Installing LArSoft: A Neutrino Simulation Network Establishment

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Abstract:

The next generation of neutrino oscillation measurements will come from the Long-Baseline Neutrino Experiment (LBNE) in 2022, and requires simulations of the neutrino interactions using Liquid Argon Software (LArSoft) prior to construction. LArSoft is written in C++ and uses Root for liquid argon experiments at Fermilab.
As an initial step of involvement for the department, I established a copy of LArSoft on a local server, which required knowledge of Root files and proficiency at coding in a bash in Linux.
With the local copy of LArSoft installed, future students have the tools necessary to run simulations of neutrino interactions in a liquid argon time projection chamber (LArTPC).

LArSoft:

• Is a Root based software developed in C++ for liquid argon detectors at Fermilab.
• The repository of programs contains simulation and reconstruction algorithms for LAr TPC detectors.
• It is an on-going collaborative programming effort involving researchers working on: LBNE, ArgoNeuT, MicroBooNE, and other detector development projects.

Installation Process:

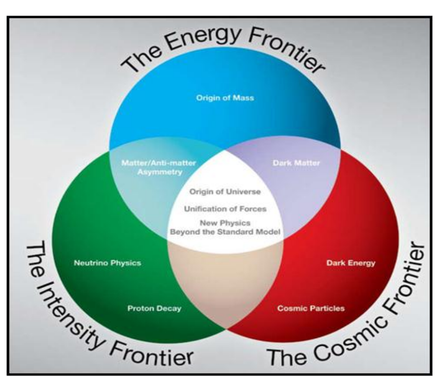
•Installed external packages such as the ART framework and tar files
• Built from source since we are not running on Fermilinux
• Created a setup script for the local environment
• Sourced the setup script to setup the base release
• Compiled packages and installed updates

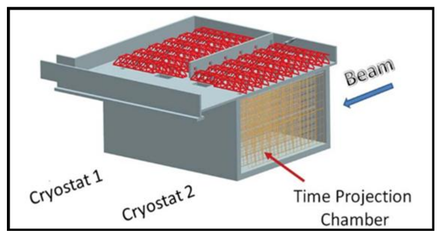
Data Analysis:

• LArSoft is used to analyze data from the LBNE detector
• The detector isn't built yet, so we use Monte Carlo/ simulated data
• Simulating data allows predictions to be made before the billion dollar experiment is built

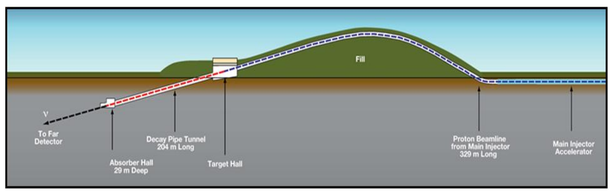
LBNE:

LBNE will send a high intensity beam of neutrinos (~ 10^{16}/second) nearly 800 miles underground from Illinois to the far detector in South Dakota.
Interactions between neutrinos and matter is very rare, therefore no tunnel is needed. The vast majority of the neutrinos will pass right through the Earth, and the 10-kiloton (22 million lbs) detector. Therefore, the experiment will need to continuously collect data for many years to measure a substantial amount of interactions.

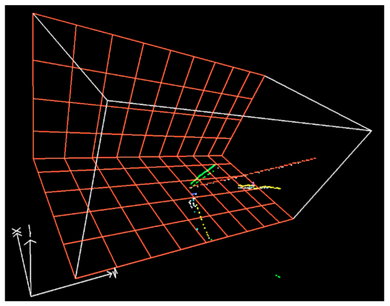




A schematic of the cryostat that make up a 10-kiloton Liquid Argon Far Detector to be located on the surface at the Sanford Underground Research Facility (SURF) in Lead, SD. This is the latest conceptual design for the time projection chamber detector.



The muon neutrinos propagate at nearly the speed of light, thus they will need to travel a rather long distance to oscillate into electron or tau neutrinos, that is why it is necessary to have the detector so fat away.



Example 3-D image of an interaction event, using simulated Monte Carlo data in LArSoft. The purpose is to trace the path of interacting neutrinos.

Acknowledgements:

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