A Veto Design for the PandaX Experiment

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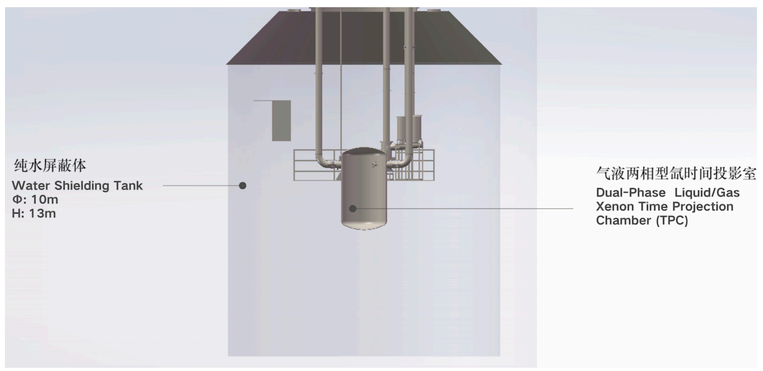
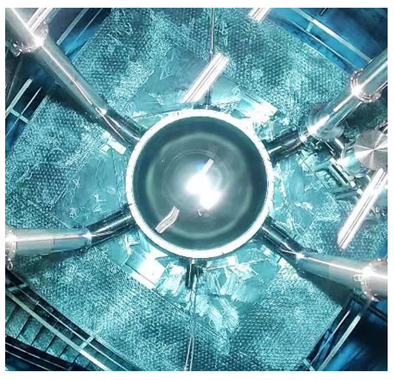
PandaX Experiment

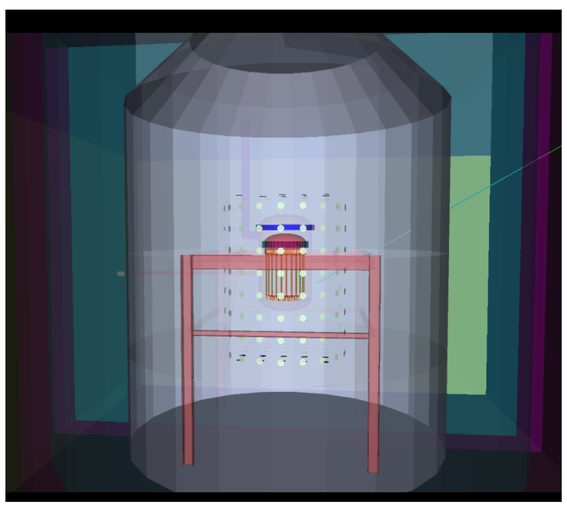
- PandaX is a multi-purpose experiment located at China Jinping Underground Laboratory (CJPL)
  - search for WIMP dark matter using liquid xenon (LXe) TPC
  - search for neutrinoless double-beta decay of ^{136}Xe
- main backgrounds include neutrons, gammas, neutrinos, etc.
- the TPC is surrounded by a 0.9 kton water shielding

