



Ghent 2017 Belnuc Symposium – Abstract submission form

Submission deadline: 17th February 2017

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Abstract title:

Monte Carlo Simulation of the effect of magnetic field on Positron Range in the GE Signa integrated PET/MR system

Abstract Body:

We investigated the change in positron range of clinically relevant PET isotopes such as ^{18}F , ^{11}C , ^{15}O , ^{68}Ga and ^{124}I for different tissue types with and without simultaneous 3T MR in the whole body integrated GE Signa PET/MR system using GATE Monte Carlo simulations.

METHODS:

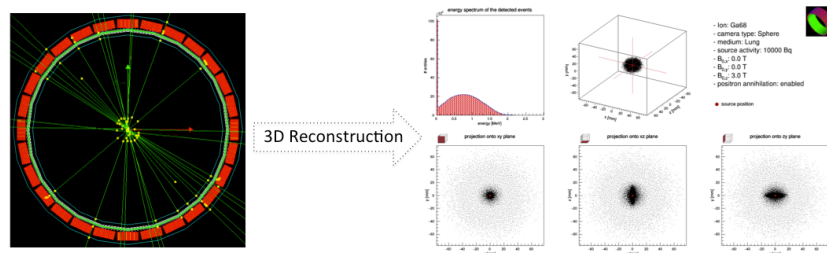
GATE Monte Carlo simulations were used to model the GE Signa 3T PET/MR with and without simultaneous 3T MR field. Software used for data acquisition and analysis was ROOT. Spherical ($r = 80$ mm) soft (mass density 1.0 g/cm^3) and lung (mass density 0.3 g/cm^3) tissue phantoms were created and a point source was placed in the center. In addition, 3 million annihilation events were simulated for each point source emitting ^{18}F , ^{11}C , ^{15}O , ^{68}Ga and ^{124}I . Moreover, we analyzed the full width at half maximum (FWHM) and compared the mean 3D spatial resolution with 0 and 3 Tesla of each isotope.

RESULTS:

The results (Figure. 1) demonstrate the influence of the PET/MR's static 3T magnetic field for the isotopes with higher positron energy, such as ^{68}Ga , ^{124}I and less prominent with ^{18}F and ^{11}C . Furthermore, the FWHM shows that the positron range is significantly dependent on the tissue type. It can be observed that the mean 3D range in the lung for ^{68}Ga was reduced by 74%, but only by 12% for soft tissue. For isotopes ^{15}O , ^{68}Ga and ^{124}I on lung, the mean range was reduced by 24% in x/y-plane, but the mean range in x/z and z/y-planes were increased by 122% when compared without MR acquisition.

CONCLUSION:

We found evidence for the need of re-evaluating the existing positron range correction algorithms for PET-MRI.



	Mean 3D range (mm)		Mean 3D range (mm)		FWHM (mm)	
	0 T		3 T		0 T	
	Soft	Lung	Soft	Lung	Soft	Lung
¹⁸ F	0.53	2.15	0.52	1.70	0.22	0.52
¹¹ C	1.03	3.88	0.98	2.51	0.27	1.03
¹⁵ O	2.41	9.12	2.06	5.32	0.75	4.10
⁶⁸ Ga	2.32	4.93	2.04	1.24	1.41	5.01
¹²⁴ I	1.82	7.30	1.61	4.12	1.72	6.08

Figure 1. Axial view (top left) of the GE SIGNA 3 T PET/MR system composed of 5 rings of 28 detector blocks and point source is placed in the center of the PET/MR scanner. (Top right) 3D reconstruction for the ⁶⁸Ga in the Lung and energy spectrum of the detected events. (Bottom middle) shows the mean 3D with 0 and 3T acquisition and FWHM for soft and lung tissue.