INVESTIGATION OF THE DECAY PATTERN OF THE PYGMY DIPOLE RESONANCE IN ^{128}TE USING THE GAMMA-3 SETUP

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In the past decades the electric dipole (E1) response of atomic nuclei was the subject of extensive investigations throughout the nuclear landscape. The major part of the E1 strength is located in the Iso-Vector Giant Dipole Resonance (IVGDR) [1]. However, in many nuclei an additional E1 strength contribution was observed on top of the low-energy tail of the IVGDR, often denoted as the Pygmy Dipole Resonance (PDR) [2]. One useful method to study the PDR below the neutron separation threshold is Nuclear Resonance Fluorescence (NRF). Real-photon scattering has the advantage of being sensitive to dipole-excited states and allows access to their nuclear properties, such as their dipole excitation strengths. However, NRF experiments are usually restricted to the observation of ground-state transitions, while de-excitations to lower-lying excited states are often too weak to be observed directly. Nevertheless, knowledge about these transitions is crucial to learn more about the decay behavior of the PDR.
In recent work, quasi-monochromatic photon beams at the High Intensity γ-Ray Source (HIγS) at Triangle Universities Nuclear Laboratory have been used to investigate the integrated population intensities of the first low-lying excited states (e.g. [3]). These experiments allowed the investigation of the decay pattern of dipole-excited states only in an indirect way, since no detailed information about the primary transitions populating the lower-lying states is accessible. However, direct observation of these primary transitions will make it possible to draw conclusions on the coupling of the PDR to the ground state and to lower-lying excited states.
To overcome the limited experimental sensitivity for the observation of primary transitions, a novel γ-γ coincidence setup, the γ^3 setup [4], was installed at HIγS. This unique setup combines quasi-monochromatic photon beams in the entrance channel with the γ-γ coincidence technique using a detector array consisting of HPGe detectors with high energy resolution and high efficiency $LaBr_3$ scintillators. It is therefore possible to observe even small branching ratios to lower-lying excited states. Furthermore, due to the polarized quasi-monochromatic photon beam, the photoabsorption cross section can be extracted as a function of the excitation energy, while simultaneously the contributions of E1 and M1 strength can be separated.
Recent experimental results on the off-shell nucleus ^{128}Te will be presented and discussed.
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REFERENCES

[1] M.N. Harakeh and A. van der Woude, *Giant Resonances* (Oxford University Press, 2001).
[2] D. Savran, T. Aumann, and A. Zilges, Prog. Part. Nucl. Phys. **70** (2013) 210.
[3] J. Isaak *et al.*, Phys. Lett. B **727** (2013) 361.
[4] B. Löher *et al.*, Nucl. Instr. and Meth. Phys. Res. A **723** (2013) 136.