Individual Letter of Intent Report

Letter of Intent: LOI-04-002

Title: Measurement of the Spin and Parity of the Exotic Θ^+ via the Reactions n(γ,K^-K^+n) and n(γ,K^+n)K^- with polarized γ and polarized ^{3}He

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This letter of intent is being developed to study the reactions n(γ,K^-K^+n) and/or n(γ,K^+n)K^- with incident circularly polarized real photons and a polarized effective neutron target, the latter provided by polarized ^{3}He. By measuring the angular distributions involved and the double-polarization asymmetry, the goal of the LOI would be to provide information on the spin-parity of the Θ^+ By the time such a measurement could be scheduled, the spin of the Θ^+ will very likely have been determined, but conversely the parity will very likely be unknown. The latter is very important since a parity determination would exclude half the available models. The ability of such a double-polarization asymmetry to fix the parity will be the focus of scrutiny of a future proposal. At present the ideas behind the experiment are based on relatively unsophisticated modeling and clearly to justify a full proposal it will be necessary to provide better estimates of effects not presently included. In particular, the calculation outlined in this LOI is limited to kaon exchange while preliminary CLAS data suggest that the production of an intermediate N* near 2.4 GeV also plays a role in Θ^+ photo-production. Thus, in addition to the expected elaboration of the technical details inherent in the measurements that is necessary to progress from the present state as a letter of intent to a full proposal, it is very important to have as sophisticated a theoretical basis for the experiment as possible. Lacking the latter, there will always be doubt that competing mechanisms will render the results ambiguous.

As stated above, although originally describing an electro-production experiment, this LOI is proceeding with the idea of using circularly polarized real photons; it would be useful to have some comparison between this approach and one that employs linearly polarized photons, including both theoretical issues and those related to the relative feasibilities of the two approaches.

In summary, the PAC regards the prospect for a Θ^+ parity determination via a double-polarization asymmetry as very interesting and encourages the proposers to continue to develop these ideas further.