I would like to thank the support of 2016-2017 JSA Graduate Fellowship on my work for the Polarized $^3$He Target and analysis for the experiment E97110.

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. Studying noise of the system and getting systematic uncertainty are challenging. I improved the signal by optimized the fitting procedure and by building a better coil. I conducted a large number of tests to measure the polarization in the target chamber. The results agree well with the regular NMR method. A reasonable results also achieved with PNMR at transfer tube and NMR at target chamber. Further improvement of the signal-to-noise ratio can be obtained using a Lock-in amplifier and a fast DAQ card. The setup is done and it is under study to optimize the system. Besides, I’m working on target installation for new experiment. I will do test on the new setup and get the target ready for 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. I have completed the studies of the normalization and raw asymmetry from the scalers from the first period. I am now testing the spectrometer optic. Several methods are tried to get elastic carbon cross sections. Elastic carbon cross sections are achieved within 10% agreement between experimental data and simulation by using reconstructed target quantities for three momentum settings and two beam energies. In the future, I will extract elastic $^3$He cross sections and asymmetries.

2 Talks

- “Experimental study of the $^3$He and neutron spin structure at low $Q^2$ using a polarized $^3$He target”, Gordon Research Conferences, New Hampshire, August 2016.


- “Experimental study of the $^3$He and neutron spin structure at low $Q^2$ using a polarized $^3$He target”, 2016 SESAPS Conference, Charlottesville, Virginia, November 2016.