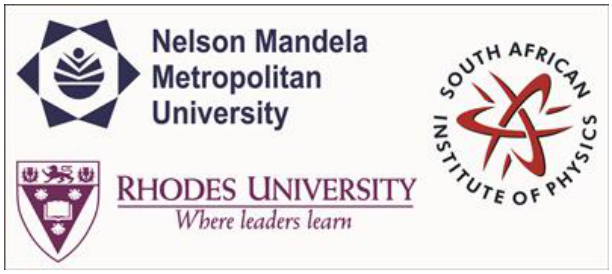

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Generation of Time-Stamps by a Digital Data Acquisition System

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Abstract content
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Position sensitive γ-ray detection techniques are a cutting-edge aspect of nuclear physics research. At iThemba LABS, a 32-fold segmented clover detector is used in conjunction with Pixie-16 modules for this purpose. The benefits of accurate γ-ray tracking are far reaching, in particular, good Doppler-correction for γ-ray events are required for radioactive ion beam research.

The data from each of the 32 electronic signals represent a pulse with height proportional to the energy deposited versus time. The information that can be extracted from an analysis of these pulse shapes enables the determination of the position of each interaction point of the γ-ray along with the corresponding energy deposited.

To this end, the digital data acquisition system must be well understood. The arrival time of a pulse can be determined either by a simple threshold method, or by the use of the so-called CFD trigger. Application of the CFD trigger has given unexpected results during experimental tests. The time-stamp generated by this method has, to different extents, been delayed with respect to the actual arrival time of the pulse. The primary goal of this work was to investigate this phenomena.

A simulation of the filtering techniques employed by the Pixie-16 module has been built in order to ascertain whether the spread in the time-stamps of the pulse signals can be minimized by an optimization of the parameters used in the digitization process. The problem was instead found in the method used to calculate the CFD function itself. The filtering process used in Pixie-16 unexpectedly exchanges the two terms that determine the CFD function. Correction of this results in a decrease in the spread of the arrival time of signals from about 300 ns to 50 ns.

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