2024 IEEE Nuclear Science Symposium (NSS), Medical Imaging Conference (MIC) and Room Temperature Semiconductor Detector Conference (RTSD) | 979-8-3503-8815-2/24/$31.00 ©2024 IEEE | DOI: 10.1109/NSS/MIC/RTSD57108.2024.10658463

Programmable Readout Electronics for Light Scintillation Detection in Liquid Xenon.

E.M. Rtimi[1], M.-A. Tétrault[1], D. Thers[2]

[1] *Universite de Sherbrooke, Institut interdisciplinaire d'innovation technologique, Sherbrooke, Québec, Canada*

[2] *Université de Nantes, SUBATECH, IMT Atlantique, Nantes, France*

Abstract

This paper presents an investigation into the feasibility of a programmable electronic architecture specifically designed for reading out scintillations in a future iteration of a full-body version of Xemis, a three-gamma nuclear medical imaging system. This system employs liquid xenon (LXe) as the detection medium inside a time projection chamber (TPC - LXe), aiming to reduce the overall dose administered to patients.

The main challenge for the readout electronics discussed here is about scaling the scintillation photon detection electronics over a 2 meter axial lenght system for clinical application, Xemis-3. The development of this programmable readout system, based on the light yield found in Xemis-2 simulations, aims replace PMTs with 16 VUV-MPPC (Multi-Pixel Photon Counters) arrays. This feasibility phase prepares for future design, with experimental validation to be done using the existing Xemis TPC test chamber. Initial simulation results indicate the effectiveness of Sigma Delta modulation readout electronics, achieving scintillation photon detection accuracy within ±1 photo. Upcoming experimental tests will evaluate this readout electronics with an FPGA at the temperature of liquid xenon.

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