# Neutron Spin Structure in the Resonance Region and Quark-Hadron Duality

Thesis Progress Report
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Thomas Jefferson National Accelerator Facility experiment E01-012 ran in January-February 2003. The goal of this experiment is to investigate the phenomenom of quark-hadron duality on $^3$He and the neutron. Duality was first observed in the 70's by Bloom and Gilman who realized that the nucleon resonances average to the high $Q^2$ scaling curve when an appropriate scaling variable is used. Bloom-Gilman duality has been recently experimentally confirmed in the unpolarized case and some new results are coming out now on the spin dependent structure function for the proton and the deuteron. Data from Jefferson Lab experiment E01-012 will provide the first precision measurement of the spin dependent structure function for $^3$He and the neutron in the resonance region in the range $1.0 \leq Q^2 \leq 4.0$ (GeV/c)$^2$. Recently theoretical interpretations have been developped but the lack of polarized data so far has limited theorists to test their predictions (for more details, see my proceedings in attachment).

E01-012 was an inclusive experiment utilizing longitudinally polarized electrons on longitudinally or transversely polarized $^3$He target. The two almost identical high resolution spectrometers (HRS) in Hall A were used in a symmetric configuration in order to double our statistics and check our systematic errors. I have performed a careful particle identification (PID) analysis in order to discriminate between good electrons and backgrounds (mostly pions) and estimate the efficiencies of the detectors (for more details, see the analysis notes listed in my C.V.).

Thus, asymmetries and cross sections differences can be formed in order to extract the polarized structure function $g_1$ and the virtual photon asymmetry $A_1$. I have presented preliminary results of $A_1^{^3\mathrm{He}}$ and $A_2^{^3\mathrm{He}}$ at the GDH 2004 Symposium. These results include the corrections for data acquisition deadtime, beam charge asymmetry, target and beam polarizations and nitrogen dilution. Only radiative corrections still have to be addressed. Neutron quantities can then be extracted from the measured $^3$He data. Recently, I generated the unpolarized cross sections for all kinematics. The agreement between both spectrometers cross sections is at a 5% level, which should decrease after a careful review of all inputs.

In summary, the analysis is well underway and I expect to graduate in August 2005.