HK 36: Structure and Dynamics of Nuclei VI

Zeit: Mittwoch 14:00–16:00 Raum: HS 14

Gruppenbericht HK 36.1 Mi 14:00 HS 14

Investigation of the dipole response in atomic nuclei in different mass regions using photon scattering experiments — •J. Wilhelmy[1], P. Erbacher[2], J. Isaak[3], B. Löher[4], M. Müscher[1], D. Savran[4], P. Scholz[1], R. Schwengner[5], M. Spieker[6], W. Tornow[7], and A. Zilges[1] — [1]University of Cologne, Institute for Nuclear Physics — [2]Goethe University of Frankfurt — [3]Institute for Nuclear Physics, TU Darmstadt — [4]GSI, Darmstadt — [5]HZDR, Dresden-Rossendorf — [6]NSCL, Michigan State University, USA — [7]Department of Physics, Duke University, USA

The nuclear γ-ray strength function (γ-SF) has great impact on reaction rates within nuclear synthesis processes. Level lifetimes, γ-decay branching ratios and parity quantum numbers of excited $J = 1$ states are extracted from high-resolution photon scattering experiments in a model-independent way. Results of complementary measurements with continuous photon flux distributions (at the bremsstrahlung facilities DHIPS [1] and γELBE [2]) and quasi-monoenergetic beams (at HIγS [3]) for nuclei in several mass regions will be presented and discussed within their systematics [4].

Supported by the BMBF (05P15PKEN9).

[1] K. Sonnabend *et al.*, NIM A **640** (2011) 6-12
[2] R. Schwengner *et al.*, NIM A **555** (2005) 211
[3] B. Löher *et al.*, NIM A **723** (2013) 136
[4] J. Wilhelmy *et al.*, Phys. Rev. C **98** (2018) 034315

HK 36.2 Mi 14:30 HS 14

Bestimmung von Paritätsquantenzahlen von Dipolzuständen des Isotops ^{142}Ce — •J. Sieber[1], T. Beck[1], S. Finch[2,3], U. Gayer[1], J. Isaak[1], R. Janssens[3,4], J. Kleemann[1], FNU Krishichayan[2,3], M. Müscher[5], O. Papst[1], N. Pietralla[1], D. Savran[6], W. Tornow[2,3], V. Werner[1] und J. Wilhelmy[5] — [1]IKP, TU Darmstadt, Germany — [2]GSI, Darmstadt, Germany — [3]IKP, Universität zu Köln, Germany — [4]Department of Physics, Duke University, Durham, NC, USA — [5]Triangle Universities Nuclear Laboratory, Durham, NC, USA — [6]Department of Physics and Astronomy, University of North Carolina, Chapel Hill, NC, USA

Für die Untersuchung der niedrig-liegenden E1-Stärke unterhalb der Dipolriesenresonanz, wurde die Dipolstärkeverteilung von ^{142}Ce unterhalb der Neutronenseparationsschwelle vermessen. Zur Vervollständigung der vorhandenen Daten wurden die Paritätsquantenzahlen der dipolangeregten Kernzustände im Anregungsenergiebereich von 4 - 5 MeV mithilfe von azimuthaler Winkelverteilung in Kernresonanzfluoreszenz-Experimenten an der High Intensity γ-ray Source (HIγS) bestimmt. Damit konnte die E1-Stärke von ^{142}Ce zwischen 4 und 5 MeV eindeutig identifiziert werden. Die Datenanalyse und die Ergebnisse werden präsentiert und mit der Dipolstärkeverteilung von ^{140}Ce [1,2] verglichen.

*Gefördert durch die DFG im Rahmen des SFB1245.

[1] R.-D. Herzberg et al., PLB 390 (1997) 49.
[2] S. Volz et al., NPA 779 (2006) 1.

