The CAPTAIN Program
3QFY14 Progress Report

The Cryogenic Apparatus for Precision Tests of Argon Interactions with Neutrinos (CAPTAIN) program is designed to make scientific and technical measurements that support the development of the Long-Baseline Neutrino Experiment. Key physics measurements are neutron interactions with liquid argon, low-energy (10-50 MeV) neutrino measurements and medium-energy (500 MeV - 8 GeV) neutrino measurements. An important technical development is a laser calibration system for liquid argon time-projection chambers. The CAPTAIN detector is a liquid argon TPC with 5 instrumented tons of argon.

During the Third Quarter, the team carried out a liquid nitrogen system-test. This allowed us to test the noise characteristics of the whole electronics chain for Mini-CAPTAIN.

Figure 1: Chuck Taylor, Jason Medina and Richard Van de Water, pose in front of the mounted Mini-CAPTAIN TPC before it is lowered into the cryostat.

Figure 2: the CAPTAIN prototype detector is filled with liquid nitrogen.

Liquid nitrogen was pumped directly into the cryostat from a nitrogen supply truck. The cryostat was ``open" in the sense that nitrogen gas was allowed to boil off to the atmosphere (the large yellow elephant trunk in Figure 2). With this configuration, the cryostat was filled to the 1000 liter level in about one hour. After several days of careful level measurements, the heat load was calculated to be about 250 Watts.

The electronics were tested via oscilloscope and through the data acquisition system - demonstrating a completely functional chain. Initial noise tests on the instrumented channels were encouraging. About 20% of the channels were fully instrumented.

The physics running plans for CAPTAIN continued to evolve. The plan is to begin with neutron running at the WNR facility at the Los Alamos Neutron Science Center with the prototype detector. Subsequent running at WNR with the full CAPTAIN detector will depend on the outcome of the measurements with Mini-CAPTAIN. The full CAPTAIN detector will be subsequently deployed at Fermi National Accelerator Laboratory (FNAL). The CAPTAIN collaboration is exploring off-axis positions close to the target and close to the absorber of the Booster Neutrino Beamline at FNAL. There has been continued scientific development with the Minerva collaboration to take advantage of a coordinated running program with CAPTAIN deployed in an on-axis position in the NuMI beamline at FNAL.

Delivery of the CAPTAIN cryostat did not happen in Quarter 3; however, progress continues at the vendor. After a cold shock of the cryostat, an extensive leak-checking program is underway. Due to the size of the cryostat and number of penetrations, helium leak-checking is time-consuming. Progress has been made and

delivery is expected in Quarter 4. Figure 3 shows the cryostat being cold-shocked at the vendor.

Figure 3: Photo from June, 2014, of the CAPTAIN cryostat on the floor at the vendor being cold shocked with nitrogen.