

## Double polarisation observable E and helicity dependent cross section for single $\pi^0$ photoproduction off proton and neutron

Thursday, June 13, 2019 4:30 PM (30 minutes)

Since the beginning of the 1960's, the internal structure of the nucleon, in particular its spin structure, and the excitation spectra of protons and neutrons have been a central issue for many theoretical models and experiments of nuclear and particle physics.

Photon-induced reactions, like meson photoproduction, allow to excite the nucleon, to have access to many different polarisation observables, and are an essential tool to disentangle the role of the different electromagnetic multipoles due to the change of sign of some contributions and the presence of interference terms between different multipole amplitudes. In addition, the use of polarised beams and/or targets allow to access additional observables which are fundamental in order to accurately determine the nucleon resonance properties.

Up to now, most efforts have been devoted to studying proton excitation but, since the electromagnetic excitations are isospin dependent, also measurements of meson-photoproduction off the neutron are required.

The A2@MAMI collaboration is carrying out a broad and systematic study on this topics, both on the proton and the neutron. The experiments are performed at the tagged photon beam facility of the MAMI accelerator in Mainz, using circularly and longitudinally polarised photons on longitudinally polarised proton and deuteron targets, for energies ranging from the pion production threshold up to 1.6 GeV. Hadronic reaction products are then measured with the large acceptance Crystal Ball spectrometer, complemented by charged particle and vertex detectors for tracking and identification.

In this talk, an overview of the results obtained so far for the double polarisation observable E (circularly polarised photon beam on a longitudinally polarised target) on the single  $\pi^0$  photoproduction off the proton and the neutron will be given.

Furthermore, new results on the helicity-dependent  $d\sigma/d\Omega \pi^0$  cross sections on the proton and the deuteron will be presented.

These new, high-quality doubly-polarised pion-photoproduction data sets give a valuable input to the study of the nucleon structure and excitation spectra of protons and neutrons, by providing a contribution to the partial wave analysis models and by allowing to constrain the multipole solution of the different analyses.

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**Session Classification:** Parallel Session B

**Track Classification:** Baryon spectrum through meson photoproduction