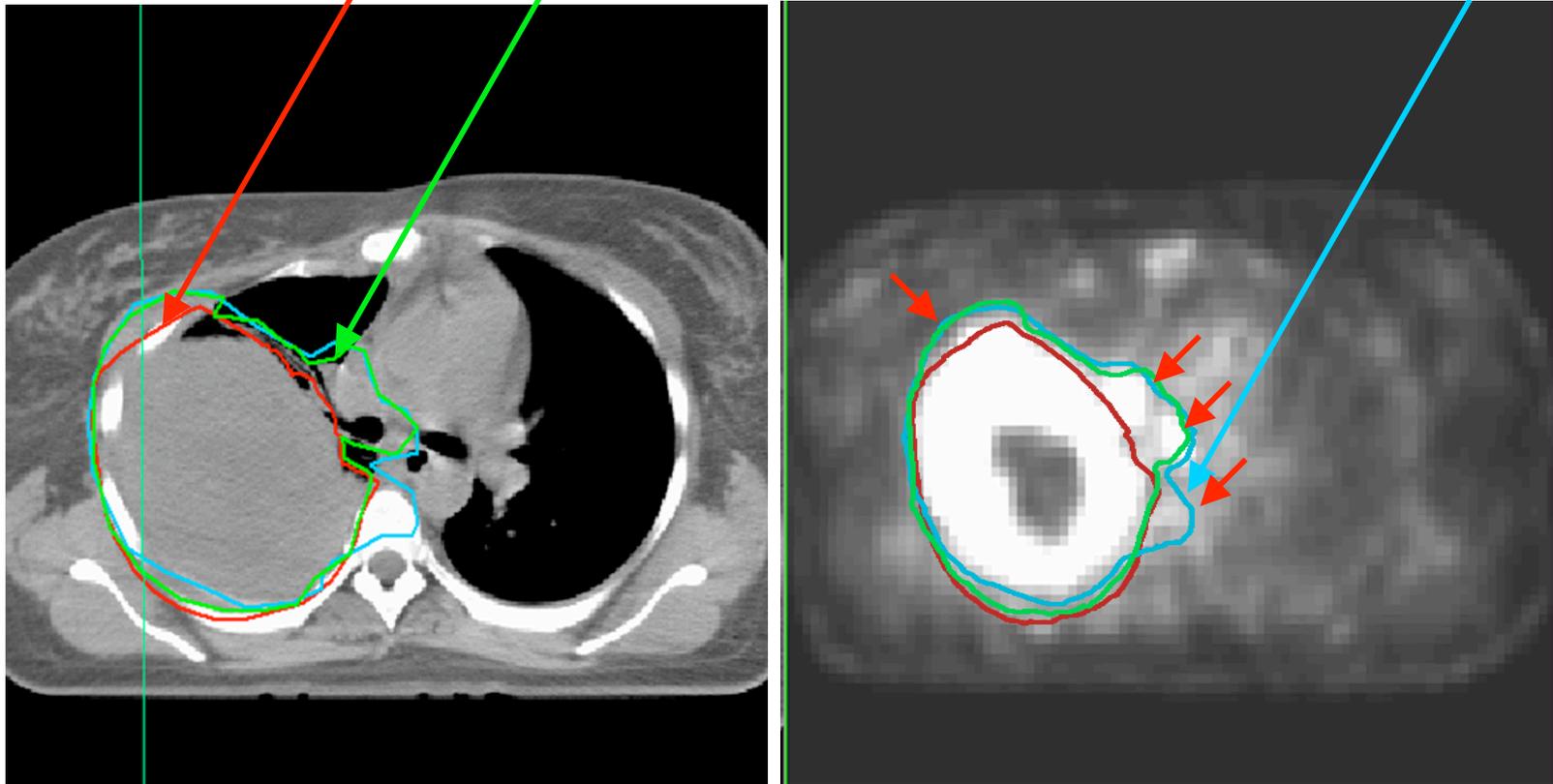


PET helps define the biologic tumor volume

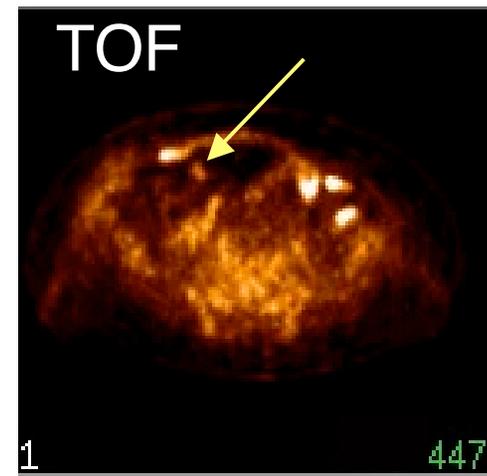
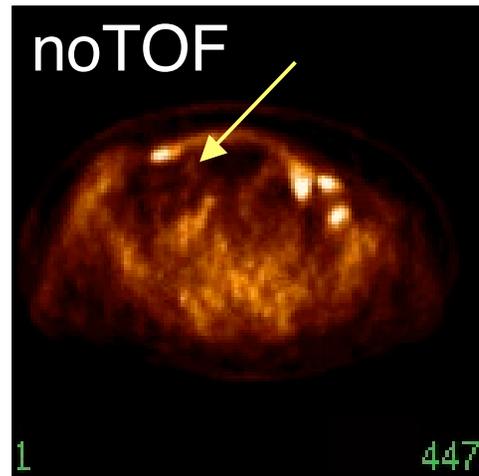
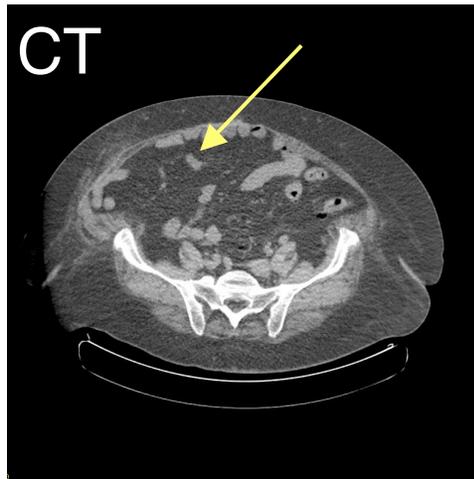
Treatment region as defined by CT

