New Baryon States from Exclusive Meson Photo-/Electroproduction off Proton Data

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Studies of the excited nucleon state (N^*) spectrum offer insight into the strong QCD dynamics underlying baryon generation. In particular, they elucidate the symmetries of the strong interaction relevant for the bound systems of three constituent quarks in the regime of large QCD-running coupling. The full spectrum of nucleon resonances shaped the transition from a deconfined mixture of quarks and gluons to a hadron gas in the few millisecond age of the Universe when the hadron mass was generated dynamically and quark-gluon confinement emerged. These fundamental subjects are addressed in the search for the "missing" baryon states. Many of the nucleon resonances expected from LQCD and quark models based on SU(6)×O(3) spin-flavor-space symmetry have escaped experimental detection.

Experiments with the CLAS detector in Hall B at JLab offer an excellent opportunity in the search for "missing" baryon states from the data on most exclusive meson photo-/electroproduction channels relevant in the N^*-excitation region. In this talk we will present results on the observation of several new nucleon resonances from the global coupled-channel analysis of most exclusive photoproduction data measured at JLab, ELSA, GRAAL, and MAMI, with a major impact from the CLAS results on $K\Lambda$, $K\Sigma$ photoproduction off protons. In addition, the combined studies of $\pi^+\pi^- p$ photo- and electroproduction off proton data from CLAS have revealed the presence of the new $N'(1720)3/2^+$ baryon state. This new state, together with the conventional $N(1720)3/2^+$ resonance, are required in order to describe the $\pi^+\pi^- p$ photo- and electroproduction off proton data with Q^2-independent nucleon resonance masses, and total and partial hadronic decay widths to the $\pi\Delta$ and ρp final states.

Combined studies of the meson photo- and electroproduction off proton data will allow us to complete the exploration of the excited nucleon state spectrum. The future studies of the N^* spectrum with the new CLAS12 detector will be focused on the search for new states of baryon matter, the so-called hybrid baryons, with the glue as an active structural component.[1]

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