HK 71: Nuclear Structure and Dynamics I

Time: Thursday 16:30–19:00 Location: H-ZO 40

Invited Group Report HK 71.1 Th 16:30 H-ZO 40

The GDR strength function in exotic nuclei measured with gamma decay — •Angela Bracco — Università di Milano e INFN sez. Milano

The study of the gamma decay from the giant dipole resonance (GDR) in nuclei far from stability both at zero and finite temperature is a powerful tool to obtain information on the nuclear properties, such as shape and isospin effects. In particular, two specific problems related to isospin effects will be discussed.

The first problem is that of the possible restoration of the isospin symmetry at finite temperature. The problem of determining isospin mixing in N=Z nuclei has been addressed both at zero and finite temperature T up to Z=N=32 (with the mixing found to increase with Z). In addition at T=2 and T=0 the isospin mixing are similar. Thus the combination of data at T=0 and T>0 provide important information on this problem. A new exclusive experiment on the GDR at T= 2 MeV in the unexplored region N=Z=40 was made using the GARFIELD-HECTOR set up at LNL. Preliminary results will be presented.

The second topic that will be discussed is the search of the pygmy resonance in the exotic 68Ni nucleus using Coulomb excitation at 600 A MeV and the RISING array at the FRS of GSI. The gamma decay of 68Ni isotopes was measured in BaF2 and HpGe detectors. A peak at approximately 11 MeV was observed. This is the first measurement of the gamma decay of the Pygmy Resonance with radioactive beams. Discussion will be made on the interest in relating these states with the oscillation of the neutron skin.

Group Report HK 71.2 Th 17:00 H-ZO 40

Systematic studies of the Pygmy Dipole Resonance by means of the (α,$\alpha'\gamma$) reaction* — •Janis Endres[1], Peter Butler[2], Muhsin N. Harakeh[3], Rolf-Dietmar Herzberg[2], Reiner Krücken[4], Norbert Pietralla[5], Lucia Popescu[6], Deniz Savran[5], Marcus Scheck[2], Felix Siebenhühner[5], Kerstin Sonnabend[5], Sotirios Harissopulos[7], Anastasios Lagoyannis[7], Heinrich Wörtche[3], and Andreas Zilges[1] — [1]IKP, Universität zu Köln — [2]Department of Physics, Liverpool, England — [3]KVI, University of Groningen, The Netherlands — [4]Physik-Department E12, TU München — [5]IKP, TU Darmstadt — [6]SCK-CEN, Mol, Belgium — [7]I.N.P. NCSR Demokritos, Athen, Greece

In the last years investigations have been made to study the electric Pygmy Dipole Resonance (PDR), mainly in semi-magic nuclei. Therefore (γ,γ') photon scattering experiments have been performed systematically [1]. In $(\alpha,\alpha'\gamma)$ coincidence experiments at $E_\alpha = 136$ MeV a comparable energy resolution and a high selectivity of E1 transitions can be obtained by using the Big-Byte Spectrometer at KVI [2]. We give an overview about systematic studies on the nuclei ^{140}Ce, ^{138}Ba, ^{124}Sn and ^{94}Mo. In comparison to the (γ,γ') reaction a structural splitting of the PDR could be observed which is possibly connected to the different isospin natures of the two groups. There is a low energy part which can be found in $(\alpha,\alpha'\gamma)$ as well as in (γ,γ') reactions and a high energy part which can only be observed in (γ,γ'). * Supported by EURONS and the 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

Group Report HK 71.3 Th 17:30 H-ZO 40

Complete dipole response in ^{208}Pb from high-resolution polarized proton scattering at 0°* — •Iryna Poltoratska for the EPPS0-Collaboration — Institut für Kernphysik, Technische Universität Darmstadt, Germany

In proton scattering at angles close to 0° one can selectively study dipole modes which, apart from the isovector giant dipole resonance, are poorly understood. Recent experimental progress at RCNP Osaka, Japan [1], allows measurements with intermediate-energy polarized beams at very forward angles including 0° combined with high energy resolution of the order $\Delta E/E \approx 8 \cdot 10^{-5}$. This new experimental opportunity was applied to study soft electric dipole modes such as Pygmy Dipole Resonance (PDR) and the so-called toroidal mode. The preliminary data analysis indicates that at very forward angles 1^- states are strongly excited via Coulomb interaction. The extracted B(E1) transition strengths are in a good agreement with data obtained from a nuclear resonance fluorescence experiment [2]. E1/M1 contributions are separated based on multipole decomposition of a cross section angular distributions and utilizing spin-transfer observables.

[1] A. Tamii et al.,Nucl. Phys. A 788 (2007) 53c.

[2] N. Ryezayeva et al., Phys. Rev. Lett. 89, 272502 (2002).

