APR14-2014-000368

Abstract for an Invited Paper
for the APR14 Meeting of
the American Physical Society

The "light-est" of all Projectiles: Nuclear Structure Studies Using Photonuclear Reactions[1]

NORBERT PIETRALLA, Tech Univ Darmstadt

Nuclear reactions induced by photons have had and continue to have a large impact on the course of nuclear physics. Photons interact purely electromagnetically with the atomic nucleus and induce minimal momentum transfer at given excitation energy. Photonuclear reaction processes can be expanded in terms of QED and photonuclear excitations are by far dominated by one-step processes. They allow for a model independent measurement of nuclear observables and, hence, for a clean characterization of effective nuclear forces. Apart from the pioneering photonuclear reactions by Bothe and Gentner in the 1930s [1], bremsstrahlung has been used most widely as an intense source of gamma-rays for photonuclear reactions from the 1940s until today. The nuclear dipole strength distribution has largely been mapped out at bremsstrahlung facilities [2,3]. While the continuous-energy distribution of bremsstrahlung photons offers a complete view of the spectrum of photonuclear excitations, it suffers from a poor sensitivity to specific energy intervals. Intense, energy-tunable, quasi-monochromatic gamma-ray beams from laser-Compton backscattering processes have revolutionized the field of photonuclear reactions for the last ten years [4]. A set of new techniques is under development and new information on fundamental nuclear modes, such as the IVGDR, IVGQR, Pygmy Dipole Resonance, and the Scissors Mode, has recently been obtained. We will attempt to give a brief overview of the state of the art and dare an outlook at the research opportunities at the next generation of gamma-ray facilities under construction in the U.S. and Europe.

[1] W. Bothe and W. Gentner, Z. Phys. 106, 236 (1937).
[2] F.R. Metzger, Proc. in Nucl. Phys. 7, 54 (1959).
[3] U. Kneissl, N. Pietralla, and A. Zilges. J. Phys. G: Nucl. Part. Phys. 32, R217 (2006).
[4] H.R. Weller et al., Prog. Part. Nucl. Phys. 62, 257 (2009).

[1]Supported by the DFG under grant No. SFB634.