Efficient patient throughput and detector usage in low cost efficient Monolithic High resolution Walk-through Flat Panel Total Body PET

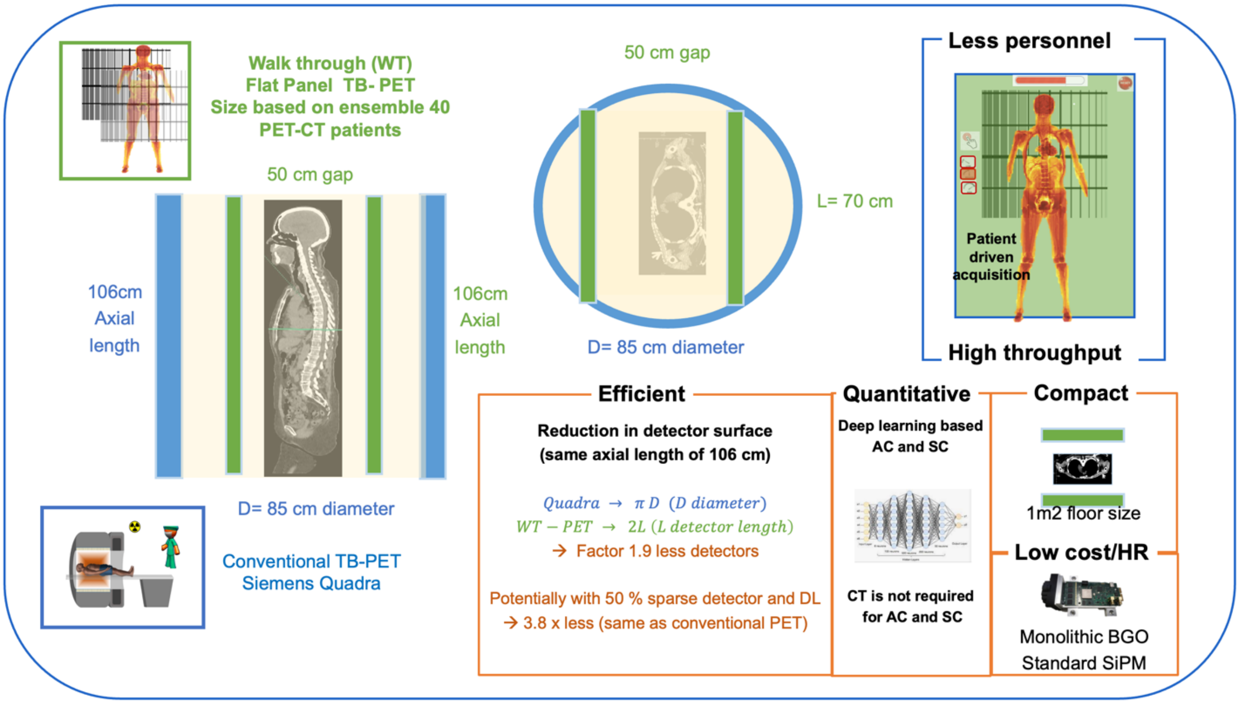
Stefaan Vandenberghe[1], Maya Abi Akl[1,2] , Nadia Withofs[3], Florence-Marie Muller[1], Jens Maebe[1], Meysam Dadgar[4], Xue Song[5], Kuangyu Shi[5], Giancarlo Sportelli[6], Nicola Belcari[6]

[1] Medical Image and Signal Processing, Ghent University, Ghent, Belgium
[2] Science Program, Texas A&M University at Qatar
[3] Department of nuclear medicine, Centre Hospitalier Universitaire de Liège,
[4] Faculty of Physics, Astronomy and Applied Computer Science, Jagiellonian University, 30-348 Cracow, Poland
[5] Insel, Bern Switzerland
[6] Department of Physics, University of Pisa

Background
Despite its very high sensitivity [1] high TB-PET throughput is limited by patient handling and shortage of personnel. Monoliths (LYSO and BGO) are valid alternative to pixelated detectors as they have a much better spatial resolution (1-1.5 mm), 6-layer DOI and CTR between 150 and 300 ps [2,3]. Therefore, they can be placed closer with a gain in both sensitivity and spatial resolution (reduced acolinearity). We design a novel monolithic low cost flat panel TB-PET system with patients in upright position.

