Nucleon and N-Delta Electromagnetic Transition Form Factors

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We consider the baryons as three constituent valence quark systems. Their dynamics is described by the covariant Spectator formalism [1,2] for a quark-diquark system, where the diquark is always on its mass-shell. The electromagnetic interaction is considered in the relativistic impulse interaction (RIA) where the photon couples with the quark through the current $j^\mu = j_1\gamma^\mu + j_2\frac{i\sigma^{\mu\nu}q_\nu}{2m}$ (m is the nucleon mass). The two form factors j_1 and j_2 account for all QCD mechanisms ($q\bar{q}$ pairs, pion cloud and gluon sea effects). Only the j_1 form factor includes pion cloud effects in its isovector part.

The nucleon wave function consists of spin-0 (isospin-0) and spin-1 (isospin-1) components written in terms of the diquark polarization vectors and the nucleon Dirac spinor [1]. Furthermore, it verifies the Dirac equation and generates the correct structure for its non-relativistic limit. Current conservation is also satisfied. The Jlab polarization data of the electromagnetic nucleon elastic form factors are described [3,4] when one assumes an S-state for the quark-diquark system [1], which means that the data does not signal any angular dependence in the wave function. The results show that spherical charge and matter distributions are compatible with the data, even when we consider Spin Direction Dependent density definitions [5]. The explicit consideration of the pion cloud effects definitively improves the description of the nucleon form factors [1].

We also calculated the N-Delta transition form factors. Preliminary results considering the Delta wave function as a mixture of a S and a D state explain the magnetic dipole G_M^* and the electric quadrupole G_E^* data [6]. Improvements are underway in order to describe also the Coulomb quadrupole form factor G_C^*.

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