Outer Detector & Muon Veto

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What is nEXO?

nEXO is a proposed tonne-scale **neutrinoless double beta decay ($0\nu\beta\beta$) search** with the isotope ^{136}Xe [1, 2].

The experiment centers around a TPC filled with **5 tonnes of liquid xenon (LXe), enriched to 90% in ^{136}Xe.** The projected sensitivity of nEXO to the $0\nu\beta\beta$ half life is ~10^{28} years [3].

Stringent low background requirements necessitate the use of a large, instrumented water shield: the Outer Detector.

The Outer Detector

nEXO's Outer Detector (OD), is being developed to both **shield the TPC from external backgrounds** (gamma & neutron radiation outside cryostats), and account for cosmogenic backgrounds by **tagging traversing muons'** Cherenkov light.

The Outer Detector will be **instrumented with ~125 Hamamatsu R5912 PMTs** from the Daya Bay Experiment. A study is underway to determine their optimal configuration.

Simulations of muons passing nearby, at the anticipated underground site SNOLAB, have been performed to quantify cosmogenic backgrounds and develop mitigation strategies.

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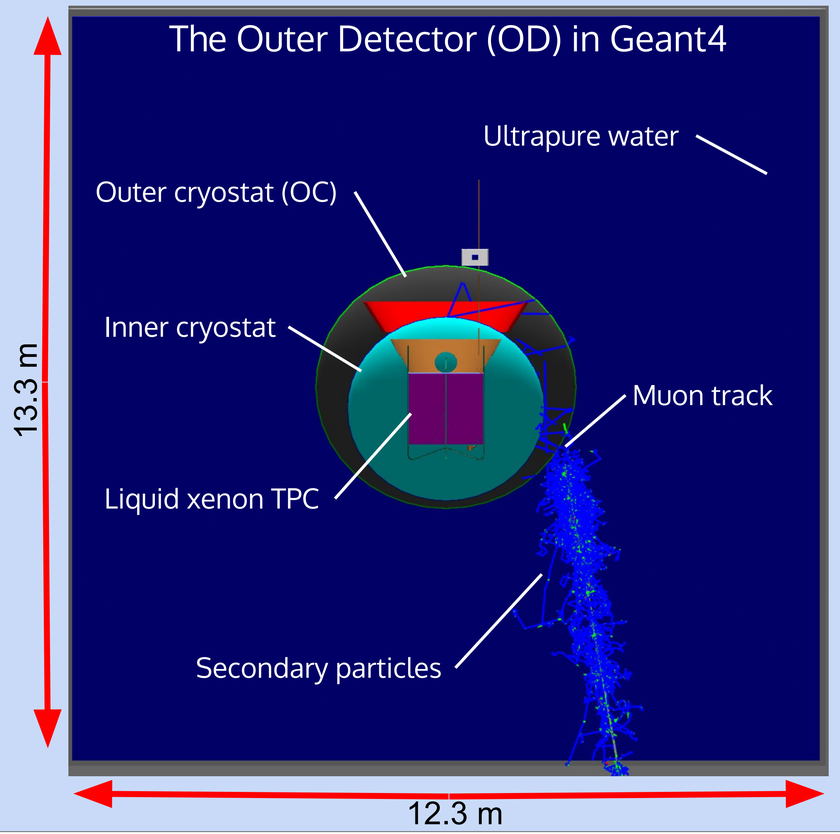
Geant4 Monte Carlo Results