Methods
Patient width (PW), top head to start of legs and depth from front of the patient to bed (measured from 40 random PET-CT patients) determined flat panel size. Sensitivity and detector surface is compared to Siemens Quadra[4]. In a next phase system simulations and extensive mock-up scanner patient test will be performed to determine scatter, motion and feasible patient-throughput.

Results
The average/max width/height/depth of the 40 patients was 52/65, 85/95 and 32/38 cm . This justifies a design of 70 cm wide, 105 cm high and 50 cm gap . The number of detectors (same FOV) is **1.9 x less** than in a Siemens Quadra for similar sensitivity. Spatial resolution will be less than 2 mm over the whole FOV (reduced acollinearity from 80 to 50 cm). The estimated component cost for 12 mm thick monolithic BGO/6 mm SiPM/readout is only 1.3 MEuro. DL will be applied on images from 50 % sparse BGO detectors to reduce system cost to that of a standard PET scanner. Scatter and attenuation correction can be applied (without CT) to non-attenuation corrected reconstructed using DL [5]. This enables fast, low dose imaging and frequent screening. Personnel costs can be reduced by letting patient start the acquisition via simple touch buttons. The footprint of the scanner is about 1m^2.



References

1. Vandenberghe S, Moskal P, Karp JS. State of the art in total body PET. EJNMMI Phys. 2020; 7(1):35.
2. Mariele Stockhoff, Milan Decuyper, Roel Van Holen, Stefaan Vandenberghe. High-resolution monolithic LYSO detector with 6-layer depth-of-interaction for clinical PET. Phys Med Biol. 2021; 66(15):10.1088/1361-6560
3. P. Carra, M.G. Bisogni, E. Ciarrocchi, M. Morrocchi, V. Rosso, G. Sportelli, N. Belcari. Performance of monolithic BGO-based detector implementing a Neural-Network event decoding algorithm for TB-PET applications, presentation at Elba PSMR-TB-PET conference 2022¶
4. Prenosil GA, Sari H, Fürstner M, Afshar-Oromieh A, Shi K, Rominger A, Hentschel M. Performance Characteristics of the Biograph Vision Quadra PET/CT system with long axial field of view using the NEMA NU 2-2018 Standard. J Nucl Med. 2022; 63(3):476-484.
5. Song Xue, Karl Peter Bohn,Rui Guo,Hasan Sari, Marco Viscione,Axel Rominger, Biao Li, Kuangyu Shi, Development of a deep learning method for CT-free correction for an ultra-long axial field of view PET scanner, abstract presented at the PSMR-TBPET conference, Elba 2022

EFFICIENT PATIENT THROUGHPUT AND DETECTOR USAGE IN LOW-COST EFFICIENT MONOLITHIC HIGH RESOLUTION **WALK-THROUGH FLAT PANEL TOTAL BODY PET**

STEFAAN VANDENBERGHE

GHENT UNIVERSITY/EDITOR EJNMMI PHYSICS

MAYA ABI AKL[1,2] , NADIA WITHOFS[3], FLORENCE-MARIE MULLER[1], JENS MAEBE[1],

MEYSAM DADGAR[4], XUE SONG[5],KUANGYU SHI[5],

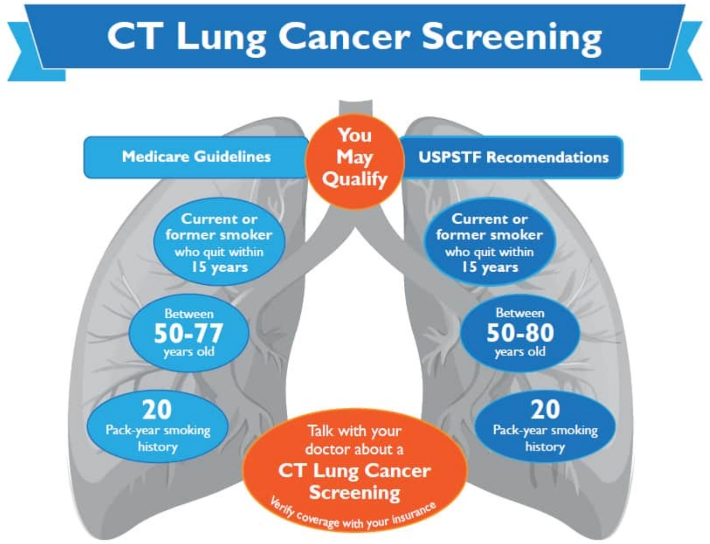
GIANCARLO SPORTELLI[6], NICOLA BELCARI[6]

