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Polarization Observables in the ^{1}H($\vec{e}$,e$'$K$^+$)$\vec{\Lambda}$ Reaction

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This experiment is designed to measure polarization observables in the $\vec{e}p \rightarrow e'K^+\vec{\Lambda}$ reaction at 2.4 and 4.0 GeV using the CLAS spectrometer in Hall B. The large acceptance of CLAS enables us to detect the scattered electron, the kaon, and the Λ-hyperon decay proton over a range of Q^2 from 0.4 to 2.7 (GeV/c)^2 and W from 1.6 to 2.4 GeV. The measured angular correlation of the decay proton will allow for the determination of the Λ polarization. The large acceptance of CLAS enables simultaneous study of the reaction over varying kinematical regions where the different s, t, or u channel processes have varying strengths. By emphasizing specific channel processes we can effectively limit the intermediate baryonic or mesonic resonances involved in the reaction.

This experiment will provide the first ever double-polarization measurements for this elementary electroproduction process. The electroproduction reaction provides insight into the basic reaction mechanism (resonance formation and decay, polarization, and interference effects), and information regarding fundamental hadronic structure information (electromagnetic form factors). Specifically, we will measure the six electron-beam helicity-dependent and helicity-independent Λ polarization components. A subset of these have factors that include the response functions $R_{TT'}$ and $R_{TL'}$, which are in turn sensitive to the Λ magnetic form factor and the $K^+K^{+*}\gamma$ transition form factor. Using the CLAS provides a unique opportunity to probe these response functions well beyond the usual parallel or in-plane kinematics by studying them over a broad range of t and kaon azimuthal angle. This experiment represents a stepping stone to improved kaon electroproduction observables.

In hadrodynamic models, the polarization observables are sensitive to the details of the reaction mechanism; that is, the number of intermediate resonances involved in the reaction, as well as their coupling constants. From the point of view of quark models, the double-polarization observables will shed light on descriptions of strong decays through $q\bar{q}$ pair production and address the ambiguity in the quantum numbers of the created $s\bar{s}$ pair created in the intermediate state. As well, our kinematics span a transition regime where it is expected that the hadrodynamic formalism will begin to give way to a description in terms of quarks and gluons. Newly developed gauge invariant models based on Regge exchanges may provide a convenient formalism over these kinematics as well as above the resonance region.