I would like to thank the support of 2017-2018 JSA Graduate Fellowship on my work for the Polarized $^3$He Target and analysis for the experiment E97110. The fellowship gave me the environment and financial resources to continue my research project.

1 Accomplishments:

For the 12 GeV program, the polarized $^3$He Target is being upgraded to satisfy new experimental requirements. One of my main task is to develop the Pulse NMR (nuclear magnetic resonance) system and calibrate Pulse NMR with NMR. A reasonable results was achieved with PNMR at transfer tube and NMR at target chamber using oscilloscope. A better signal-to-noise ratio is under study using a Lock-in amplifier and a fast DAQ card. Besides, I worked on the installation for new experiment. Right now, I’m passing my knowledge to new student and helping get the target ready for the experiment.

My other main research project is related to the JLab Hall A E97110 small angle GDH experiment. Its goal is to perform a precise measurement of the $Q^2$-dependence of the extended GDH integral and of the moments of the neutrons and $^3$He spin structure functions at low $Q^2$. The measured data will allow us to test predictions of chiral perturbation theory and the extrapolation to the real photon point ($Q^2=0$) will test the GDH sum rule on the neutron. In order to reach small scattering angle necessary for the low $Q^2$ range, a new septum magnet was installed in Hall A for this experiment. Unfortunately, the magnet was initially defective due to mis-wiring. There are two periods for this experiment, the first period had the magnet mis-wire problem, while in the second period, the magnet had been fixed and was properly working.
I have been analyzing the first period data. This year, I have completed the spectrometer optics. Elastic carbon cross sections were obtained and the agreement is within 10% with world data. Further more, the optic was tested with extended target, a good agreement was achieved with elastic $^3$He cross section and nitrogen for all energy settings. For the first time, inelastic cross sections, asymmetries, and cross section differences are obtained for first period experimental data. The result agrees well with second period where we have the overlap region. This region is one of the place where we can test how good is the optic and the method to extract cross section. In the future, I will extract the GDH sum at the lowest, and the most important data point of the experiment.

2 Talk

- “Experimental study of the $^3$He and neutron spin structure at low $Q^2$ using a polarized $^3$He target”, The 9th International Workshop on Chiral Dynamics, Duke University, Durham, North Carolina, September 2018.