Abstract

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My work during the SULI project was doing two different projects for neutrino cross sections. Neutrinos are neutral low interactive particles. A neutrino cross section is the measurement of probability of the interaction of a neutrino with the target. Understanding neutrinos is important for the DOE because it can help us understand the matter-antimatter asymmetry. Understanding why this happened could give us the knowledge necessary to understand the early universe. To do this, neutrinos are studied in different experiments at Fermilab. For my internship I worked on two experiments: the Modern Modular Bubble Chamber (MMBC) and NuMI Off-Axis νe Appearance (NOvA) experiments. The MMBC looks to obtain better measurements of the hydrogen neutrino cross section to help with the data collection and analysis of future experiments. For the MMBC I worked on building a muon detector called “Cosmic Watch”. The Cosmic Watch detects muons by using a plastic scintillator. When cosmic rays reach the Earth’s atmosphere they collide with particles, creating different particles that “shower” down to the surface. One of these particles is the muon, which reaches the surface of the Earth where it interacts with the Cosmic Watch. The muon enters the plastic scintillator and excites electrons in the material of the scintillator. These electrons quickly go back to a de-excited state by releasing a photon. The photon is then detected by a silicon photomultiplier (SiPM). For the NOvA experiment I worked on data analysis for simulations. I compared different simulation configurations to better understand neutrino cross sections. Both of these projects helped me learn new skills. With the Cosmic Watch I learned how to solder circuit boards and with the simulation analysis I learned to code using C++. The most valuable skill I learned was problem solving while working on these different projects.