Contribution ID: **103** Type: **Contributed Oral**

Advancements in SiPM Characterization and Optical Simulations for Noble-Liquid Detectors in Nuclear Physics

Saturday, 17 February 2024 12:00 (15 minutes)

Silicon photomultipliers (SiPMs) are the photo-detection technology of choice for future noble-liquid scintillator rare-event search experiments, both in neutrino-less double beta decay and dark matter. The Light only Liquid Xenon (LoLX) experiment is a small-scale R&D liquid xenon (LXe) detector located at McGill University. LoLX aims to perform detailed characterization of SiPM performance in LXe, and to characterize the light emission and transport from LXe to inform future LXe detectors. To perform these characterizations, we require a flexible and accurate optical simulation framework which can be easily adapted to various detector configurations. Chroma is a fast and modern GPU accelerated photon transport simulation framework, with simulation speeds outperforming by up to 200 times the performance of traditional CPU simulations such as GEANT4. The next-generation neutrinoless double beta decay experiment, nEXO, and the LoLX collaborations have worked to create a robust simulation toolkit using the Chroma framework to enable accurate optical simulations for detector sensitivity characterizations and rapid R&D development. The Chroma-based simulation toolkit has undergone extensive recent upgrades, which includes extensions to allow for coupling to stand-alone GEANT4 simulations, scintillation light generators based on the NEST model, and Cherenkov light generators based on the G4Cerenkov model. To produce accurate simulations, we also require a detailed response model simulation of SiPM light detection and correlated noise effects. The SiPM response model includes modelling of all effects such as after-pulsing, optical crosstalk, external crosstalk and dark noise. We will present an overview of the upgraded simulation toolkit and response model, and its impact on future detector characterization and noble-liquid detector R&D for nuclear and particle physics research.

Your Email

david.gallacher@mail.mcgill.ca

Supervisor

Thomas Brunner

Supervisor Email

thomas.brunner@mcgill.ca

Affiliation

McGill University

Your current academic level,

PhD student

Primary author: GALLACHER, David

Presenter: GALLACHER, David

Session Classification: Morning 4 - Feb. 17, 2024