



Intensity Frontier Fellowship: Beamline Monitors for LBNF
Alysia Marino

My Intensity Frontier Fellowship centered on research and development of beamline monitors for the proposed Deep Underground Neutrino Experiment (DUNE). DUNE will rely on a new intense neutrino beam at Fermilab as part of the Long Baseline Neutrino Facility (LBNF). Precise measurements of the neutrino oscillation parameters will require very precise knowledge of the fluxes of neutrinos produced in LBNF. In situ detectors to verify the flux behavior provide a valuable validation of the beam flux. This project focused on muon detectors. Muons are produced inside the decay pipe from the same pion decays that produce the muon neutrinos, and therefore are correlated with the neutrino flux. Measurements of the muons exiting the absorber would be used to monitor the beam profile and stability, and a determination of the absolute flux and energy spectrum of these muons would place a constraint on the absolute neutrino flux at energies above 3 GeV that is independent of the uncertainties on neutrino interaction cross sections.

Two prototype systems for LBNF, one using a variable-pressure gas Cherenkov detector and the other using solid state detectors are currently deployed in the muon alcoves of the NuMI neutrino beamline. Since start of my time Fermilab during my intensity frontier fellowship, I have taken over the maintenance, operation, and calibration of the detectors. I restarted the data taking and produced detailed documents on their operation. The time that I spent at Fermilab with this fellowship were critical for this effort. For the Gas Cherenkov detector, I took data scans at many different pressures with the beam operating in both neutrino-mode and anti-neutrino mode. The analysis of this data is in progress and has resulted in two undergraduate honors theses. We hope to publish the measured muon distribution in the future. For the solid state detectors, I had many useful conversations with Fermilab

scientists and staff, and since my return from Fermilab we have developed additional solid state prototype detectors that will be deployed at Fermilab very soon. During my fellowship, I also served as the Project Manager for the muon systems for LBNF.