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Probing the 1p-1h neutron origin of the Pygmy Dipole Resonance

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Abstract

The first comprehensive study of the single-particle nature of pygmy dipole resonance (PDR) in double-magic ^{208}Pb [1] and semi-magic ^{120}Sn [2] nuclei with an excess of neutrons is presented. The results were obtained from theoretical calculations based on energy-density functional plus quasiparticle-phonon model (EDF+QPM) approach [3] and large-scale shell model (LSSM) and compared to novel (d,p) and (d,pγ) experiments and resonant proton scattering data [1, 2]. The new findings establish (d,p) and (d,pγ) reactions as an additional, valuable, experimental probe for studying PDR and its collectivity. In addition to the one-particle nature of the excited states, various characteristics of the strength distributions are discussed to elucidate the microscopic structure of the PDR. Unprecedented access to the theoretical wave functions demonstrating the one-particle-one-hole (1p-1h) neutron origin of the PDR in the investigated nuclei was achieved. The present studies of the PDR will support ELI-Gamma-Above-Neutron-Threshold (ELIGANT) day-one experiments at ELI-NP which target the GDR and the PDR ground state γ-decays, as well as studies of multi-step γ-decays through low-lying states. With the unique possibilities of the VEGA system, the ELI-NP can deliver high-resolution data stemming from photon-induced excitations and reactions. In this regard, further studying the PDR at ELI-NP will provide new insights into the dynamics of isospin-asymmetric nuclear matter and the properties of neutron stars.

References

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