

NUV-sensitive Deep-junction (NUV-DJ) SiPMs, a new technology optimized for fast timing applications

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In recent years, Fondazione Bruno Kessler (FBK) in Trento, Italy, has been actively involved in the development of several Silicon Photomultiplier (SiPM) technologies, particularly for applications such as time of flight-positron emission tomography (TOF-PET) where a fast timing is crucial. This work presents FBK's latest development, the Near-Ultraviolet Deep-junction (NUV-DJ) SiPM technology, which has an improvement in photo detection efficiency (PDE) and single photon time resolution (SPTR) with respect to the state-of-the-art SiPMs. The NUV-DJ microcell has 40 μm pitch and features a unique design with the high-electric field region placed deeper in the device enabling an enhancement of the avalanche triggering probability even with longer wavelength photons.

The PDE showed outstanding values of 70% (including a nominal fill factor of the microcell of 80.8%), at 420 nm of wavelength and 9 V of excess bias. For a 4x4 mm² SiPM using a high-frequency readout, it was measured a SPTR of 60 ps FWHM at 20 V of excess bias, and a CTR of less than 100 ps FWHM with 2.76x2.76x18 mm³ LYSO:Ce crystal at 10 V of excess bias. The measured CTR using standard readout electronics showed excellent values of about 115 ps FWHM at overvoltage larger than 10 V. These findings represent cutting-edge advances in timing and PDE and are very promising for TOF-PET applications employing LYSO, LSO, BGO, and LaBr₃ crystals or in scenarios where a high PDE in the NUV range is imperative.

Field

Detectors and electronics

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