HK 8: Kernphysik / Spektroskopie

Zeit: Montag 14:00–16:00 Raum: 2G

HK 8.1 Mo 14:00 2G

Experimental spin distribution in nuclear level schemes from F to Cm. — •Till von Egidy[1] and Dorel Bucurescu[2] — [1]Physik-Department, Technische Universität München — [2]National Institute of Physics and Nuclear Engineering, Bucharest, Romania

The spin distribution of nuclear levels is an essential ingredient of formulas for nuclear level densities. However, experimental information is rather scarce. The distribution is usually assumed to follow the formula $f(J) = \exp(-J^2/2\sigma^2) - \exp(-(J+1)^2/2\sigma^2)$ with the spin cut-off parameter σ which corresponds roughly to the maximum of the spin distribution. The theory predicts that σ increases with the moment of inertia, with the nuclear mass and with the nuclear temperature. But the various parameters for these dependencies are not well known. We investigated the experimental spin distribution of 310 nuclei between F and Cm below about 2 MeV in order to test various formulas for σ and to determine the corresponding parameters with least squares fits. The best results will be presented and discussed.

HK 8.2 Mo 14:15 2G

Pygmy Dipole Strength in Exotic Nuclei. — •Nadia Tsoneva und Horst Lenske — Institut für Theoretische Physik, Universität Gießen

By incorporating HFB calculations for the nuclear ground states and describing excited states by QPM theory we investigate low-energy dipole excitations in spherical N=50, N=82 isotones and the $Z = 50$ isotopes, known as Pygmy Dipole Resonances (PDR). The approach relies on density functional theory providing us with the proper link between a phenomenological description of nuclear ground state properties and nuclear many-body theory. The properties of PDR excitations are studied in detail by analyzing the corresponding neutron and proton dipole transition densities from which we derive criteria for these dipole excitations as generic modes in charge-asymmetric exotic nuclei. From one-phonon QRPA calculations in N=50, N=82 and $^{110-132}$Sn nuclei (N>Z) a close connection between the total neutron PDR strengths and the neutron skin thickness defined by the relative difference of neutron and proton rms radii was found. An interesting observation is the most exotic ^{100}Sn nucleus (N=Z), where at E*=8.3 MeV a state dominated by proton skin excitations was found, hence indicating a proton PDR. The fragmentation pattern of the low-energy dipole excitations is studied by multi-phonon QPM theory. For that purpose we have performed calculations in large model spaces including up to three-phonon components. The results are compared to a variety of experimental data which are described rather satisfactorily. Supported by DFG, contract Le439/5 and GSI.

HK 8.3 Mo 14:30 2G

Dipole strength in ^{89}Y and ^{90}Zr up to the neutron-separation energy * — •R. Schwengner[1], G. Rusev[1,2], N. Tsoneva[3], N. Benouaret[1,4], R. Beyer[1], F. Doenau[1], M. Erhard[1], E. Grosse[1,5], A.R. Junghans[1], J. Klug[1], K. Kosev[1], C. Nair[1], K.D. Schilling[1], and A. Wagner[1] — [1]Forschungszentrum Dresden-Rossendorf, 01314 Dresden — [2]Duke University, Durham, NC 27708, USA — [3]Universität Gießen, 35392 Gießen — [4]Université d'Alger, 16111 Alger, Algerie — [5]Technische Universität Dresden, 01062 Dresden

Dipole and quadrupole excitations in the semimagic $N = 50$ nuclei ^{89}Y and ^{90}Zr were investigated at the superconducting electron linear accelerator ELBE with bremsstrahlung produced at electron energies from 9 to 13 MeV. About 200 γ transitions in ^{89}Y and 180 in ^{90}Zr were identified up to about 11 and 12 MeV, respectively.

