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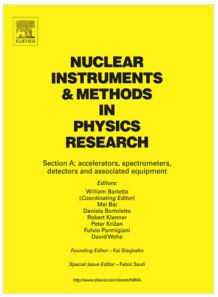

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A Fully Automated and Scalable Timing Probe-Based Method for Time Alignment of the LabPET II Scanners

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Abstract

A fully automated time alignment method based on a positron timing probe was developed to correct the channel-to-channel coincidence time dispersion of the LabPET II avalanche photodiode-based positron emission tomography (PET) scanners. The timing probe was designed to directly detect positrons and generate an absolute time reference. The probe-to-channel coincidences are recorded and processed using firmware embedded in the scanner hardware to compute the time differences between detector channels. The time corrections are then applied in real-time to each event in every channel during PET data acquisition to align all coincidence time spectra, thus enhancing the scanner time resolution. When applied to the mouse version of the LabPET II scanner, the calibration of 6 144 channels was performed in less than 15 min and showed a 47 % improvement on the overall time resolution of the scanner, decreasing from 7 ns to 3.7 ns full width at half maximum (FWHM).

Keywords: Positron Emission Tomography (PET), Timing Probe, Time Alignment

1. Introduction

Time of arrival of 511 keV photons in detectors is a key measurement in PET scanners. This information is mandatory to detect true coincidences. Inherent statistical fluctuations in photon generation, electronic noise, time walk due to

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