Electroproduction and transition form factors - on the road to a baryon spectrum

Philip L. Cole on behalf of the CLAS Collaboration

The CLAS detector at Jefferson Lab is a unique instrument, which has provided the lion's share of the world's data on meson photo- and electroproduction in the resonance excitation region. The electroexcitation amplitudes for the low-lying resonances $P_{33}(1232)$, $P_{11}(1440)$, $D_{13}(1520)$, and $S_{11}(1535)$ were determined over a wide range of $Q^2 < 5.0$ GeV^2 in a comprehensive analysis of exclusive single-meson ($\pi^+ n$, $\pi^0 p$) reactions in the electroproduction off protons. Further, CLAS was able to precisely measure $\pi^+\pi^- p$ electroproduction differential cross sections provided by the nearly full kinematic coverage of the detector. The electrocouplings of the $P_{11}(1440)$ and $D_{13}(1520)$ excited states are determined from the exclusive-$\pi^+\pi^- p$ reaction. Consistent results on the electrocouplings from two-independent analyses (single- and double-pion electroproduction) have provided compelling evidence for the reliable extraction of the N^* electrocouplings. Preliminary results on the electrocouplings of the $S_{31}(1620)$, $S_{11}(1650)$, $D_{33}(1700)$, and $P_{13}(1720)$ states have recently become available. Theoretical analyses of these results have revealed that there are two major contributions to the resonance structure: a) an internal quark core and b) an external meson-baryon cloud. These CLAS results have had considerable impact on QCD-based studies on N^* structure and in the search for manifestations of the dynamical masses of the dressed quarks. Future CLAS12 N^* structure studies at high photon virtualities will considerably extend our capabilities in exploring the nature of confinement and dynamical chiral symmetry breaking in baryons.