Differential Cross Section and Λ Recoil Polarization Measurements for the $\gamma p \to K^+\Lambda$ Reaction in the *g11a* Dataset

Study of the excited nucleon (N^*) spectrum is a goal at the forefront of modern experimental nuclear physics. By comparing the spectrum of states allowed by QCD to those predicted by effective models, scientists may be able to assess contributions of valence quarks, sea quarks, and gluonic degrees of freedom to nucleon structure. Until recently, the majority of N^* searches were performed using πN scattering data, but the high photon luminosities available at CEBAF have allowed for large-statistics photoproduction datasets. It is possible that N^* states with only weak couplings to πN exist; study of photoproduction reactions with a variety of final states will allow for study of assessment N^* states.

It has been established that polarization information provides a strong constraint on physics models. Due to the parity-violating $\Lambda \to p\pi^-$ decay, the $\gamma p \to K^+\Lambda$ reaction presents a fantastic opportunity for both single- and double-polarization observable measurements.

Prior to this *g11a* measurement, discrepancies in differential cross section ($d\sigma$) measurements from the CLAS and SAPHIR experiments led to ambiguities in partial-wave analyses of the reaction. These new *g11a* results show excellent agreement with the previous CLAS measurements and provide an increase in precision and 300 MeV extension of the observed center-of-mass energy range. The new CLAS results also show agreement with results from the LEPS Collaboration at extreme forward and backward angles.

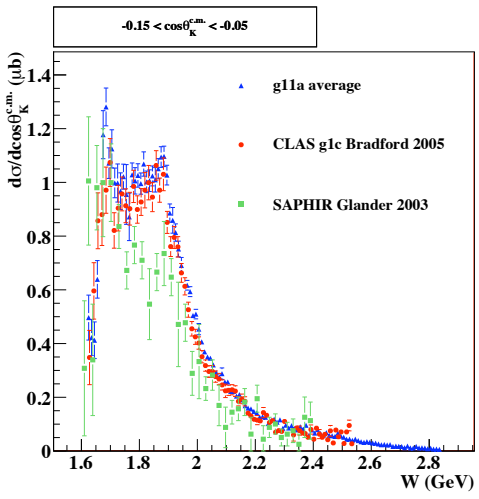

FIG. 1: $d\sigma/d\cos\theta_K^{c.m.}$ (μb) *vs.* W (GeV) results at a fixed production angle. These results are shown in blue, previous CLAS results in red and SAPHIR results in green.

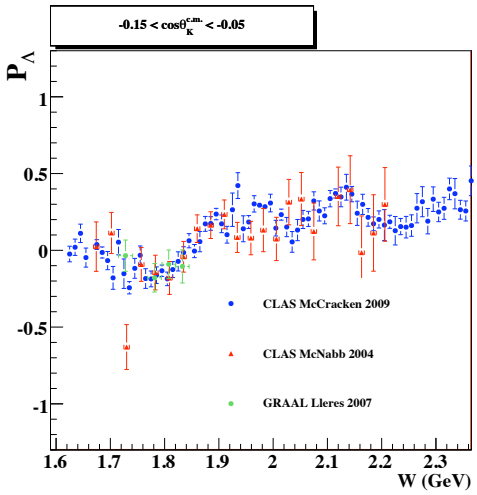

FIG. 2: P_Λ *vs.* W (GeV) results at a fixed production angle. These results are shown in blue, previous CLAS results in red and GRAAL results in green.

This analysis also presents measurements of P_Λ, the polarization of the Λ along the direction normal to the reaction plane. These results show a significant increase in precision and range over world data, indicating a rich structure at backward and intermediate production angles. The data agree well with previous results from the CLAS, SAPHIR, and GRAAL Collaborations.

The increased precision of these $d\sigma$ and P_Λ measurements will add analysis power to studies of $K^+\Lambda$ photoproduction mechanisms. The addition of data at energies outside of the resonance region ($W \gtrsim 2.5$ GeV) at all production angles will allow for independent analyses of resonant (*i.e.*, through N^* states) and non-resonant (t- and u-channel) production mechanisms. With the addition of future polarization data from CLAS and other experiments, a full analysis of $\gamma p \to K^+\Lambda$ helicity amplitudes will be possible.