Treatment region actually used

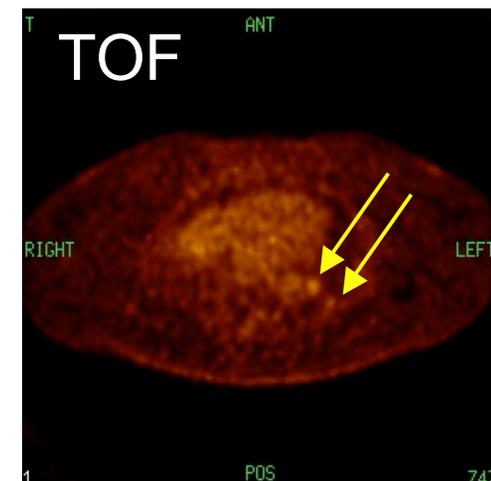
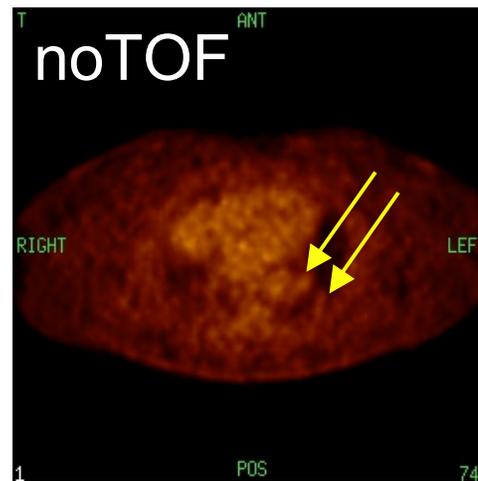
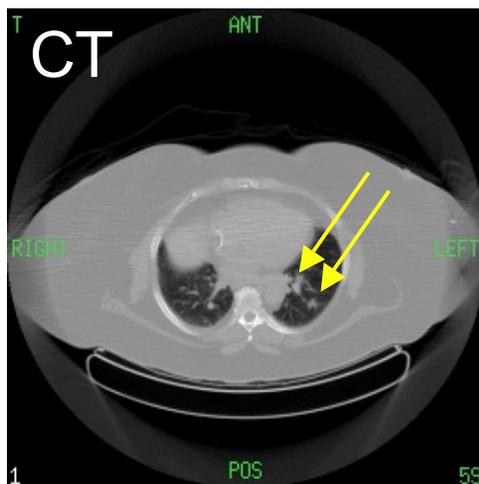
Treatment region as modified by PET



TOF improves detectability



Colon cancer, 119 kg (BMI = 46.5)

