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STIR image reconstruction of a long axial field of view PET scanner for NEMA spatial resolution study

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December 3, 2020

STIR user's and developer's meeting 2020

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OUTLINE

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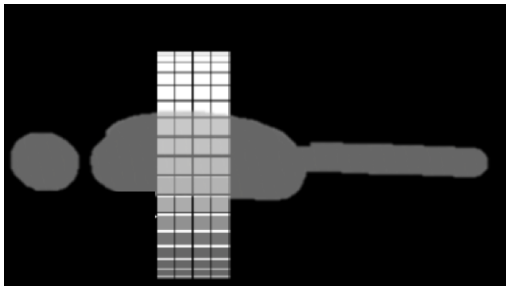
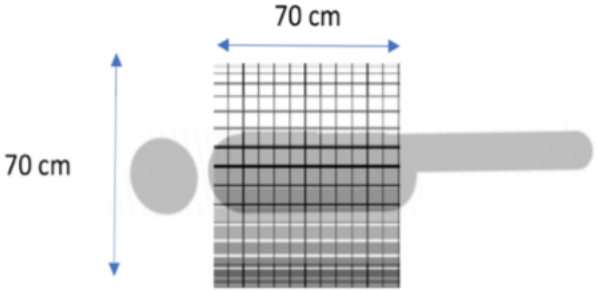
- Ugent PET system designs
- Sensitivity results
- Spatial resolution: Image reconstruction in STIR

Different system designs

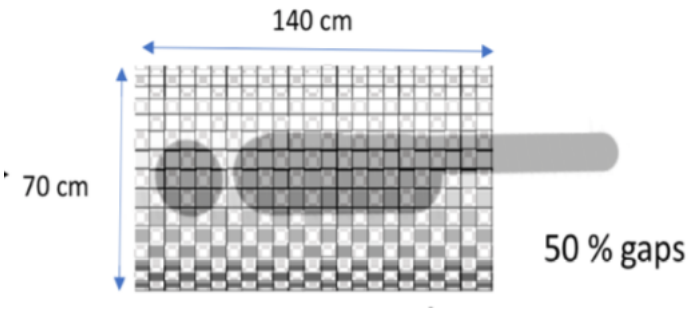
Axial ring splitting



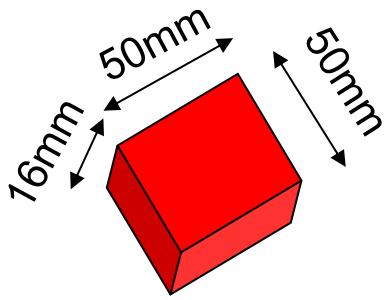
aFOV=35cm
D=70cm
40 detectors per ring



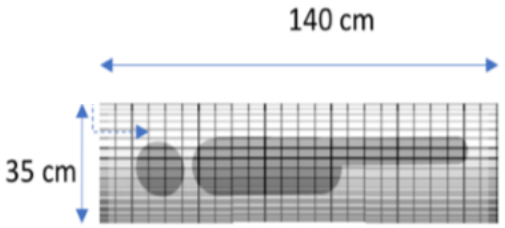
aFOV=2x35cm=70cm
D=70cm
40 detectors per ring



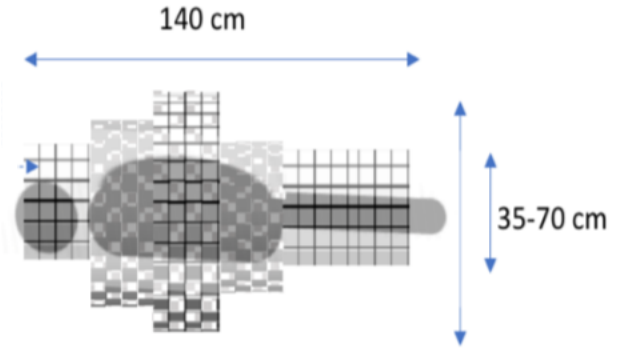
20 detectors per ring



LYSO



Pediatric mode



Adaptive design

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NEMA protocol

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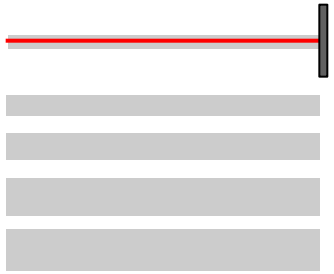
Sensitivity:

