HK 3 Kernphysik/Spektroskopie

Zeit: Freitag 14:00–16:00 Raum: TU MA004

Gruppenbericht

HK 3.1 Fr 14:00 TU MA004

Observation of soft and giant dipole modes in ^{132}Sn and neighboring unstable nuclei — •Adam Klimkiewicz for the LAND-FRS collaboration — GSI, Darmstadt, Germany

Secondary beams of unstable neutron-rich $^{129-132}$Sn, $^{132-135}$Sb and ^{136,137}Te isotopes (∼500 MeV/u) were produced by in-flight fission of a primary ^{238}U beam at GSI, Darmstadt. Dipole strength distributions ranging from the neutron threshold up to 30 MeV excitation energy were derived from the measured electromagnetic excitation cross sections in a Pb target using the LAND setup at the fragment separator FRS.

The data reveal the giant dipole resonance structure. In addition, in some of the isotopes, clear evidence for a resonant-like, relatively narrow structure at lower excitation energy is obtained. In ^{132}Sn this low-lying resonance is centered at 10 MeV and comprises 4(2) % of the TRK sum rule. The systematics of the parameters of low-lying and giant dipole resonances will be presented. The low-lying resonance will be discussed with regard to soft dipole modes expected to arise from a neutron skin vibration against the nucleus core, see also earlier photoabsorption measurements on stable N=82 nuclei [1]. The data are compared to (Q)RPA calculations [2,3] and the impact on r-process nucleosynthesis calculations is briefly addressed [4].

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[1] A.Zilges et al., Phys. Lett. B**542** (2002) 43-48
[2] D.Sarchi et al., Phys. Lett. B**601** (2004) 27-33
[3] D.Vretenar et al., Nucl. Phys. A**692** (2001) 496-517
[4] S.Goriely, Phys. Lett. B**436** (1998) 10-18

HK 3.2 Fr 14:30 TU MA004

Test of the critical point symmetry X(5) in the A=180 mass region — •O. Möller[1], A. Dewald[1], B. Melon[1], P. Petkov[1,2], A. Fitzler[1], K. Jessen[1], J. Jolie[1], C. Ur[3], M. Axiotis[3], and C. Rusu[3] — [1]Institut für Kernphysik, Universität zu Köln, Deutschland — [2]Institute for Nuclear Research and Nuclear Energy, Sofia, Bulgaria — [3]INFN, Laboratori Nazionali di Legnaro, Legnaro, Italy

The investigation of nuclear phase transition phenomena is one of the new and very challenging topics in nuclear structure physics.
Recently N=90 nuclei became of special interest as testing ground for the new dynamic symmetry at the critical point of shape phase transition from axially deformed to spherical nuclei, called X(5) [1]. Based on the energy spectra and relative transition probabilities the even $^{176-180}$Os nuclei can be considered to be very promising X(5) candidates in a new mass region. In order to perform stringent tests for these Os nuclei, experimental data on absolute transition probabilities are needed. Therefore we performed different experiments: We measured lifetimes of the 2_1^+-states at the Köln FN-Tandem facility using the electronic timing technique. Lifetimes of higher lying states in ^{178}Os were measured in a RDDS coincidence experiment with the GASP spectrometer and the Köln plunger device. The excellent agreement of our present results with the X(5) predictions encouraged us to continue this project, further experiments on this topic are scheduled.

[1] F. Iachello, Phys. Rev. Lett. 87, 52502 (2001)

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HK 3.3 Fr 14:45 TU MA004

Untersuchung gemischtsymmetrischer Zustände in ^{94}Mo mit hochauflösender Elektronen- und Protonenstreuung* — •M. Kuhar[1], O. Burda[1], N. Botha[2], J. Carter[3], R.W. Fearick[2], S.V. Förtsch[4], C. Fransen[5], H. Fujita[3], A. Lenhardt[1], P. von Neumann-Cosel[1], R. Neveling[4], N. Pietralla[6], V.Yu. Ponomarev[1], A. Richter[1], E. Sideras-Haddad[3], R. Smit[4] und J. Wambach[1] — [1]Institut für Kernphysik, Technische Universität Darmstadt — [2]Physics Department, University of Cape Town — [3]School of Physics, University of the Witwatersrand — [4]iThemba LABS, Somerset West — [5]Institut für Kernphysik, Universität zu Köln — [6]Department of Physics and Astronomy, State University of New York, Stony Brook

