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The burst effect in SiPM at cryogenic temperature

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Silicon Photomultipliers (SiPMs) are highly sensitive solid-state photodetectors consisting of a 2D array of small-size Avalanche Photodiodes (APDs) working in Geiger mode, connected in parallel and joined together on a common silicon substrate.
They have extraordinary features of high sensitivity down to single-photon level, fast timing and high dynamic-range while maintaining low-voltage operation, mechanical robustness and insensitivity to magnetic fields.
In addition, cryogenic operation of SiPMs allows to keep the dark count rate (DCR) at very low levels of mHz/mm^2, with respect to $\sim$hundreds of kHz/mm^2 at room temperature.
Due to all these good properties, they are a very promising photodetectors that could find applications in many field of physics, and in particular, during last years, they start to play a crucial role in the detection of scintillation light of noble liquids in dark matter and neutrino-physics experiments.
A newly discovered phenomenon occurring in some types of SiPM models when operated at liquid nitrogen temperature, has been recently discovered by our group (Guarise M., et al. "A newly observed phenomenon in the characterization of SiPMs at cryogenic temperature." JINSTRUM 16.10).
This phenomenon, which is extremely important especially for low noise applications, has been called bursts effect and consists in trains of consecutive avalanche events, characterized by a rate that is about 100 times higher than that of the single-event-uncorrelated dark counts. The net effect results in an overall increase of the DCR of the sensor when operated at cryogenic temperatures. We performed different kind of tests to understand the origin of this phenomenon and we also work in synergy with producers to try to find the internal mechanism at the basis of this behavior.
Preliminary results concerning the tests performed with SiPMs placed at LN2 temperature aimed to investigate the cause of this phenomenon, will be presented.

Collaboration

Role of Submitter

I am the presenter

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