RECENT ADVANCES IN NUCLEAR STRUCTURE PHYSICS FROM PHOTONUCLEAR REACTIONS

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Recently, even next-to-leading order processes in the electroweak interaction, such as double-beta decay or double-gamma decay, attracted a great deal of attention. In particular, the Competitive Double-gamma nuclear Decay (γγ/γ-decay) has been discovered [1] at TU Darmstadt. Also photonuclear reactions using novel quasi-monochromatic gamma-ray beams have considerably advanced our experimental opportunities [2] and provided new information on highly off-yrast low-spin nuclear structures. We will report on our recent discovery of the γγ/γ-decay as well as on precision studies in photonuclear reactions of nuclear dipole phenomena.

Using quasi-monochromatic polarized γ-ray beams we first measured the E2 decay rate of the M1 scissors mode. That experiment addressed the 1+sc -> 2+1 transition in 156Gd and also provided evidence for a rotational 2+ state on top of the 1+ scissors mode's band head.
In addition, we have studied [3] the chain of stable Chromium isotopes featuring stable nuclei on both sides of a neutron shell closure (here N=28). Our new data on 54Cr (N=30) show an increase of low-energy E1 strength by about a factor of 2 with respect to 50,52Cr [3]. This represents the first measurement of the increase of the pygmy-E1-strength across a neutron shell closure. It provides evidence for the neutron-character of the low-energy E1 strength often dubbed 'pygmy dipole resonance' in stable nuclei. The data invalidate a naive mass-scaling of the PDR.

Next-generation gamma-ray beam facilities, such as ELI-NP, promise a further boost of the field for the years to come.