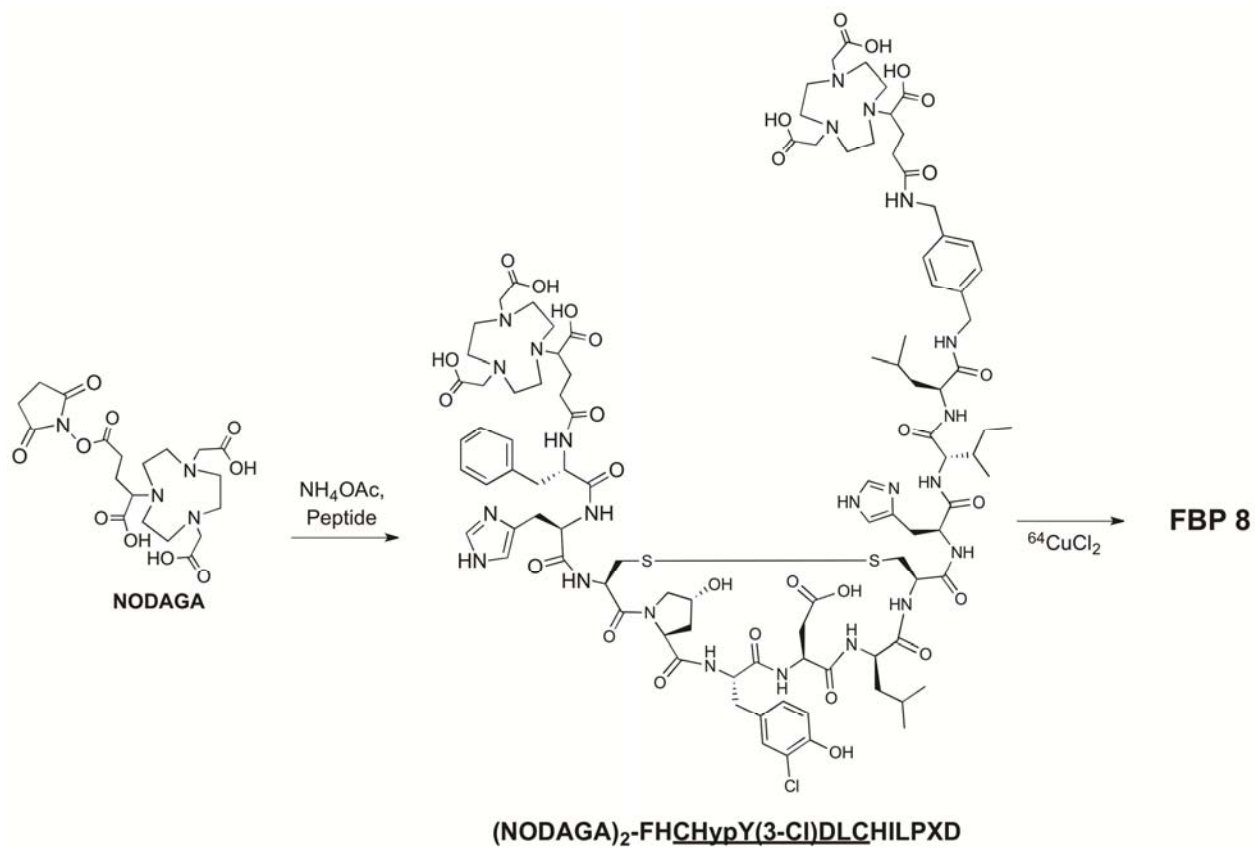


SUPPLEMENTAL METHODS

PET/MR acquisition and analysis

PET data were acquired using the BrainPET, a MR compatible PET scanner that operates inside of a Magnetom TIM Trio 3T MRI (Siemens) and provides an axial field of view of ~20 cm, covering the whole rat body length. The list-mode emission data were rebinned in the sinogram space for fast reconstruction. The uncorrected PET volume was first reconstructed and binary segmented based on an empirically determined threshold in soft tissue and air. A uniform linear attenuation coefficient (0.096 cm^{-1} , corresponding to water at 511 keV) was assigned to all soft tissue voxels and the resulting attenuation map (combined with the coil attenuation map) was forward projected to derive the attenuation correction factors in sinogram space. The scatter sinogram is obtained using a fully 3D scatter calculation method based on the single scatter estimation method. First the normalization and attenuation corrected emission volume is reconstructed. Second, a scatter estimate is obtained by Monte Carlo simulations from this volume and the attenuation map. Third, this scatter estimate is scaled axially to fit the tails of the normalized true data which accounts for the out of field of view scatter. The normalization was calculated from a 64 hr scan of a plane-source rotated in the FOV. The images were reconstructed with the ordinary Poisson ordered subsets expectation maximization (OP-OSEM) algorithm using 16 subsets and 6 iterations. The reconstructed volume consists of 153 slices with 256×256 pixels ($1.25 \times 1.25 \times 1.25 \text{ mm}^3$). The spatial resolution at the center of the field of view is approximately 2.5 mm. MR imaging was performed simultaneously to the PET acquisition. 3D gradient echo T1-weighted time-of-flight (TOF) MR angiography sequences were performed with an echo time of 3.86 ms, repetition time of 21 ms, flip angle of 18° , field of view = 9×18 cm, bandwidth = 178 Hz/pixel, 2 averages, and an acquisition time of 15.3 min. TOF data was

reconstructed into $256 \times 256 \times 128$ matrices with an in-plane pixel spacing of $0.703 \times 0.703 \text{ mm}^2$, and a slice thickness of 0.7 mm.



