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Nanocrystals for fast timing applications embedded in a polystyrene matrix

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Nanocrystals like ZnO:Ga or $CsPbBr_3$ were identified as potential scintillators for fast timing applications, including medical imaging techniques such as TOF-PET (time-of-flight positron emission tomography) or TOF-CT (time-of-flight computed tomography). Both feature sub-nanosecond scintillation decays which is a crucial property for this type of application.
However, such materials with desired properties are available either as a colloidal solution, or in powder form, and thus unsuitable as bulk scintillating detectors with sufficient ruggedness. Therefore, the small-sized materials need to be incorporated into a suitable matrix, improving their durability, applicability, absorption of radiation or light extraction efficiency.
We will present our recent progress with ZnO:Ga and $CsPbBr_3$ nanocrystals embedded in a polymer matrix. The main focus will be kept on nanocomposites using $CsPbBr_3$ nanocrystals because we recently characterized their timing capability with a unique novel setup coupled to analog Silicon Photomultipliers and low energy X-ray excitation. This allowed for the characterization of low-stopping power scintillator, such as low-filling (up to 10 %) of nanocrystals in a polystyrene matrix.
Even though the nanocomposite samples of $CsPbBr_3$ in polystyrene were not fully optimized, a more than twofold better time resolution with respect to conventional LYSO:Ce was achieved for the low-energy X-rays. Our study represents a promising starting point for the optimization of such nanocomposites towards their use in TOF-PET or TOF-CT.

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