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Energy and position reconstruction in the Light only Liquid Xenon (LoLX) experiment

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The Light-only Liquid Xenon (LoLX) experiment operates at McGill University in collaboration with TRIUMF. The experiment uses silicon photomultipliers (SiPMs) to examine liquid xenon (LXe) scintillation characteristics for detecting rare physical events, such as neutrinoless double beta decay or dark matter. The primary goals are to understand SiPM performance and study LXe scintillation characteristics in the light-only channel. The LoLX phase 2 detector is a 4-cm cube consisting of two types of SiPMs—HPK VUV4 and FBK HD3—and a VUV-sensitive photomultiplier tube (PMT). During the first commissioning run, we used external gamma sources to study the detector's performance. To study the position-dependent event response, we developed a detailed photon propagation simulation using Chroma, a GPU-based photons simulation framework. In this work, we combined experimental data with light propagation simulations to perform energy and position reconstruction, helping us understand the intrinsic liquid xenon scintillation light production and resolution.

Keyword-1

Liquid Xenon

Keyword-2

Silicon photomultipliers

Keyword-3

Neutrinoless double beta deca

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