Cryogenic Apparatus for Precision Tests of Argon Interactions with Neutrinos (CAPTAIN)

- The CAPTAIN experiment began as part of a Los Alamos National Laboratory (LANL) Laboratory Directed Research and Development (LDRD) project and has evolved into a multi-institutional collaboration.
- Study interactions in liquid argon with neutron sources and neutrino sources for neutron reconstruction and low energy supernova neutrino identification in liquid argon TPC.
- Two Liquid Argon Time Projection Chambers (ArTPC) detectors: CAPTAIN and Mini-CAPTAIN.

The CAPTAIN detector
- 7700 L cryostat
- 1 m drift
- 5-ton fiducial mass
- 500 V/cm drift field
- 3-mm wire spacing
- MicroBooNE electronics
- Photon detection system PDS (Ar scintillation)
- Laser Calibration System (LCS) (tracks)
- Purity System (Ar purity)

Mini-CAPTAIN Commissioned and Run for Neutron Measurements

The Mini-CAPTAIN detector
- TPC has 1000 wires (3 planes) and a max. drift length of 32 cm (1 m diameter)
- 16-1” PMTs facing the TPC volume
- Purity monitor attached to the side of the TPC

Mini-CAPTAIN in WNR

Neutron Studies at the Weapon Neutron Research Facility (WNR), Los Alamos

- Study neutron interaction signature for high energy neutrons for DUNE.
- Study low energy nAr→nAr interaction for NC from supernovae neutrinos.
- Mini-CAPTAIN has been run in the WNR neutron beam at Los Alamos Neutron Science Center (LANSCE).
- WNR provides a high flux neutron beam with a broad energy spectrum.
- Neutron energy is determined by time of flight.

Simulated ratio of visible to true energy for muon neutrinos and anti neutrinos in LArTPC. Missing energy is caused by neutrons (from Clark McGrew).

Mini-CAPTAIN Data

- Engineering runs in 2015 and first physics run in 2016.
- First laser and neutron data has been collected and under analyzing.
- Planning 2nd neutron running in WNR in summer, 2017.

The CAPTAIN Detector

- Will study low energy neutrinos for DUNE supernova physics program: $E_{\nu} < 100$ MeV, never done before.
- Considering low energy neutrino sources at SNS, LANL or JPARC.

Status:
- Cryostat in hand, pressure tested
- All electronics are in hand and tested
- LAr recirculation system in hand
- TPC wiring ongoing
- Motorized laser controls OK