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# New scintillators for SPECT, PET and TOFPET

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Abstract. Several newly developed scintillators, namely Lu2SiO5:Ce, LuAlO3:Ce, and LaBr3:Ce, have attractive properties for nuclear medical imaging. These properties include excellent energy resolution, high light output, short decay lifetime, and reasonably high density and effective atomic number. This presentation compares the properties of these materials and analyzes how well they meet the requirements for TOF PET. The most important criterion is the initial photon intensity, which is the rate at which photons are produced in the first nanosecond (and is equal to the light output divided by the decay time). By this metric, LaBr3:Ce is the most promising material, with a light output of 61,000 photons/MeV (50% higher than NaI:Tl) and a primary decay time of 35 ns, giving it an initial photon rate of 4000 photons/MeV/ns. This is roughly five times higher than LSO (811 photons/MeV/ns) and six times higher than LuAP (629 photons/MeV/ns). An additional benefit of LaBr3 is its outstanding energy resolution - it achieves 2.9% fwhm for 662 keV gamma rays, which is twice as good as that of NaI:Tl (which typically achieves 6% fwhm for this energy). In addition, preliminary work has been done with solid-state scintillator materials (such as PbI2 and HgI2), which have nanosecond decay times and light output similar to BGO (˜8000 photons/MeV), and so initial photon intensities about twice that of LaBr3. However, these properties are obtained at cryogenic temperatures.

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