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Design of Two-Phase Liquid-Xenon Compton-Imaging Detector<sup>1</sup> CHRISTOPHER WAHL, ETHAN BERNARD, CHRISTOPHER KACHULIS, NICOLE LARSEN, BRIAN TENNYSON, SIDNEY CAHN, DANIEL MCKINSEY, Yale University, MANAWADUGE DE SILVA, NICHOLAS DESTEFANO, MOSHE GAI, University of Connecticut — Liquid xenon offers a unique set of features for gamma and neutron measurements, including high Z, fairly high density  $(3 \text{ g/cm}^3)$ , gamma/neutron discrimination, fast (27-ns) scintillation signals, and demonstrated 4% FWHM energy resolution at 662 keV. Improvements to an existing detector are being made to create a position-sensitive liquid-xenon detector capable of Compton imaging. The proposed design will operate in two-phase mode to record initial scintillation light (S1), then drift free electrons past sense wires and into a gas region where the electrons will produce proportional scintillation light (S2), which very accurately counts the drifting electrons. The combination of the S1 and S2 signals, which are anti-correlated in energy, is predicted to give 2.6% FWHM energy resolution at 662 keV. The crossed sense wires will have 3-mm pitch and predicted mm-scale position resolution. A preamp to read out each wire is being designed to fulfill space and noise constraints. In order to precisely know the energy from each gamma-ray interaction, the scintillation light from each interaction must be distinguished from that due to others. Simulation, including optical reflections, is used to determine the optimal optical segmentation of the active volume using thin Teflon walls.

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