Abstract (draft)

This proposal is aimed to extend the experimental program "A Search for Excited Nucleons and Hybrid Baryons at Masses M $\geq$ 1.8 GeV with CLAS12 in Hall B" [1] to the measurement of the exclusive π^+n, π^op, ηp, $K^+\Lambda$, $K^+\Sigma$, and $\pi^+\pi^-p$ electroproduction channels off the proton with the initial electron beam of energies E_{beam} = 6.6 GeV and E_{beam} = 8.8 GeV in a range of photon virtualities Q^2 from 0.05 GeV^2 to 2.0 GeV^2 and at invariant masses of the final hadron system W from thresholds up to 3.0 GeV utilizing the CLAS12 detector system and the Forward Tagger in Hall B. This extension will provide access to the electrocouplings of nucleon resonances excited in the virtual-photon-proton s-channel at still almost unexplored photon virtualities from 0.05 GeV^2 to 0.2 GeV^2. In the Q^2-range from 0.2 GeV^2 to 1.0 GeV^2 we will overlap with the 11-GeV beam energy data and rely on them above 1.0 GeV^2. This proposal enhance substantially our capabilities to:

- search for new baryon states with a glue as a constituent component, so-called hybrid baryons, by extending the measurements towards small photon virtualities with maximal expected magnitudes of the hybrid-baryon electroexcitation amplitudes;

- search for three-quark "missing" resonances at low photon virtualities in electroproduction of different final hadron states with the highest fluxes of virtual photons ever achieved in exclusive meson electroproduction experiments;

- study the structure of prominent nucleon resonances in mass range up to 3 GeV in regime of the biggest meson-baryon cloud contributions and explore the N* longitudinal electroexcitation approaching the photon point.

Exclusive meson-baryon (MB) final states will be measured in the topologies where the scattered electron and one of the two final hadrons were detected, while the four-momentum of the second hadron will be reconstructesd employing energy-momentum conservation. In the KY channels besides the electroproduced K^+ the p from the hyperon decay will be measured. For the final $\pi^+\pi^-p$ state the observables will be obtained from the combination of all possible event topologies where the scattered electron and all final hadrons are detected as well as when only two of three final hadrons are detected while the four-momentum of the third hadron is reconstructed from energy-momentum conservation. Unpolarized

differential cross sections will be obtained for the aforementioned exclusive channels and complemented by differential transverse-transverse and transverse-longitudinal interference cross sections. In KY channels, the angular dependencies of the differential cross sections will be augmented by data on induced and transferred polarization for recoiling hyperon, while for the $\pi^+\pi^- p$ exclusive electroproduction, nine independent one-fold differential cross sections will extracted in each bin of W and Q^2.

From these data the $\gamma_v pN^*$ electrocouplings will be determined employing the analysis tools described in [1, 2] after they will be further developed to reproduce the observables from the CLAS12 at $Q^2 < 0.2$ GeV^2. The results at different Q^2s from different exclusive channels enhance substantially our capability for discovery of new baryon states. Consistent results on resonance masses, $\gamma_v pN^*$ electrocouplings for all exclusive decay channels under study, and Q^2-independent partial hadronic decay widths, all over the covered Q^2-range, will offer convincing evidence for existence of new states. The hybrid baryons will be identified as additional states in the N*-spectrum beyond the regular three-quark states as it was predicted in recent LQCD studies of the baryon spectrum [3] that demonstrated the emergence of hybrid baryons from the QCD-Lagrangian. Since spin-parities of hybrid baryons are expected to be the same as those for regular three-quark states, information on the $\gamma_v pN^*$ electrocoupling evolution with Q^2 becomes critical in the search for hybrid baryons. The distinctively different Q^2-evolution of hybrid-baryon electrocouplings is expected considering the different color-multiplet assignments for the quark-core in a regular versus a hybrid baryon, i.e. a color singlet and octet, respectively. Low photon virtualities offer a preferential regime for the studies of hybrid-baryon electrocouplings. Moreover, this kinematic range corresponds to the biggest contributions from the meson-baryon cloud, allowing us to considerably improve the knowledge on this component, which is relevant for the structure of all N* states studied so far [2] as well as to explore the longitudinal N* electroexcitation as the photon virtuality goes to zero.

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[1] A. D'Angelo *et al.*, "A Search for Excited Nucleons and Hybrid Baryons at Masses M > 1.8 GeV with CLAS12 in Hall B". A Proposal to the CLAS collaboration for Review as part of the Run Group A Science Program.

[2] I.G. Aznauryan *et al.*, Int. J. Mod. Phys. E**22**, 1330015 (2013).

[3] J. J. Dudek and R. G. Edwards, Phys. Rev. D**85**, 054016 (2012).