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Photoproduction of mesons off quasifree nucleons and light nuclei

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Photoproduction of mesons off nuclei is important for several different topics. Reactions with free and quasifree nucleons (mainly protons and neutrons bound in the deuteron) have given much new input for the investigation of the excitation spectrum of the nucleon. For this, experimentally mainly the exploration of several polarization observables (circularly and linearly polarized beams, longitudinally and transversally polarized beams), in addition to differential cross sections, is important. Also the measurement of reactions with mesons pairs in the final state (in particular $\pi\pi$ and $\pi\eta$) has opened new windows to the nuclear excitation spectrum because such reactions are sensitive to higher lying states with a more complicated excitation structure which tend to de-excite in sequential decays via intermediate excited states. During the last few years techniques have been developed to study such reactions also for quasifree neutrons bound in light nuclei, which is necessary to disentangle the isospin structure of the electromagnetic excitations. In the meantime, even double-polarization observables for the production of neutral meson pairs off quasifree neutrons are experimentally accessible.

Furthermore, photoproduction of mesons off nuclei is also a very valuable testing field for meson-nucleon interactions and the production of exotic hadronic states. The nature of the narrow states observed for the production of eta mesons from light nuclei are still not understood and controversially discussed. Also the possible manifestation of di-baryonic states in coherent double π^0 production off the deuteron is under discussion. Recently, also several new data sets for photoproduction of mixed-charged pion pairs were collected, which are sensitive to the contribution of the ρ -meson to photoproduction in the second resonance region, which is very important for the strong suppression of the second resonance peak for nuclear targets which is assumed to be a nuclear in-medium effect. We will give a summary of recent results.

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