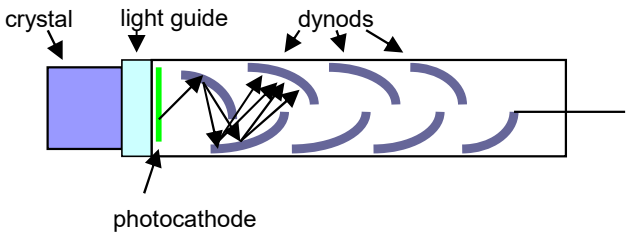
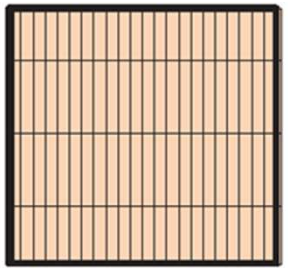
PET/MR and Quadra

NRU 6. March 2024

Detector evolvement from PMT to SiPM





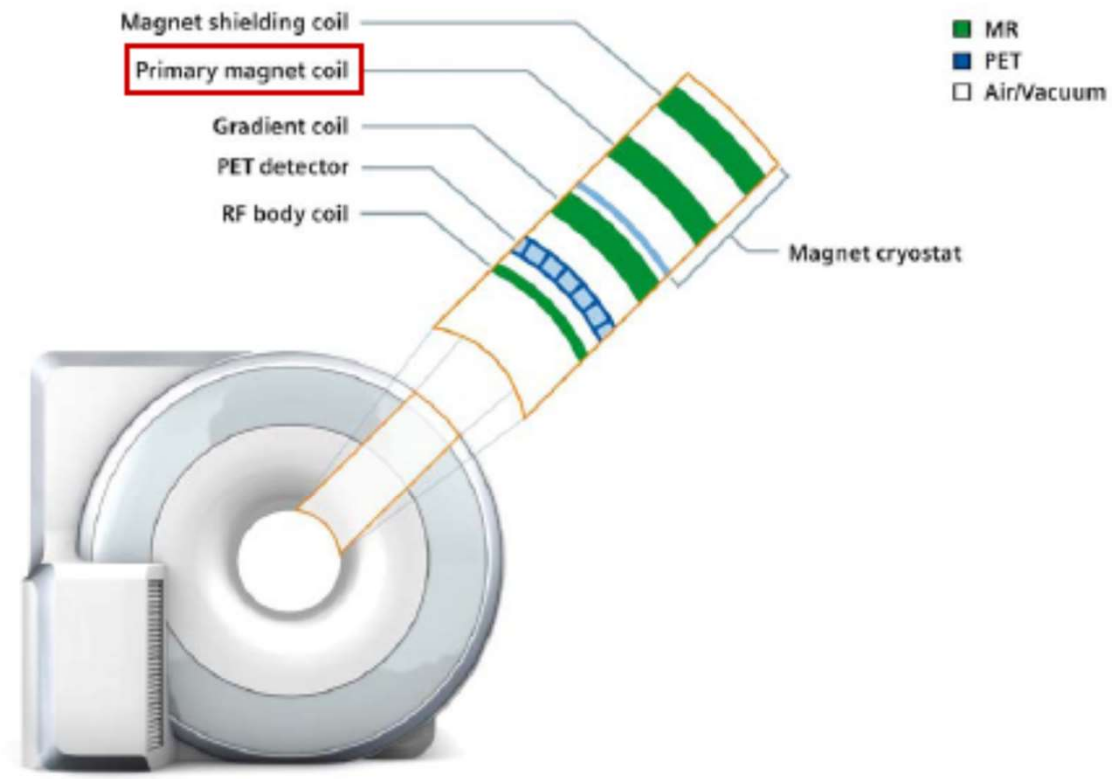
mCT

Vision

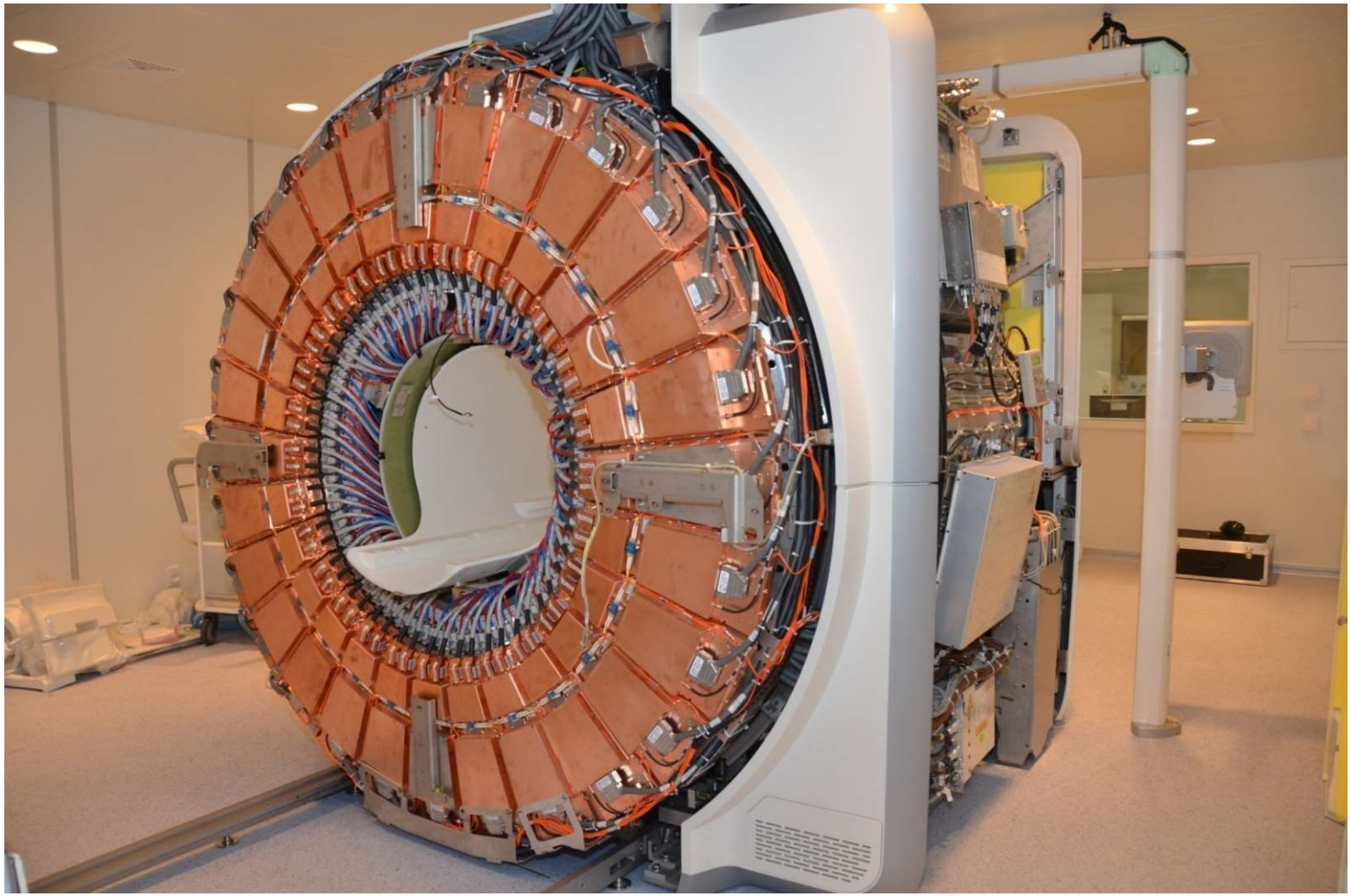
two is now one.

