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Pygmy Resonances in Exotic Nuclei

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The progress of the new generation of experimental facilities on radioactive ion beams opens the opportunity to investigate unknown regions of exotic nuclei, far from the valley of beta-stability.
One of the most interesting findings, was the observation of enhanced, resonance-like, low-energy, dipole strength, as a common feature of stable and unstable nuclei with neutron excess.
This clustering of strong dipole transitions was named Pygmy Dipole Resonance (PDR). It was suggested that the PDR is due to an oscillation of a small
portion of neutron-rich nuclear matter relative to the rest of the nucleus.
Here, we present systematic investigations based on self-consistent HFB and QPM theory on dipole and other multipole excitations in several isotonic and isotopic chains of nuclei, particularly exploring their connection to the thickness of the neutron or proton skin, respectively [1-3].
From the analysis of the structure of low-energy electric dipole and quadrupole states and the corresponding neutron and proton transition densities a Pygmy Dipole [1,3] and a Pygmy Quadrupole Resonances (PQR) [2] are identified as a distinct and unique excitation, different from giant resonances and low-energy collective quadrupole states, respectively. The total PDR and PQR strengths are found to be related to the neutron skin thickness.

In addition, it has been suggested that the pygmy resonances are
independent of the type of nucleon excess (neutron or proton) [1,2].

Furthermore, recent calculations of low-energy E1 and
spin-flip M1 excitations in N=82 nuclei are presented in comparison with
experimental data [3]. These investigations allow to decompose the
dipole strength below the GDR to elastic E1 component, related to skin
oscillations and PDR, and background component composed of elastic and inelastic
E1 and M1 transitions, respectively. The obtained information reveals
new aspects in the isospin dynamics of the nucleus.

References:

[1] N. Tsoneva, H. Lenske, Phys. Rev. C 77, 024321 (2008), and refs. therein.
[2] N. Tsoneva, H. Lenske, Phys. Lett. B submitted, arXiv:0910.3487 [nucl-th].
[3] A. P. Tonchev, S. L. Hammond, J. H. Kelley, E. Kwan, H. Lenske, G. Rusev, W. Tornow, and N. Tsoneva, Phys. Rev. Lett., accepted, and refs. therein.

Are you a student, postdoc or an attendee from an "emerging"country and would like to apply for financial support?

yes

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