

Photoproduction of mesons off quasifree nucleons

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Photoproduction of mesons off the nucleon is a very efficient tool for the study of the excitation spectrum of the nucleon related to the fundamental properties of the strong interaction. Much progress has been made during the last decade in particular due to the measurements of several polarization observables in particular with polarized beams and polarized targets. Availability of such polarization observables allows for much better constraint model analyses, because they are sensitive to small interference terms in the amplitudes. However, up to now the experimental data base is only much improved for reactions off free protons. The investigation of the isospin degree of freedom requires also measurements with neutron targets. In the absence of free neutron targets experiments must be done with quasifree nucleons bound in light nuclei, in particular in the deuteron. Such experiments are complicated by the effects of nuclear Fermi motion, which smears out all observed structures and by the presence of Final State Interactions (FSI) which may significantly influence the reaction amplitudes in comparison to free nucleons. However, also for this issue significant progress has been achieved during the last few years. In particular at the Bonn CBELSA/TAPS experiment and the Mainz Cball/TAPS experiment such reactions have been systematically investigated. The effects of Fermi motion can be mostly removed when the center-of-mass energy of the photon-participant-nucleon system is reconstructed from the final state kinematics of the reaction products. Several attempts have been made to model in a better way FSI effects, but also phenomenological approaches, which are based on the assumption that FSI effects in the deuteron are for many reactions similar for recoil protons and neutrons, have been used. For the measurement of polarization observables such effects cancel often to a large extent because they effect different polarization states in the same way. We will discuss recent results for the photoproduction of η - and π^0 -mesons and for $\pi\pi$ - and $\pi\eta$ -pairs. Reactions like photoproduction of neutral meson pairs off quasifree neutrons are among the technically most difficult ones and can practically only be measured when almost the complete solid angle is covered by an electromagnetic calorimeter. Some results of these experiments, such as the narrow structures observed in the excitation function of the $n\eta$ final state, where quite surprising and are not yet fully understood.

Such experiments may also profit from production mechanisms which only contribute to photoproduction from light nuclei such as coherent production of mesons or meson pairs. This may partly help to disentangle the isospin structure of the reaction amplitudes, but is also under discussion for example for the possible manifestation of a di-baryon state in coherent photoproduction of $\pi^0\pi^0$ pairs off the deuteron. Recent results will be discussed.

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