LOI12-15-004: *Search for Hybrid Baryons with CLAS12 in Hall B*

J. Dudek

This letter of intent is motivated by the desire to discover hybrid baryons, those baryons whose internal structure contains an excitation of the gluon field as well as the required quarks. The proposal is to electroproduce them from protons and to detect their decay in a range of final states.

Unlike in the meson sector, hybrid baryons may only have J^P quantum numbers already accessible to conventional baryons, and as such we require an observable which is capable of differentiating between the two possibilities, or which can be used to assess the degree of admixture if the eigenstates turn out to be admixtures.

Unfortunately the current degree of understanding of hybrid baryons within QCD is rather low - to date we have some suggestions from lattice QCD calculations with artificially heavy quark masses that such states are present in the positive parity nucleon and delta spectrum. The determined mass gap from the nucleon, if it remains constant at smaller quark masses, would place the hybrid states within the energy reach of the proposed experiment. Beyond this, there is only limited insight regarding hybrid baryons, coming from models of varying degrees of sophistication, concerning transition form-factors and hadronic decays.

It appears that the experimental program proposed does not require a theoretical understanding to be in place in advance of the data-taking and analysis, and as such the embryonic state of theory should not be held against the effort. The data can be taken and analyzed and the theoretical interpretation may follow subsequently.

There are some odd omissions in the text that should be addressed in any future full proposal: While the $I = 1/2$, $J^P = 1/2^+, 3/2^+$ hybrid baryons are presented as the target of the search, no discussion is given regarding the other predicted hybrid baryons, the $I = 1/2$ state with $J^P = 5/2^+$ and the two $I = 3/2$ states - if they are not accessible in the search, the reader should be presented with a reason why not. Since the extraction of resonance pole information from amplitude analysis is a vital step in the program, more detailed discussion and references should be presented, beyond simply referring to "these advanced tools".