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Insight into Strong QCD and the Emergence of Mass from N* Experiments

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Studies of nucleon resonance (N*) electroexcitation amplitudes (gvpN* electrocouplings) within a broad range of virtual photon four-momentum squared Q2 offer unique information on many facets of the strong interaction in the regime of large QCD running coupling (sQCD regime) seen in the generation of different resonances. The results on the gvpN*electrocouplings from exclusive meson electroproduction data measured with the CLAS detector at JLab and their impact on understanding of sQCD dynamics will be presented in this talk. These CLAS data have provided the first and only available results on the evolution of the gvpN* electrocouplings with Q2 to 5 GeV2 for most N*states in the mass range up to 1.8 GeV. A successful description of the CLAS results on the Q2-evolution of the Delta(1232)3/2+, N(1440)1/2+, and Delta(1600)3/2+ electrocouplings has been achieved within the continuum Schwinger method (CSM) by employing the same momentum dependence of the dressed quark mass inferred from the QCD Lagrangian, which also reproduces the experimental results on the pion elastic electromagnetic form factor and parton distribution functions, and the nucleon elastic form factors. This success has conclusively demonstrated the capability for gaining insight into the emergence of hadron mass (EHM) from the exploration of the Q2-evolution of the gvpN* electrocouplings. These studies also allow us to establish either universality or environmental sensitivity of the dressed quark mass function and to explore qq-correlation amplitudes of different spin-parities and the mixing between configurations of different orbital angular momentum. Exploration of the resonance electroexcitation with the CLAS12 detector and in the future with a possible 22 GeV machine at JLab offer the only foreseen opportunity to extend information on the gvpN*electrocouplings for Q2 from 5-30 GeV2. Analyses of these results will cover the full range of distances where the dominant part of hadron mass and N* structure emerge from QCD.

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