Supplemental figure 1. Synthesis and chemical structure of ^{64}Cu -FBP8.

Supplemental Table 1

OLINDA - Organ Level Internal Dose Assessment Code (copyright Vanderbilt University, 2003)

NOTE: This code gives doses for stylized models of average individuals - results should be applied with caution to specific human subjects.

NOTE: Users should always carefully check input data (shown below) and critically review the reported results.

Organ Doses (mSv/MBq), Nuclide: Cu-64 (1.27E01 hr), Adult Male

Target Organ	Alpha	Beta	Photon	Total	EDE Cont.	ED Cont.
Adrenals	0.00E000	4.22E-05	7.35E-03	7.40E-03	4.44E-04	1.85E-05
Brain	0.00E000	1.13E-04	8.99E-05	2.03E-04	0.00E000	5.08E-07
Breasts	0.00E000	2.20E-04	6.20E-04	8.41E-04	1.26E-04	4.20E-05
Gallbladder Wall	0.00E000	2.20E-04	6.19E-03	6.41E-03	0.00E000	0.00E000
LLI Wall	0.00E000	2.20E-04	2.71E-03	2.93E-03	0.00E000	3.51E-04
Small Intestine	0.00E000	4.51E-03	3.22E-03	7.74E-03	4.64E-04	1.93E-05
Stomach Wall	0.00E000	6.06E-04	2.77E-03	3.38E-03	0.00E000	4.05E-04
ULI Wall	0.00E000	2.20E-04	3.24E-03	3.46E-03	0.00E000	8.64E-06
Heart Wall	0.00E000	3.91E-04	1.58E-03	1.97E-03	0.00E000	0.00E000
Kidneys	0.00E000	3.96E-01	4.47E-02	4.41E-01	2.64E-02	1.10E-02
Liver	0.00E000	2.56E-02	8.73E-03	3.44E-02	2.06E-03	1.72E-03
Lungs	0.00E000	1.15E-03	1.40E-03	2.55E-03	3.06E-04	3.06E-04
Muscle	0.00E000	2.20E-04	1.70E-03	1.92E-03	0.00E000	4.81E-06
Ovaries	0.00E000	9.86E-05	2.86E-03	2.96E-03	7.39E-04	5.91E-04
Pancreas	0.00E000	2.20E-04	5.44E-03	5.66E-03	0.00E000	1.42E-05
Red Marrow	0.00E000	1.59E-04	2.29E-03	2.45E-03	2.94E-04	2.94E-04
Osteogenic Cells	0.00E000	5.61E-04	1.25E-03	1.81E-03	5.42E-05	1.81E-05
Skin	0.00E000	2.20E-04	8.08E-04	1.03E-03	0.00E000	1.03E-05
Spleen	0.00E000	6.23E-04	5.78E-03	6.40E-03	0.00E000	1.60E-05
Testes	0.00E000	2.20E-04	1.47E-03	1.69E-03	0.00E000	0.00E000
Thymus	0.00E000	2.20E-04	5.86E-04	8.06E-04	0.00E000	2.02E-06
Thyroid	0.00E000	2.20E-04	2.51E-04	4.71E-04	1.41E-05	2.36E-05
Urinary Bladder Wall	0.00E000	1.26E-01	2.00E-02	1.46E-01	8.76E-03	7.30E-03
Uterus	0.00E000	4.72E-04	5.12E-03	5.59E-03	0.00E000	1.40E-05
Total Body	0.00E000	2.64E-03	1.96E-03	4.60E-03	0.00E000	0.00E000
Effective Dose Equivalent (mSv/MBq)					3.97E-02	

