Measurement of PTFE Reflectance of Xenon Scintillation Light for the LZ Detector

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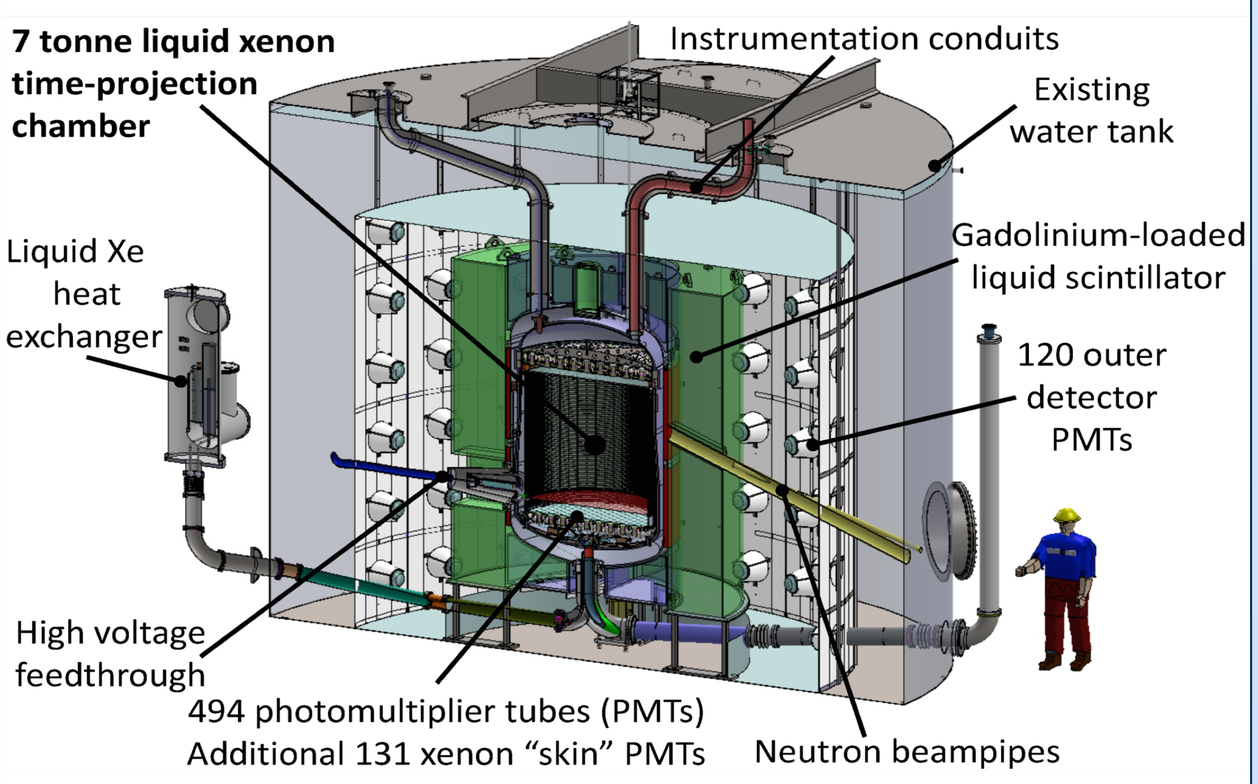
Introduction

The LUX-ZEPLIN (LZ) experiment is a next-generation direct detection experiment under construction to search for dark matter. LZ takes advantage of the high VUV reflectivity of PTFE to achieve high light collection efficiency. Thinner PTFE layers may reduce radiological backgrounds, and thus these are preferred so long as no significant loss in reflectance results. Reflectance measurements near wavelengths of 178 nm of thin PTFE sheets immersed in liquid xenon were performed in Michigan Xenon Detector.