SIEMENS

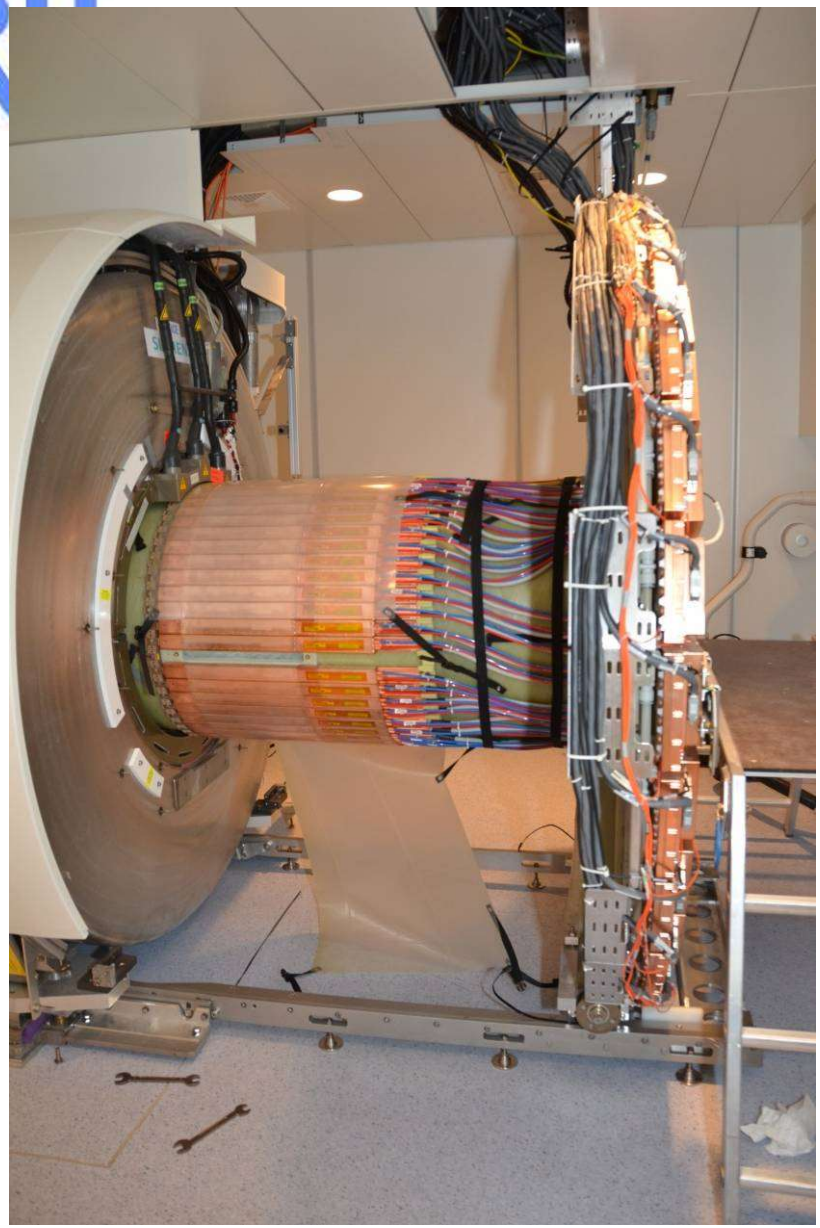
The first whole-body MR-friendly PET architecture



PET/MR



All PET electronics is encapsulated in a Faraday cage to avoid RF-interference



PET(/MR) service (PET module exchange)