Statistical methods were applied to estimate the contributions of inelastic transitions and to correct the intensities of the ground-state transitions for their branching ratios. The photoabsorption cross sections obtained in this way provide information about the dipole-strength function on the tail of the giant dipole resonance (GDR) towards energies below the neutron-separation energy. We observed extra dipole strength with respect to a smooth extrapolation of the GDR in the energy range from about 6 – 11 MeV.

The observed extra strength is compared with results of calculations within the Quasiparticle-Phonon Model, which also make predictions about the nature of the strength.

* Supported by the DFG.

HK 8.4 Mo 14:45 2G

Untersuchung der Pygmydipolresonaz in ^{124}Sn mit Hilfe der $(\alpha, \alpha'\gamma)$ Reaktion* — •Janis Endres[1], Peter Butler[2], Peter Dendooven[3], Mushin Harakeh[3], Rolf-Dietmar Herzberg[2], Reiner Krücken[4], Lucia Popescu[5], Deniz Savran[6], Marcus Scheck[2], Kerstin Sonnabend[6], Sotirios Harissopulos[7], Anastasios Lagoyannis[7], Heinrich Woertche[3] und Andreas Zilges[1] — [1]Institut für Kernphysik, Universität zu Köln — [2]Department of Physics, University of Liverpool, Großbritannien — [3]Kernfysisch Versneller Instituut, Groningen, Niederlande — [4]Physik-Department E12, TU München — [5]SCK-CEN, Mol, Belgium — [6]Institut für Kernphysik, TU Darmstadt — [7]I.N.P. NCSR Demokritos, Athen, Griechenland

Seit einigen Jahren wird die Pygmydipolresonanz (PDR) insbesondere in halbmagischen Kernen systematisch mit der Methode der Kernresonanzfluoreszenz (KRF) untersucht [1]. In $(\alpha, \alpha'\gamma)$ Koinzidenzexperimenten kann eine ähnlich hohe Selektivität auf E1 Anregungen mit guter Energieauflösung erzielt werden. Der Vergleich zwischen (γ, γ') und $(\alpha, \alpha'\gamma)$ Experimenten an den N=82 Isotonen ^{140}Ce [2] und ^{138}Ba zeigt eine unerwartete strukturelle Aufspaltung der E1 Stärkeverteilung. Im November 2007 wurde am Big-Byte Spektrometer (BBS) des KVI mit ^{124}Sn ein Z=50 Isotop vermessen. Erste Ergebnisse dieses $(\alpha, \alpha'\gamma)$ Experiments und Vergleiche zu KRF-Resultaten werden präsentiert.

* Gefördert durch die DFG (SFB 634).

[1] U. Kneissl et al., J. Phys. G 32 (2006) R1
[2] D. Savran et al., Phys. Rev. Lett. 97 (2006) 172502

HK 8.5 Mo 15:00 2G

Niedrig liegende Dipolstärke in ^{136}Xe* — •Deniz Savran[1], Matthias Fritzsche[1], Jens Hasper[1], Kai Lindenberg[1], Sebastian Müller[1], Norbert Pietralla[1], Linda Schnorrenberger[1], Kerstin Sonnabend[2] und Andreas Zilges[1] — [1]Institut für Kernphysik, TU Darmstadt — [2]Institut für Kernphysik, Universität zu Köln

Der Ursprung niedrig liegender elektrischer Dipolstärke weit unterhalb der Dipolriesenresonanz, der sogenannten Pygmydipolresonanz (PDR) wie sie in zahlreichen Kernen experimentell beobachtet wird, ist immer noch weitgehend unverstanden. Ein elementarer experimenteller Zugang ist die systematische Untersuchung der Entwicklung der PDR entlang von Isotopen- oder Isotonenketten. Am S-DALINAC in Darmstadt wurden die stabilen N=82 Kerne mit Hilfe der Kernresonanzfluoreszenz-Methode untersucht. Ergebnisse der neuesten Messung an ^{136}Xe sowie ein detaillierter Vergleich zu Rechnungen im Quasi Particle Phonon Model (QPM) werden präsentiert.