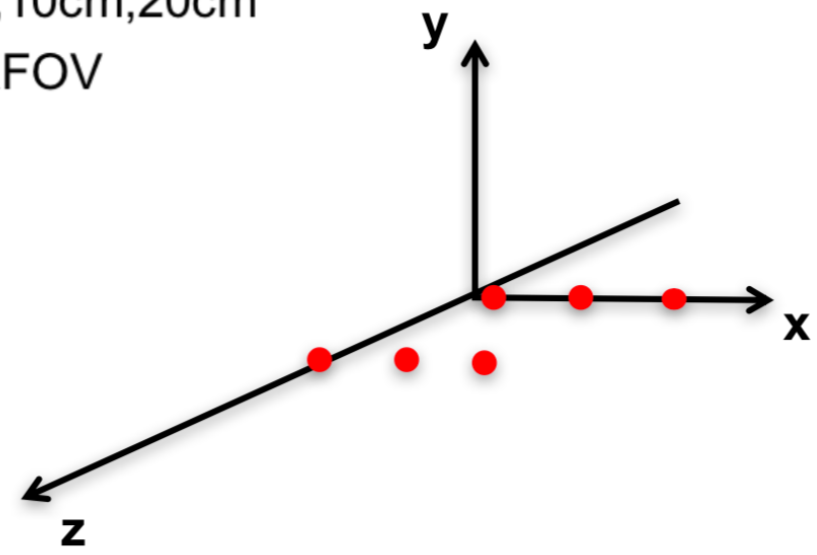
$$Sens = \frac{T}{A \times t}$$



Spatial resolution:

x=1cm,10cm,20cm

z=0, $\frac{3}{8}$aFOV



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35cm and 70cm aFOV

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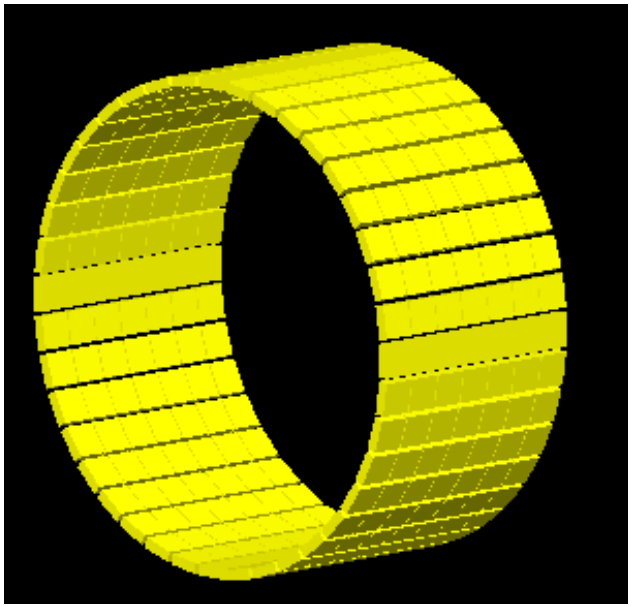
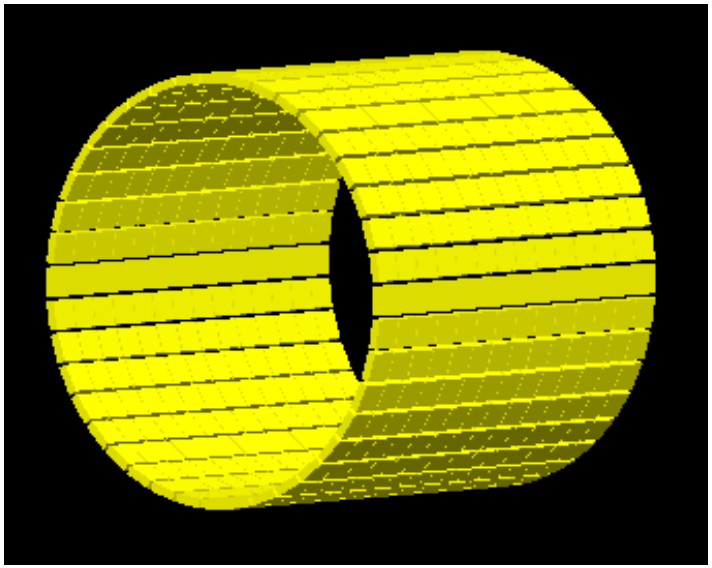