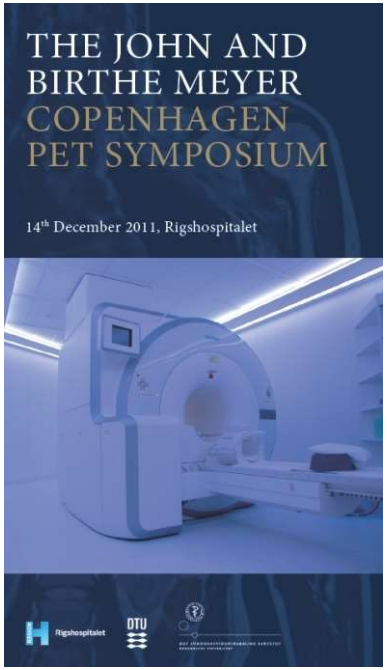
Arrival: 29.November 2011

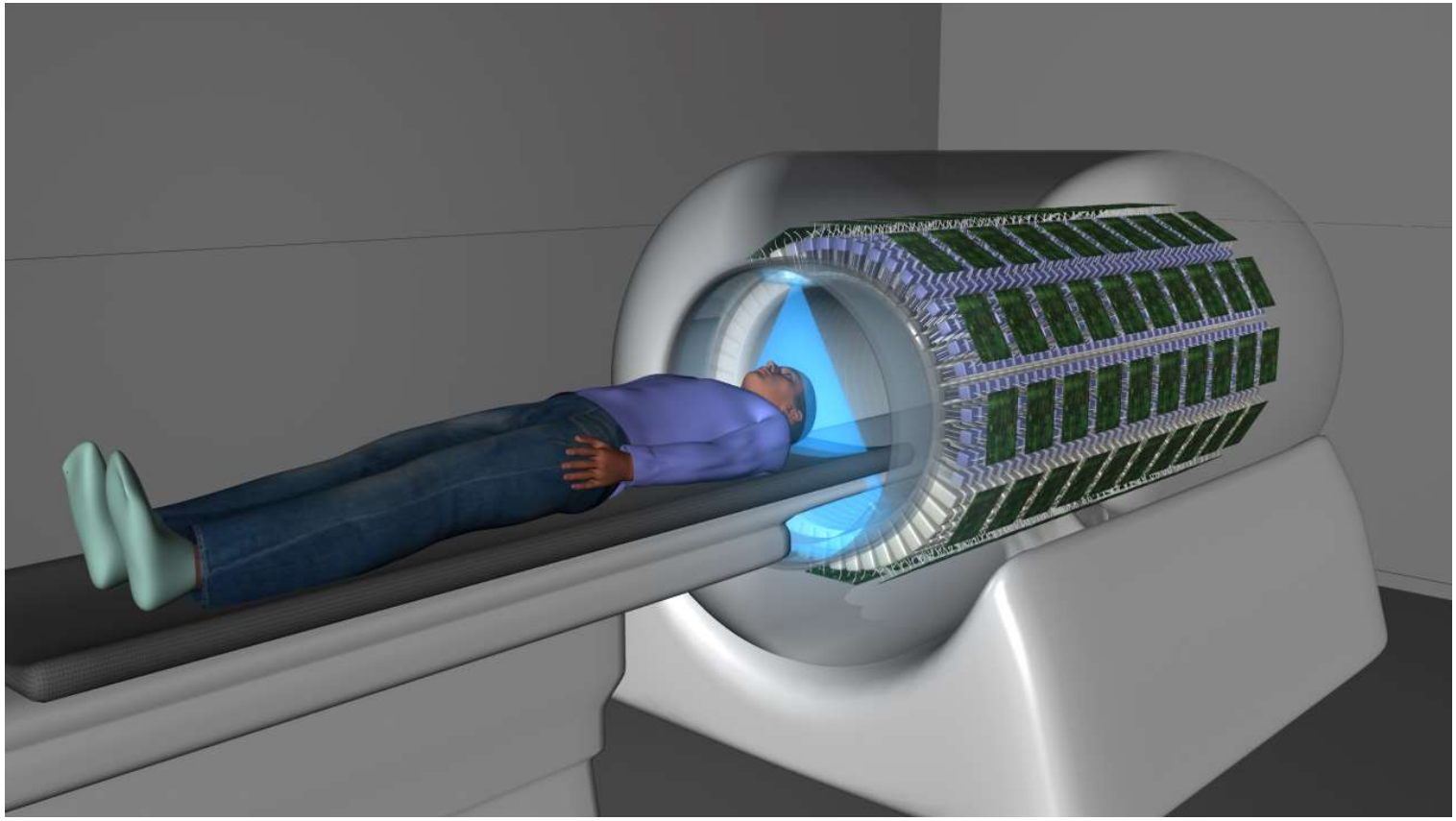
2011

$2024

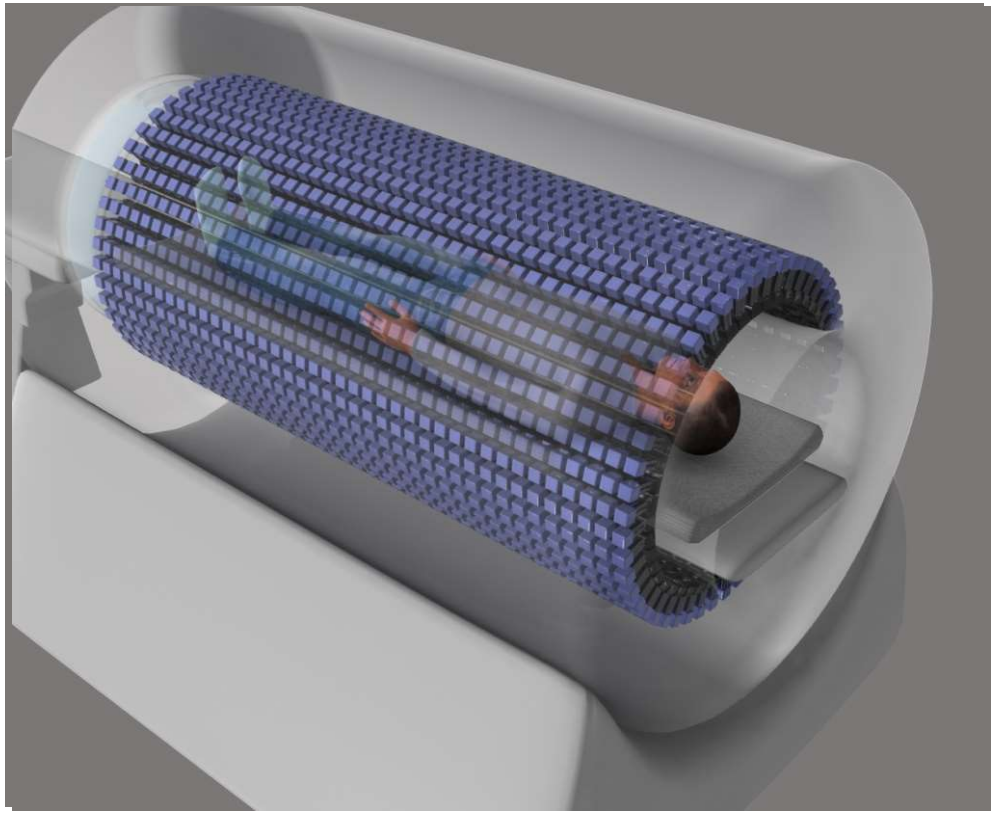
Arrival: 29.November 2011

Inauguration 14.December 2011





Maximizing Sensitivity by Total-Body PET



~40-fold increase
for adult total-body imaging

~20-fold increase
for pediatric total-body imaging

~4-fold increase
for single organ imaging

Completed EXPLORER Scanner

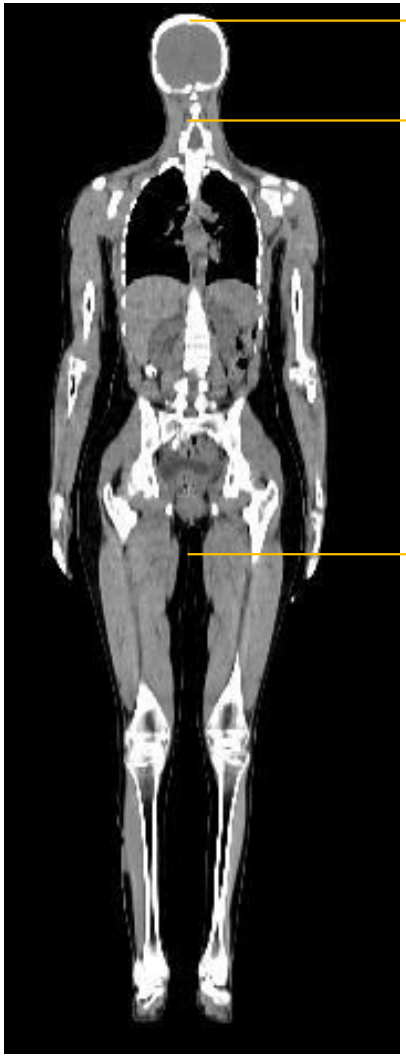
System:
Ring diameter: 78.6 cm
Transaxial FOV: 68.6 cm
Axial FOV: 194.8 cm

# of crystals: 564,480
crystal blocks: 13,440
of SiPMs: 53,760

