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Doubly-polarised pion photoproduction and the GDH sum rule on the nucleon at MAMI

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New measurements of the helicity dependence of the total inclusive photo-absorption cross section and of the partial cross sections for several reaction channels on the proton and on the neutron were carried out at the tagged photon beam facility of the MAMI accelerator (Mainz) by the A2 experiment in the energy region 200 < E_γ < 1500 MeV.

These new, high-quality doubly-polarized 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.

Furthermore, the helicity dependent observables provide the main ingredient for the verification of the well-known Gerasimov-Drell-Hearn (GDH) sum rule, which relates the helicity-dependent photoasborption process to the main static nucleon properties (mass, charge, spin). For this reason, such a verification is of particular interest in the understanding of the nucleon spin structure, the γ-N interaction, as well as the physics of strongly interacting systems. Thanks to the use of polarized deuteron and ^{3}He targets, the A2 experiment can study all the $\gamma N \rightarrow N\pi(\pi)$ partial channels, as well as the total cross sections, for the neutron too.

The new precise results on double-polarization measurements of the total and differential cross sections for the partial $\gamma N \rightarrow \pi X$ channels on the proton and on the neutron, obtained by the A2 collaboration, are compared to the existing model predictions and to the few, available results. These new data are significantly increasing the available statistics, especially on the neutron, thus providing an important testing ground for all existing models. Moreover, the results obtained on ^{3}He give information not only on the GDH integral on the neutron, but also on the ^{3}He nuclear structure and allow an investigation of the nucleon properties inside this nucleus.

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