Neutron running with a liquid argon TPC to study ν-Ar final state interactions and cosmogenic backgrounds important for LBNE

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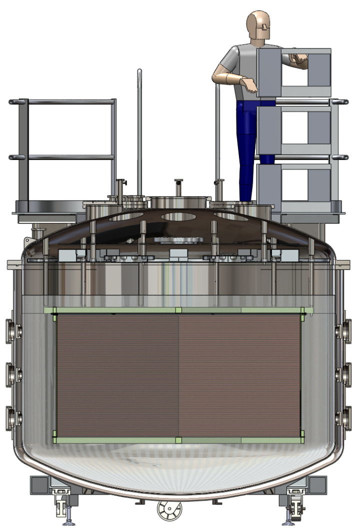
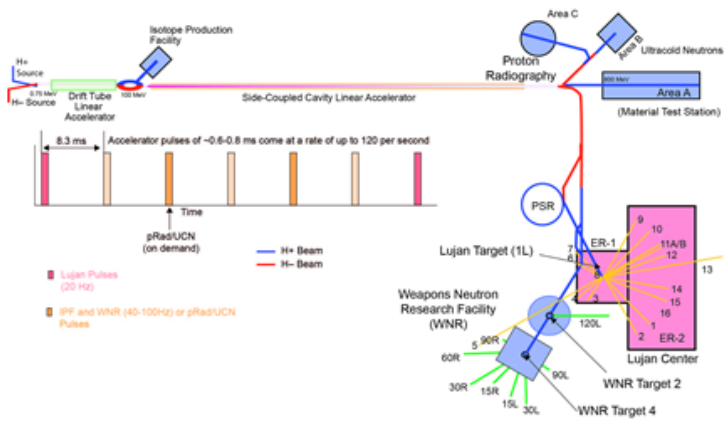
The Long-Baseline Neutrino Experiment (LBNE) is being planned for Fermilab and a far detector location in South Dakota. The far detector will be a 10 kiloton fiducial mass liquid argon time-projection chamber (TPC).

As part of the effort to develop the project, a five ton fiducial mass liquid argon TPC is being built at LANL using internal laboratory funds (see figure). The chamber consists of three active wire planes





with 3mm pitch and 3mm wire spacing. The detector volume is a hexagonal prism with a 1 meter height and 1 meter apothem. The hexagonal prism is oriented with the hexagon in the horizontal plane. The electric field is oriented in the vertical direction with the electron drift upwards. The readout is done with cold electronics developed for LBNE and MicroBooNE.

At the Los Alamos Neutron Science Center (LANSCE) (see figure), a well-characterized neutron beam with an endpoint kinetic energy of 600 MeV is available. Using time of flight, interactions at specific energies up to this endpoint are measured. We propose to locate the LANL TPC in this beam with appropriate shielding to conduct several studies important for LBNE. Initially, we would run in a low-intensity mode.

In LBNE, due to significant kinematic differences between neutrino and anti-neutrino CC interactions, the resolution of (anti)neutrino energy reconstruction is different and not well constrained. This generates a CP asymmetry even in the absence of leptonic CP violation. Constraining any source of CP asymmetry is critical for LBNE's search for leptonic CP violation. As argon has 40 nucleons, interactions in the few GeV neutrino energy regime can liberate several nucleons. We will measure neutron interactions in the detector to develop methodologies to constrain the energy carried away by neutrons in neutrino interactions. Also, if LBNE is run on the surface, neutrons could mimic electron neutrino signals. We will search for and characterize such events. Finally, we will use the data to understand high-energy spallation processes.

We will run in a second, high-intensity mode. The purpose here is to study spallation produced nuclei that will constitute background to a burst supernova signal. The data will also be used to benchmark simulations that predict the total spallation background as a function of overburden.