aFOV=35cm
D=70cm
40 detectors per ring
7 rings



aFOV=2x35cm=70cm
D=70cm
40 detectors per ring
14 rings

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Sensitivity study

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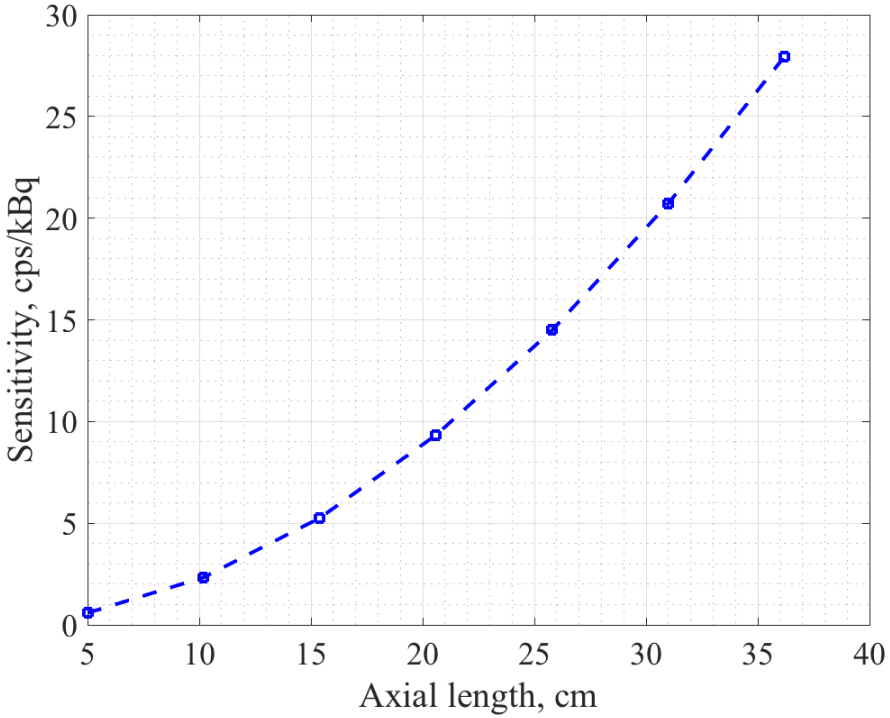
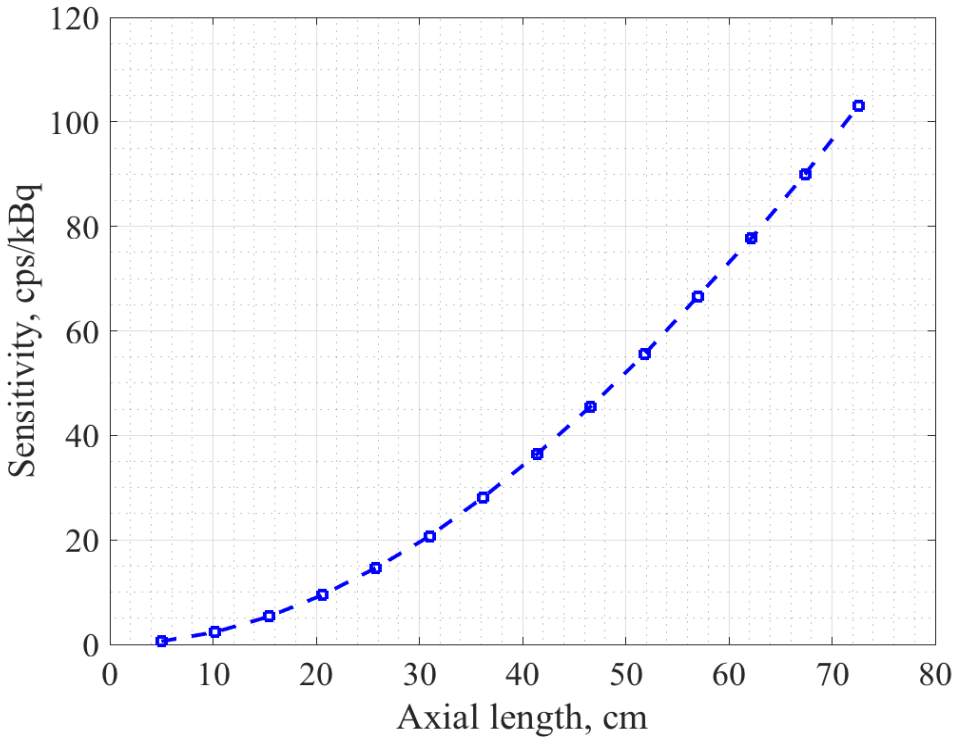
35cm aFOV