Effective Dose (mSv/MBq)

2.22E-02

Organ Doses (rem/mCi), Nuclide: Cu-64 (1.27E01 hr), Adult Male

Target Organ	Alpha	Beta	Photon	Total	EDE Cont.	ED Cont.
Adrenals	0.00E000	1.56E-04	2.72E-02	2.74E-02	1.64E-03	6.84E-05
Brain	0.00E000	4.19E-04	3.33E-04	7.52E-04	0.00E000	1.88E-06
Breasts	0.00E000	8.15E-04	2.30E-03	3.11E-03	4.67E-04	1.56E-04
Gallbladder Wall	0.00E000	8.15E-04	2.29E-02	2.37E-02	0.00E000	0.00E000
LLI Wall	0.00E000	8.15E-04	1.00E-02	1.08E-02	0.00E000	1.30E-03
Small Intestine	0.00E000	1.67E-02	1.19E-02	2.86E-02	1.72E-03	7.16E-05
Stomach Wall	0.00E000	2.24E-03	1.02E-02	1.25E-02	0.00E000	1.50E-03
ULI Wall	0.00E000	8.15E-04	1.20E-02	1.28E-02	0.00E000	3.20E-05
Heart Wall	0.00E000	1.45E-03	5.85E-03	7.30E-03	0.00E000	0.00E000
Kidneys	0.00E000	1.46E000	1.66E-01	1.63E000	9.78E-02	4.08E-02
Liver	0.00E000	9.49E-02	3.23E-02	1.27E-01	7.63E-03	6.36E-03
Lungs	0.00E000	4.25E-03	5.17E-03	9.42E-03	1.13E-03	1.13E-03
Muscle	0.00E000	8.15E-04	6.31E-03	7.12E-03	0.00E000	1.78E-05
Ovaries	0.00E000	3.65E-04	1.06E-02	1.09E-02	2.74E-03	2.19E-03
Pancreas	0.00E000	8.15E-04	2.01E-02	2.09E-02	0.00E000	5.24E-05
Red Marrow	0.00E000	5.87E-04	8.47E-03	9.06E-03	1.09E-03	1.09E-03
Osteogenic Cells	0.00E000	2.07E-03	4.61E-03	6.69E-03	2.01E-04	6.69E-05
Skin	0.00E000	8.15E-04	2.99E-03	3.80E-03	0.00E000	3.80E-05
Spleen	0.00E000	2.31E-03	2.14E-02	2.37E-02	0.00E000	5.92E-05
Testes	0.00E000	8.15E-04	5.43E-03	6.24E-03	0.00E000	0.00E000
Thymus	0.00E000	8.15E-04	2.17E-03	2.98E-03	0.00E000	7.46E-06
Thyroid	0.00E000	8.15E-04	9.29E-04	1.74E-03	5.23E-05	8.72E-05
Urinary Bladder Wall	0.00E000	4.66E-01	7.40E-02	5.40E-01	3.24E-02	2.70E-02
Uterus	0.00E000	1.75E-03	1.89E-02	2.07E-02	0.00E000	5.17E-05
Total Body	0.00E000	9.75E-03	7.26E-03	1.70E-02	0.00E000	0.00E000

Effective Dose Equivalent (rem/mCi)

1.47E-01

Effective Dose (rem/mCi)

8.20E-02

Number of Disintegrations in Source Organs:

Adrenals	9.60E-06	MBq-h/MBq or uCi-h/uCi
Brain	2.24E-03	MBq-h/MBq or uCi-h/uCi
Breasts	0.00E000	MBq-h/MBq or uCi-h/uCi