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HK 71.4 Th 18:00 H-ZO 40

Electromagnetic excitation of nickel nuclei at LAND/R^{3}B — •Dominic Rossi for the LAND-S287-S295-Collaboration — Institut für Kernchemie, Johannes Gutenberg-Universität Mainz, D-55128 Mainz, Germany

The dipole response of stable and unstable nickel isotopes has been investigated at GSI in Darmstadt. Relativistic secondary beams of $^{57-72}$Ni, with energies of approximately 500 MeV/u, have been produced in the projectile FRagment Separator (FRS) and subsequently excited by heavy-ion-induced Coulomb excitation at the LAND/R^{3}B setup. Due to the possibility to perform kinematically complete measurements with this setup, the excitation energy distributions can be determined by reconstructing the invariant mass. Measurements with Pb and C targets allow extraction of pure electromagnetic excitation data, enabling the access to the dipole strength distribution in the continuum. Cross sections for selected isotopes will be presented.

HK 71.5 Th 18:15 H-ZO 40

Wavelet Analysis and Characteristic Scales of Dipole and Quadrupole Giant Resonances in ^{28}Si, ^{40}Ca, ^{48}Ca and ^{166}Er * — •Inna Pysmenetska, Peter von Neumann-Cosel, and Achim Richter — Institut für Kernphysik, TU Darmstadt, Germany

Modern experiments allow to study the fine structure of giant resonances even in heavy nuclei. A novel method using continuous and discrete wavelet transforms provides extraction of characteristic energy scales of the giant resonances and a nearly model-independent determination of level densities. This technique is applied to diverse (e,e′) and (p,p′) data studying the magnetic quadrupole resonances in ^{48}Ca, electric dipole and quadrupole resonances in ^{28}Si , ^{40}Ca and ^{166}Er and various model calculations attempting to describe the fine structure.

HK 71.6 Th 18:30 H-ZO 40

Time-dependent-Hartree-Fock-Bogoliubov monopole response in even-even superfluid spherical nuclei — •Sara Fracasso and Paul D. Stevenson — University of Surrey, Guildford, Surrey, GU27XH (UK)

The monopole linear response has been investigated in even-even spherically symmetric systems, such as Oxygen and Calcium isotopes, by means of a radial Time-dependent-Hartree-Fock-Bogoliubov (TDHFB) approach, based on a Skyrme functional complemented with a zero-range density dependent pairing force [1]. A new code (TDHF-Brad) has been developed to perform the time evolution of the HFB solutions, currently obtained with HFBRAD [2].

Our calculations, the first of their kind and which follow the recent TDHFB predictions for the pairing-vibrations [3], are compared with the available experimental data. Consequences of the complex character of the anomalous densities are in particular discussed.

A comparison with results from the self-consistent HFB+QRPA of [4] has also been performed. Besides the inclusion of both the residual spin-orbit and Coulomb terms in QRPA, the same energy density functional in both the normal and the anomalous sector has been implemented in the two models, whose parameters have been tuned to allow a reasonable comparison. These features allow us to draw quite robust conclusions.

[1] S. Fracasso et al., in preparation; [2] K. Bennaceur et al., Comp. Phys. Comm. 168, 96 (2005); [3] B. Avez et al., Phys. Rev. C 78, 044318 (2008); [4] J. Li et al., Phys. Rev. C 78, 064304 (2008).

HK 71.7 Th 18:45 H-ZO 40

Low-energy dipole and quadrupole states related to neutron skins — •Nadia Tsoneva[1,2] and Horst Lenske[1] — [1]Institut für Theoretische Physik, Universität Giessen, Germany — [2]Institute for nuclear research and nuclear energy, Sofia, Bulgaria

We present investigations on dipole and quadrupole excitations in skin nuclei, in particular in the N=50, 82 isotones and Z=50 isotopes. We explore their connection to the thickness of the neutron(proton) skin, respectively. Our theoretical method relies on density functional theory which provides us with a proper link between nuclear many-body theory of the nuclear ground state and its phenomenological description [1]. For the calculation of the nuclear excited states we apply QPM theory. From QPM calculations in these nuclei we observe low-energy dipole strength located below the particle emission threshold and related to the size of the neutron(proton) skin [1]. The genuine character of the PDR mode as a skin vibration is confirmed by the shape and structure of the transition densities. The spectral distributions are in a good agreement with the available experimental data [1]. In addition, quadrupole states are investigated along isotopic chains. By analysing their state vectors and transition densities a clear separation between collective isoscalar, isovector and mixed symmetry states is achieved. A new quadrupole mode related to PQR [2] in tin isotopes is suggested.

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[1] N. Tsoneva, H. Lenske, Phys. Rev. C **77**, 024321 (2008).
[2] N. Tsoneva and H. Lenske, CGS13 Conf. Proc, to be publ.