NEMA sensitivity of 28 kcps/MBq

70cm aFOV



NEMA sensitivity of 103 kcps/MBq

Biograph vision (26.1cm aFOV): NEMA sensitivity of 16.4 kcps/MBq

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Spatial resolution study

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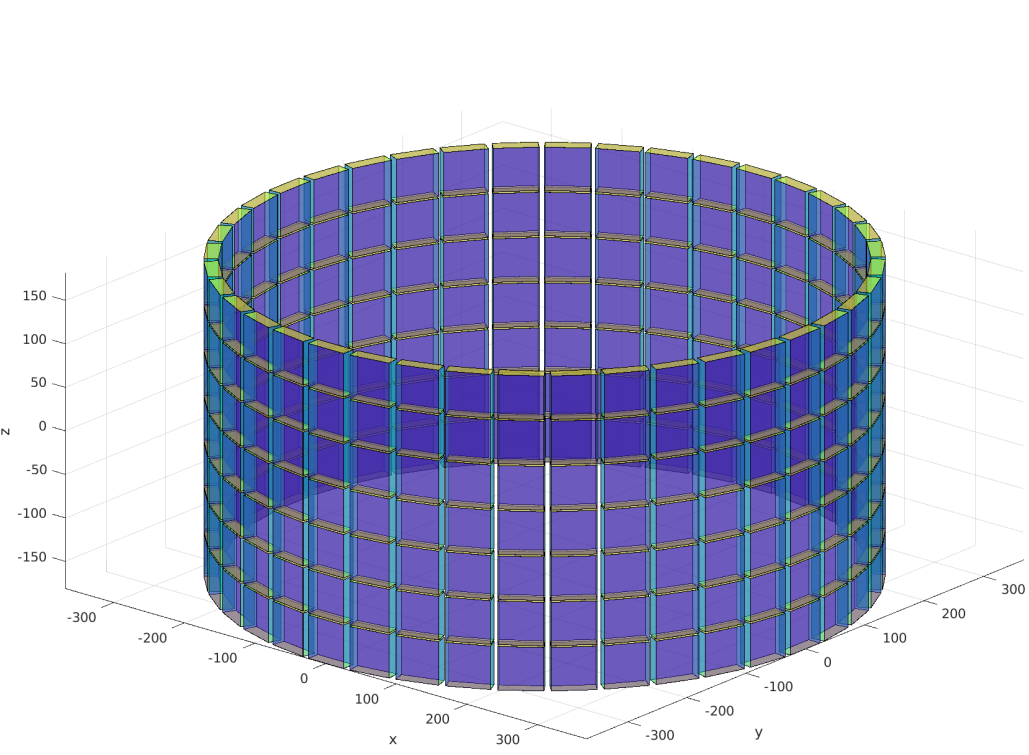
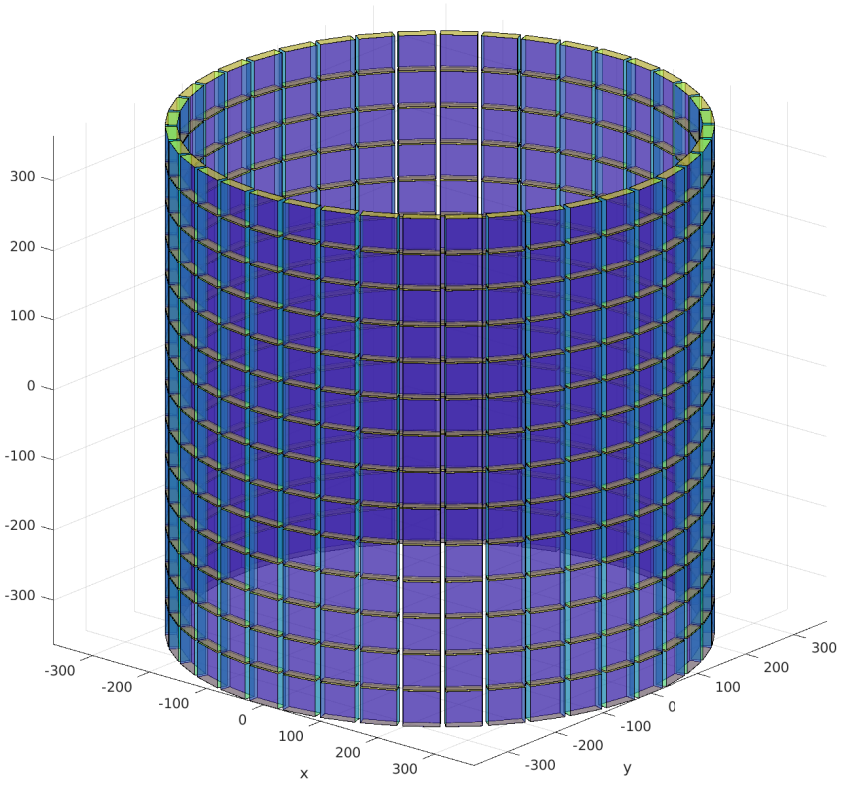
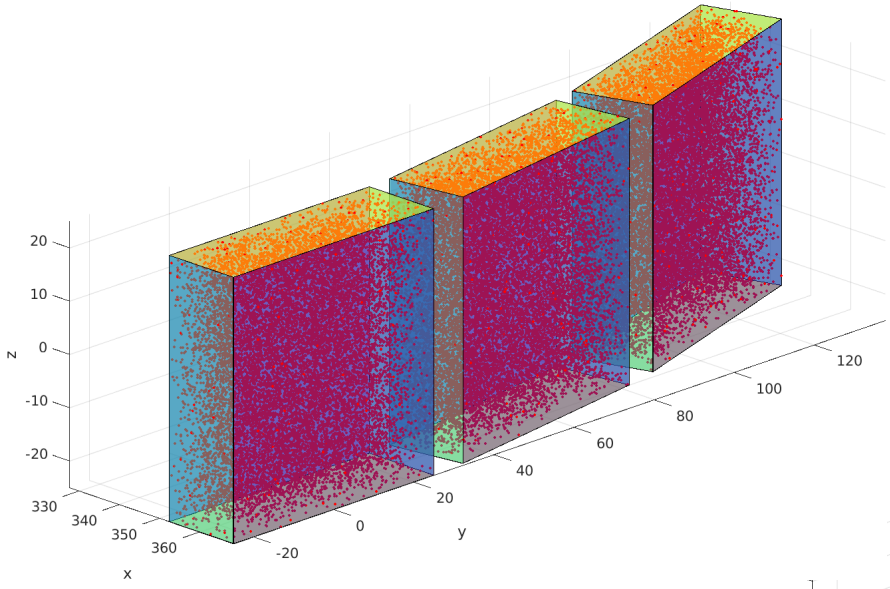
Scanner geometry in STIR