Gallbladder Contents	0.00E000	MBq-h/MBq or uCi-h/uCi
LLI	0.00E000	MBq-h/MBq or uCi-h/uCi
Small Intestine	5.06E-02	MBq-h/MBq or uCi-h/uCi
Stomach	2.80E-03	MBq-h/MBq or uCi-h/uCi
ULI	0.00E000	MBq-h/MBq or uCi-h/uCi
Heart Contents	0.00E000	MBq-h/MBq or uCi-h/uCi
Heart Wall	1.72E-03	MBq-h/MBq or uCi-h/uCi
Kidneys	1.65E000	MBq-h/MBq or uCi-h/uCi
Liver	6.82E-01	MBq-h/MBq or uCi-h/uCi
Lungs	1.60E-02	MBq-h/MBq or uCi-h/uCi
Muscle	0.00E000	MBq-h/MBq or uCi-h/uCi
Ovaries	1.20E-05	MBq-h/MBq or uCi-h/uCi
Pancreas	0.00E000	MBq-h/MBq or uCi-h/uCi
Red Marrow	0.00E000	MBq-h/MBq or uCi-h/uCi
Cortical Bone	0.00E000	MBq-h/MBq or uCi-h/uCi
Trabecular Bone	0.00E000	MBq-h/MBq or uCi-h/uCi
Spleen	1.59E-03	MBq-h/MBq or uCi-h/uCi
Testes	0.00E000	MBq-h/MBq or uCi-h/uCi
Thymus	0.00E000	MBq-h/MBq or uCi-h/uCi
Thyroid	0.00E000	MBq-h/MBq or uCi-h/uCi
Urinary Bladder Contents	7.39E-01	MBq-h/MBq or uCi-h/uCi
Uterus/Uterine Wall	5.20E-04	MBq-h/MBq or uCi-h/uCi
Remainder	2.26E-01	MBq-h/MBq or uCi-h/uCi

Dynamic bladder model used:

Fraction: 0.81

T-bio: 0.89 hr

Fraction: 0.15

T-bio: 6.3 hr

Void Interval: 1.5 hr

Target Organ Masses:

Adrenals	1.63E001 g
Brain	1.42E003 g
Breasts	3.51E002 g
Gallbladder Wall	1.05E001 g
LLI Wall	1.67E002 g
Small Intestine	6.77E002 g
Stomach Wall	1.58E002 g

ULI Wall	2.20E002 g
Heart Wall	3.16E002 g
Kidneys	2.99E002 g
Liver	1.91E003 g
Lungs	1.00E003 g
Muscle	2.80E004 g
Ovaries	8.71E000 g
Pancreas	9.43E001 g
Red Marrow	1.12E003 g
Osteogenic Cells	1.20E002 g
Skin	3.01E003 g
Spleen	1.83E002 g
Testes	3.91E001 g
Thymus	2.09E001 g
Thyroid	2.07E001 g
Urinary Bladder Wall	4.76E001 g
Uterus	7.90E001 g
Total Body	7.37E004 g

* Mass modified by user

Radiation Weighting Factors:

Alpha: 5.00E00
Beta: 1.00E00
Photon: 1.00E00

** Weighting factor modified by user

OLINDA - Organ Level Internal Dose Assessment Code (copyright Vanderbilt University, 2003)

NOTE: This code gives doses for stylized models of average individuals - results should be applied with caution to specific human subjects.

NOTE: Users should always carefully check input data (shown below) and critically review the reported results.

