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Probing the Proton's Internal Structure with Generalized Parton Distributions: From Jefferson Lab to the EIC

Quantum Chromodynamics (QCD) reveals its complexity at large distances and low energies. Understanding the internal structure of the nucleons is therefore essential for a complete understanding of QCD in this regime. Generalized Parton Distributions (GPDs) play a crucial role in this effort, as they provide a means to map both the spatial and the longitudinal momentum distributions of partons in the nucleons. Beyond offering a three-dimensional view of the proton's internal structure, GPDs are also closely linked to the nucleon's spin structure and its internal force distribution. As a result, GPDs have been the focus of intense global experimental efforts.

At Jefferson Lab, extensive measurements have been conducted to study GPDs, primarily through exclusive reactions such as Deeply Virtual Compton Scattering (DVCS)—the exclusive electroproduction of a real photon at the partonic level. In addition to DVCS, other exclusive processes, including Timelike Compton Scattering, Double DVCS, and the exclusive electroproduction of mesons, have been investigated. These results provide a detailed picture of the valence structure of the nucleon.

Looking ahead, future experiments at Jefferson Lab will further leverage the capabilities of the CEBAF accelerator, while the upcoming Electron-Ion Collider (EIC) will significantly enhance our understanding of the gluon content of nucleons.

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