80 detector row CT

UNITED IMAGING

Sligthly less ambitious: 1 m FOV



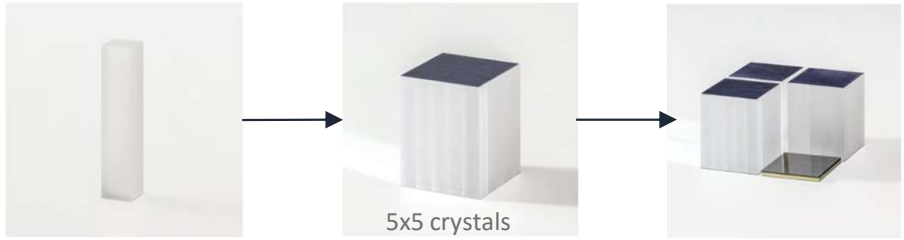
Made out of

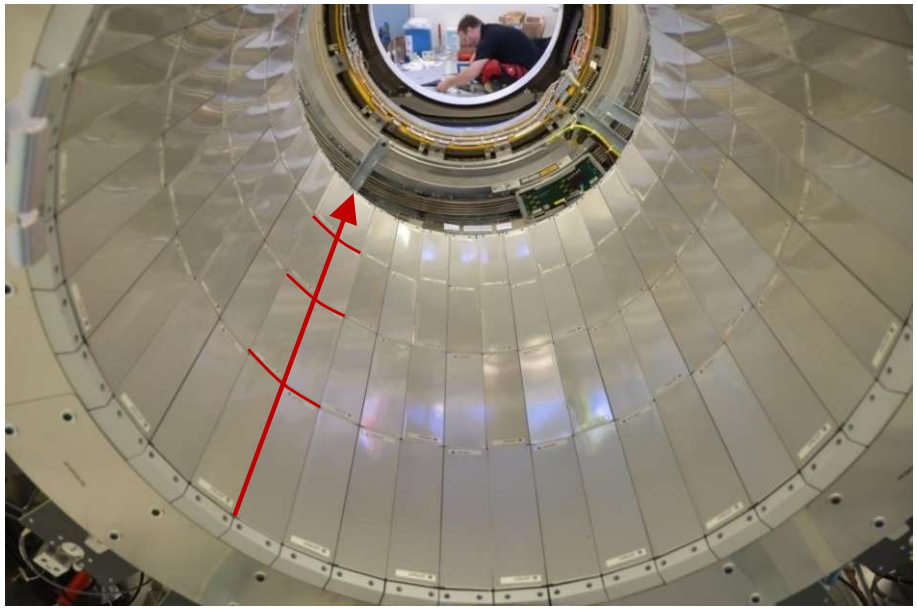
4 Vision systems, each with:

8 rings á 10 crystals axial

38 modules á 20 crystals in each ring

3.2-mm crystal Vision technology





crystals: 243.200 (ca. 400 kg)

[(5x5) * (2x4) * 8 * 38] * 4 stk * 0.15 cm^3 * 7.4 g/ cm^3

Specs?

Practically identical with Siemens Vision for

Spatial resolution
Energy resolution
Timing (for TOF)

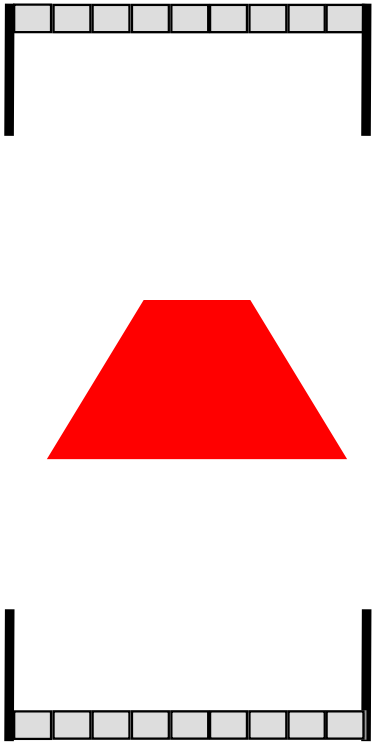
Major difference (obviously):

Sensitivity

What is sensitivity?

