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Current status and development of Digital CMOS SiPM for scintillator-based radiation detectors toward all-digital sensors

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Modern scintillator-based radiation detectors require silicon photomultipliers (SiPMs) with photon detection efficiency > 40% at 420 nm, possibly extended to the vacuum ultraviolet (VUV) region, SPTR < 100 ps, and DCR < 150 kcps/mm2. To enable single-photon time stamping, digital electronics and sensitive microcells need to be integrated in the same CMOS substrate, with a readout frame rate higher than 5 MHz for arrays extending over a total area up to 4×4 mm2. This is challenging due to the increasing doping concentrations at low CMOS scales, deep-level carrier generation in shallow trench isolation fabrication, and power consumption, among others.

The presentation will first show an overview of the advances at 350 nm and 110 nm CMOS nodes, which will be benchmarked against available SiPMs obtained in other CMOS and commercial customized technologies. Experimental results of the newest CMOS SiPM realized at 110 nm, exhibiting a Photo Detection Efficiency of 61% at 420 nm, a dark count rate of 140 kcps/mm2, will be shown. Their application to radiation sensors will be also demonstrated through experimental results in LySO scintillator light readout.

Based on these CMOS nodes, the presentation will further describe the concept of digital multithreshold SiPMs, a new sensor realized at 110 nm and 350 nm CMOS nodes, including SiPM detection elements, single cell digitalization, and on-chip digital signal processing circuitry, aiming at a real-time readout and analysis of the light emitted by scintillators.Experimental results of the first sensor prototypes will be reported.

Do you need a VISA letter for traveling to Canada ?

No

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