HK 68: Structure and Dynamics of Nuclei XII

Zeit: Freitag 14:00–16:00 Raum: S1/01 A03

Gruppenbericht HK 68.1 Fr 14:00 S1/01 A03

Axial asymmetry of excited heavy nuclei as essential feature for the prediction of level densities — •Eckart Grosse[1], Arnd R. Junghans[2], and Ralph Massarczyk[3] — [1]Institute of Nuclear and Particle Physics, Technische Universität Dresden — [2]Institute of Radiation Physics, Helmholtz-Zentrum Dresden-Rossendorf — [3]Los Alamos National Laboratory, New Mexico, USA

In previous studies a considerable improvement of predictions for neutron resonance spacings by a modified back-shifted Fermi-gas model (BSFM) was found. The modifications closely follow the basic priciples for a gas of weakly bound Fermions as given in text books of statistical physics: (1) Phase transition at a temperature defined by theory, (2) pairing condensation independent of A, and (3) proportionality of entropy to temperature (and thus the level density parameter) fixed by the Fermi energy.

For finite nuclei we add: (4) the back-shift energy is defined by shell correction and (5) the collective enhancement is enlarged by allowing the axial symmetry to be broken. Nearly no parameter fitting is needed to arrive at a good reproduction of level density information obtained by various methods for a number of nuclei in a wide range of A and E. To that end the modified BSFM is complemented by a constant temperature approximation below the phase transition point. The axial symmetry breaking (5), which is an evidently essential feature, will also be regarded with respect to other observables for heavy nuclei.

HK 68.2 Fr 14:30 S1/01 A03

Study of the Photon Strength Function in Te-128 — •Johann Isaak[1,2], Tobias Beck[3], Vera Derya[4], Udo Gayer[3], Bastian Löher[5], Norbert Pietralla[3], Christopher Romig[3], Deniz Savran[5], Joel Silva[1,2], Makbule Tamkaş[1,6], Werner Tornow[7], Henry R. Weller[7], Andreas Zilges[4], and Markus Zweidinger[3] — [1]EMMI, Darmstadt — [2]FIAS, Frankfurt — [3]IKP, TU Darmstadt — [4]IKP, University of Cologne — [5]GSI, Darmstadt — [6]Graduate School of Natural and Applied Sciences, Yıldız Technical University, Istanbul — [7]TUNL, Duke University, Durham, USA

The Photon Strength Function (PSF) is a crucial input parameter for statistical model calculations such as Hauser-Feshbach calculations to study the nucleosynthesis of the elements in the universe. In practice, it is a challenging task to determine the PSF experimentally. Therefore, photon-scattering experiments were performed at the High Intensity γ-ray Source (HIγS) at Duke University, Durham, USA. Due to the monochromatic photon beam that is provided at HIγS, the excitation energy is well known as well as the ensemble of states that are populated, i.e. mainly J=1 states. The emitted photons from the subsequent deexcitation are measured with the γ-γ coincidence setup γ^3 [1]. With this experimental approach it is possible to determine the PSF for dipole transitions on top of the ground state and the PSF build on low-lying excited states. Recent results on Te-128 are presented and discussed.

[1] B. Löher *et al.*, NIM A 723 (2013) 136.

* Supported by HA216/EMMI and DFG (SFB 634 and ZI 510/7-1).

HK 68.3 Fr 14:45 S1/01 A03

Investigation of the γ-decay behavior of ^{52}Cr with the γ^3 setup at HIγS — •J. Wilhelmy[1], V. Derya[1], P. Erbacher[2], U. Gayer[3], A. Hennig[1], J. Isaak[4], B. Löher[5], N. Pietralla[3], P. Ries[3], C. Romig[3], D. Savran[5], W. Tornow[6], V. Werner[3], A. Zilges[1], and M. Zweidinger[3] — [1]Institute for Nuclear Physics, University of Cologne — [2]Institute for Applied Physics, Goethe University of Frankfurt a.M. — [3]Institute for Nuclear Physics, TU Darmstadt — [4]ExtreMe Matter Institute EMMI and Research Division, GSI, Darmstadt — [5]GSI, Darmstadt — [6]Department of Physics, Duke University, USA

The study of the γ-ray strength function (γSF) is important for correct theoretical predictions of nucleosynthesis processes. In the *fp* shell an unexpected low-energy enhancement of the γSF was observed [1]. To study this low-energy enhancement in more detail the γ-decay behavior of the *fp* shell nucleus ^{52}Cr was investigated with the high-efficiency γ^3 setup [2] at the High Intensity γ-ray Source facility at TUNL in Durham, USA, which provides selective excitation in multipolarity (mainly dipole) and energy (quasi mono-energetic). The γ^3 setup consists of an array of HPGe and $LaBr_3$ detectors with high efficiency and enables the measurement of γ-γ coincidences. First experimental results will be presented and discussed in this contribution.

Supported by the BMBF (05P15PKEN9), the Alliance Program of the Helmholtz Association (HA216/EMMI), and the BCGS.