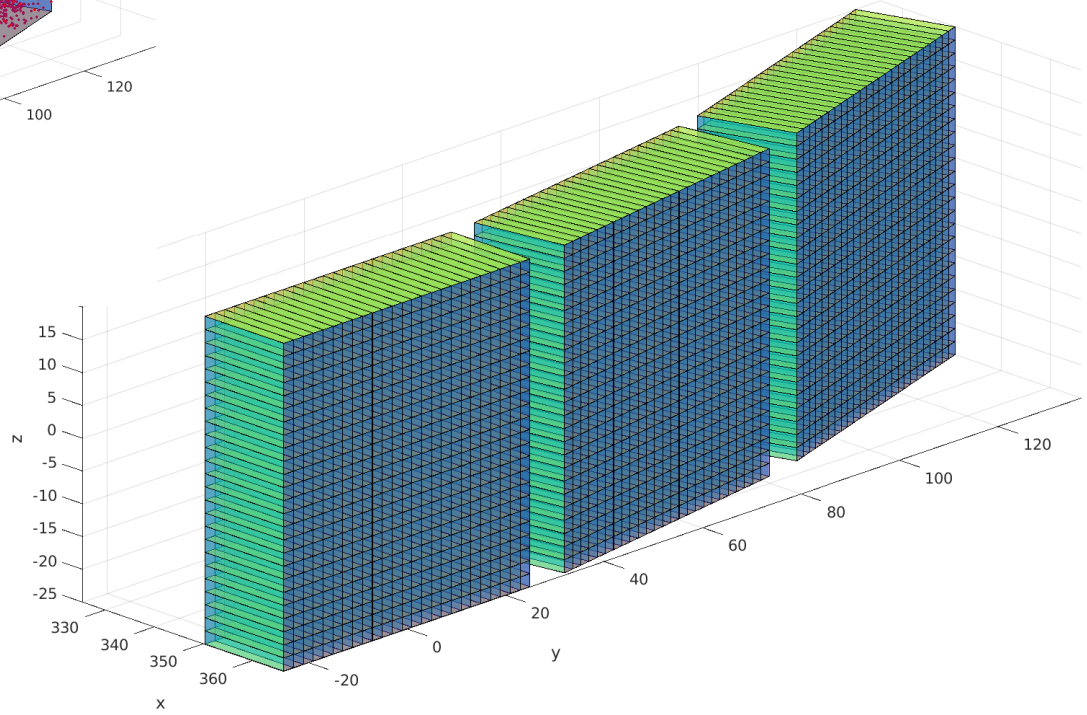


Spatial resolution study

Discretization of the blocks of detectors – crystal map



2mmx2mmx16mm



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Spatial resolution study

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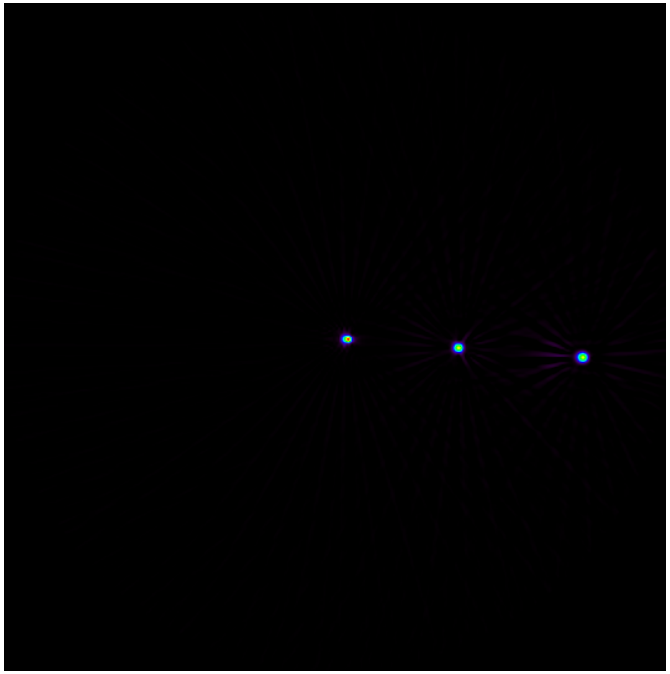
Image reconstruction in STIR using FBP:

