

## Abstract

Pioneering measurements performed with low duty factor beams have demonstrated that studies with the  $(e, e'\pi^+)$  reaction promise access to much exciting physics. We propose to perform a survey of the  $(e, e'\pi^+)$  reaction versus  $A$  and  $Q^2$  using the high resolution spectrometers in Hall A.

The exchange of pions by nucleons inside the nucleus creates a population of constituent pions. The spectral function of this population can be measured via  $(e, e'\pi)$  using quasi-free kinematics with excitation above the resonance region. Performing a longitudinal-transverse separation helps to distinguish constituent pion knockout from pion creation on the nucleon. A systematic study using Rosenbluth separations will establish the sensitivity of the reaction to the pionic content of the nucleus, and studies of the cross section versus momentum transfer will probe the dependence of any enhancement or suppression of virtual-pion momentum.

Studies at relatively high values of  $Q^2$  can investigate the propagation of pions through the nuclear medium. One of the predictions of pQCD is that, at large momentum transfer, elastic and inelastic final-state interactions of the hadrons in the nuclear medium will be reduced and that they will exhibit “color transparency”. By performing response function separations for several different  $Q^2$  and  $A$ , we aim to obtain data that will allow the extraction of this information in as model-independent way as possible. Measurements at  $z \approx 1$  will greatly simplify the interpretation of any data obtained.

Results are presented to indicate that the  $(e, e'\pi^+)$  reaction is a superior probe for these studies than many other reactions. Furthermore, many of the sources of systematic error common to L/T separations with these other reactions are shown to be much more easily controlled in  $(e, e'\pi^+)$ , making this experiment an excellent choice for the early experimental program of Hall A.