[1] A. C. Larsen *et al.*, Phys. Rev. Lett. **111**, (2013) 242504
[2] B. Löher *et al.*, Nucl. Instr. and Meth. A **723** (2013) 136

HK 68.4 Fr 15:00 S1/01 A03

Statistical decay of dipole-excited states of Zr isotopes* — •Udo Gayer[1], Markus Zweidinger[1], Tobias Beck[1], Nathan Cooper[2], Johann Isaak[3,4], Bastian Löher[5], Laura Mertes[1], Haridas Pai[1], Norbert Pietralla[1], Philipp Ries[1], Christopher Romig[1], Deniz Savran[5], Marcus Scheck[6,7], Werner Tornow[8], and Volker Werner[1] — [1]IKP, TU Darmstadt — [2]University of Richmond, Richmond, USA — [3]EMMI, GSI, Darmstadt — [4]FIAS, Frankfurt — [5]GSI, Darmstadt — [6]School of Engineering, UWS, Paisley, UK — [7]SUPA, Glasgow, UK — [8]Duke University, Durham, USA

Decay properties of electric dipole excitations below the neutron separation threshold of ^{92,94,96}Zr have been determined in several (γ,γ') and $(\vec{\gamma},\gamma')$ experiments at the Darmstadt High Intensity Photon Setup and the High-Intensity Gamma-Ray Source in Durham, USA. The model of statistical decay is used to guide an interpretation of this low-lying dipole strength which is frequently discussed to arise from the low-energy tail of the giant dipole resonance and potentially an additional resonance structure often referred to as the pygmy dipole resonance. The availability of three complete data sets in the Zr isotopic chain allowed for a precise test of these extrapolations to low energies using different models for the level density and the photon strength function. In the talk, data and calculations will be presented and the suitability of photon scattering data for this kind of analysis will be discussed.

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HK 68.5 Fr 15:15 S1/01 A03

Deformation dependence of low-energy M1 strength in Fe isotopes — •Ronald Schwengner[1] and Stefan Frauendorf[2] — [1]Helmholtz-Zentrum Dresden-Rossendorf, 01328 Dresden — [2]University of Notre Dame, Notre Dame, IN 46556, USA

The low-energy enhancement of dipole strength functions observed in various experiments has been described in shell-model calculations as caused by many M1 transitions. The calculations have been done for a few nuclides near shell closures so far [1,2]. We present results of shell-model calculations for a series of Fe isotopes with increasing collectivity. The calculations were performed using the code NuShellX [3] with the ca48mh1 interaction [4]. The change of the M1 strength functions with increasing deformation is discussed.

[1] R. Schwengner, S. Frauendorf and A.C. Larsen, Phys. Rev. Lett. 111, 232504 (2013).
[2] B.A. Brown and A.C. Larsen, Phys. Rev. Lett. 113, 252502 (2014).
[3] B.A. Brown and W.D.M. Rae, Nucl. Data Sheets 120, 115 (2014).
[4] M. Hjorth-Jensen, T.T.S. Kuo and E. Osnes, Phys. Rep. 261, 125 (1995).

HK 68.6 Fr 15:30 S1/01 A03

Laser-nucleus reactions in coherent gamma-ray fields — •Adriana Pálffy and Hans A. Weidenmüller — Max-Planck-Institut für Kernphysik, Heidelberg

The generation of coherent gamma-ray fields envisaged at new laser facilities such as the Extreme Light Infrastructure (ELI) holds promise to open the new field of laser-induced nuclear reactions, so far an unknown territory. The laser-nucleus reaction is expected to depend sensitively on how fast successive photon absorption processes occur compared to the nuclear relaxation rate. Here we investigate theoretically the laser-nucleus interaction both in the quasiadiabatic regime and in the sudden regime. In the quasiadiabatic regime, the nucleus (almost) attains statistical equilibrium between two subsequent photon absorption processes. Consecutive absorption of many MeV-gamma photons then leads to the formation of a compound nucleus with excitation energy several hundred MeV above yrast, i.e., in a so-far totally unexplored parameter regime [1, 2]. In the sudden regime, several or many photons are absorbed before the nucleus has time to relax. In that case, the gamma-ray coherent laser pulse may set several or even all nucleons free. This regime offers the possibility to investigate the transition from a bound system of strongly correlated nucleons to a set of independent particles.

[1] A. Pálffy and H. A. Weidenmüller, Phys. Rev. Lett. 112, 192502 (2014).
[2] A. Pálffy, O. Buss, A. Hoefer and H. A. Weidenmüller, Phys. Rev. C 92, 044619 (2015).

HK 68.7 Fr 15:45 S1/01 A03

Online Strahlmonitor für das ELI-NP Gamma-Beam-System

— •Philipp Ries[1], Catalin Matei[2], Matthias Nicolay[1], Norbert Pietralla[1], Calin A. Ur[2] und Volker Werner[1] — [1]Institut für Kernphysik, Technische Universität Darmstadt, 64289 Darmstadt — [2]Extreme Light Infrastructure - Nuclear Physics, 077125 Magurele, Rumänien

Die Extreme Light Infrastructure ist ein europäisches Gemeinschaftsprojekt zur Forschung an und mit weltweit einzigartigen Lasern. Im Rahmen dieses Projekts wird die Einrichtung Extreme Light Infrastructure - Nuclear Physics (ELI-NP) am Standort Magurele bei Bukarest in Rumänien geschaffen. Unter anderem soll hier durch Compton Rückstreuung von Laserlicht an relativistischen Elektronen ein quasimonochromatischer Gammastrahl von höchster Intensität und bislang unerreichter Energieschärfe für kernphysikalische Experimente zur Verfügung gestellt werden. Um die Qualität des Gammastrahls während der Experimente zu überwachen, wird ein System zur Echtzeit-Strahlanalyse entwickelt, welches in der Lage sein wird, Energie, Intensität, Polarisationsgrad und Position des Strahls durch Compton-Streuung zu prüfen. Der Setup wird zunächst mit Hilfe von GEANT4-Simulationen ausgearbeitet und die einzelnen Elemente in Laborexperimenten mittels Eichquellen getestet. Diese Tests und die vollständige Konstruktion werden am Institut für Kernphysik der TU Darmstadt stattfinden.

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