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

I.G Aznauryan, V.D Burkert, V.I Mokeev for the CLAS Collaboration

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 Nπ and Nη 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 Nπ 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

[1] I .G. Aznauryan and V. D. Burkert, Prog. Part. Phys.,1 (2012).

[2] I. G. Aznauryan, et al., arXiv:0907.1901 [nucl-th].

[3] I. G.Aznauryan, et al., Phys. Rev. **C80**, 055203 (2009).

[4] V.I.Mokeev, et al., Phys. Rev. **C80**, 045212 (2009).

[5] I.G.Aznauryan, V.D.Burkert, and V.I.Mokeev, arXiv:1108.1125