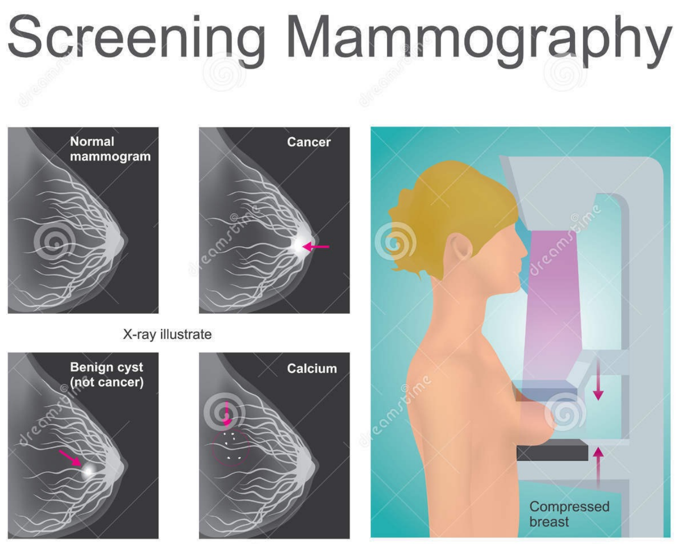
EXPECTED INCREASE IN PET(-CT) PATIENTS

Why ?

- Not only detection but more and more (expensive and complex) therapy prediction and follow-up
  - Early detection → improved therapy outcome
  - First PET scan (20 % normals)
  - Follow-up (40%)
- Selected screening: genetic, blood test, patient history
  → Fast evolutions towards early diagnosis of cancer
- Already CT screening for lung cancer (heavy long term smokers) in US
- Lung cancer, breast cancer, prostate cancer…
- With selected screening there will be a high number of patients and repeat scans
- Personnel availability is a problem in many NM depts

- **How** to deal with this:
  - Lower dose imaging
  - **Faster imaging + Throughput**
  - Lower cost imaging (systems + procedure)
  - **Less personnel** per scan





RESEARCH REPORTS

Molecular Imaging Market will expand at an impressive CAGR of around 11.3% from 2021 to 2031