HK 36.3 Mi 14:45 HS 14

Dipole strength of ^{164}Dy below the neutron separation threshold — •O. Papst[1], V. Werner[1,2], N. Pietralla[1], T. Beck[1], J. Beller[1], C. Bernards[2], M. Bhike[3,4], N. Cooper[2,5], B. P. Crider[6,7,8], U. Gayer[1], J. Isaak[1], J. Kleemann[1], FNU Krishichayan[3,4], B. Löher[1], F. Naqvi[2,7], E. E. Peters[6], F. M. Prados-Estevez[6], R. S. Ilieva[9], T. J. Ross[4], D. Savran[10], M. Scheck[1,11,12], W. Tornow[3,4], J. R. Vanhoy[5,13], S. W. Yates[5], and M. Zweidinger[1] — [1]IKP, TU Darmstadt — [2]WNSL, Yale University, New Haven, CT, USA — [3]TUNL, Durham, NC, USA — [4]Duke University, Durham, NC, USA — [5]UND, Notre Dame, IN, USA — [6]UKY, Lexington, KY, USA — [7]MSU, East Lansing, MI, USA — [8]MSU, Starkville, MS, USA — [9]UNIS, Guildford, UK — [10]GSI, Darmstadt — [11]UWS, Paisley, UK — [12]SUPA, Glasgow, UK — [13]USNA, Annapolis, MD, USA

Low-lying E1 strength in heavy nuclei is frequently addressed as a Pygmy Dipole Resonance and associated to a semi-collective neutron-skin oscillation. It can be expected to be sensitive to the nucleus' symmetry axes, separating into two parts for axially deformed nuclei (K-splitting). Data are sparse for such nuclei. In nuclear resonance fluorescence experiments conducted at the γ^3 setup at the High Intensity γ-ray Source (HIγS), the dipole strength above 4 MeV of the deformed nucleus ^{164}Dy was studied using a polarized, quasi-monochromatic γ-ray beam, such that E1 and M1 strengths can be discussed. Resulting average quantities are compared to statistical model calculations.

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HK 36.4 Mi 15:00 HS 14

Investigation of the Pygmy Dipole Resonance in ^{120,124}Sn using the combined γ-ray and particle spectrometers CAGRA and Grand Raiden — •M. Weinert for the CAGRA-Collaboration — University of Cologne, Institute for Nuclear Physics, Germany

During the CAGRA+GR campaign in 2016, the magnetic spectrometer Grand Raiden at the RCNP in Osaka (Japan) has been used in combination with the clover-detector array CAGRA to study the excitation and decay behavior of the Pygmy Dipole Resonance (PDR) in various nuclei. Placing the Grand Raiden spectrometer at very forward angles, dipole excitations can be investigated with high sensitivity, while the CAGRA spectrometer observes the corresponding γ-decays with high efficiency. These types of experiments have already shown that the observed electric dipole response of atomic nuclei strongly depends on the excitation mechanism. A splitting of the states in the PDR region into at least two groups of states with different underlying isospin character has already been observed in other nuclei [1-3]. This contribution will present first results from the measurements of ^{120}Sn(α,α'γ)@130MeV and ^{124}Sn(p,p'γ)@80MeV from the CAGRA+GR campaign. A comparison of results from different experiments using complementary probes on these two nuclei will be given and possible evidence for an isospin splitting in ^{120}Sn will be discussed.

Supported by DGF (ZI 510/7-1 and SFB 1245).

[1] J. Endres *et al.*, Phys. Rev. C **85**, 064331 (2012)
[2] L. Pellegri *et al.*, Phys. Lett. B **738** (2014) 519
[3] D. Savran *et al.*, Phys. Lett. B **786** (2018) 16

HK 36.5 Mi 15:15 HS 14

Multi-messenger investigation of the Pygmy Dipole Resonance in ^{140}Ce — •D. Savran[1], V. Derya[2], S. Bagchi[1,3], J. Endres[2], M.N. Harakeh[3], J. Isaak[4], N. Kalantar-Nayestanaki[3], E.G. Lanza[5], B. Löher[4], A. Najafi[3], S. Pascu[2,6], S.G. Pickstone[2], N. Pietralla[4], V.Yu. Ponomarec[4], C. Rigollet[3], C. Romig[4], M. Spieker[2], A. Vitturi[7,8], and A. Zilges[2] — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt — [2]Institut für Kernphysik, Universität zu Köln — [3]KVI-CART, University of Groningen, the Netherlands — [4]Institut für Kernphysik, TU Darmstadt — [5]INFN Sezione di Catania, Italy — [6]National Institute for Physics and Nuclear Engineering, Bucharest — [7]Dipartimento di Fisica e Astronomia Galileo Galilei, Universita di Padova, Italy — [8]INFN Sezione di Padova, Italy

