



Low Background kTon-Scale Liquid Argon TPCs

August 31, 2020

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PNNL is operated by Battelle for the U.S. Department of Energy



Introduction

- Value in making experiments multipurpose
- Next-generation neutrino physics LArTPCs have thresholds of ~ 10 MeV
- Significant new physics at ~ 1 MeV or keV scales
 - Neutrino astrophysics, dark matter, coherent elastic neutrino-nucleus scattering,...
- Potential upgrades to a next-generation (DUNE) detector
 - Lower radioactive backgrounds
 - Lower energy thresholds
 - Do all this without perturbing the main physics goals

Low Background Module Requirements

- Dual-phase
 - ✓ Bulk argon, without internal components for radiopurity
 - ✓ Fiducialization and self-shielding
- Enhanced radiopurity
 - ✓ Low radioactivity underground argon
 - ✓ Increased detector materials radiopurity requirements (do not require DM experiment levels!)
 - ✓ Improved radon control
- Additional shielding
 - ✓ Water and plastic
- Low threshold readout
 - ✓ High signal/noise from gas-multiplication readout, Use light readout for electroluminescence photons (S2)
- Enhanced Photon Detection System (PDS)
 - ✓ Reflectors, SiPMs, Increased coverage

Low Background Module

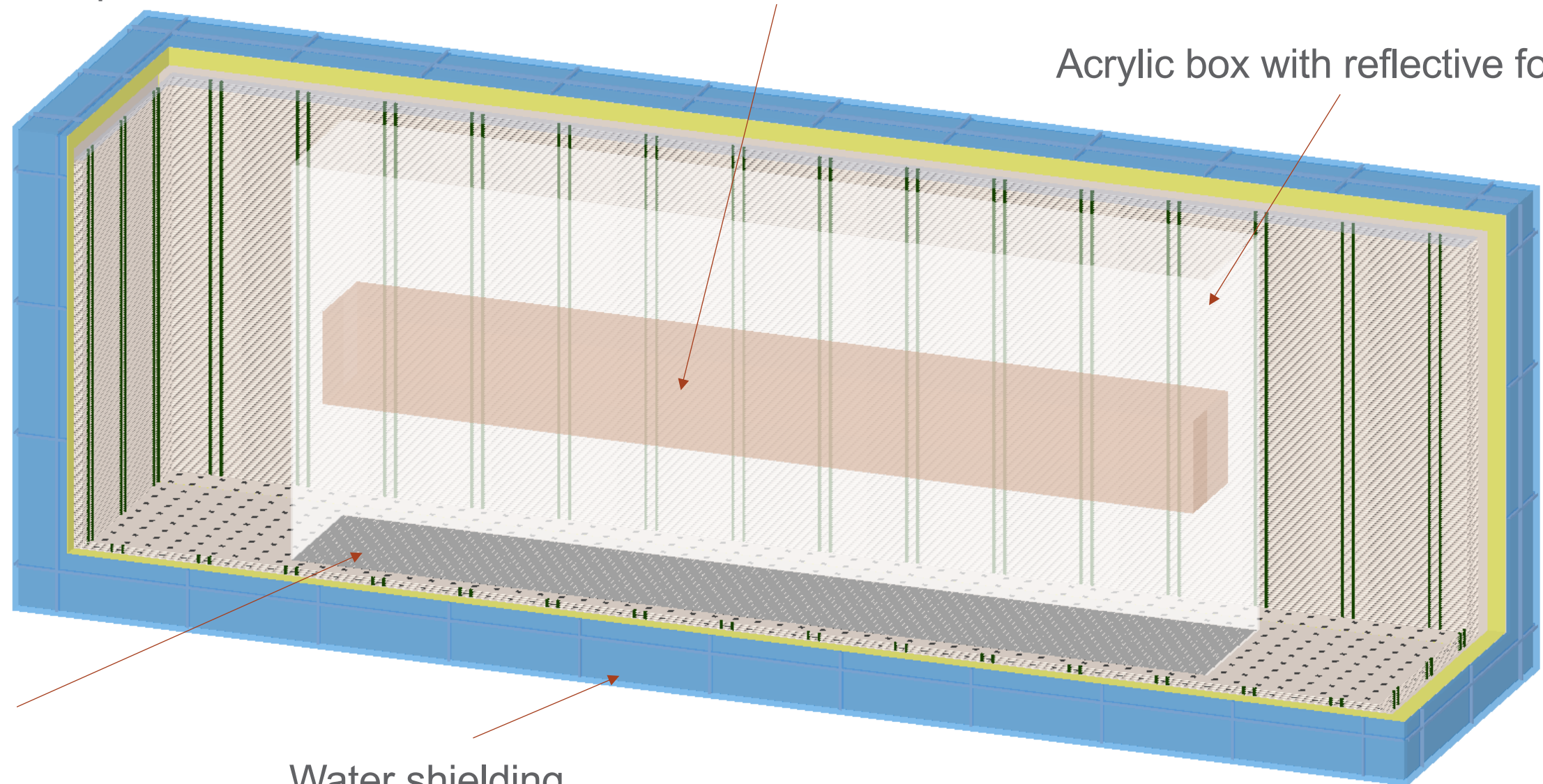
Standard dual phase module

1 kton fiducial volume

Acrylic box with reflective foils

SiPMs

Water shielding

