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CAPTAIN: Current Neutron and Future Stopped Pion Neutrino Measurements

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All neutrino oscillation experiments face the problem of reconstructing the incoming neutrino energy using only the visible interaction products. Unfortunately, the initial neutrino interaction is not well understood, and some of the interaction products not are visible. In preparation for the analysis of neutrino oscillation data collected using liquid argon time projection chambers, the Cryogenic Apparatus for Precision Tests of Argon Interactions with Neutrinos (CAPTAIN) program makes crucial measurements addressing these problems in two distinct phases. The first uses Mini-CAPTAIN to measure the cross section of neutrons impinging on an argon target with a kinetic energy of more than 50 MeV. This measurement will help determine the signature of neutrino generated neutrons in a LArTPC. Mini-CAPTAIN, a LArTPC with 400 kg of instrumented mass, is currently deployed in a neutron beamline at the Los Alamos Neutron Science Center (LANSCE) at Los Alamos National Laboratory (LANL). The LANSCE beam provides a well-known flux of neutrons up to a kinetic energy of 800 MeV. The total cross section will be measured as a function of neutron kinetic energy, and partial cross sections for n + Ar $\longrightarrow$ p + X and n + Ar $\longrightarrow$ $\pi^{\pm}$ + X will be measured above the threshold for the produced protons and pions. I will report results from a February 2016 engineering run during which Mini-CAPTAIN collected neutron data with a photon-detection system, discuss the upcoming neutron run and their implications for the long-baseline oscillation analysis at DUNE. Finally, I will discuss a future deployment of CAPTAIN, a LArTPC with 5 tons of instrumented mass, at a stopped-pion neutrino source and the implications of the measurements for the future DUNE supernova physics program.

Primary author: Dr DOKANIA, Neha (Stony Brook University)

Presenter: Dr DOKANIA, Neha (Stony Brook University)

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