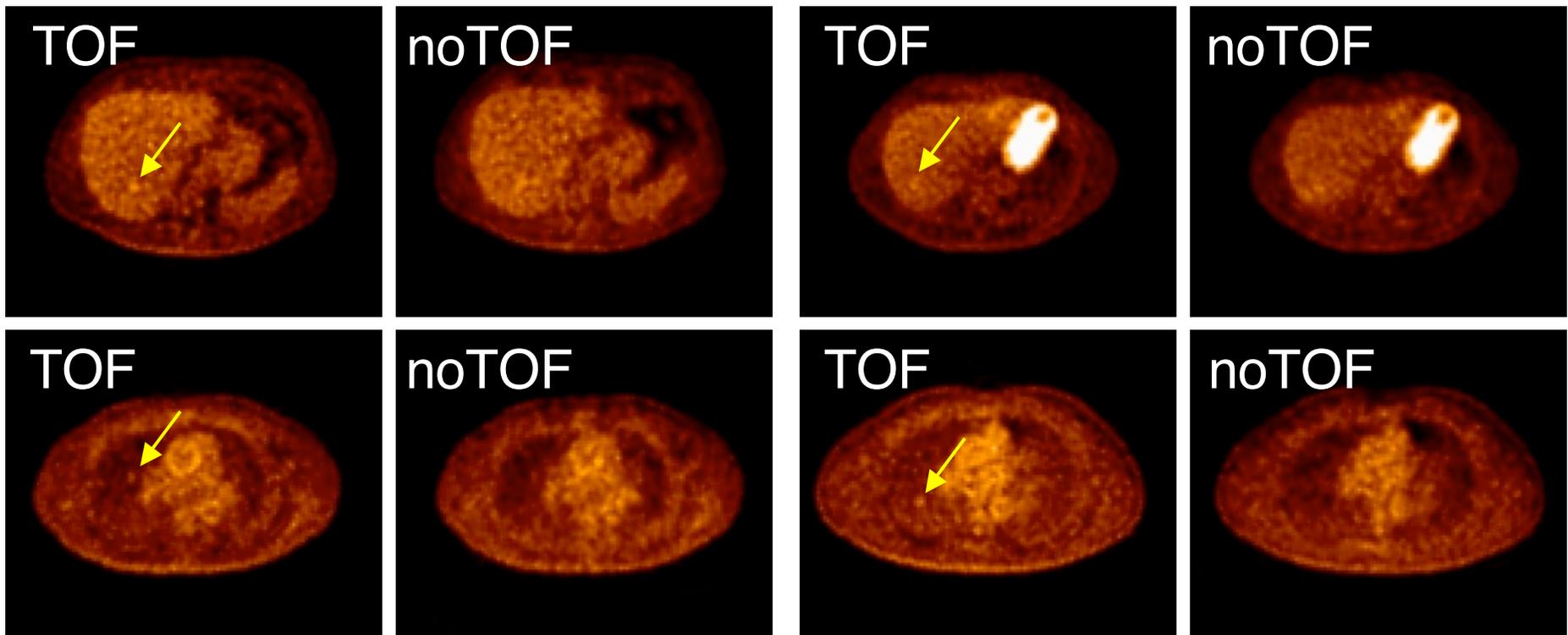
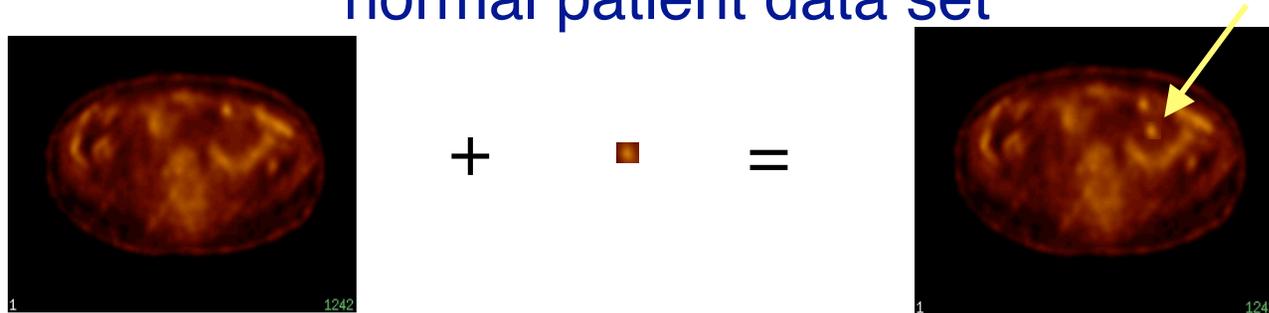


