MODELING OF AX-PET BASED ON GEANT4 AND GATE

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Abstract

AX-PET is a novel PET detector based on long axially arranged crystals and orthogonal Wavelength shifter (WLS) strips, both individually readout by Geiger-mode Avalanche Photo Diodes (G-APD). Its design was conceived in order to reduce the parallax error and simultaneously improve spatial resolution and sensitivity. The sensitivity can be further enhanced by adding additional crystal layers as well as by including Inter-crystal scatter (ICS) events, identified and processed in the post-acquisition. Its unique features require dedicated Monte Carlo (MC) simulations and its non conventional design makes its modeling rather challenging. We developed an AX-PET model based on Geant4 and GATE packages. Simulations were extensively validated against experimental data obtained from both small scale laboratory and full module setups. The first ones aimed at developing an analytical model of the WLS behavior which was afterwards coupled to GATE. Full AX-PET acquisitions were used afterwards to test the GATE simulations. The agreement between data and simulations was very good. AX-PET simulations are employed to test and optimize image reconstruction software and, at the same time, train ICS identification and reconstruction algorithms.