

This project covers research in three directions. The first is the measurement of neutral pion production in MINERvA. I will work with my students and postdoc, present at Fermilab, to complete the first paper on semi-inclusive neutral pion production in the Medium Energy neutrino beam and to expand this into measurements of semi-exclusive and exclusive neutral pion/proton production sensitive to the delta resonance and neutrino Deeply Virtual Meson Production. The second direction is to develop the application of Neural Networks for particle ID/reconstruction. We are investigating the approach of semantic segmentation where not only is the presence of the particle in the event determined but which individual hits contributed to that particle. This will aid in the reconstruction of the particle properties (direction and energy). The third is to do a detailed study of the effects that `non-classical' neutrino trajectories might have on the proposed measurement of the CP violating phase in DUNE. These are trajectories where the neutrino does not travel in the most direct path between production and detection. While intuition suggests that the contribution by these exotic trajectories will be small, their impact should be studied to insure the success of DUNE.