

Nucleon resonance electrocouplings as a window to strong interactions in non-perturbative regime

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Studies of nucleon resonance electrocouplings $\gamma_v NN^*$ from the data on exclusive meson electroproduction off nucleons represents an important part in the N^* Program with the CLAS detector [1], allowing us to explore the non-perturbative strong interaction that is responsible for the formation of the nucleon and its excited states.[2].

The CLAS measurements have extended considerably the data base on differential cross sections for $N\pi$ and $N\eta$ electroproduction channels, longitudinally polarized beam and beam-target asymmetries for π electroproduction off protons at Q^2 up to 6.0 GeV^2 . Electrocouplings of the $P_{11}(1440)$, $D_{13}(1520)$, and $S_{11}(1535)$ resonances were determined in analyses within the framework of two conceptually different reaction models [3].

Data were also collected on charged double pion electroproduction off protons leading to nine independent differential $\pi^+\pi^-p$ cross sections at Q^2 up to 1.5 GeV^2 . Using a phenomenological approach [4], the $P_{11}(1440)$ and $D_{13}(1520)$ electrocouplings were determined from the $\pi^+\pi^-p$ electroproduction data for the first time. The results are consistent with the results of the independent $N\pi$ electroproduction analyses [3]. Electrocouplings of the $S_{31}(1620)$, $S_{11}(1650)$, $D_{33}(1700)$, and $P_{13}(1720)$ states have also become available from this channel [5].

These results revealed that there exist two major contributions to $\gamma_v NN^*$ electrocouplings: a) an internal quark core, and b) an external meson-baryon cloud. Recent theoretical developments using the Dyson-Schwinger Equations of QCD for the interpretations of $\gamma_v NN^*$ electrocouplings provide guidelines to search for the manifestation of dynamically dressed quark masses. Lattice QCD is making progress toward $\gamma_v NN^*$ electrocoupling description from QCD Lagrangian. The new data will be discussed in light of these new developments.

A further extension of the N^* Program with the CLAS12 detector after completion of JLAB 12 GeV Upgrade Project will be presented.

References

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