

Exploiting Cherenkov radiation and cross-luminescence emission with BGO/BaF2 metacrystals

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In the field of time-of-flight positron emission tomography (PET-TOF), the time resolution of the scintillation-based detector is an essential feature. Recent studies have shown that some materials have fast emissions in the vacuum ultraviolet (VUV) region.

To acquire the fast-rising signals of these emissions, we are using optimized Coincidence Time Resolution (CTR) test boards with two output signals (timing and energy). Since the VUV silicon photomultipliers (SiPMs) do not have a protective layer on top of the metal, two different coupling materials are used and compared. The experiment is focused on Barium Fluoride (BaF₂) crystals exploiting their cross-luminescence characteristic using VUV (SiPMs) from Fondazione Bruno Kessler (FBK). Moreover, a yttrium doped variant of these crystals (BaF₂-Y) has been considered for comparison. The results show a DTR of 123.6 ps and 93ps for the pure and doped variants, respectively. As reference detectors, we use a near-ultraviolet (NUV) from FBK coupled with a 3×3×5 mm³ LYSO:Ce,Ca and a 3×3×15 mm³ BGO pixels, with time resolutions (DTR) of 65.1 ps (Gaussian) and 300 ps (Laplacian), respectively.

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