Organ Doses (mSv/MBq), Nuclide: Cu-64 (1.27E01 hr), Adult Female

Target Organ	Alpha	Beta	Photon	Total	EDE Cont.	ED Cont.
Adrenals	0.00E000	4.91E-05	9.67E-03	9.72E-03	5.83E-04	2.43E-05
Brain	0.00E000	1.34E-04	1.14E-04	2.48E-04	0.00E000	6.19E-07
Breasts	0.00E000	2.85E-04	7.73E-04	1.06E-03	1.59E-04	5.29E-05
Gallbladder Wall	0.00E000	2.85E-04	7.04E-03	7.32E-03	0.00E000	0.00E000
LLI Wall	0.00E000	2.85E-04	3.47E-03	3.75E-03	0.00E000	4.50E-04
Small Intestine	0.00E000	5.13E-03	4.28E-03	9.41E-03	5.64E-04	2.35E-05
Stomach Wall	0.00E000	7.22E-04	3.19E-03	3.91E-03	0.00E000	4.70E-04
ULI Wall	0.00E000	2.85E-04	4.06E-03	4.34E-03	0.00E000	1.09E-05
Heart Wall	0.00E000	5.15E-04	2.08E-03	2.60E-03	0.00E000	0.00E000
Kidneys	0.00E000	4.30E-01	4.80E-02	4.78E-01	2.87E-02	1.20E-02
Liver	0.00E000	3.50E-02	1.07E-02	4.56E-02	2.74E-03	2.28E-03
Lungs	0.00E000	1.44E-03	1.94E-03	3.38E-03	4.05E-04	4.05E-04
Muscle	0.00E000	2.85E-04	2.10E-03	2.39E-03	0.00E000	5.97E-06
Ovaries	0.00E000	7.81E-05	3.78E-03	3.85E-03	9.64E-04	7.71E-04
Pancreas	0.00E000	2.85E-04	6.40E-03	6.69E-03	0.00E000	1.67E-05
Red Marrow	0.00E000	1.97E-04	2.71E-03	2.91E-03	3.49E-04	3.49E-04
Osteogenic Cells	0.00E000	7.70E-04	1.66E-03	2.43E-03	7.30E-05	2.43E-05
Skin	0.00E000	2.85E-04	9.57E-04	1.24E-03	0.00E000	1.24E-05
Spleen	0.00E000	7.60E-04	7.12E-03	7.88E-03	0.00E000	1.97E-05
Thymus	0.00E000	2.85E-04	7.37E-04	1.02E-03	0.00E000	2.56E-06
Thyroid	0.00E000	2.85E-04	2.79E-04	5.65E-04	1.69E-05	2.82E-05
Urinary Bladder Wall	0.00E000	1.66E-01	3.20E-02	1.98E-01	1.19E-02	9.91E-03
Uterus	0.00E000	4.66E-04	6.03E-03	6.50E-03	0.00E000	1.63E-05
Total Body	0.00E000	3.41E-03	2.44E-03	5.85E-03	0.00E000	0.00E000
Effective Dose Equivalent (mSv/MBq)					4.65E-02	
Effective Dose (mSv/MBq)						2.68E-02

Organ Doses (rem/mCi), Nuclide: Cu-64 (1.27E01 hr), Adult Female

Target Organ	Alpha	Beta	Photon	Total	EDE Cont.	ED Cont.
Adrenals	0.00E000	1.82E-04	3.58E-02	3.59E-02	2.16E-03	8.99E-05
Brain	0.00E000	4.96E-04	4.21E-04	9.17E-04	0.00E000	2.29E-06
Breasts	0.00E000	1.06E-03	2.86E-03	3.91E-03	5.87E-04	1.96E-04
Gallbladder Wall	0.00E000	1.06E-03	2.60E-02	2.71E-02	0.00E000	0.00E000
LLI Wall	0.00E000	1.06E-03	1.28E-02	1.39E-02	0.00E000	1.67E-03
Small Intestine	0.00E000	1.90E-02	1.58E-02	3.48E-02	2.09E-03	8.70E-05
Stomach Wall	0.00E000	2.67E-03	1.18E-02	1.45E-02	0.00E000	1.74E-03
ULI Wall	0.00E000	1.06E-03	1.50E-02	1.61E-02	0.00E000	4.02E-05
Heart Wall	0.00E000	1.90E-03	7.71E-03	9.62E-03	0.00E000	0.00E000
Kidneys	0.00E000	1.59E000	1.78E-01	1.77E000	1.06E-01	4.43E-02
Liver	0.00E000	1.29E-01	3.94E-02	1.69E-01	1.01E-02	8.44E-03
Lungs	0.00E000	5.31E-03	7.18E-03	1.25E-02	1.50E-03	1.50E-03
Muscle	0.00E000	1.06E-03	7.78E-03	8.84E-03	0.00E000	2.21E-05
Ovaries	0.00E000	2.89E-04	1.40E-02	1.43E-02	3.57E-03	2.85E-03
Pancreas	0.00E000	1.06E-03	2.37E-02	2.48E-02	0.00E000	6.19E-05
Red Marrow	0.00E000	7.29E-04	1.00E-02	1.08E-02	1.29E-03	1.29E-03
Osteogenic Cells	0.00E000	2.85E-03	6.15E-03	9.00E-03	2.70E-04	9.00E-05
Skin	0.00E000	1.06E-03	3.54E-03	4.60E-03	0.00E000	4.60E-05
Spleen	0.00E000	2.81E-03	2.64E-02	2.92E-02	0.00E000	7.29E-05
Thymus	0.00E000	1.06E-03	2.73E-03	3.78E-03	0.00E000	9.45E-06
Thyroid	0.00E000	1.06E-03	1.03E-03	2.09E-03	6.27E-05	1.04E-04
Urinary Bladder Wall	0.00E000	6.15E-01	1.19E-01	7.34E-01	4.40E-02	3.67E-02
Uterus	0.00E000	1.72E-03	2.23E-02	2.41E-02	0.00E000	6.01E-05
Total Body	0.00E000	1.26E-02	9.03E-03	2.17E-02	0.00E000	0.00E000
Effective Dose Equivalent (rem/mCi)					1.72E-01	
Effective Dose (rem/mCi)						9.93E-02

