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# Proton Polarizabilities from a Partial-Wave Analysis of Compton Scattering Data / Sum Rules Connecting Real and Virtual Compton Scattering on the Nucleon

*Thursday, 31 May 2018 15:10 (30 minutes)*

Talk 169:

I would like to present a first partial wave-analysis (PWA) of the experimental cross sections of Compton scattering on the proton [1]. The resulting solutions reveal an appreciable sensitivity to small refinements of the experimental database, which could explain the discrepancies among the various extractions of proton polarizabilities (see e.g. [3] for review). The database inconsistency can soon be resolved by the ongoing Compton experiments at the Mainz Microtron (MAMI).

[1] N. Krupina, V. Lensky and V. Pascalutsa, arXiv:1712.05349 [nucl-th].

[2] O. Gryniuk, F. Hagelstein and V. Pascalutsa, Phys. Rev. D92 (2015) 074031; ibid. D94 (2016) 034043.

[3] F. Hagelstein, R. Miskimen and V. Pascalutsa, Prog. Part. Nucl. Phys. 88 (2016) 29-97.

Talk 4:

The response of a nucleon to external electromagnetic probes at low energies and low momenta is encoded in structure constants, the *nucleon polarizabilities*.

In this presentation, I will discuss new relations (sum rules) that connect the structure constants measured in real, virtual, and doubly-virtual Compton scattering (CS). These relations are obtained, assuming the analyticity of the CS amplitude.

Two of the new sum rules connect structure constants dependent on the nucleon spin, e.g., the longitudinal-transverse polarizability $\delta_{LT}$, accessed in inclusive electron scattering, is related to the static spin polarizability $\gamma_{E1E1}$, measured in the real CS, and the slope of spin generalized polarizabilities (GPs) $P^{(M1,M1)1} - P^{(L1,L1)1}$, measured in the virtual CS. The other two sum rules hold for the unpolarized doubly-virtual CS and relate some structure constants that can only be measured in off-forward doubly-virtual CS (not experimentally accessible at present) to the slopes of the nucleon's scalar GPs and moments of the unpolarized structure functions $F_1(x,Q^2)$ and $F_2(x,Q^2)$. One more relation constrains the low-$Q^2$ behaviour of the subtraction function in the CS amplitude, which enters the two-photon-exchange contribution to the Lamb shift of (muonic) hydrogen.

I will discuss the verification of these sum rules, using empirical data and $\chi$PT, and the use of these relations to constrain the low-energy structure of the nucleon.

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