The helicity structure of the nucleon excitation spectrum

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The first measurement of the helicity dependence of the total inclusive photoabsorption process on the proton has been carried out at MAMI (Mainz) [1] and in the energy range 200 MeV $\leq E_\gamma \leq$ 800 GeV. In addition, the helicity dependence of the the $N\pi(\pi)$ photoproduction channels has also been studied [2].
These data give completely new and up to now unaccessible information about the polarization degress of freedom of the proton. In particular, they allow a first experimental verification of the Gerasimov-Drell-Hearn (GDH) sum rule and a first evaluation of the forward spin polarizability γ_0. They also greatly improve the precision of our knowledge of the multipoles which are responsible of the excitation of the individual resonances.

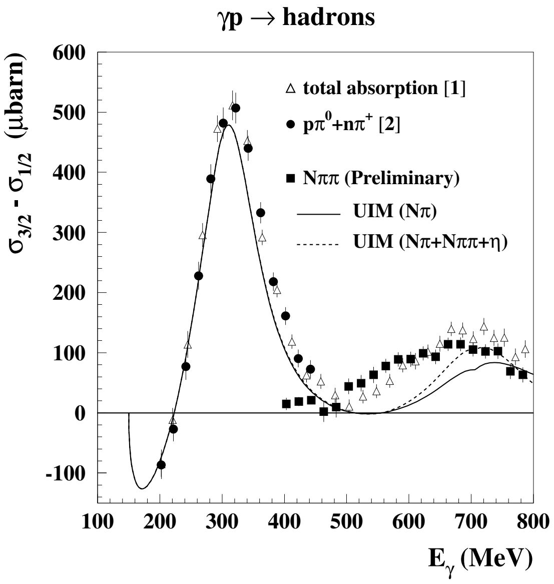

Figure 1: The helicity dependent $(\sigma_{3/2} - \sigma_{1/2})$ (where the subscripts 3/2 and 1/2 correspond to the parallel and antiparallel γ-proton spin configuration) cross section for the inclusive total photon absorption process and for the the $N\pi(\pi)$ channels on the proton obtained at Mainz is compared to the predictions of the UIM model [3].

An example of the quality of the obtained results is shown in Fig.1. In this contribution, the helicity dependence of the single and double pion photoproduction channels in the first and second resonance region will be presented. A particular view will be given to the excitation of the D_{13} resonance. The values of its helicity amplitudes determined from the data are significantly different from the latest Particle Data Group estimate.

References

[1] J. Ahrens *et al.*, Phys. Rev. Lett. **87** (2001) 22003.
[2] J. Ahrens *et al.*, Phys. Rev. Lett. **84** (2000) 5950 and Phys. Rev. Lett., in press.
[3] D. Drechsel *et al.*, Nucl.Phys. A**645** (1999) 145.