E08-027: A MEASURE OF G2P AND THE LONGITUDINAL-TRANSVERSE SPIN POLARIZABILITY

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The proton is not 'fundamental' in the same way as the point-like electron; it's a composite system with a messy internal structure of quarks and gluons, exhibiting complex many-body interactions. When we probe a proton with an electron beam in an inclusive scattering experiment, this deviation from simple point-like behavior is characterized by structure functions. Four functions are needed to completely describe the proton, with each describing a particular aspect of the proton's compositeness. Due to the complexity of the scattering interactions, these quantities can not be analytically determined from the underlying theory of the quark and gluon interaction : Quantum Chromodynamics, or QCD for short. Instead, they are determined experimentally.

The fourth proton structure function, g_2^p, describes the spin-dependent behavior of a proton when it is immersed in a transverse magnetic field. It is relatively unknown because of the technical difficulty involved in measuring it. E08-027 aims to measure g2p and help complete our understanding of proton structure.

Due to its fundamental nature, knowledge of g_2^p is very important in a wide array of physics topics. It's necessary to help understand why effective theories of QCD fail when attempting to describe spin-dependent properties of the proton, such as the proton's polarizabilities. Knowledge of g2p also turns out to be critical for a full understanding of the simplest bound atomic systems like the hydrogen atom, where the nucleus is a single proton. Furthermore measuring g2p will help clarify discrepancies seen between experiment and theory for hyperfine splitting and the proton charge radius. It is by addressing these issues that E08-027 will help complete our understanding of the nucleon structure.