DAQ Developments to Enable the Study of Non-beam Physics in MicroBooNE and LBNF

My interest in neutrino physics stems from its potential to explore phenomena beyond the standard model (SM). The large size of detectors in neutrino experiments allows sensitivity to astrophysics and exotic searches, such as neutrinos from supernova collapses, dark matter, and proton decay. Among all the neutrino detectors, the newly developed technology of liquid argon time projection chambers (LAr TPC) has unique capabilities in energy resolution, particle identification, and detection in the low-energy regime. These considerations lead me to join the SLAC group in both the MicroBooNE and LBNF collaborations, where I could pursue these explorations and contribute to the development of the next generation of these detectors.

I am particularly interested in measurements of neutrinos from supernovae and in searches for dark matter. The neutrinos from supernovae are uniquely suited to probe detailed features of supernova core collapses, and can be exploited to further constrain physics beyond the SM. In addition, the characterization of dark matter is recognized as a pressing question in fundamental physics. Since the MicroBooNE detector will be the largest LAr TPC in the U.S. in the next several years, it will provide us with the best chance to study the sensitivity of supernova neutrinos, and will be sensitive to signals from boosted dark matter. To pursue these studies, it is crucial to have continuous data acquisition (DAQ), reconstruction algorithms optimized to low-energy particles, and thorough studies on background events.

I am currently in charge of commissioning the supernova mode of the DAQ system in the MicroBooNE experiment, which continuously writes data to files on the disks of each sub-event PC, and sends data to tape only upon the arrival of a supernova early warning alert (SNEWS). Moreover, since the amount of data from the continuous stream ($\sim$ 50 MB/second per crate) is much greater than the capability of our data handling system, we need to apply a zero-suppression algorithm to reduce the data size.

The SLAC group is responsible for key components of the 35-ton prototype detector at LBNF that perform the detector readout and zero-suppression. In addition to my DAQ responsibility at MicroBooNE, I will devote about 25% of my time to this task. I would like to serve as a local expert at Fermilab, in particular during the commissioning period in spring.

As a follow-up of the supernova mode of the DAQ system and a preparation of the sensitivity analysis for low-energy neutrinos from supernovae, I plan to work on the reconstruction of low-energy particles, exploring the threshold of the LAr TPC. In the meanwhile, I have recently taken over the responsibility for the sensitivity analysis of supernova neutrinos, to be delivered in the next months. This analysis will rely on the detector performance in the low-energy regime and on the understanding of background. In addition, as I am presently co-convener of the MicroBooNE Monte Carlo (MC) production team, I will continue my management of MC production.