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Extracting neutron polarizabilities from Compton scattering on quasi-free neutron in gamma d->gamma n p

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Compton scattering processes are ideal to study electric and magnetic dipole polarizability coefficients of nucleons [1]. These fundamental quantities parametrize the response to a monochromatic photon probe. In this work, the inelastic channel $\gamma d \rightarrow \gamma n p$ is treated in χ EFT, with a focus on the NQFP - neutron quasi-free peak - kinematic region. In this region, the momentum of the outgoing proton is small enough that it is considered to remain at rest. This provides access to the Compton scattering process $\gamma n \rightarrow \gamma n$ from which the neutron scalar polarizabilities α and β are extracted. Using χ EFT, differential cross-sections, $d^3\sigma/dE_{nd}\Omega_\gamma\Omega_n$, in the photon energy range of 200-400 MeV are computed. The biggest contribution comes from the impulse approximation, with small corrections stemming from final state interaction, meson exchange currents and rescattering. A new extraction of neutron polarizabilities from a two-parameter fit to the Kossert et al. [2] data taken at MAMI in 2002 is presented. Previously, the experiment was designed and the data analysed based on a theoretical model [3] that computed the NQFP differential cross-sections. The re-analysis of this data in a consistent, model independent framework - χ EFT - provides reliable extraction of polarizabilities with controlled uncertainties.

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References

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