H. Regan[1,3], and P.-A. Söderström[3,4] for the NuBall N-SI-99-Collaboration — [1]Department of Physics, University of Surrey, Guildford, GU2 7XH, UK — [2]ent of Physics, UniverInstitut für Kernphysik, Technische Universität Darmstadt, Schlossgartenstrasse 9, 64289 Darmstadt, Germany — [3]National Physical Laboratory, Teddington, Middlesex, TW11 0LW, UK — [4]GSI Helmholtzzentrum für Schwerionenforschung GmbH, 64291 Darmstadt, Germany

New data on half lives of nuclear excited states in ^{178}W are presented. Data were taken in a measurement using the NuBall array at the IPN Orsay. Previously unkown half lives in the sub-nanosecond range of excited states of ^{178}W have been measured by employing the fast timing method using 20 $LaBr_3$ detectors. In particular, the half lives of the 12^+ state at 3235 keV and the 11^- state at 3053 keV have been measured for the first time. Reduced transition rates and hindrance factors were calculated based on the new experimental data. The study shows evidence for anomalously high transition rates from these levels to the ground state band. An 1389 keV E1 transition depopulating the 11^- state at 3053 keV is the first observation of such an anomalous E1 transition rate from a K-isomer in an even-even nucleus. The results are discussed in terms of t-band admixture to the ground state band.

HK 27.4 Wed 15:00 J-HS H

Description of ^{31}Ne in Halo EFT — •Wael Elkamhawy[1] and Hans-Werner Hammer[1,2] — [1]IKP, TU Darmstadt — [2]EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH

Previous investigations of ^{31}Ne via $1n$-removal reactions on C and Pb targets revealed that it is a deformed nucleus with a significant P-wave halo component. We construct a P-wave Halo EFT for ^{31}Ne in order to provide an appropriate framework for its description. Thereby, we use a spherical Halo EFT that is ideally suited to describe the properties of halo nuclei beyond S-waves.

Within this framework, we calculate electromagnetic properties such as the form factors and extract the different multipole moments and the corresponding radii. Since the low-energy observables appear explicitly within Halo EFT, we are able to establish universal correlations between them. Moreover, we consider the photodisintegration of ^{31}Ne into the continuum and determine the differential B(E1) transition strength which in practice is measured using Coulomb excitation of the ^{31}Ne nucleus.

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HK 27.5 Wed 15:15 J-HS H

Resonances and virtual states in 3n systems — •Sebastian Dietz[1], Sebastian König[1,2,3], and Hans-Werner Hammer[1,2] — [1]IKP, TU Darmstadt — [2]EMMI, GSI Darmstadt — [3]North Carolina State University, Raleigh, NC, USA

We present the analytical continuation of the three-neutron (3n) T-matrix to the unphysical sheets searching for resonances and virtual states. Based on explicit as well as implicit contour deformations of the corresponding Faddeev equation in momentum space we will explore the 3n pole trajectory as a function of the two-neutron interaction strength and show the accessible energy regions. Results are presented for a two-neutron interaction represented by a Yamaguchi potential as well as an interaction derived from pionless effective field theory.

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HK 27.6 Wed 15:30 J-HS H

Spurious poles in hadronic three-particle problems — •Martin Ebert[1], Hans-Werner Hammer[1,2], and Akaki Rusetsky[3] — [1]IKP, TU Darmstadt — [2]EMMI, GSI Darmstadt — [3]HISKP and BCTP, Universität Bonn

The particle-dimer picture is a useful tool to simplify the three-particle problem by including information about the two-particle system. However, in higher orders the dimer propagator can exhibit spurious poles. We present a non-perturbative approach to deal with this problem and compare to fully perturbative schemes. The method is tested with a Yamaguchi model potential.

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HK 27.7 Wed 15:45 J-HS H

Electromagnetic currents from chiral EFT in few-nucleon systems — •Rodric Seutin[1,2,3], Sebastian König[1,2], Kai Hebeler[1,2], and Achim Schwenk[1,2,3] — [1]Institut für Kernphysik, Technische Universität Darmstadt — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — [3]Max-Planck-Institut für Kernphysik, Heidelberg

Using chiral EFT one is able to construct current operators at the one- and two-body level as they provide important contributions to observables. For example, a significant part of magnetic observables comes

from two-body current contributions. We discuss the development of electromagnetic currents in few-nucleon systems and their applications to electromagnetic form factors, radii, and magnetic moments. All results are obtained by using chiral nucleon-nucleon plus three-nucleon interactions combined with current operators at the one- and two-body level. In particular, we study results for 3H and 3He and explore the theoretical uncertainties.

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