something about… counts per Bq in known geometry
preferably just one number

Sensitivity in ”3D” is position dependent

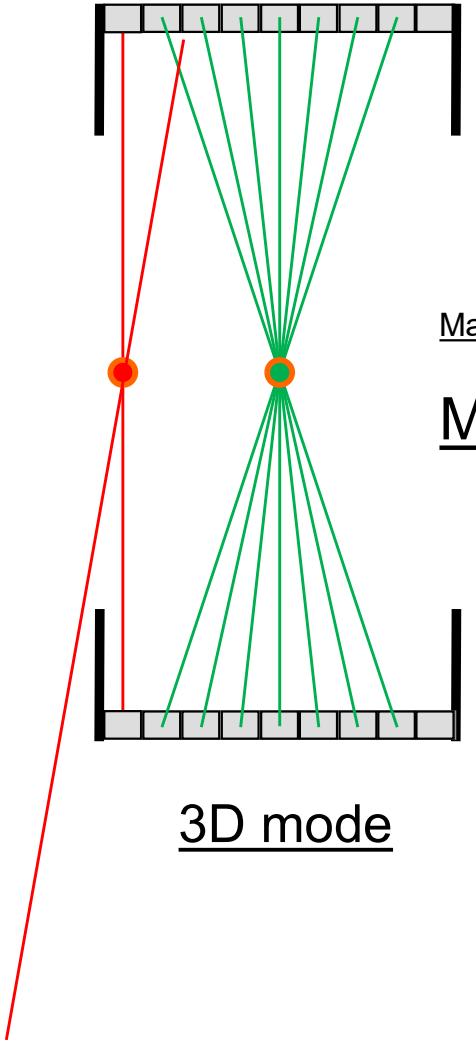


3D mode

There is a large difference between center and edge slices due to the number of LORs that contribute

The ”ideal” triangle is most often truncated like this:

(we are not allowing all angles)



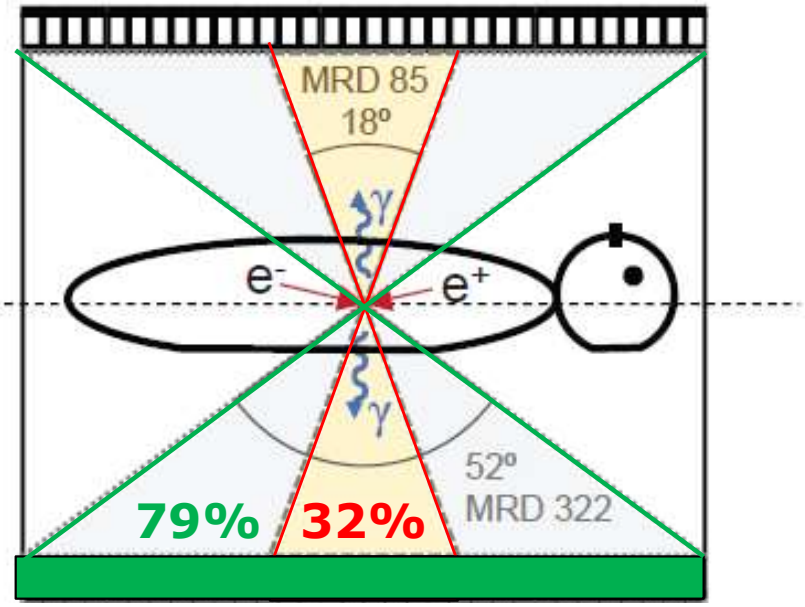
3D mode

Max Ring Distance

MRD = 6

Sensitivity for point source in center

Ø82 cm



L = 106 cm

Expanding

MDR = Max Ring Difference

from 85 to full value of 322

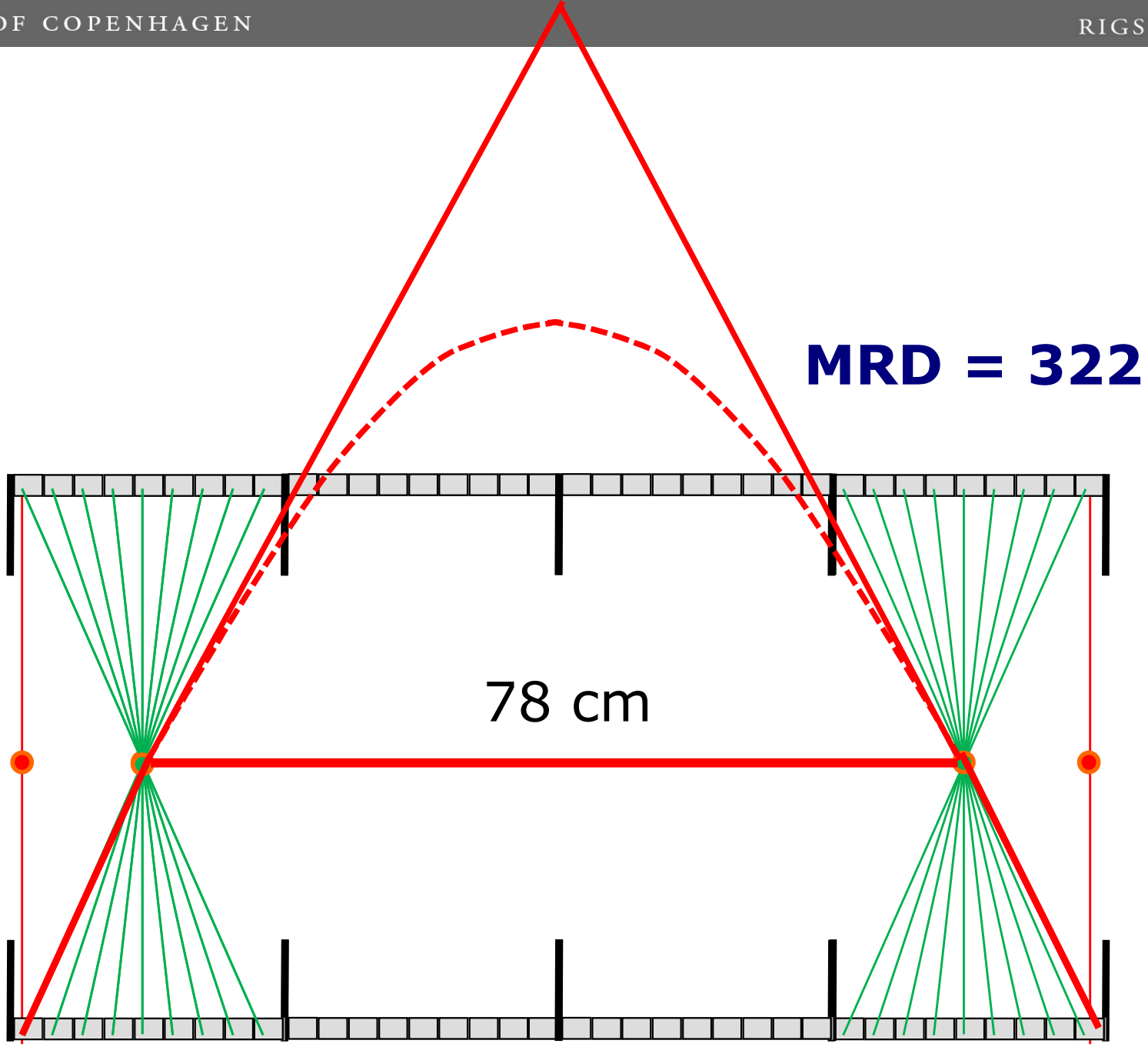
Increases the sensitivity at the **center** by a factor of 2.5, but it still drops to 0 at the edge.

