APR18-2018-000248

Abstract for an Invited Paper
for the APR18 Meeting of
the American Physical Society

New Results on the Nucleon Resonance Spectrum and Structure from Photo- and Electroproduction Experiments[1]

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Studies of the excited nucleon (N^*) spectrum and structure offer unique information on many facets of strong QCD dynamics in the generation of resonances of different quantum numbers. Advances in nucleon resonance studies in experiments with electromagnetic probes will be presented. Experimental studies of meson photoproduction off the nucleon at the JLab/CLAS, ELSA, and MAMI facilities have provided detailed information on all exclusive meson photoproduction channels relevant in the resonance region. Analyses of these data have considerably extended our knowledge of the N^* spectrum. Several candidate N^* states were included in the PDG as an outcome of these efforts with critical impact of the strangeness photoproduction data from CLAS. Studies of the N^*-electroexcitation amplitudes ($\gamma_v pN^*$ electrocouplings) at different photon virtualities Q^2 continue their rapid progress, offering insight into $N*$ structure. The CLAS detector at JLab has produced the dominant part of the data on meson electroproduction channels off the nucleon in the resonance region for Q^2 up to 5.0 GeV^2. The $\gamma_v pN^*$ electrocouplings have become available for most N^* states in the mass range up to 1.8 GeV and Q^2 up to 5.0 GeV^2. Physics analyses of these results have revealed the structure of $N*$ states as a complex interplay between an inner core of three dressed quarks and an external meson-baryon cloud. A successful description of the $\Delta(1232)3/2^+$ and N$(1440)1/2^+$ electroexcitation amplitudes starting from the QCD Lagrangian was achieved within the Dyson-Schwinger Equation (DSE) approach with the same momentum dependence of the constituent quark mass, offering sound evidence for the capability of exploring the dynamics of hadron mass generation. Independent analysis of the CLAS data on N^* electroexcitations within the light front quark model has supported the running quark mass concept. Extension of the resonance electroexcitation studies with the CLAS12 detector will make it possible to explore N^* structure at the highest photon virtualities ever achieved, from 5.0 GeV^2 to 12 GeV^2, addressing the most challenging problems on the nature of hadron mass and the emergence of quark-gluon confinement. In addition, the search for hybrid-baryons with glue as an active structural component will be carried out, completing the N^*spectrum exploration.

[1]The Southeastern Universities Research Association (SURA) operates the Thomas Jefferson National Accelerator Facility for the United States Department of Energy under contract DE-AC05-84ER40150.