* Gefördert durch die DFG (SFB 634)

HK 8.6 Mo 15:15 2G

Dorway state phenomena in nuclei simulated through microwave billiards — Sven Åberg[1], Thomas Guhr[2], •Maksim Miski-Oglu[3], and Achim Richter[3] — [1]Matematisk Fysik, LTH, Lunds Universitet, Lund, Sweden — [2]Fachbereich Physik, Universität Duisburg–Essen, Duisburg, Germany — [3]Institut für Kernphysik, Technische Universität Darmstadt, Darmstadt, Germany

In a unifying way, the doorway mechanism explains spectral properties in a rich variety of open mesoscopic quantum systems, ranging from atoms to nuclei. A distinct state and a background of other states couple to each other which sensitively affects the strength function. The recently measured superscars in the barrier billiard provide an ideal model for an in–depth investigation of this mechanism. We introduce two new statistical observables for its study, the maximum coupling coefficient to the doorway and directed spatial correlators. Using Random Matrix Theory and random plane waves, we obtain a consistent understanding of the experimental data.

HK 8.7 Mo 15:30 2G

Numerische Behandlung eines Quadrupol-Oktupol-Modells — •Michael Strecker — Institut für Theoretische Physik der Justus-Liebig-Universität, Heinrich-Buff-Ring 16, D-35392 Giessen, Germany

Ein Hamiltonoperator für axiale quadrupol- und oktupol-deformierte Kerngestalten mit einem äußeren Nukleon wird benutzt, um die Spektren von Aktiniden-(ug)-Kernen zu beschreiben. Ein Coriolisterm koppelt die kollektive Drehbewegung mit der des Nukleons. Das Modell

hat sich bereits gut für die Beschreibung von Spektren und ihrer Paritätsaufspaltung bewährt. Dabei wird eine Einschränkung auf gleiche Schwingungsfrequenzen in beiden Freiheitsgraden gemacht und die Energien mit Hilfe von Fitparametern an die experimentellen Ergebnisse angeglichen.

Im Vortrag wird eine geeignete Methode für die numerische Behandlung aufgezeigt, womit auch ungleiche Schwingungsfrequenzen zugänglich werden. Außerdem wird untersucht, wie man den Entkopplungsparameter, welcher bisher als Fitparameter in das Modell eingeht, mit Hilfe von expliziten Einteilchenrechnungen unter Verwendung von Überlappintegralen erhalten kann.

HK 8.8 Mo 15:45 2G

Bohr Hamiltonian with different mass coefficients for the ground– and γ bands — •Rostislav V. Jolos[1,2] and Peter von Brentano[2] — [1]Joint Institute for Nuclear Research, Dubna, Russia — [2]Institut für Kernphysik der Universität zu Köln

In the description of the collective nuclear dynamics the mass coefficient plays an important role as the potential energy. Frequently it is assumed that the mass coefficient in the lab. frame is a constant. And in the case of the well deformed nuclei the same mass coefficient is used for description of the rotational motion and for vibrations. Experimental data show, however, that the ratio of the mass coefficients for the gamma–vibrations and for rotations takes the values 3–5 [1]. The implied large difference means that the mass tensor of the Bohr Hamiltonian cannot be reduced to a scalar. However, the inclusion of scalar and other components of the mass tensor can explain the difference in the values of the mass coefficients for the γ–vibrations and the ground state rotations. A simplified estimate of the ratio B_γ/B_{rot} obtained using the cranking model expressions for the mass coefficients is in agreemant with the data. The more general form of the kinetic energy term for the Bohr Hamiltonian given in the intrinsic frame is derived.

[1]R.V.Jolos and P. von Brentano, Phys. Rev. C **76**, 024309 (2007).

Work supported by DFG through Br799/12 and by DFG East European–Germany collaboration grant.