In a Vision, MDR = 79.

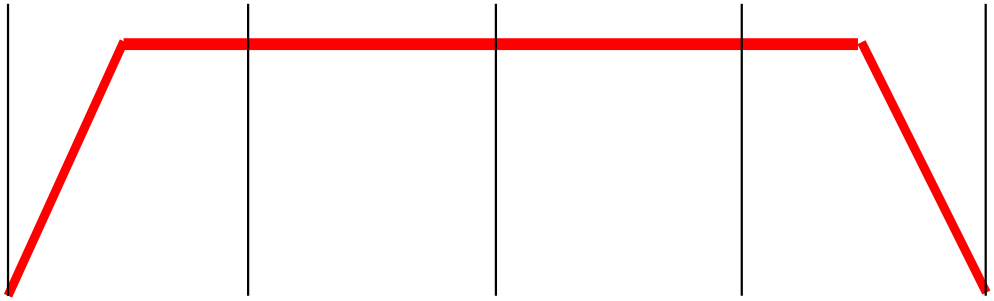
Now: Quadra = 1.08 Vision

*Future: Quadra ~ 3 * Vision*

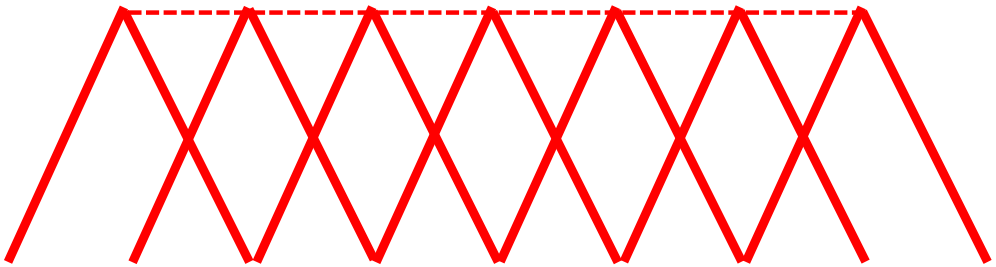
Figure based on Prenosil et al. JNM 2021

