

Paul Mattione
Rice University

2008 – 2009 Jefferson Science Associates Graduate Student Fellowship Award Report

The 2008 – 2009 JSA Graduate Student Fellowship Award supported my physics research at Jefferson Lab. It enabled me to travel to a physics conference to learn more about my field of research and to interact with other physicists from around the world. With the help of the JSA fellowship I'm on track to finish my Rice University PhD thesis, $K^{*0}(892)\Lambda$ & $K^+\Sigma^-(1385)$ Photoproduction on the Deuteron, in the summer of 2010.

My research focuses on the measurement of the spectrum of excited nucleons and their decays, an important part of the effort to understand the structure of the nucleon. Coupled-channel analyses of pion, eta, and kaon production reactions are capable of extracting more information on the excited hadron resonances than simply using a partial-wave analysis of each of the reactions individually. However, these analyses are currently limited due to the missing polarization observables and cross-sections in many of these reactions. More physics data will result in improved quark model predictions of the large mass N^* states, where wide resonances and insufficient data make it difficult to differentiate the states from the background.

In this vein, the CLAS g13 experiment at Jefferson Lab collected 50 billion events on deuterium using circularly and linearly polarized photon beams. It's predicted that the s-channel production of the $\gamma n \rightarrow K^{*0}(892)\Lambda$ and $\gamma n \rightarrow K^+\Sigma^-(1385)$ reactions will couple non-negligibly to the decays of several of the excited N^* states. These include the $N^*(1945)$, $N^*(2070)$, and $N^*(2090)$ for $K(892)^*0\Lambda$ production, and the $N^*(1980)$ and $N^*(2095)$ for $K^+\Sigma^-(1385)$ production.

With the support of the JSA fellowship I was able to make a lot of progress on my research, as well as perform service work for the CLAS collaboration. I have assisted the CLAS collaboration by taking shifts at the detector, being the on-call time-of-flight expert for the detector, and by performing electromagnetic calorimeter calibrations of the g13 data. Over the last year I was able to finalize the procedure of my analysis, and have recently obtained the yields of the $\gamma D \rightarrow K^{*0}(892)\Lambda(p)$ and $\gamma D \rightarrow K^+\Sigma^-(1385)(p)$ reactions in the CLAS g13a data. Over the course of the next several months, I will compute the cross-sections of these reactions, and plan to publish the data in physics journals.

In the meantime, I have presented my progress on my research at the CLAS Collaboration meetings in June and November of 2009. I have also presented my research to the international community in November at Hadron 2009 in Tallahassee, Florida, and will do so again at the April 2010 APS meeting in Washington D.C. In these presentations, I have detailed the theory and motivation for studying the $\gamma n \rightarrow K^{*0}(892)\Lambda$ and $\gamma n \rightarrow K^+\Sigma^-(1385)$ reactions, the CLAS detector and the g13 experiment, the analysis procedure, and the resulting data yields.

I used some of the travel money awarded to me from the fellowship to travel to the 2008 Gordon Research Conference on Nuclear Physics in Tipton, NH. At the conference, I was able to see many experts from around the world present and discuss various topics in nuclear physics. By attending, not only was I able to learn more about the measurement of the N^* states, but I became exposed to other topics in nuclear physics that I was unfamiliar with. The conference expanded the horizons of my understanding of nuclear physics, and I am fortunate that I was able to go.

I also used the travel money to attend a workshop at Jefferson Lab, Electromagnetic $N-N^*$ Transition Form Factors, in October 2008. At the workshop I was able to learn from JLab experts about how the nuclear excitations were parameterized, and how one could measure them to learn more about the structure of the nucleons. Finally, I used some travel money to go back to Rice University for administrative purposes, namely to find a new advisor after Gordon Mutchler passed away.

With the 2008 – 2009 JSA Graduate Student Fellowship Award I was able to do a lot of work, both for my research and for the CLAS collaboration. I was able to attend the 2008 Gordon Research Conference on Nuclear Physics as well as the Electromagnetic $N-N^*$ Transition Form Factors Workshop and learned a lot more about my field of study. I have presented my work at several conferences so far, and plan on finishing my PhD thesis, $K^{*0}(892)\Lambda$ & $K^+\Sigma^-(1385)$ Photoproduction on the Deuteron, at Rice University in the summer of 2010. I appreciate the opportunities that the JSA fellowship award granted, and I have tried to make the most of them.