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New developments on FBK position sensitive silicon photomultipliers

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Silicon Photomultipliers (SiPMs) are solid-state single photon detectors that show excellent performance in a wide range of applications. In 2015 FBK (Trento, Italy) developed a position sensitive SiPM technology, called "linearly-graded"(LG-SiPM), that showed position reconstruction resolution below 250 μm on an 8x8 mm² device area with only four readout channels and minimal distortions. This technology was proven effective in the readout and discrimination of pixelated LYSO crystals for PET applications (J. Du 2018) and in the 3D reconstruction of alpha particle tracks in an optically readout TPC (A. Gola 2020). Both these applications employed multiplexing techniques to reduce the number of readout channels for a 2x2 SiPM arrays while maintaining the position sensitivity across the surface.
In this work we present the new developments on LG-SiPM. In particular the new SiPMs have a larger active area (10x10 mm²) and they are based on NUV-HD technology, having a peak photon detection efficiency at 420 nm, as opposed to the older technology with peak sensitivity around 550 nm. With these SiPMs we aim to demonstrate the readout channel multiplexing technique applied to larger areas, up to 3x3 elements arrays for a total surface of 30x30 mm².
We also present a one-dimensional position sensitive detector developed for the readout of scintillating fiber mats or for X ray spectroscopy detectors. This sensor is rectangular, with a form factor of 10:1, and it has position sensitivity across the longest dimension. The second dimension is kept small in order to reduce the dark counts and improve the spatial resolution also at low light levels. As in the previous device the 1D version provides high resolution with a low number of readout channels and can be combined into linear arrays with channel multiplexing.

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