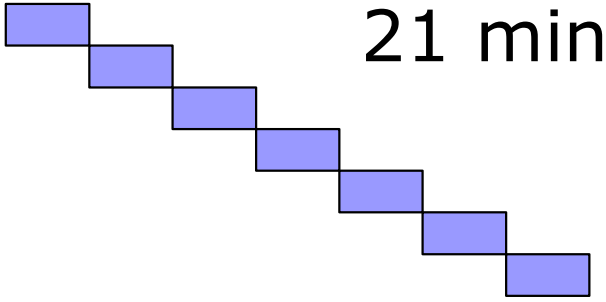

MRD = 322
78 cm

WB of 78 cm: 1 Quadra = 8 Vision



3 min

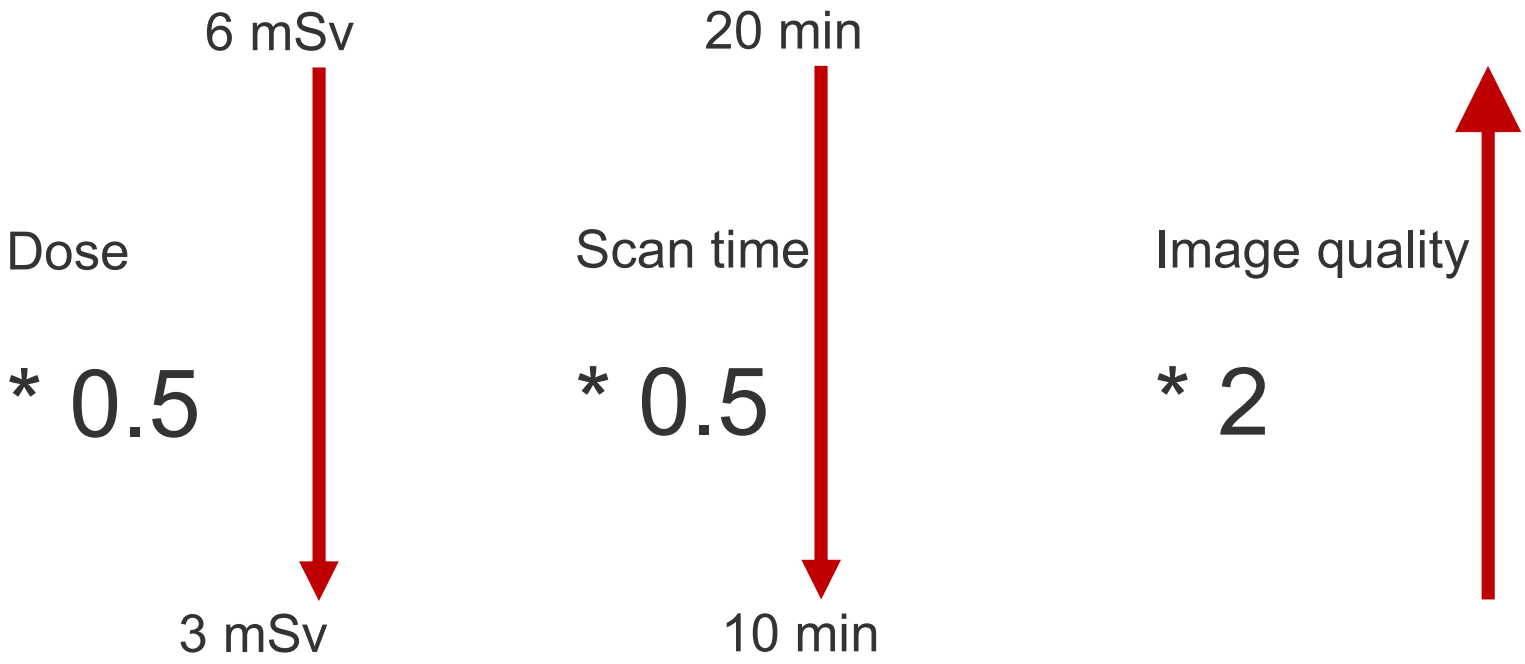




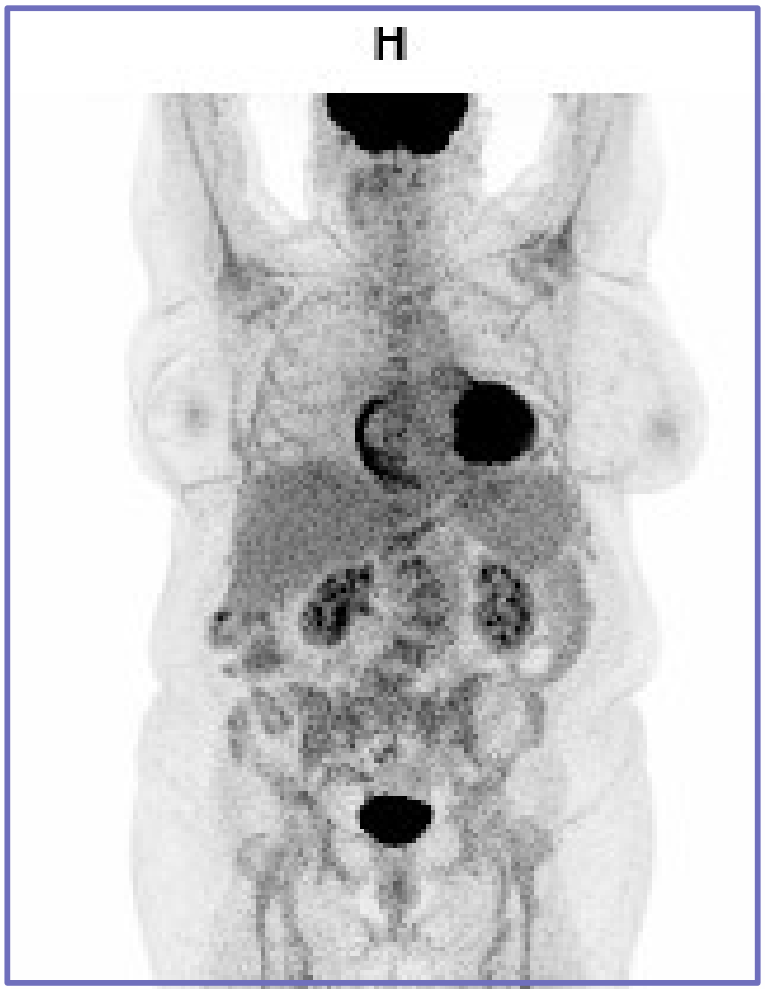
21 min

Including actual +8 % point-sensitivity and 6 % decay (average for F-18) we get 1 Quadra = 8 Vision for WB skan.

So now we can (example)



