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Improvement of time-of-flight resolution of PET scanner using additional prompt photon

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Positronium Imaging (PI) has become one of the most prospective branch of Positron Emission Tomography. During the PI measurement two classes of events are required: double-coincidence events originated from pair of back-to-back annihilation photons and triple-coincidence events comprised with three photons, i.e, two annihilation photons and one additional prompt photon. The standard reconstruction of the emission position along the line-of-response of triple-coincidence event is the same as in the case of double-coincidence event and is based on times and positions of two annihilation photons only; an information introduced by the additional prompt photon is ignored. In this presentation, we propose to extend the reconstruction of position of triple-coincidence event by taking into account the time and position of prompt photon. Moreover, we incorporate the knowledge about the positronium lifetime distribution and derive the algorithm for the position reconstruction. We discuss the limitations of the method based on the simulation data.

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