1. Create sinogram
2. Reconstruct the image using FBP 3DRP or SSRB with 2D



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Spatial resolution study

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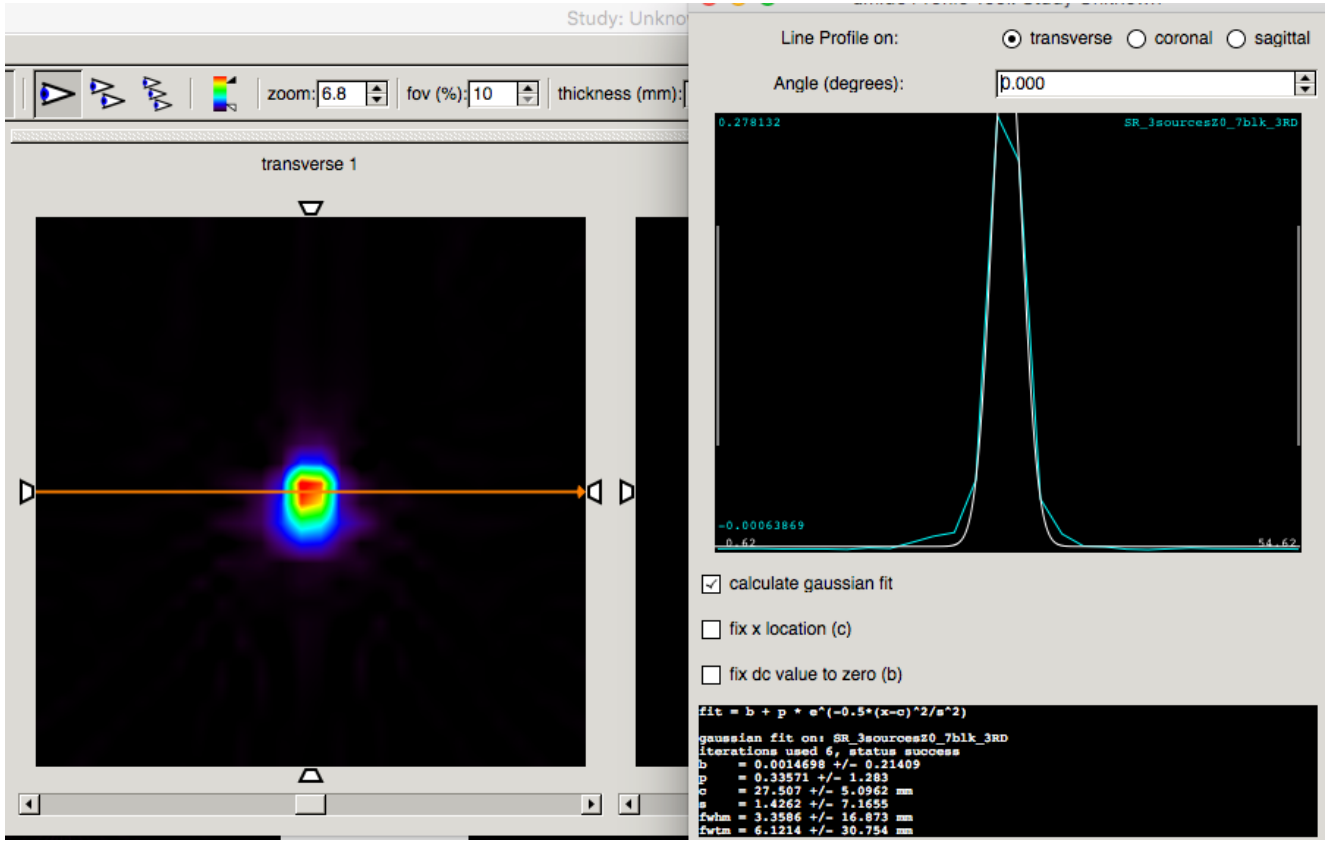
Generate line profile to find the FWHM



Three components of resolution are measured by taking profiles of the point sources. Radial and tangential components are in the transaxial plane and the axial component is along the axis of the scanner

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35cm aFOV - All segments considered – 3D

Z=0	X = 1cm	X = 10cm	X = 20cm
Radial (mm)	3.4	4.7	5.45
Tangential (mm)	5.05	5.5	6.1
Axial (mm)	3.4	3.4	3.42

Z= 3/8 aFOV	X = 1cm	X = 10cm	X = 20cm
Radial (mm)	4.2	5.1	5.9
Tangential (mm)	5.8	5.8	6.1
Axial (mm)	3.3	3.4	3.5

Spatial resolution study

70cm aFOV - 175 segments considered – 3D
(could not reconstruct all segments, sinogram 126G)

Z=0	X = 1cm	X = 10cm	X = 20cm
Radial (mm)	3.4	4.7	5.45
Tangential (mm)	5.05	5.5	6.1
Axial (mm)	3.4	3.4	3.42

Z= 3/8 aFOV	X = 1cm	X = 10cm	X = 20cm
Radial (mm)	4.2	5.1	5.9
Tangential (mm)	5.8	5.8	6.1
Axial (mm)	3.3	3.4	3.5

