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Rapid characterization of SiPMs for nEXO and future noble liquid experiments

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Silicon photomultipliers (SiPMs) are an excellent solid-state photon detection technology that is becoming increasingly popular in the field of particle and medical physics. The features of SiPMs that make them an ideal candidate for photon detection are their compact size, lightweight, high gain, low operating voltage, low dark noise, and insensitivity to the magnetic field. The nEXO (Enriched Xenon Observatory) is a future tonne scale experiment that will be looking for neutrinoless double beta decay in the 136Xe isotope. Many large future experiments like nEXO, ARGO, etc. will be using SiPMs in their photon detection system. Newly developed vacuum ultraviolet (VUV) sensitive SiPMs will be directly used for the readout of xenon scintillation photons (λ = 175nm) in the nEXO experiment. In this research project, VUV-SiPMs from two different vendors are characterized using current-voltage (IV) and pulse-level measurements performed at TRIUMF, from room temperature to liquid xenon temperature. These data are analyzed to extract the SiPM's features like breakdown voltage, gain, dark noise rate and correlated noise probability. The results from IV and pulse analysis are compared. The method is proposed for rapid quality control of large numbers of SiPMs using IV measurements.

Supervisor

Dr. Simon Viel

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Supervisor Email

simonviel@cunet.carleton.ca

Your Email

bindiyachana@cmail.carleton.ca

Primary author: Ms CHANA, Bindiya (Carleton University)

Presenter: Ms CHANA, Bindiya (Carleton University)

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