Studies of N* structure from the CLAS meson electroproduction data

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The studies of the excited proton state (N^*) structure from the data on exclusive meson electroproduction off protons are of key importance for the exploration of non-perturbative strong interaction which is responsible for the formation of baryons from quarks and gluons [1, 2]. With its nearly complete coverage of the final-state phase space, the CLAS detector at Jefferson Lab has provided the lion's share of the world's meson-electroproduction data for differential cross sections of π^+n, π^0p, ηp, $\pi^+\pi^-p$, KY channels and the asymmetries arising from single- and double-polarization observables in $N\pi$ and KY electroproduction. Electrocouplings for most of the N^* states in the mass range of up to 1.8 GeV have been determined from analyses of $N\pi$ electroproduction at photon virtualities (Q^2) up to 5.0 GeV^2 [1, 3] and from the $\pi^+\pi^-p$ channel [2, 4] at Q^2 up to 1.5 GeV^2. Consistent results for the electrocouplings of the $P_{11}(1440)$ and $D_{13}(1520)$ excited proton states as obtained from independent analyses of major $N\pi$ and $\pi^+\pi^-p$ electroproduction channels suggest a reliable evaluation of these fundamental quantities. Preliminary results on electrocouplings of several N^* states in the mass range above 1.6 GeV, which decay preferentially to the $N\pi\pi$ final state, have become available from $\pi^+\pi^-p$ electroproduction data for the first time [2].

Physics analyses of these N^* electrocouplings [1, 4] have revealed that the structure of the excited nucleon is formed of an internal core of dressed quarks with an external meson-baryon cloud. Our N^*-electrocoupling results have substantial impact on the development of the theoretical description of hadron structure starting from the QCD Lagrangian within the framework of Lattice QCD and Dyson-Schwinger Equation approaches. They also provide a testing ground for advanced quark models of the N^* structure [2].

References

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