Der Kern ^{94}Mo ist ein besonders gut untersuchtes Beispiel für die Existenz von Ein- und Zweiphononzuständen gemischter Symmetrie [1,2]. Als experimentelle Signaturen dienen Auswahlregeln für den Gammazerfall in symmetrische Zustände sowie zwischen Zuständen mit Ein- und Zweiphononcharakter. Komplementäre Experimente mit hochauflösender ($\Delta E \approx 30-35$ keV FWHM) Elektronenstreuung am S-DALINAC ($E_0 \simeq 70$ MeV, $\Theta = 93° - 165°$) und Protonenstreuung am iThemba LABS ($E_0 = 200$ MeV, $\Theta = 4.5° - 26°$) erlauben einen Test der Reinheit gemischtsysmmetrischer Zustände. Erste Resultate werden im Rahmen von QPM- und Schalenmodellrechnungen diskutiert.

[1] N. Pietralla et al., Phys. Rev. Lett. 83, 1303 (1999); 84, 3775 (2000)
[2] C. Fransen et al., Phys. Lett. B 508, 219 (2001); Phys. Rev. C 67, 024307 (2003)

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HK 3.4 Fr 15:00 TU MA004

Oktupol Korrelationen in der Region $N \sim 88^*$ — •M. Babilon[1,2], N. V. Zamfir[2], D. Kusnezov[3], E. A. McCutchan[2], L. Kern[1] und A. Zilges[1] — [1]Institut für Kernphysik, TU Darmstadt, D-64289 Darmstadt — [2]Wright Nuclear Structure Laboratory, Yale University, New Haven, USA — [3]Sloane Physics Laboratory, Yale University, New Haven, USA

Mikroskopische Modelle sagen das Auftreten von starken Oktupol-Korrelationen in Kernen der Region $N \sim 88$ voraus. Experimentelle Daten der Isotope $^{148-154}$Sm erlauben die systematische Untersuchung möglicher Signaturen solcher Korrelationen im Rahmen des *spdf*-Interacting Boson Approximation Modells (IBA). Eigenschaften niedrig liegender Zustände können beschrieben werden, wenn man an einen einfachen Hamiltonian mit positiver Parität ein Boson mit negativer Parität koppelt [1,2]. Um Eigenschaften von Zuständen mit höherem Spin zu beschreiben, ist jedoch die Berücksichtigung mehrerer Bosonen negativer Parität nötig. Um die Studien zu erweitern, wurden am Tandem-Beschleuniger des WNSL der Yale University zwei Experimente zum Zerfallsverhalten des Kerns ^{152}Gd durchgeführt. Ergebnisse dieser Experimente werden vorgestellt und mit *spdf*-IBA Rechnungen verglichen.

*Gefördert durch die DFG (SFB 634) und das USDOE unter Fördernummer DE-FG02-91ER-40609.

[1] D. Kusnezov und F. Iachello, Phys. Lett. B **209**, 420 (1988).
[2] N. V. Zamfir und D. Kusnezov, Phys. Rev. C **67**,014305 (2003).

HK 3.5 Fr 15:15 TU MA004

Structure of the 2_1^+ state in radioactive ^{68}Ge from g factor and lifetime measurements$^+$ — •J. Leske[1], K.-H. Speidel[1], S. Schielke[1], O. Kenn[1], J. Gerber[2], P. Maier-Komor[3], S.J.Q. Robinson[4], Y.Y. Sharon[5], and L. Zamick[5] — [1]Helmholtz-Institut für Strahlen- und Kernphysik, Univ. Bonn, Germany — [2]Institut de Recherches Subatomiques, Strasbourg, France — [3]Physik-Dept. TU München, Garching, Germany — [4]Univ. of Southern Indiana, Evansville, Indiana, USA — [5]Rutgers Univ., Piscataway, NJ, USA