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Spatial resolution study

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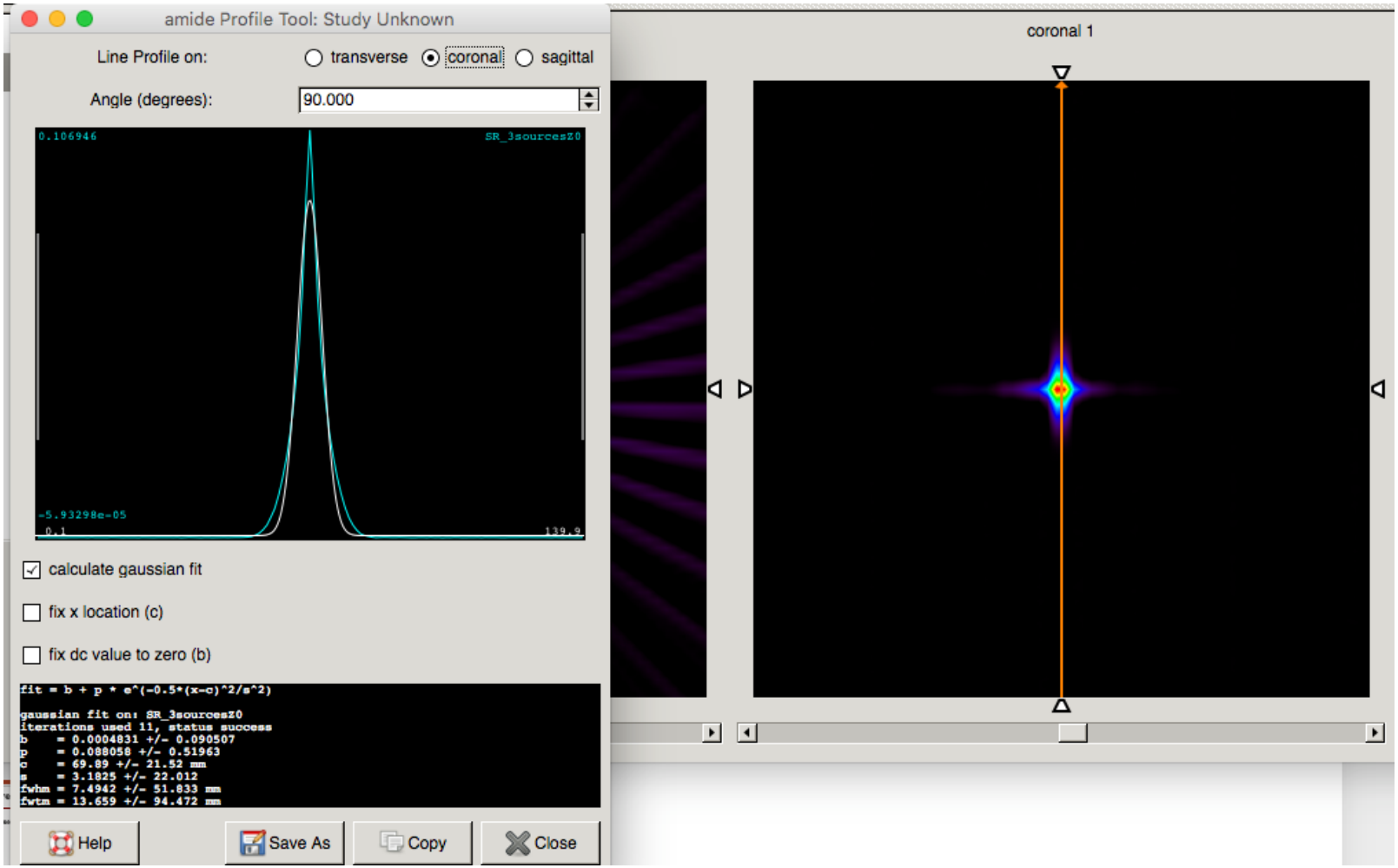
70cm aFOV –all segments considered – SSRB + 2D



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Next steps

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- Reconstruct the image in 3D for the 70cm aFOV scanner with all segments considered
- Make the code faster
- Reconstruct in listmode with MLEM
- Reconstruct the 140cm aFOV with gaps