Lung cancer, 125 kg (BMI = 51)

Philips Gemini TF

LROC study with synthetic lesions:

a sphere of activity measured separately and added to normal patient data set



Metrics to quantify detectability

Computer observer

- *channelized hotelling SNR*

Human observer

- *LROC*

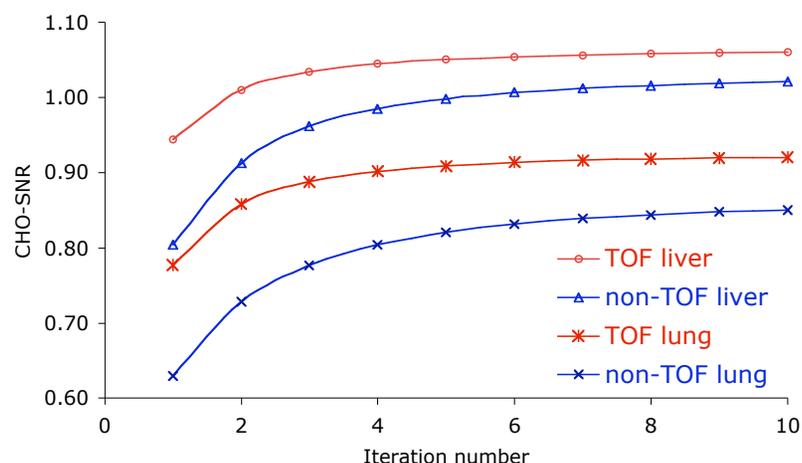
A_{LROC} of *TPF* vs. *FPF*

measures the accuracy in detection and localization for a binary task

True positive fraction $TPF = \frac{N_{TP}}{N_{TP} + N_{FN}}$

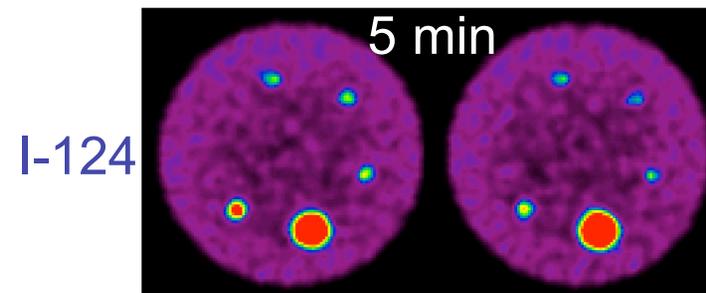
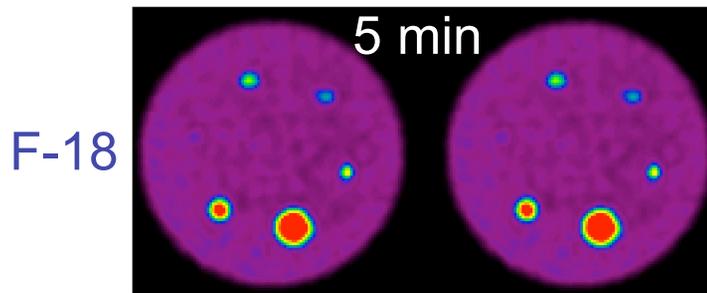
False positive fraction $FPF = \frac{N_{FP}}{N_{TN} + N_{FP}}$

**CHO-SNR in Liver and lung lesions
versus reconstruction iteration number**

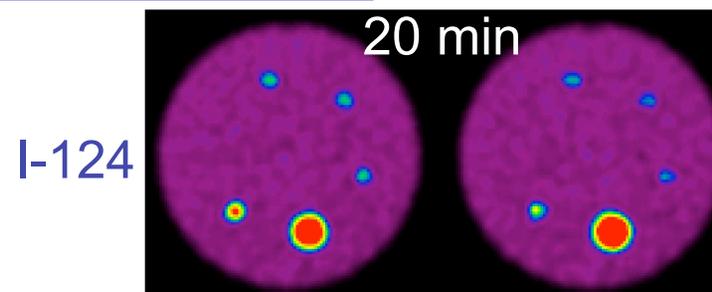
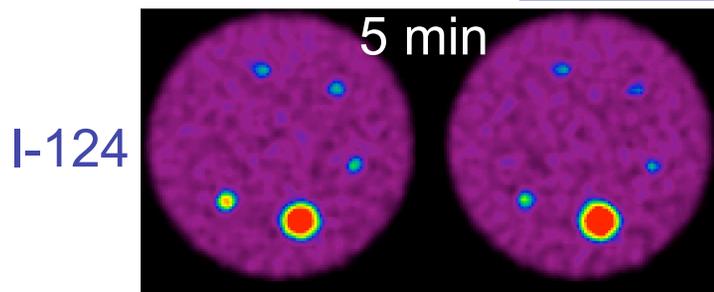


