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State of the art silicon photomultipliers with LSO: Ce codoped Ca scintillators achieve 84ps coincidence time resolution for PET

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The coincidence time resolution (CTR) of 511keV gamma detectors is becoming increasingly important for time-of-flight positron emission tomography (TOF-PET) since the additional time information enables further background suppression in the reconstructed image. In this work we present CTR measurements performed with the latest generation FBK SiPMs coupled to LSO:Ce codoped 0.4%Ca crystals. We tested two different technologies, i.e RGB-HD (4x4mm2) and NUV (3x3mm2) both cou- pled to the same LSO:Ce codoped Ca crystals. With NUV SiPMs we measured best CTR values of 84±4ps FWHM for 2x2x3mm3 crystals and 140±5ps FWHM for 2x2x20mm3 crystals. We compare the measurements performed on same detectors at two independent test setups: FBK and CERN, each employing different electronics. The agreement in the results from the two setups was found to be within a few percent. We set these results into perspective against previous measurements on Hamamatsu SiPMs for identical crystals, and study various factors such as single pho- ton time resolution (SPTR), photon detection efficiency (PDE) and light extraction efficiency in order to understand the source of improvement in CTR.

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