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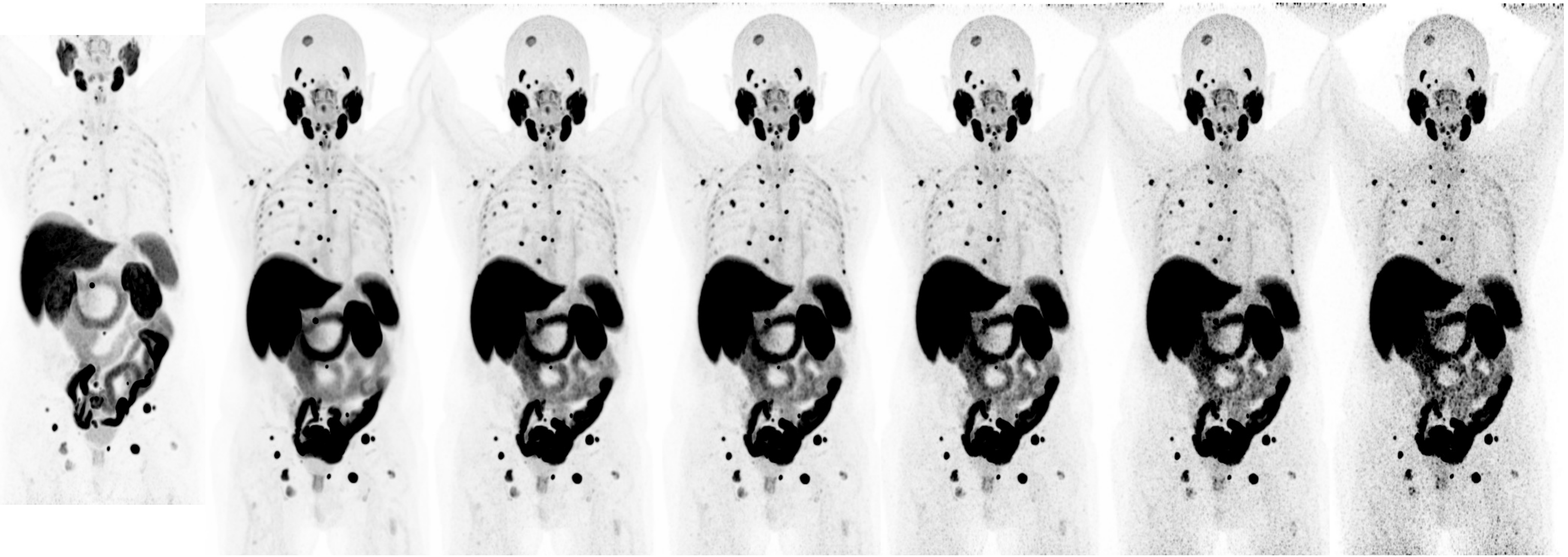
Vision 600
standard PET- CT
120 min. p.i. Σ 12 min
Cost 2-3 Meuro

Total body PET Vision Quadra
180 min. p.i.
Cost 8-10 Meuro !

PSA 14.8 ng/ml
249 MBq F18-PSMA1007
80 kg / 185 cm



10 min | 3min | 2min | 1min | 30sec | 15sec

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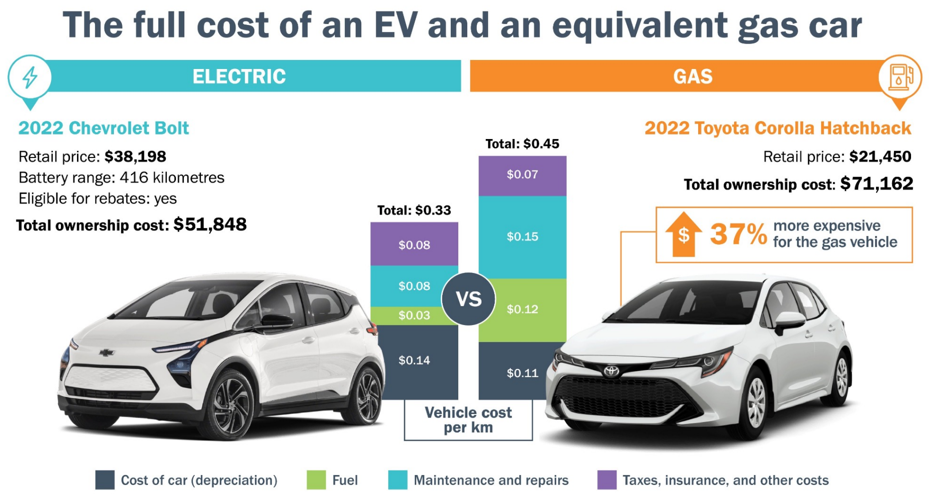
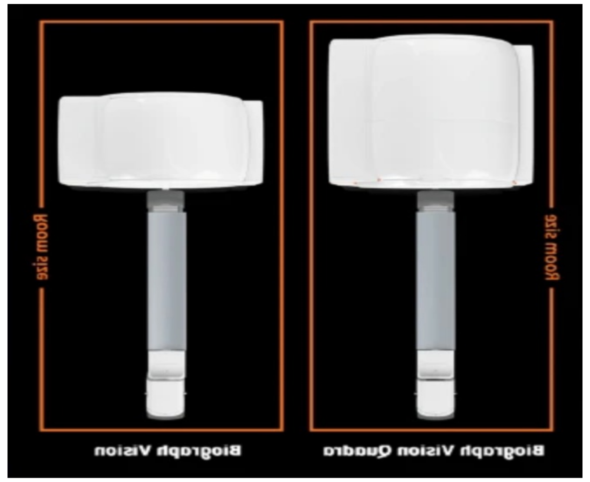
Challenge to combine this with fast patient throughput

