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An Algorithmic Approach to Identify Non-Pure Positron Emitters for Positron Emission Tomography (PET) Imaging Applications
ELYSSA HOFGARD, Department of Physics, Stanford University — Positron emission tomography (PET) is a medical imaging technique that uses radiolabeled tracers to image biological processes. Traditional PET imaging systems are optimized to detect pairs of gamma rays, known as annihilation photons, generated through positron-electron annihilation. We focus on non-pure positron emitters that also emit high energy gamma rays, allowing for triple coincidences. The long half lives of these isotopes can allow for more accurate imaging of slow biochemical processes. We develop an algorithm to classify particles in a triple coincidence, taking a probabilistic approach to the identification problem by synthesizing geometrical, spatial, energy, and temporal information. We first consider the geometric criteria of the PET system. We then consider the energy deposited by each particle, employing the maximum likelihood estimation method for each particle type. We finally consider the temporal information, employing time of flight (TOF) PET and statistical distance measures for each potential particle configuration. For preliminary testing, we use GATE (GEANT4 application for tomographic emission) Monte Carlo software. Preliminary test results demonstrate that the algorithm correctly identifies particles in a triple coincidence.

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