

Hall B Run Group K: *Quark-Gluon Confinement and Strong QCD*

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This Hall B Run Group comprises three previously approved experiments that are now under Jeopardy. The experiment aims to build datasets in $p\pi^+\pi^-$ and KY exclusive production. Analysis on these preliminary datasets show progress towards achieving the goals of each of the experiments.

Lattice QCD calculations suggest that there is a rich pattern of excited states of mesons and baryons within QCD. In particular, there might exist a multiplet of hybrid states. The energy scale for these hybrid excitations is roughly 1.3 GeV above corresponding S-wave states in both the meson and baryon sectors. In the nucleon sector, the suggestion is that there is a multiplet of states at $J^P = \frac{1}{2}^+, \frac{3}{2}^+$ and $\frac{5}{2}^+$ and energy above 2.1 GeV. There are also suggestions of similar hybrid baryons in the Δ sector. The search for hybrid baryons is very complementary to the search for hybrid and exotic mesons in GlueX and COMPASS and elsewhere. There have been no LQCD calculations to date, though, that provide information on the branching fractions for the decays of hybrid baryons.

The first experiment, E12-16-10 aims to search in the energy range above 2.1 GeV and build a dataset that can be used within partial wave analyses, including data in $p\pi^+\pi^-$ and $K^+\Lambda$. The preliminary analyses look promising even with a small fraction of the possible data that could be completed. It will be through a full collection of a dataset, potentially 10x above available amounts, that progress can be made to answer whether there might exist hybrid baryons.

A powerful way we can probe the internal structure of excited states is via their electromagnetic transition form-factors, and in particular the electrocouplings for decays into γN . The experiment E12-06-010A aims to study nucleon resonances via exclusive KY production. The preliminary analyses look promising. This continues to be a timely experiment to carry out.

The DVCS program is a flagship component of the 12GeV project. The the dispersive re-analysis of the published CLAS 6 data to extract the D -term and the pressure distribution within the nucleon have made a considerable splash. The experiment E12-06-010B will look in DVCS in CLAS12 datasets. Preliminary analyses on new datasets at 6.5 and 7.5 GeV beam energy are promising. Acquiring the full dataset is warranted, and can help to realize the goal of extracting the real and imaginary parts of the amplitudes with a few percent accuracy.