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(G*) Implementation of Cherenkov Physics in Chroma for nEXO's Muon Veto

Wednesday, 8 June 2022 11:30 (15 minutes)

nEXO is a proposed neutrinoless double beta decay ($0\nu\beta\beta$) experiment anticipated to be built 2 km underground at SNOLAB. nEXO is expected to reach a half-life sensitivity of 1.35×10^{28} years, which requires ultra-low background levels. To achieve this, a water-Cherenkov muon veto, also known as the Outer Detector (OD), surrounds the liquid xenon time projection chamber and the cryostat. This tank of ultra pure water shields the xenon from gamma and neutron radiation, and detects high energy cosmic muons passing through the water via their Cherenkov radiation. The Cherenkov photons are detected by photomultiplier tubes (PMTs) inside the OD and are used to tag the muons passing by, allowing for a veto against cosmogenic backgrounds in the $0\nu\beta\beta$ dataset.

Before finalizing the design of the OD, simulations need to be run to optimize the placement of the PMTs. Last summer, the nEXO OD group adopted Chroma, a GPU-based ray tracing program, to simulate light propagation in the Outer Detector. Chroma, along with being easily editable for new detector set ups, is much faster (~ 100 - $1000\times$) than running comparable CPU-based ray tracing in Geant4 simulations. This talk discusses the implementation of the required physics to generate muon Cherenkov photons with the correct optical properties and distributions for Chroma photon propagation.

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