Recent results on N^* studies in the $\gamma_v p \to \pi^+\pi^- p$ channel.

The determination of $\gamma_v NN^*$ transition helicity amplitudes (electrocouplings) from meson electroproduction data taken at different photon virtualities Q^2 allow us to access the degrees of freedom that are relevant in the nucleon structure at different distance scales. Moreover, these measurements are sensitive to the strong interaction mechanisms that are responsible for the formation of nucleon resonances and for the confinement of quarks in baryons.

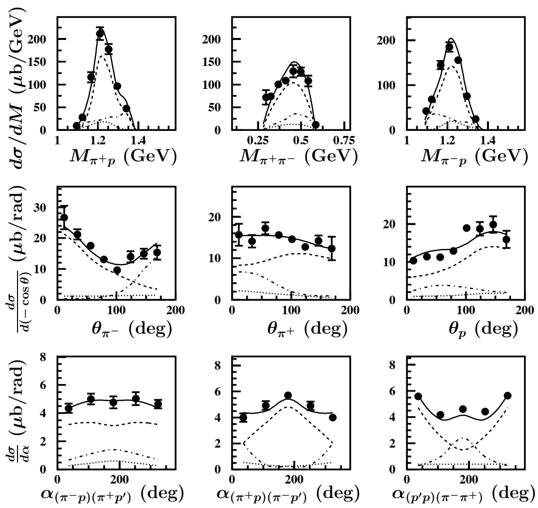

Figure 1: $\pi^+\pi^- p$ differential cross sections at $W = 1.51$ GeV and $Q^2 = 0.425$ GeV^2. The full JM model calculations are shown by the solid lines. The contributions from $\pi^-\Delta^{++}$, $\pi^+\Delta^0$ isobar channels and direct processes are given by the dashed, dotted and dashed-dotted lines, respectively.

The $\gamma_v p \to \pi^+\pi^- p$ exclusive channel is of particular importance, being one of the biggest contributor in N^* excitation region. This year (2009) detailed information on nine independent differential $\pi^+\pi^- p$ electroproduction cross sections were obtained for the first time from the data of E-94-005 CLAS experiment at invariant masses of the final hadronic system W $<$ 1.6 GeV and photon virtualities $0.25 < Q^2 <$ 0.56 GeV^2. Example of the data set is shown in Fig. 1

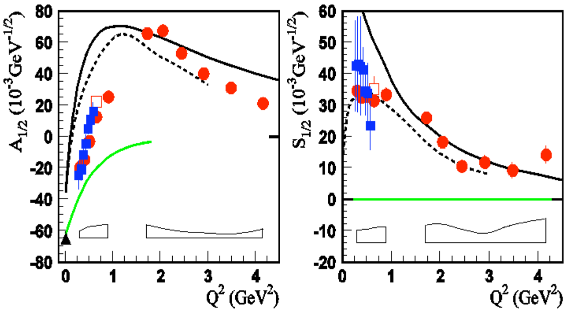

Figure 2: Electrocouplings for $P_{11}(1440)$ state determined from the CLAS data on $N\pi$ electroproduction (red points) and preliminary results from the CLAS data on $\pi^+\pi^- p$ channel (blue points). The lines represents various quark model calculations, showing the data sensitivity to quark model expectations.

These data allowed us to establish all essential contributing mechanisms from their manifestation in observables (Figure 1) within the framework of the JLab-MSU (JM) reaction model. The JM model provides good data description, allowing us to isolate resonant contributions to observables, needed for the evaluation of $\gamma_v NN^*$ electrocouplings. Electrocouplings for the $P_{11}(1440)$ and $D_{13}(1520)$ states were determined, for the first time, from analysis of the $\pi^+\pi^- p$ channel. In Figure 2 we show $P_{11}(1440)$ electrocouplings determined from the $N\pi$ and $\pi^+\pi^- p$ channels. These channel have completely different non-resonant contributions and provide independent information on the extracted resonance electrocouplings. They can thus be used to test the systematics in the extraction of resonance couplings. The consistent results obtained from the analyses of two channels is evidence for the reliable extraction of these fundamental quantities from the meson electroproduction data.