I-124 PET imaging for dose monitoring

- e^+ branching ratio of 0.23 — TOF will be helpful with low statistics
- Half of e^+ decays have a subsequent 602 keV cascade γ emission
- Correct for cascade coincidences
 - cascade γ in coincidence with γ from e^+ decay
- Need to model the radial and time profile in the “scatter” estimation



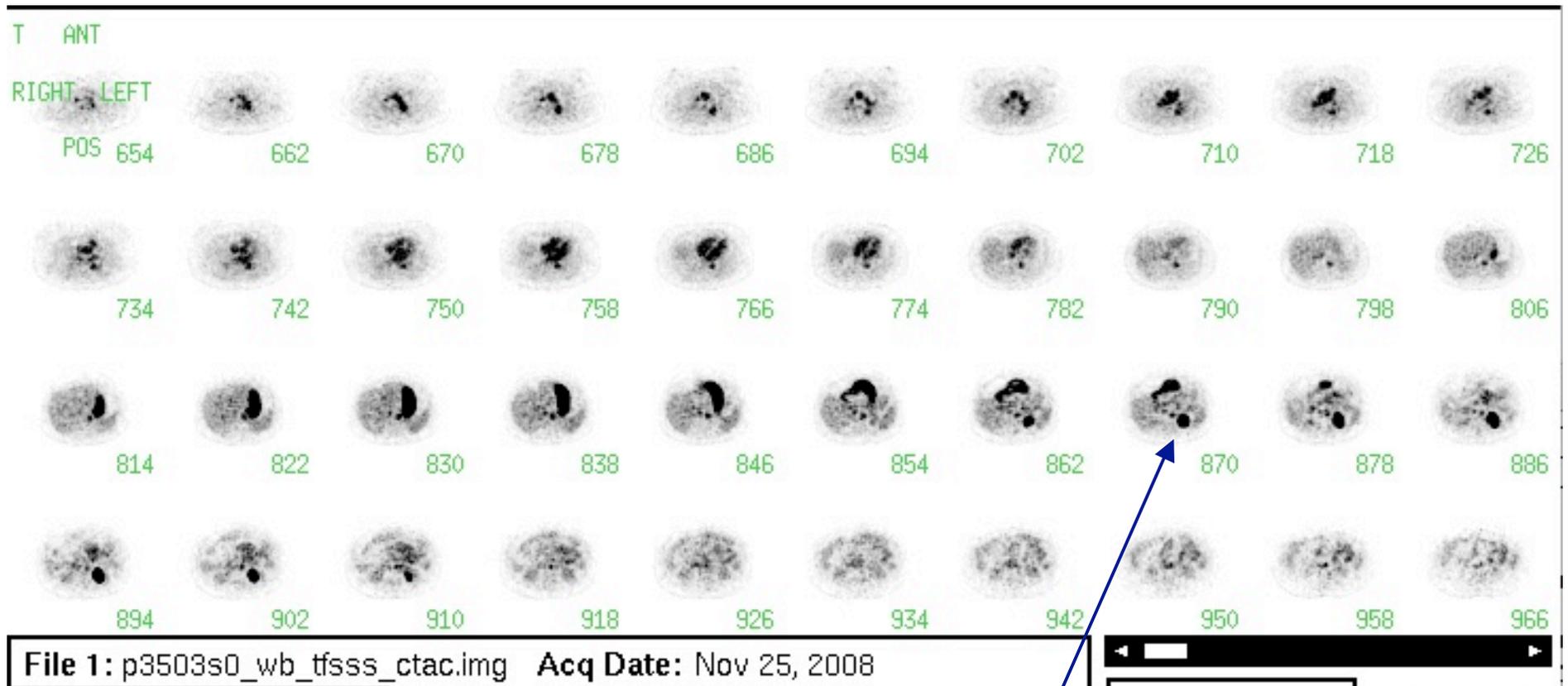
After cascade coincidence correction



20-cm lesion phantom, 6:1 contrast, 1.5mCi of activity

Monoclonal antibody (MoAb) to detect clear cell Renal Cancer

^{124}I -cG250 imaging followed by radioimmunotherapy with ^{131}I - cG250



2 mCi injection ^{124}I -cG250

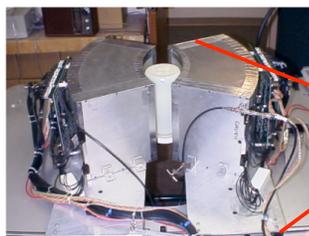
kidney uptake

Philips Gemini TF

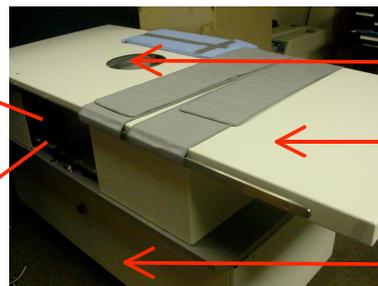
Dedicated PET instrument for breast imaging