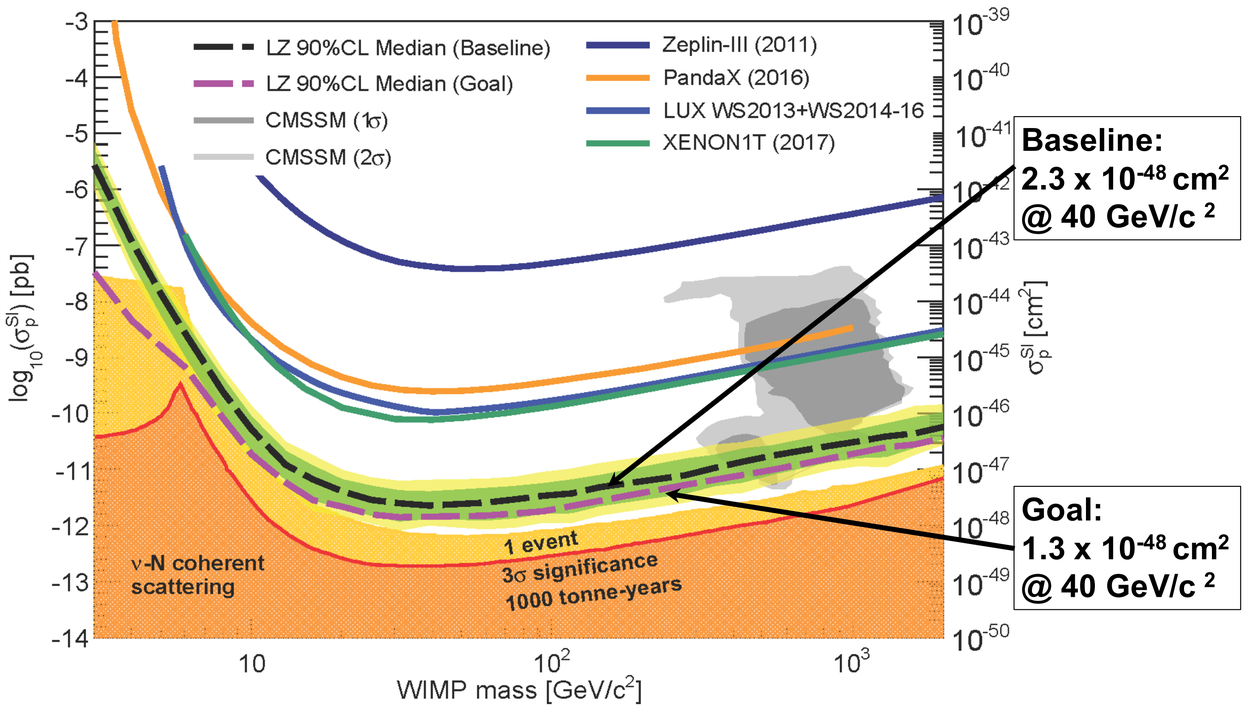
LZ Detector

The LZ detector contains a dual-phase liquid xenon time projection chamber with a total active mass of 7 tons looking for dark matter candidates, WIMPs. The detector is located at the Sanford Underground Research Facility (SURF) in South Dakota.



Projected LZ Sensitivity

Spin independent cross sections for 5.6 T fiducial, 1000 live-days



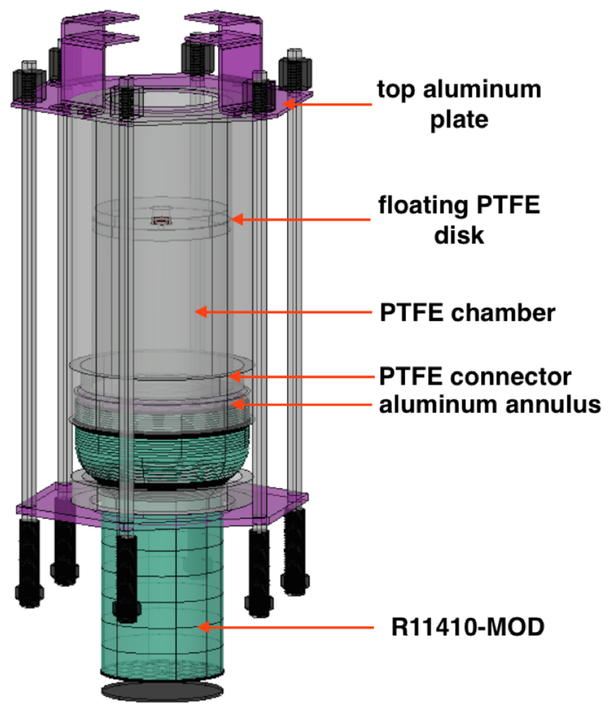
Will explore significant fraction of available phase space:

- WIMP sensitivity 2.3 × 10^{-48} cm^2 @ 40 GeV/c^2 with 1,000 live days (and approaching neutrino floor).

