Internal Structure and Dynamics of Hadrons

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The study of internal structure and dynamics of hadrons is one of the active areas at present as it provides valuable insight into the perturbative and nonperturbative aspects of Quantum Chromodynamics (QCD) in terms of quark and gluon degrees of freedom. However, its direct application is extremely difficult because of the interplay of nonperturbative effects such as color confinement and multi-quark coherence. Two approaches are very successful in explaining the hadron structure and related properties. The first one is the chiral constituent quark model which successfully explains the `proton spin crisis' and low energy matrix elements having implications for the flavor and spin dynamics. The other approach is the light-front dynamics which has direct application in Minkowski space. Since it has the distinct feature of accounting for the vacuum fluctuations in quantum field theories, it provides a natural framework for the study of the hadron structure in three dimensions at high energy in terms of the Generalized Parton Distributions (GPDs) and the Transverse Momentum Distributions (TMDs). The frame independent n-particle light-cone wave functions (LCWFs) are essential to describe the bound state structure of a relativistic composite system like the nucleon. The GPDs and TMDs have attracted a lot of theoretical and experimental attention recently as they encode extensive information on the hadron's structure and they can be probed in exclusive processes like the deeply virtual Compton scattering (DVCS) or hard exclusive production of vector mesons.