- Improved spatial resolution
- Reduced attenuation

Split ring improves access for biopsy and allows imaging axilla



Detectors

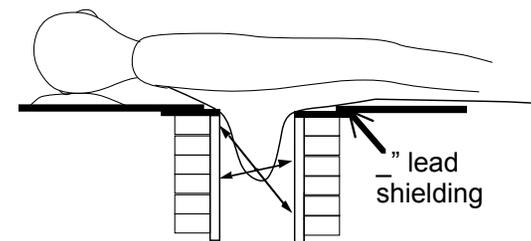


Imaging FOV

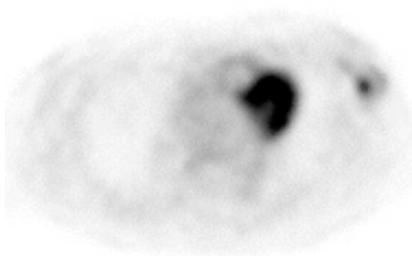
Table top

Electronics

A



B

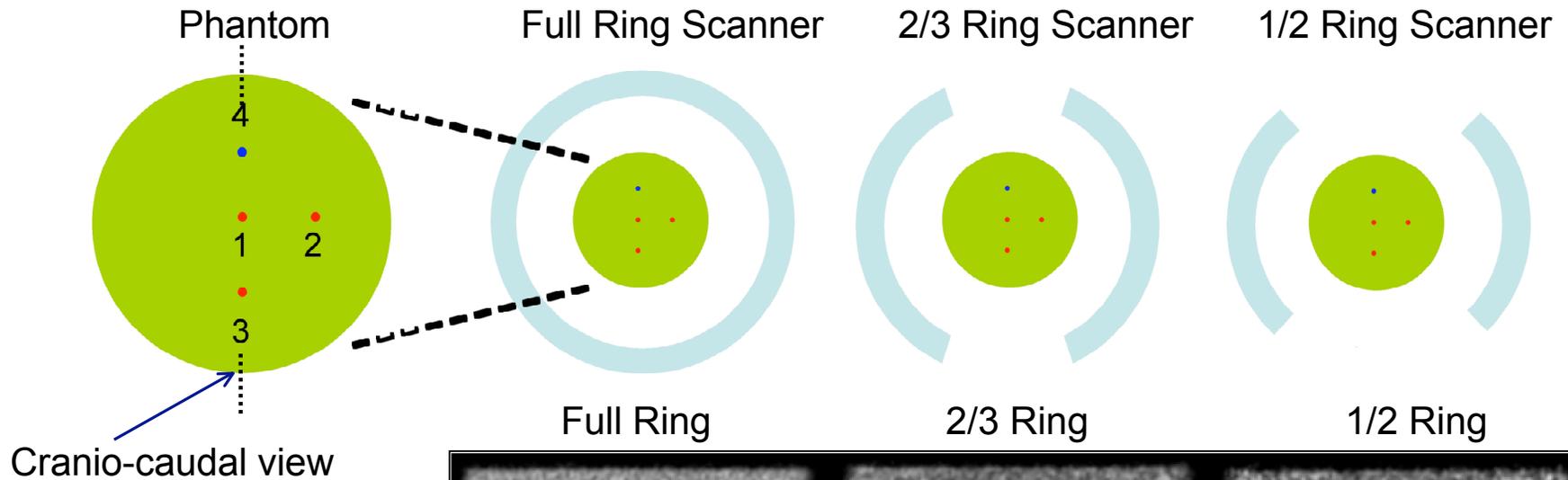


whole-body scan



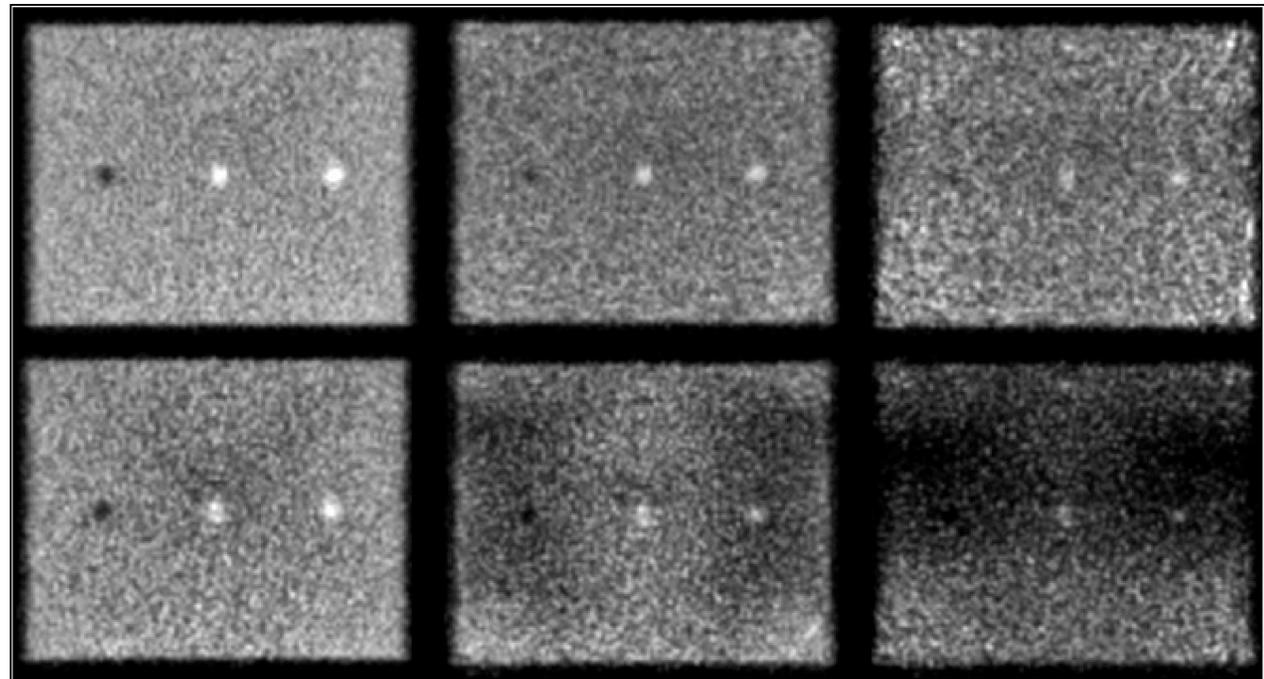
BPET scan

Limited angle tomography with TOF PET



