PERFORMANCE CHARACTERISTIC OF THE NIH ATLAS SMALL ANIMAL PET SCANNER

J. Seidel*, I. Lee*, F. J. Barbosa†, M. Desco‡, J. Pascau‡, C. A. Johnson§, S. Riboldi*, M. V. Green*, J. J. Vaquero*‡, V. G. Zavarzin**

National Institutes of Health, *Nuclear Medicine, Clinical Center and §Center for Information Technology; †Physics Division, Thomas Jefferson National Accelerator Facility; ‡UMCE, Hospital General Universitario "Gregorio Maranon"; **DAQ Technology Department, A & D Precision, Co.

Introduction: The Advanced Technology Laboratory Animal Scanner (ATLAS) is a small animal positron emission tomography (PET) scanner with depth-of-interaction (DOI) capability designed to image animals the size of mice and rats. We report performance measurements and show animal studies that suggest that ATLAS offers advantages over systems without DOI capability.

Methods and Materials: ATLAS (Figure 1) consists of eighteen detector modules arranged around an 18-sided polygon each of which is comprised of a 9 x 9 array of optically isolated phoswich elements. Each
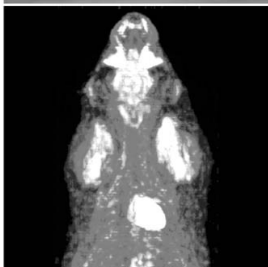
phoswich element is comprised of an entrance LGSO crystal (2 x 2 x 7mm) optically glued to a GSO exit crystal (2 x 2 x 8 mm). The exit array is glued to the flat glass face of a position-sensitive photomultiplier tube. Ring diameter is 11.8 cm, aperture 8 cm, effective field-of-view 6 cm and axial field-of-view 2 cm. Data collection is 3-D with each module in time coincidence with the opposite seven modules. DOI (or scintillator-of-interaction) is determined by a method that depends on the different light decay times of the scintillators: LGSO: 40 ns, GSO: 60 ns.

Performance measurements were made on ATLAS that included spatial resolution, sensitivity, NEC rates and scatter fractions for rat and mousesized objects. Animal studies were also performed to qualitatively evaluate 2-D FORE and 3-D OSEM ExPo reconstructed image quality under realistic operating conditions.

Results: Representative performances estimates for ATLAS are shown in Table 1. An example image from a rat FDG study is shown in Figure 1.

Table 1.	
Spatial Resolution (central/FBP)	1,8 mm radial
Spatial Resolution (central/3DOSE/ExPo)	1,3 mm radial
Spatial Resolution (@2 cm/FBP)	2,3 mm radial
Spatial Resolution (@2 cm/3DOSE/ExPo)	1,3 mm radial
Central Point Source Sensitivty (>100 keV)	2,70%
Central Point Source Sensitivty (>250 keV)	1,80%
Peak NEC rate (mouse/>100 keV, >250 keV)	18,3K/sec, 13,3K/sec @ 11 uCi/ml
Peak NEC rate (rat/>100 keV, >250 keV)	11,3K/sec, 8,8K/sec @ 4 uCi/ml
Scatter Fraction (mouse/>100 keV, >250 keV)	0,25, 0,18
Scatter Fraction (rat/>100 keV, >250 keV)	0,34, 0,25

Discussion and Conclusion: DOI detector modules allow ring diameter to be reduced and crystal thickness maintained while suppressing degradation of radial resolution with increasing radius. As a result, the sensitivity of ATLAS (1.8%, >250 keV) is extremely high for a machine.