

Photoproduction of $\pi^0\pi^\pm$ pairs off nucleons

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Photoproduction of meson pairs (in particular $\pi\pi$ and $\pi\eta$ pairs) has gained a lot of interest because it gives access to nucleon resonances that decay not directly to the nucleon ground state but in a cascade decay involving an excited intermediate state. Much emphasis has been put on neutral final states ($\pi^0\pi^0$ and $\pi^0\eta$ pairs) which are not much effected by non-resonant background contributions. However, there are several issues which can only be investigated when also pairs with charged mesons are studied. The isospin decomposition of the reaction amplitudes is one of them. But an even more important one is that only pion pairs with charged pions allow to study the contribution of the ρ meson to nucleon resonance decays (the $\rho^0 \rightarrow \pi^0\pi^0$ decay is isospin forbidden).

Previous results [1] have suggested that already at low incident photon energies the $D_{13}(1520)$ nucleon resonance has a surprisingly large decay branching ratio to the $N\rho$ final state. This is not only important for the study of free nucleon resonances. A long standing problem is the strong suppression of the second and third nucleon resonance region in total photoabsorption reactions. A possible explanation discussed for the second resonance bump is a strong in-medium modification of the $D_{13}(1520)$ resonance caused by its coupling to the ρ -meson. For the ρ itself strong in-medium modifications have been discussed in the framework of many models and indications from experimental data have also been found (see [2] for a review). The ρ - D_{13} coupling could than trigger the corresponding modifications of the D_{13} .

In a series of experiments with the Crystal Ball/TAPS detector at the Mainz MAMI accelerator we have started to study in detail the production of $\pi^0\pi^\pm$ pairs off the free proton, the deuteron, and heavier nuclei. In the present talk mainly results from the free $\gamma p \rightarrow p\pi^0\pi^\pm$ reaction will be presented which aim at a more precise investigation of the $D_{13}(1520) \rightarrow N\rho$ decay and also at a detailed investigation of the reaction amplitudes from the $N\rho$ decay channel and sequential resonance decays at higher incident photon energy. First, preliminary results from quasi-free production of $\pi^0\pi^\pm$ pairs off the deuteron will also be discussed in view of the isospin composition of the reaction. Data from a ^4He target, which due to the high density of the helium nucleus should show significant in-medium effects, have been measured very recently, but are still in an early state of analysis.

References

- [1] W. Langgärtner et al., Phys. Rev. Lett. **87**, 052001 (2001).
- [2] S. Leupold, V. Metag, U. Mosel, Int. J. of Mod. Phys. **E 19**, 147 (2010).

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