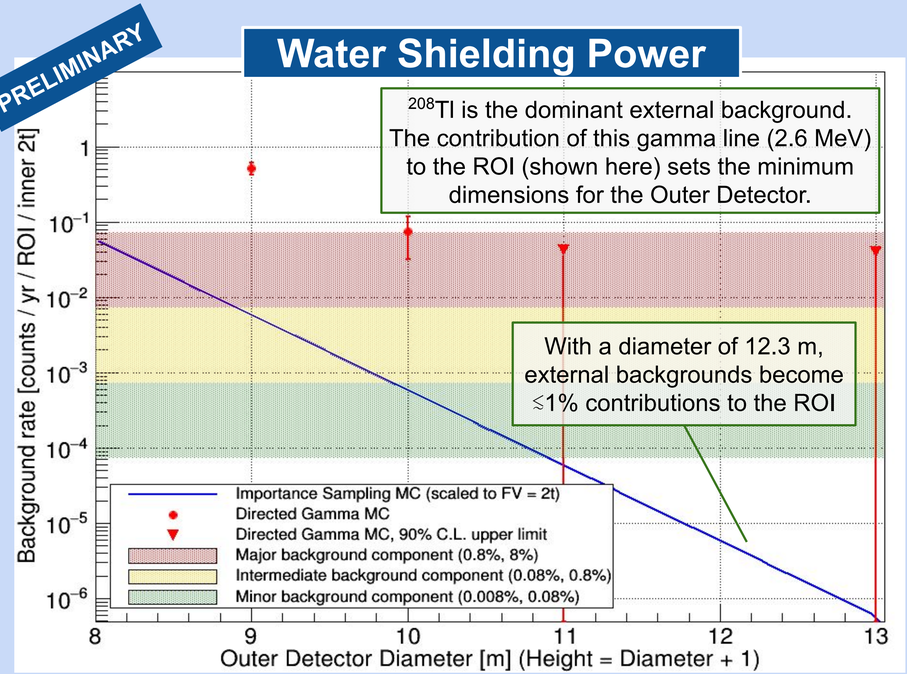
(1) An Outer Detector of diameter of 12.3 m, and height of 13.3 m, provides adequate shielding against all external backgrounds (radiation from the rock, instrumentation, water... [4]).

(2) ^{137}Xe is the dominant cosmogenic background to nEXO. It is produced at a rate of 14.1 ± 0.7 [atoms/yr] in the full LXe vessel from nearby muon showers at SNOLAB.

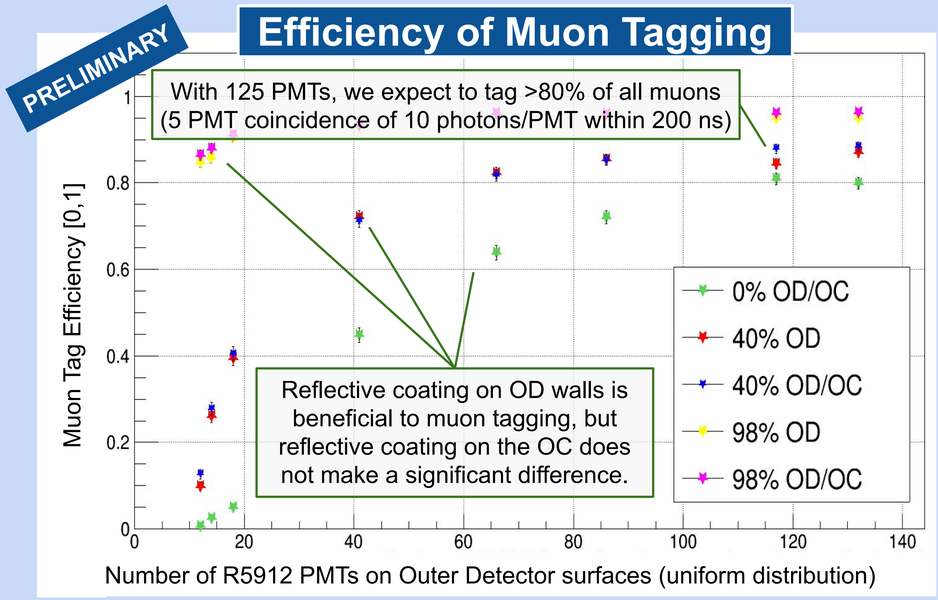
(3) 125 PMTs is sufficient to tag muons of concern at SNOLAB, and mitigate the effects of cosmogenic backgrounds.



Water Shielding Power



Efficiency of Muon Tagging



References

1. "nEXO pre-Conceptual Design Report." *arXiv:1805.11142* (2018).
2. "Sensitivity and Discovery … ", Phys. Rev. C 97.6 (2018): 065503.
3. "Sensitivity of the nEXO Experiment...", S. Sangiorgio, Neutrino2020 #548.
4. "Radioactive Background Control for nEXO", R. Tsang, Neutrino2020 #84.