I would like to thank JSA/JLab Graduate Fellowship Program Committee for awarding me this fellowship. During the year 2014-2015, I worked on the polarized $^3He$ target and the Hall A E08-027 $g_2^p$ experiment at JLab.

1 JLab 12 GeV Polarized $^3He$ Target

For the 12 GeV program at JLab, there are seven polarized $^3He$ target experiments approved and a plan was developed to upgrade the polarized $^3He$ target to meet the requirements. The first stage aims to have a 40 cm long, 10 amg target with 30 $\mu$A electron beam current and reach an in-beam target polarization of 60%, a factor of 2–3 improvement in the figure of merit. In addition, the precision of polarization measurement will be improved from 5% to 3%. I have been the main student on this project for four years. Significant contributions have been made to optimize the target system and reduce the design labor, such as the new heater tape based convection system and radiation shielding for pumping chamber. The new $^3He$ convection cell system and pulsed-NMR system were setup for the first time at JLab from scratch. Initial tests of the convection cell and the pulsed-NMR system have been done and proven successful. During this year, I also spent much time help training two new graduate students who will work on the $^3He$ target for the incoming $A_1^n$ experiment. One poster about polarized $^3He$ target progress was presented in the Gordon Research Conference 2014 - Photonuclear Reactions in Holderness, NH.

2 JLab E08-027 $g_2^p$ Experiment

JLab has been at the forefront of a program to measure the spin-dependent structure functions $g_1^n$, $g_1^p$, $g_2^n$ and their moments over a wide kinematic ranges. But $g_2^p$ data is absent at low
and moderate $Q^2$. The JLab Hall A E08-027 $g_2$ experiment aims to perform a high precision measurement of the proton structure function $g_2$ in the low $Q^2$ region ($0.02 < Q^2 < 0.2 \text{ GeV}^2$) for the first time. The measured data will provide an unambiguous benchmark test of chiral perturbation theory (χPT) calculations and examine the Burkhardt-Cottingham sum rule at low $Q^2$. The experimental data was taken in 2012. Significant contributions have been made to the data analysis, such as the new method to study VDC multi-track efficiency, which was already applied for previous small angle GDH and Coulomn sum rule experiments. During this year, I worked on the target packing fraction, the volume ratio of liquid He to ammonia in the target cell. A new Monte-carlo simulation program was setup to study the acceptance, yields and packing fraction, which can also be used for future experiments. The preliminary physics asymmetry and cross section results of this experiment is expected to be extracted out in the following year. With the support of fellowship travel grant, I also presented the JLab future spin experiments $A_1^n$ and $d_2^n$ during the 7th Hadron Physics Workshop in Duke Kunshan University in 2015.

3 Talks and Posters

- "$A_1^n$ and $d_2^n$ Measurements with JLab 12 GeV", The 7th Workshop on Hadron Physics in China and Opportunities Worldwide, Duke Kunshan University, China, August 3-7 2015.