

Dead Time Effects and Image Quality Evaluation at High Activities for the SAFIR Dual Ring Prototype

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The SAFIR Dual Ring Prototype is a high-performance preclinical PET-Insert designed to operate at activities of up to 500 MBq within the bore of a 7T Bruker BioSpin MRI system. It features an axial coverage of 35.6 mm with a coincidence resolving time of 194 ps FWHM, an energy resolution of 13.8% FWHM and has been fully characterized according to the 2008 NEMA NU-4 standard.

The focus of this study was to examine the detector performance at high activities with respect to the image quality following the NEMA NU-4 standard.

We evaluated the dependency of the spill-over ratio, recovery coefficient and uniformity on the total activity within the phantom for up to 500 MBq.

Furthermore, we investigated the effects of the detector dead time per channel at different activities.

A maximum relative increase in the spill-over ratio of 7.3% for water and 5.1% for air was observed after applying all corrections, while no noticeable trend was observed for the recovery coefficients.

The percent standard deviation of the phantoms uniform region improved by 8.8%.

At 484 MBq, 11% of single events were lost due to dead time effects.

Lastly, we present a method to correct PET image data for the effects of detector dead time, and showcase the effects of said method on the image quality.

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