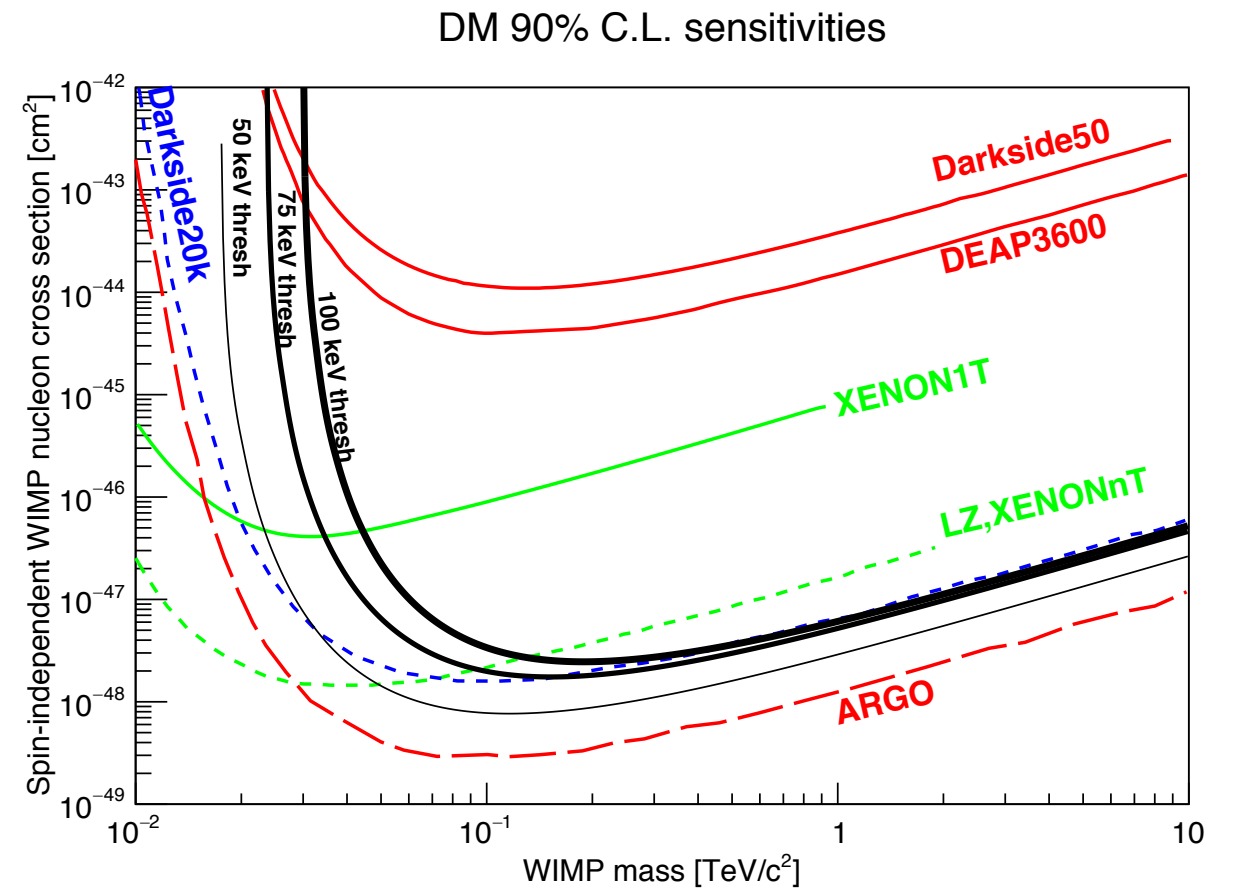


MeV-Scale Physics

- ^{39}Ar reduction
 - Data rate reductions
 - Improved event timing measurements and energy resolution of non-beamline physics
- Supernova bursts
 - Reduced neutron and ^{39}Ar activity allows lower thresholds and increased distance
 - Can use as supernova burst trigger module for full detector
- Diffuse supernova neutrinos
 - Neutron background reduction improves sensitivity
- Solar neutrinos
 - Improved measurements of ^8B and *hep* neutrinos
- Xenon doping for neutrinoless double decay?

keV-Scale Physics

- Direct dark matter detection of WIMPs
 - arXiv:2005.0482 (accepted JINST)
- Solar neutrinos
 - Elastic scattering to make precision measurements across full solar spectrum (including pp-neutrinos)
- Directional neutrino astrophysics
 - Elastic scattering to identify neutrino sources (eg indirect dark matter detection)
- Coherent Elastic Neutrino-Nucleus Scattering
 - Beam line, atmospheric neutrinos



Conclusions

- Multipurpose experiment
- Upgrades required:
 - Fiducialization, enhanced radiopurity, low radioactivity underground argon, additional shielding, low threshold readout, enhanced light detection
- Range of new physics sensitivity:
 - Supernova, solar, CEvNS neutrinos
 - Dark matter
- LOI prepared, if interested in collaboration, let us know!



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Thank you