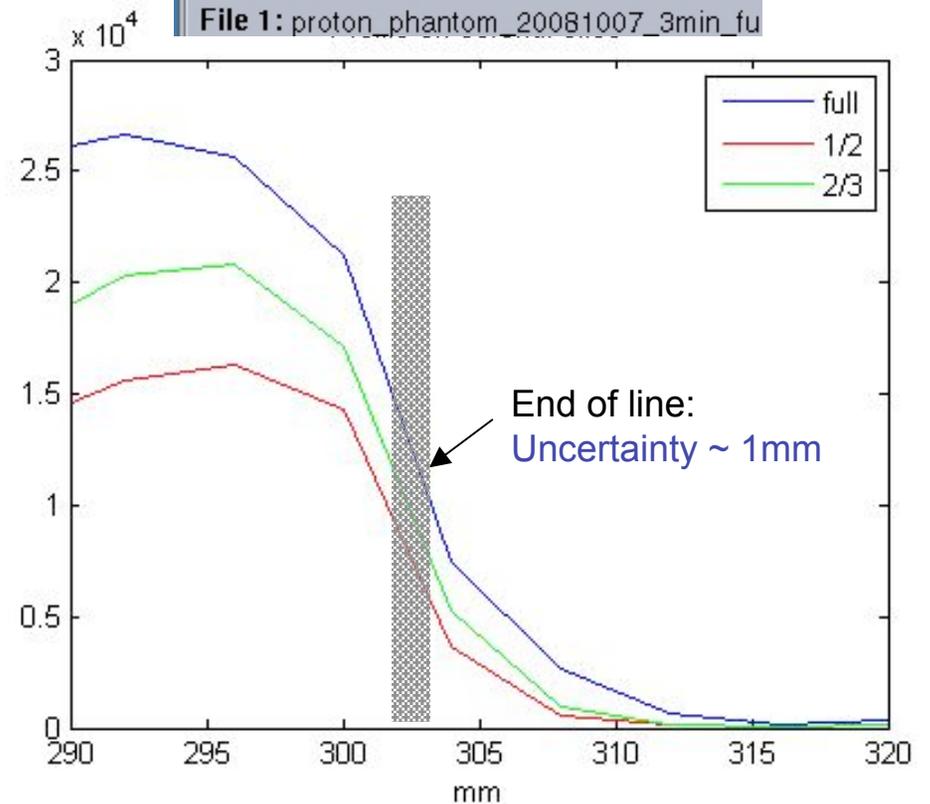
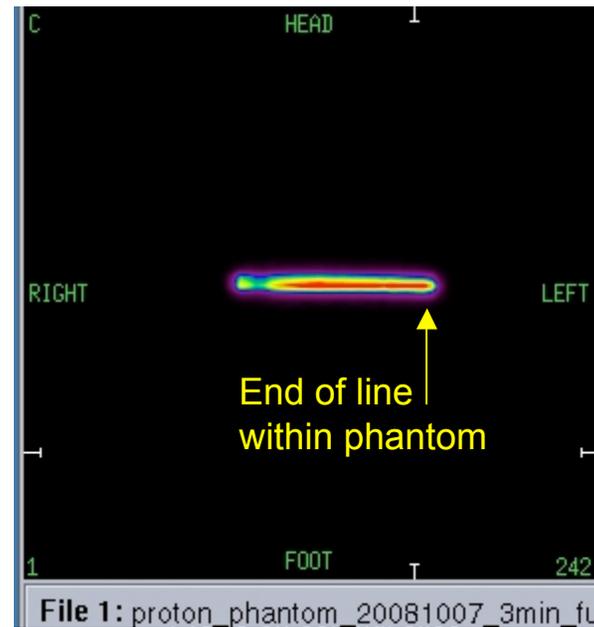
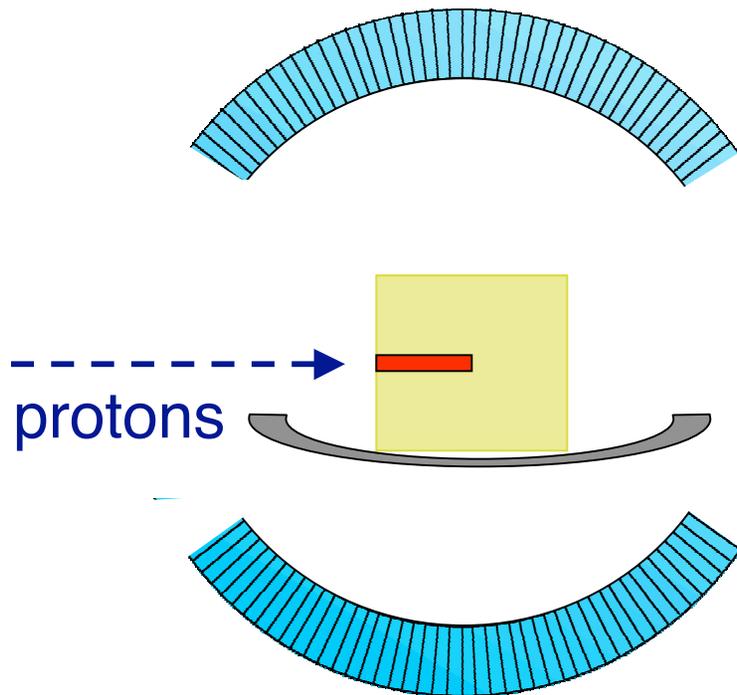
TOF, 200ps

Non-TOF



Proton Therapy

Measurements of line source in tissue-density body phantom with Lanthanum Bromide scanner



Summary - Imaging with TOF

- Clinical TOF PET/CT scanner achieves 600 ps system timing
 - TOF gives a noticeable improvement in image quality
 - increased confidence of lesion detectability
 - sharper features and lesions with higher contrast
 - most significant improvement with heavy patients
 - potential to reduce scan time
 - improved accuracy of quantification
- Faster scintillators can achieve improved system timing
 - lanthanum bromide proto-type achieves 375ps
- Potential applications in limited angle tomography
 - dedicated breast imaging
 - dedicated instrument to characterize proton dose