

Key Studies for the ArgonCube 2x2 Demonstrator

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Overview

This document collects a rough list of the high-priority studies we would like to complete during the ArgonCube 2x2 Demonstrator / ProtoDUNE-ND program.

Phase 1:

Test Description:

Module 0 operation in single-module cryostat with mostly dummy pixel anodes

Studies:

Cryogenics/Purification:

Purity, Pressure management, Liquid level stability

→ Note: although not in the 2x2 cryostat, these results are still relevant for system design.

Drift Field:

HV stability, Field uniformity and stability?

Light Readout:

Signal/Noise level, SPE gain, Rates vs. threshold, Cross-talk?, Stability

Basic cosmic study (trigger rates, SiPM multiplicities, total charge distribution, PE/MIP)

Charge Readout:

Noise level, Self-trigger optimization, Gain and linearity, Pixel hit rates vs. threshold,

Cross-talk, Stability

Phase 2:

Test Description:

Module 0 operation in single-module cryostat with complete pixel anodes

Studies:

Repeat Phase 1 studies, as needed

Drift Field:

Field uniformity/mapping

Light Readout:

Light-charge signal correlation

Charge Readout:

Fraction of in-spec channels, Full 3D signal assembly/imaging,

Basic track/shower reconstruction (cosmics), Signal matching across cathode,

Light-charge signal correlation,

Basic cosmic study (track rate, angular distribution, MIP dEdx distribution)

Phase 3:

Test Description:

Full ArgonCube 2x2 Demonstrator Operation (Module 1-4 in 2x2 cryostat)

Studies:

Repeat Phase 2 studies, as needed

Cryogenics/Purification:

Purity, Pressure management, Liquid level stability

Light and Charge Readout:

Module-to-module signal correlation, Relative module performance,
Impact of dead volumes between modules

Phase 4:

Test Description:

Full ArgonCube 2x2 Demonstrator Operation in NuMI beam, w/Minerva trackers
→ ProtoDUNE-ND

Studies:

Repeat Phase 3 studies, as needed

2x2:

Beam correlation, Neutrino signal identification and reconstruction, pileup rejection

Minerva:

Gain calibration, stability, track identification and reconstruction

Combined:

Track matching between 2x2 and Minerva systems