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Study of the Nuclear Electric and Magnetic Dipole Response using Monoenergetic and Polarized Photons[1]

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In stable and weakly bound neutron-rich nuclei a resonance-like concentration of dipole strength is observed at excitation energies around the neutron separation energy. This clustering of strong dipole transitions has been named the pygmy dipole resonance (PDR) in comparison to the giant dipole resonance that dominates the E1 response. Microscopic nuclear models predict the existence of the PDR arising from an oscillation of a small portion of neutron-rich nuclear matter relative to the rest of the nucleus. In addition, the dipole strength distributions at the particle separation energies might affect the reaction rates in astrophysical scenarios where photo-disintegration reactions are important, i.e., in hot stars and stellar explosions. This talk is giving an overview of the high-sensitivity studies of E1 and M1 transitions in neutron closed-shell nuclei using the nearly monoenergetic and 100% linearly polarized photon beams from the High-Intensity-Gamma-Ray Source facility. The fine and gross structure of the dipole-strength distribution of the PDR has been observed for the first time and novel information about the character of this mode of excitation has been obtained. The observations will be compared with calculations using statistical and quasiparticle random-phase approximation.

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