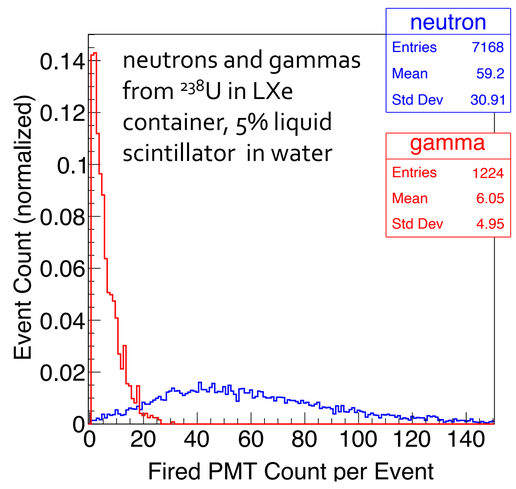


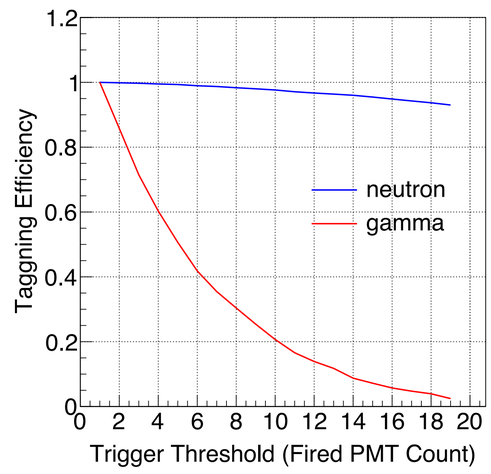


Neutron and Gamma Veto

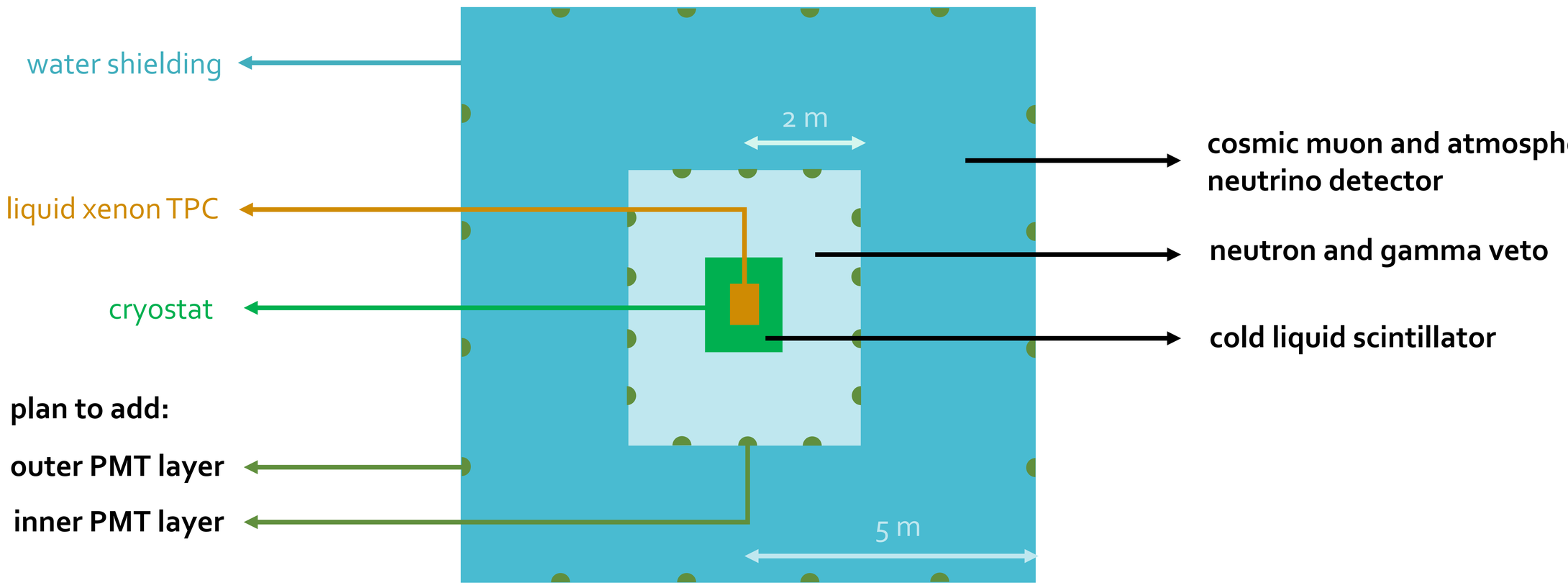
- install 198 8-inch MCP PMTs from NNVT on a cylindrical surface enclosing the cryostat
- use Tyvek paper to increase photon detection efficiency
- first phase: use pure water
- second phase: add 5% liquid scintillator in water forming water-based liquid scintillator to increase the light yield





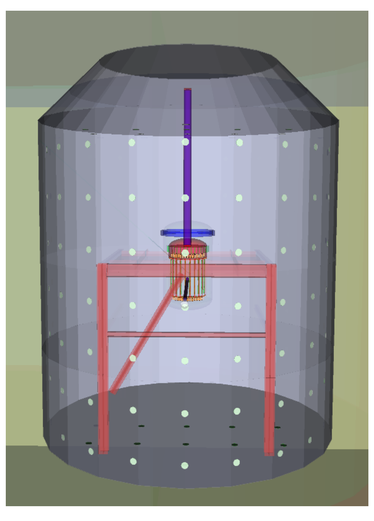


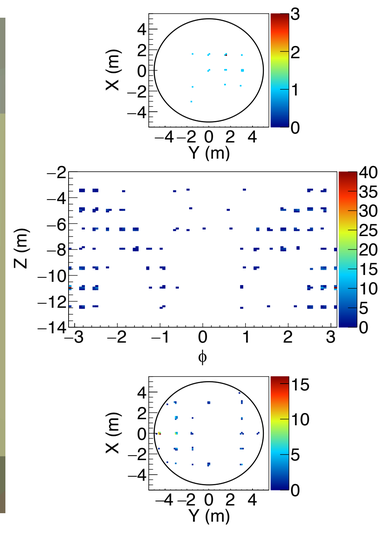
Veto Schematic



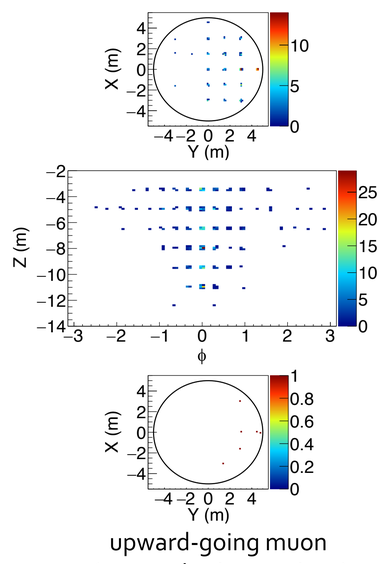
Muon and Atmospheric Neutrino Detection

- muon rate at CJPL is 60 / m² / year. Muons bring neutrons in particular through hadronic showers and should be vetoed
- atmospheric neutrinos are important background for heavy WIMP with a mass larger than about 10 GeV
- an in situ measurement can constrain the flux prediction and improve WIMP sensitivity, expect about 70 events per year
- install 202 8-inch PMTs on the wall of the water tank





downward-going muon



upward-going muon (atmospheric neutrinos)

Cold Liquid Scintillator R&D

- under LXe temperature, LAB-based liquid scintillator turns into a thick and cloudy liquid
- use it to provide pressure to the LXe container, and reduce the requirement on the wall thickness of the LXe container
- use wavelength shifting (WLS) fibers to collect scintillation light in the cold liquid scintillator for vetoing neutrons and gammas
- cloudiness helps with the light collection by the WLS fibers, as demonstrated by the LiquidO technology