Michigan Xenon (MiX) detector

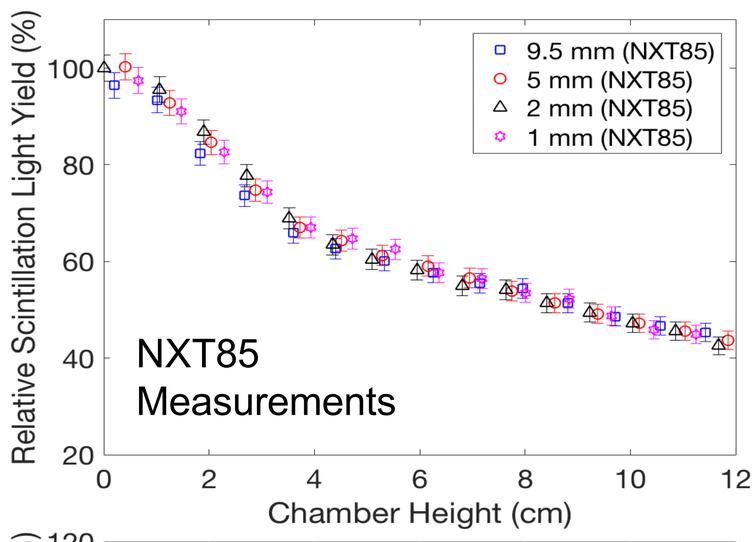
In order to perform the reflectance measurements, a chamber was designed and built. The detector contains a 3-inch photomultiplier tube and a floating PTFE disk, which provides a way to easily modify the fractional area of the chamber by varying the height of the floater.

Mono-energetic scintillation light of 178 nm is generated by the 5.304 MeV α particles emitted from a ^{210}Po source in the floater through ionization and excitation of xenon atoms.

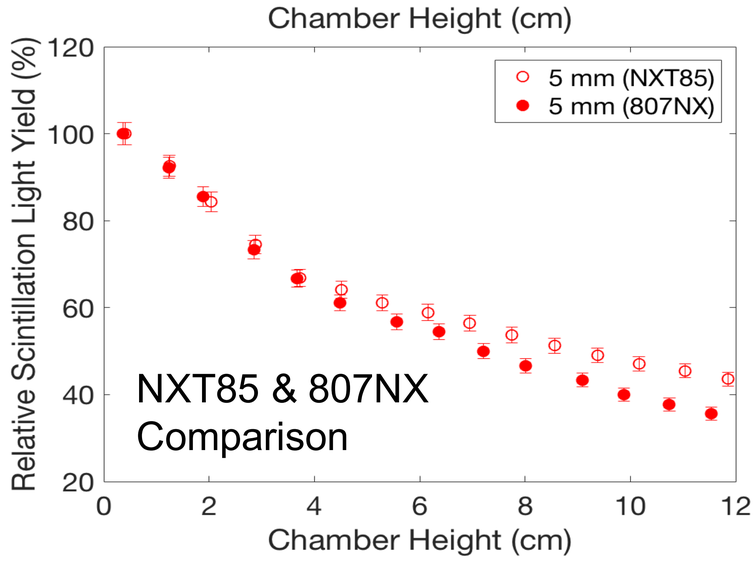


VUV Reflectance Measurements

Reflectance measurements of two types of PTFE (APT NXT85 and 807NX), for various thicknesses, for VUV xenon scintillation light of 178 nm have been done at University of Michigan using the Michigan Xenon detector.



There is no dependence on the thickness of both PTFE materials for the reflectance of 178nm xenon scintillation light for the tested thicknesses in the range of 1 mm to 9.5 mm within uncertainties.



Absolute reflectivity measurements for NXT85 and 807NX PTFE materials are 97.5% and 96.1%, respectively[2].

Acknowledgment

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References

[1] J. Haefner et al, NIM A856, (2017) 86, Reflectance dependence of PTFE on thickness for xenon scintillation light, arXiv:1608.01717 [physics.ins-det]
[2] F. Neves et al, JINST 12, (2017), P01017, Measurement of the absolute reflectance of PTFE immersed in liquid xenon, arXiv:1612.07965 [physics.ins-det]