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Studies of event burst phenomenon with SiPMs at cryogenic temperature

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Silicon photomultipliers (SiPMs) are used to collect scintillation photons in many cryogenic noble liquid detectors deployed around the world, such as DarkSide, nEXO, MEGII, ProtoDUNE and DUNE. An event burst phenomenon was observed during routine characterization on many models of SiPMs operated in liquid nitrogen. These bursts of consecutive pulses are initiated by an intense dark photoelectron pulse with an event rate much lower than the time-uncorrelated thermal dark pulse. Although the occurrence of these event bursts pulse rate is very low, it can potentially compromise some dedicated rare physics event searches which are also anticipated to be of extremely low rate. Here, we systematically study the behavior of the event burst phenomenon and identify the probable cause of the phenomenon. This investigation is important on the selection of SiPMs for use in noble liquid detectors, high energy physics experiments, and industrial applications where SiPMs are used in cryogenic environment.

Primary author: TSANG, Thomas (Brookhaven National Lab)

Co-authors: GIACOMINI, Gabriele; CHEN, Hucheng; RESCIA, Sergio; GAO, Shanshan; RADEKA, Veljko

Presenter: TSANG, Thomas (Brookhaven National Lab)

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