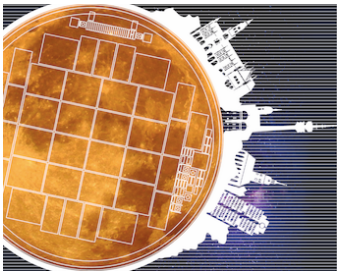

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Silicon Photomultipliers developed at FBK for Physics Applications

Recent developments in Silicon Photomultiplier (SiPM) technology make it an attractive choice for large-scale Physics experiments, as an alternative to traditional Photomultiplier Tubes (PMTs). Potential advantages of SiPMs include high sensitivity, compactness, lower operating voltage, low cost, high gain uniformity and high radio purity.
Near Ultra Violet, High Density (NUV-HD) SiPM technology features peak photon-detection efficiency (PDE) of 65% at 410 nm, DCR at room temperature of 50 kHz/mm2, correlated noise of 10% at 55% PDE, and microcell pitch ranging from 15um to 40um. Recent interest in the SiPM readout of liquid scintillators (mainly Ar and Xe) triggered the development of a Low-Field variant of the NUV-HD technology (NUV-HD-LF). This technology is optimized for operation at such low temperatures and features a DCR of a few mHz/mm2 at 77 K. At this temperature, few-photon counting capability was demonstrated, with S/N of 13.8, using a 24 cm2 SiPM array coupled to a single analog readout channel.
As regards SiPMs application in high-radiation environments, FBK designed the Ultra-High-Density SiPMs (RGB-UHD), based on smaller cells size. Such a technology is aimed at reducing SiPM non-linearity in high dynamic range applications, such as in calorimeters, and to increase radiation hardness. Cell pitch ranges from a 12.5 um down to 5 um, corresponding to the remarkable cell density of 7400 and up to 46000 cells/mm2. The 10 um cell reaches a PDE of 35% at 515 nm, while the microcell recharge time constant is below 5 ns for the 7.5 microcell.

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