The Photoresponse of Atomic Nuclei: Collective Excitations and Photodissoziation*

A. Zilges[1], M. Babilon[1], J. Hasper[1], K. Lindenberg[1], S. Müller[1], K. Ramspeck[1], D. Savran[1], K. Sonnabend[1], S. Volz[1], M. Zarza[1]
[1] Institut für Kernphysik, TU Darmstadt, Schlossgartenstr. 9, D-64289 Darmstadt, Germany.

Real photons are an ideal tool to address challenging questions in Nuclear Structure and Nuclear Astrophysics.

Below the particle threshold they can be used to study the distribution of dipole and quadrupole strength in Nuclear Resonance Fluorescence (NRF) experiments. A recent finding is a concentration of electric dipole strength in the energy region around 6-10 MeV in various mass regions [1,2,3]. This collective excitation mode which is frequently denoted as Pygmy Dipole Resonance exhausts up to 1% of the E1 Energy Weighted Sum Rule and seems to be connected to an enrichment of neutrons in the nuclear skin. Photon scattering experiments and additional experiments with hadronic probes try to reveal more details about the structure of this excitation mode.

The detailed knowledge about the photoresponse above the particle threshold is important for the determination of astrophyically relevant reaction rates. A rather narrow energy window above the neutron threshold defines e.g. the precise path of the p–process to synthesize proton rich heavy nuclei [4]. We produce a Planck spectrum with real photons from bremsstrahlung to measure reaction rates in this energy window by means of the photoactivation technique [5]. New experiments at the GSI facility use virtual photons from inverse Coulomb dissociation to study the (γ,n) reaction rate of more exotic radioactive nuclei too.

* This work is supported by the Deutsche Forschungsgemeinschaft (SFB 634).

[1] T. Hartmann *et al.*, Phys. Rev. Lett. **93**, 192501 (2004).
[2] K. Govaert *et al.*, Phys. Rev. C **57**, 2229 (1998).
[3] A. Zilges *et al.*, Phys. Lett. **B 542**, 43 (2002).
[4] M. Arnould *et al.*, Phys. Rep. **A 500**, 1 (2005).
[5] K. Sonnabend *et al.*, Phys. Rev. C **70**, 035802 (2004).