Beside the Giant Dipole Resonance, many nuclei show the feature of additional low-lying electric dipole (E1) strength, which is usually denoted as Pygmy Dipole Resonance (PDR). Most of the available data has been obtained in photon induced reactions or coulomb excitation, which are, however, not sensitive to the structure of the E1 excitations. We have therefore started a campaign to provide additional experimental data using complementary probes or observables. For the semi-magic nucleus ^{140}Ce we combine the results from different experiments using proton, α as well as photon scattering in a multi-messenger investigation [1]. The results are presented and compared to calculations within the Quasi-particle Phonon Model.

[1] D. Savran et al., Phys. Lett. B 786 (2018) 16

HK 36.6 Mi 15:30 HS 14

Studying the Pygmy Dipole Resonance in ^{90}Zr in a (p,p'γ) experiment — •M. Steffan, A. Bohn, V. Everwyn, M. Färber, F. Kluwig, M. Müscher, S. G. Pickstone, S. Prill, P. Scholz, M. Weinert, J. Wilhelmy, and A. Zilges — University of Cologne, Institute for Nuclear Physics, Germany

This talk will present experimental data of a proton scattering experiment on ^{90}Zr which was performed at the combined setup SONIC@HORUS in the energy region of the Pygmy Dipole Resonance [1]. The 10MV FN Tandem accelerator delivered a 15 MeV proton beam to the particle-γ coincidence spectrometer. The coincident detection of scattered protons and γ-rays allows the determination of

branching ratios and, thus, extends the knowledge on the $J^\pi = 1^-$ states of ^{90}Zr previously identified by nuclear resonance fluorescence measurements [2]. For this a comparison to NRF data will be given, including the excitation behavior of both methods. Furthermore, aspects of the experimental procedure and their impact on observations will be discussed.

Supported by DFG (ZI 501/7-1). AB and MS are supported by the Bonn Cologne Graduate School of Physics and Astronomy.

[1] D. Savran, T. Aumann, A. Zilges, Prog. Part. Nucl. Phys. **70** (2013) 210

[2] R. Schwengner *et al.*, Phys. Rev. C **78** (2008) 064314

HK 36.7 Mi 15:45 HS 14

Probing pygmy mode inhibition by the nuclear deformation in stable Ge Isotopes — •Nadia Benouaret[1], Ronald Schwengner[2], Daniel Bemmerer[2], Ronald Beyer[2], Arnd Junghans[2], and Andreas Wagner[2] — [1]University of Sciences and Technologie USTHB, 16111Alger, Algeria — [2]Helmholtz-Zentrum Dresden-Rossendorf, 01328 Dresden

In a previous Nuclear Resonance Fluorescence (NRF) Experiment on the low-lying dipole response in the stable isotope ^{74}Ge near the neutron threshold, no significant enhancement of dipole strength has been observed [1]. This extra strength denoted as Pygmy resonance on the low energy tail of the isovector Giant dipole resonance impacts the radiative rapid neutron capture rates in astrophysical environment.

The spherical ^{70}Ge (Q=0.04 b) being from the same isotopic chain as ^{74}Ge is a good candidate to check whether this behavior in ^{74}Ge is linked to its nuclear deformation (Q=-0.19 b). We present preliminary Results on ^{70}Ge from an NRF Experiment carried out at the γELBE Bremsstrahlung facility (HZDR). The dipole transition distribution shows a significant enhancement of the dipole strength forming a resonance-like structure just below the neutron threshold $S_n = 11.5MeV$ in comparison to that observed previously in ^{74}Ge. This is quite surprising since as pointed before the strength should increase with the neutron number. This finding may provide a hint to the deformation which inhibits the Pygmy mode excitation.

[1] R. Massarczyk et al., Phys. Rev. C 92, 044309 (2015).