Number of Disintegrations in Source Organs:

Adrenals	9.60E-06	MBq-h/MBq or uCi-h/uCi
Brain	2.24E-03	MBq-h/MBq or uCi-h/uCi
Breasts	0.00E000	MBq-h/MBq or uCi-h/uCi
Gallbladder Contents	0.00E000	MBq-h/MBq or uCi-h/uCi
LLI	0.00E000	MBq-h/MBq or uCi-h/uCi
Small Intestine	5.06E-02	MBq-h/MBq or uCi-h/uCi
Stomach	2.80E-03	MBq-h/MBq or uCi-h/uCi

ULI	0.00E000	MBq-h/MBq or uCi-h/uCi
Heart Contents	0.00E000	MBq-h/MBq or uCi-h/uCi
Heart Wall	1.72E-03	MBq-h/MBq or uCi-h/uCi
Kidneys	1.65E000	MBq-h/MBq or uCi-h/uCi
Liver	6.82E-01	MBq-h/MBq or uCi-h/uCi
Lungs	1.60E-02	MBq-h/MBq or uCi-h/uCi
Muscle	0.00E000	MBq-h/MBq or uCi-h/uCi
Ovaries	1.20E-05	MBq-h/MBq or uCi-h/uCi
Pancreas	0.00E000	MBq-h/MBq or uCi-h/uCi
Red Marrow	0.00E000	MBq-h/MBq or uCi-h/uCi
Cortical Bone	0.00E000	MBq-h/MBq or uCi-h/uCi
Trabecular Bone	0.00E000	MBq-h/MBq or uCi-h/uCi
Spleen	1.59E-03	MBq-h/MBq or uCi-h/uCi
Thymus	0.00E000	MBq-h/MBq or uCi-h/uCi
Thyroid	0.00E000	MBq-h/MBq or uCi-h/uCi
Urinary Bladder Contents	7.39E-01	MBq-h/MBq or uCi-h/uCi
Uterus/Uterine Wall	5.20E-04	MBq-h/MBq or uCi-h/uCi
Remainder	2.26E-01	MBq-h/MBq or uCi-h/uCi

Dynamic bladder model used:

Fraction: 0.81

T-bio: 0.89 hr

Fraction: 0.15

T-bio: 6.3 hr

Void Interval: 1.5 hr

Target Organ Masses:

Adrenals	1.40E001 g
Brain	1.20E003 g
Breasts	3.60E002 g
Gallbladder Wall	8.00E000 g
LLI Wall	1.60E002 g
Small Intestine	6.00E002 g
Stomach Wall	1.40E002 g
ULI Wall	2.00E002 g
Heart Wall	2.40E002 g
Kidneys	2.75E002 g
Liver	1.40E003 g
Lungs	8.00E002 g

Muscle	1.70E004 g
Ovaries	1.10E001 g
Pancreas	8.50E001 g
Red Marrow	1.30E003 g
Osteogenic Cells	9.00E001 g
Skin	1.79E003 g
Spleen	1.50E002 g
Thymus	2.00E001 g
Thyroid	1.70E001 g
Urinary Bladder Wall	3.59E001 g
Uterus	8.00E001 g
Total Body	5.69E004 g

* Mass modified by user

Radiation Weighting Factors:

Alpha:	5.00E00
Beta:	1.00E00
Photon:	1.00E00

** Weighting factor modified by user

Supplemental video 1. 3D rendering of a representative rat injected with ^{64}Cu -FBP8 after pulmonary embolism showing clear embolus detection with PET imaging and low background signal.