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The three photon yield from e+ annihilation in biological liquids
R. LAFOREST, Washington University School of Medicine, K. MERCURIO, Department of Physics, Washington University, P. ZERKEL, Washington University School of Medicine, L.G. SOBOTKA, Departments of Chemistry and Physics, Washington University, R.J. CHARITY, Department of Chemistry, Washington University — Positrons annihilate either by the emission of 2-511 keV photons or 3-photons (from the decay of positronium in the triplet state.) The fraction of the 3-photon decay depends on the chemical environment and notably on the concentration of O_2. Consequently, 3-photon event detection has been proposed as a mean to measure hypoxia, a condition prevailing in cancer. The (delayed) three-photon yield in various fluids, at both high and low O_2 levels, has been extracted by fitting the time dependence of the two-photon yield to a set of coupled differential equations. The differential equations, in a simple and satisfactory fashion account for the e+ capture to form positronium and the decay and interconversion of the two forms. The total fraction of three photon events (both direct and delayed), which could be used for event-by-event position localization in PET-like imaging, is estimated to be ~ 0.5 % with the measured (from our work) delayed component of no more than 0.25% in water (or blood-like) samples. There is no (or an exceedingly small) dependence on the dissolved oxygen content in aqueous solutions.

Lee Sobotka

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