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Taking Photos of the Nuclear Giant Dipole Resonance

Content

The response of atomic nuclei to external, harmonically oscillating electric fields, i.e., their photoresponse [1], is dominated by their isovector Giant Dipole Resonance (GDR). While the existence of the GDR is known for almost a century [2] and while it is often considered as the archetype of a collective nuclear mode, a variety of fundamental questions to its very nature is still unanswered: With what probability does the GDR de-excite by internal γ-decay to intrinsic excitations? Does the internal γ-decay branching ratio to low-energy states evolve over the GDR as a function of excitation energy? How does the branching ratio between internal decay and particle emission change as a function of excitation energy? What is the lifetime of the GDR?

We will address these fundamental questions in our presentation. We will present and discuss our recent data from photonuclear reactions that provide new evidences. The GDRs of the nuclides 140Ce, 154Sm, 164Dy, 208Pb, and 232Th have been studied with quasimonochromatic photon beams of energies between 11 and 17 MeV at the High Intensity γ–ray Source (HIγS) at the Triangle Universities Nuclear Laboratory (TUNL). Nuclear Resonance Fluorescence of the GDR and Smekal-Raman scattering to the first excited state have been measured quantitatively and first results have been already published [3].

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[3] J. Kleemann, N. Pietralla et al., Phys. Rev. Lett. 134, 022503 (2025).

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