The g factor of the 2_1^+ state of radioactive ^{68}Ge ($T_{1/2} = 270$ d) has been measured for the first time. The technique used is based on α transfer from a ^{12}C target to 180 MeV ^{64}Zn projectiles that incorporates the favourable conditions of inverse kinematics as in projectile Coulomb excitation. It also includes the good features of the transient field technique applied to the nuclear spin precessions. In addition, we have remeasured the lifetimes of several excited states using the Doppler-Shift-Attenuation method. All measurements were carried out at the Munich tandem accelerator. The g factor value obtained, $g(2_1^+) = +0.55(14)$, is in good agreement with the collective value, g = Z/A = +0.47, and is also consistent with the precise data of the stable even-A Ge isotopes. The deduced $B(E2)$ values and the g factor have been interpreted in the framework of the spherical shell model assuming a closed ^{56}Ni core and neutron and proton orbitals in the fp shell model space. Among the various effective interactions used the FPD6 interaction without A–scaling yielded surprisingly the best overall agreement with the experimental data.

[+] supported by the BMBF

HK 3.6 Fr 15:30 TU MA004

First g factor measurements on the 2_1^+ states in $^{36,38}Ar$ and their shell model interpretations[+] — •S. Schielke[1], K.-H. Speidel[1], J. Leske[1], J. Gerber[2], P. Maier-Komor[3], S.J.Q. Robinson[4], Y.Y. Sharon[5], and L. Zamick[5] — [1]Helmholtz-Institut für Strahlen- und Kernphysik, Univ. Bonn, Germany — [2]Institut de Recherches Subatomiques, Strasbourg, France — [3]Physik-Dept. TU München, Garching, Germany — [4]Univ. of Southern Indiana, Evansville, Indiana, USA — [5]Rutgers Univ., Piscataway, NJ, USA

First measurements of g factors of the 2_1^+ states in $^{36,38}Ar$ have been performed via α transfer reactions in inverse kinematics combined with the technique of transient magnetic fields. In addition, $B(E2)$ values were deduced from newly measured lifetimes using the Doppler-Shift-Attenuation method. These investigations were mainly motivated by the specific features, that for ^{36}Ar with N=Z=18, isospin symmetry effects as well as neutron-proton pairing correlations, and for ^{38}Ar with 20 neutrons, the N=20 shell closure should dominate the nuclear structure. Hence, for these nuclei with the inclusion of similar data for ^{40}Ar, appropriate shell model calculations ought to explain subtle alterations of the structure with neutron number. In the measurements, ^{32}S and ^{34}S beams of the Cologne and Munich tandem accelerators were used as projectiles bombarding a multilayered target with natural carbon for the nuclear reaction. Excellent agreement was achieved between experiment and theory for all Ar isotopes.

[+] supported by the DFG

HK 3.7 Fr 15:45 TU MA004

Dominant neutron component in the $^{68}Zn(4_1^+)$ wave function from g factor measurements[+] — •J. Leske[1], K.-H. Speidel[1], S. Schielke[1], J. Gerber[2], and P. Maier-Komor[3] — [1]Helmholtz-Institut für Strahlen- und Kernphysik, Univ. Bonn, Germany — [2]Institut de Recherches Subatomiques, Strasbourg, France — [3]Physik-Dept. TU München, Garching, Germany

The g factor of the 4_1^+ state in ^{68}Zn has been measured for the first time employing projectile Coulomb excitation in inverse kinematics. A multilayered target consisting of thin layers of C/Gd/Ta/Cu was bombarded with a ^{68}Zn beam of 180 MeV provided by the Munich tandem accelerator. The γ rays emitted from the excited states were measured in coincidence with forward scattered carbon ions. Spin precessions occured in the transient field of the magnetized Gd layer. A Si detector was used for detection of the carbon ions whereas the γ rays were detected by pairs of NaI(Tl) scintillators and Ge detectors. The superior energy resolution of the Ge detectors was essential for separating the $(4_1^+ \rightarrow 2_1^+)$ γ line from neighbouring and Doppler-shifted $(2_3^+ \rightarrow 2_1^+)$ 1261 keV line in the forward hemisphere. The negative g factor deduced is a surprise as its sign contradicts large-scale shell model predictions. It can only be understood if $g_{9/2}$ neutrons are a strong component in the nuclear wave function. This result will be discussed in the context of similar measurements in ^{64}Zn for which the g factor of the 4_1^+ state was found to be positive in agreement with the collective as well as shell model predictions.

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