

Neutrino energy reconstruction is one of the largest sources of systematic uncertainty in modern neutrino oscillation experiments. The energy of a neutrino event can be mis-estimated if particles interact inelastically or are unable to be reconstructed because of scattering in the detector medium. This is referred to as Secondary Interactions (SI) of particles. These processes will be a significant problem for the future DUNE experiment, and must be studied.

Until recently, data for pion-argon scattering had existed only below pion kinetic energy of 240 MeV, and thus there is little understanding of pion-argon SI at energies relevant to DUNE. The recent Liquid Argon in a Testbeam (LArIAT) experiment has provided pion-Argon scattering data up to 1.2 GeV, and my upcoming measurement on DUNE's prototype detector, ProtoDUNE, will provide data at even higher energies. I will use this data to constrain SI models used in DUNE's experimental simulations.

Geant4 is used to simulate particles as they travel through a detector, and will be used by DUNE to simulate SI. It currently does not support the ability to quantify its SI model uncertainties by comparing to pion scattering data. My first goal for this research is to implement this ability into Geant4. I will then use this to compare to the recent LArIAT data. This work will be informed by previous work conducted by the T2K experiment, and will allow the data from ProtoDUNE to be used similarly in the future.