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DISCOVERY OF LEAD SULFATE, A NEW SCINTILLATOR FOR HIGH-RATE HIGH-RESOLUTION PET.

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Lead sulfate ($PbSO_4$), a newly discovered scintillator that is not affected by air or moisture, has a density of 6.2 gm/cm^3 and a 1/*e* attenuation length for 511 keV annihilation photons of 1.2 cm. In a naturally occurring mineral form of $PbSO_4$ (anglesite) at room temperature, the fluorescence decay lifetime is predominantly (68%) a 136 ns exponential, with significant fast components having 7.6 ns (7%) and 27 ns (25%) decay times. The total light output in an imperfect, 3 mm cube of anglesite is about 60% that of BGO. The peak emission wavelength is 350 nm, which is transmitted by borosilicate glass windowed photomultiplier tubes. When quality synthetic crystals become available, which we anticipate occurring in the next year, the light output and fluorescent decay time of lead sulfate may improve.

We anticipate that lead sulfate will be useful in high resolution (<2.5 mm fwhm) PET tomograph designs where each crystal is individually coupled to a photodetector. It provides the same high stopping power for 511 keV photons as BGO, but its initial scintillation intensity of 117 photons/ns/MeV is about three times greater than BGO, implying that significantly better coincident timing resolution can be expected. In addition, the faster decay time should reduce the dead time to less than half that of BGO.

We anticipate that lead sulfate may also be useful in block detector PET tomograph designs. While the reduced (60% of BGO) light output will degrade the ability to use Anger logic to correctly identify the crystal of interaction, the reduced dead time should significantly increase the count rate capabilities of these designs.