One of the first patients on Quadra PET/CT at Rigshospitalet



Vision, standard WB PET/CT

QUADRA, 10 min recon

Activity 3 MBq/kg

Quadra

30 s

60 s

90 s

180 s

300 s

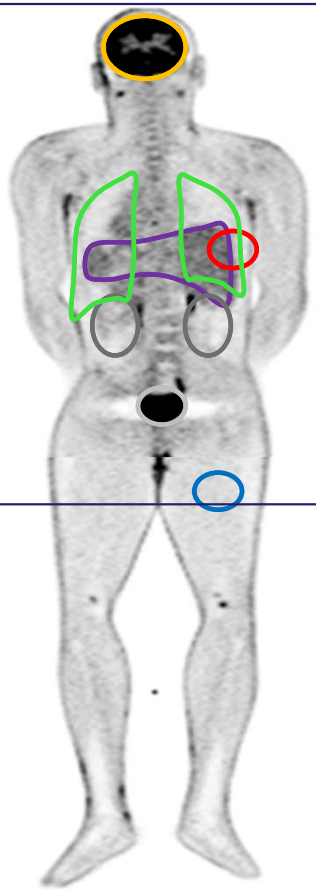
600 s

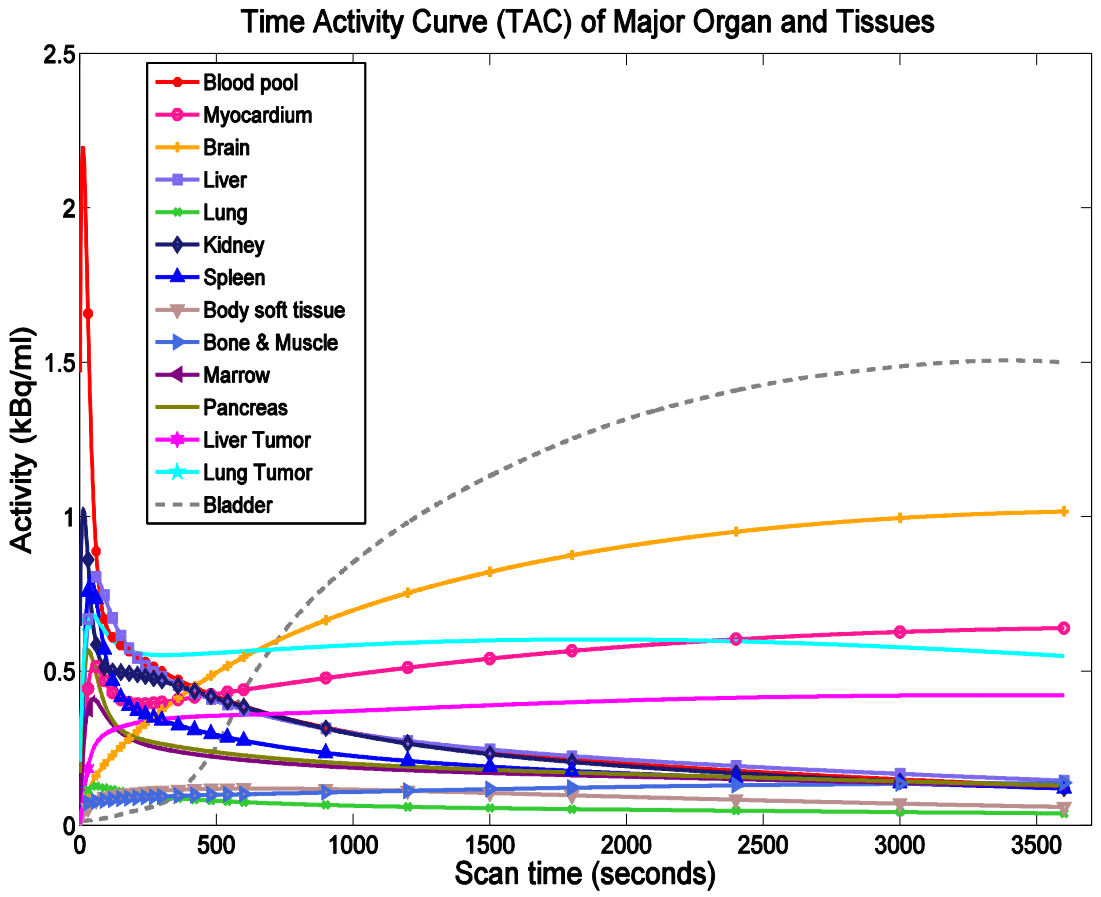
Vision 12 min

mCT 15 min

Total-Body Tracer Kinetics

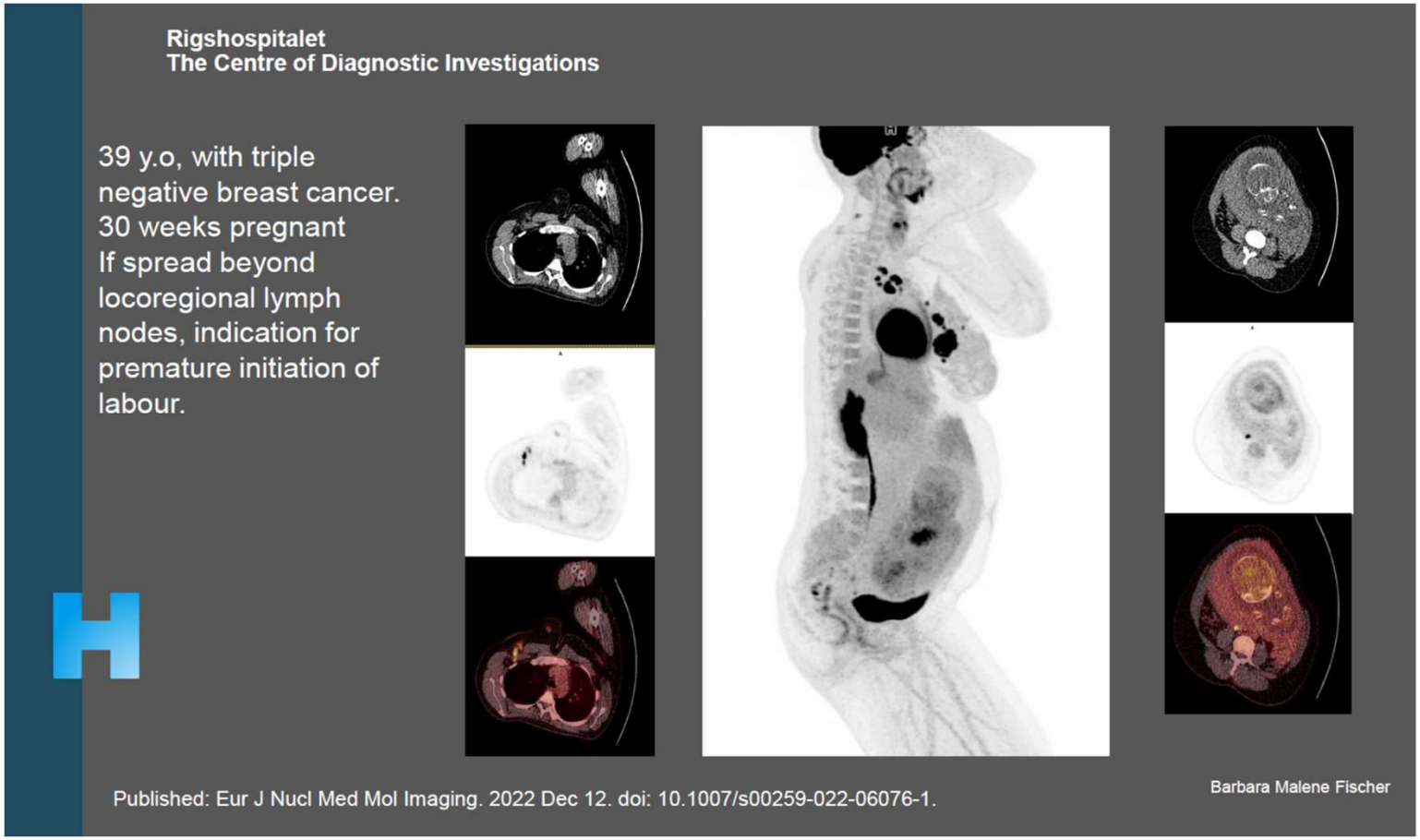
106 cm





(Courtesy of Simon Cherry)

24 MBq [^{18}F]FDG -> 0.5 mSv Acq.time 30 min



Total dose to foetus including ultra-low dose CT:

< 1 mSv