COST OVER LIFETIME



Siemens Vision



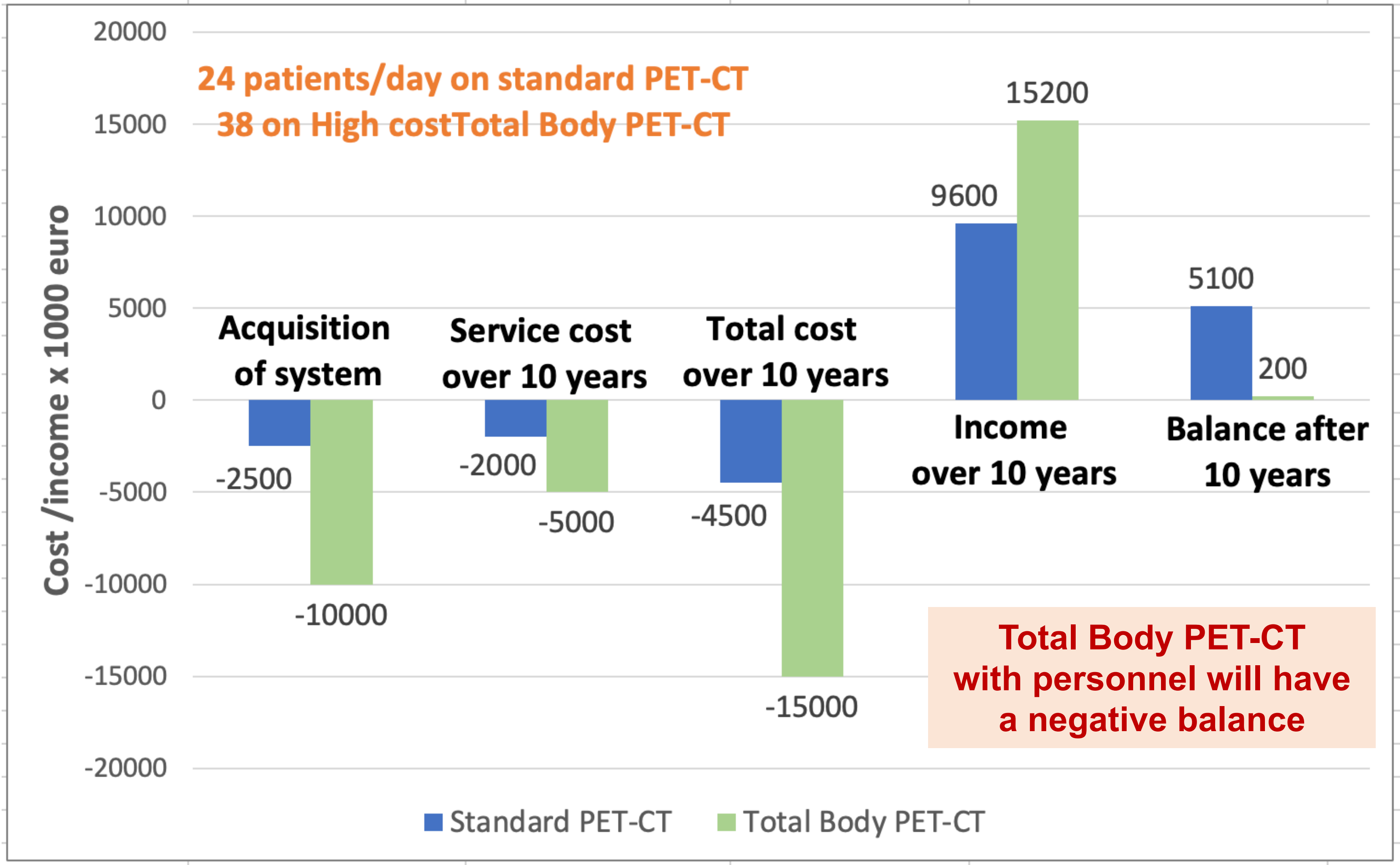
Siemens Quadra

Assumptions

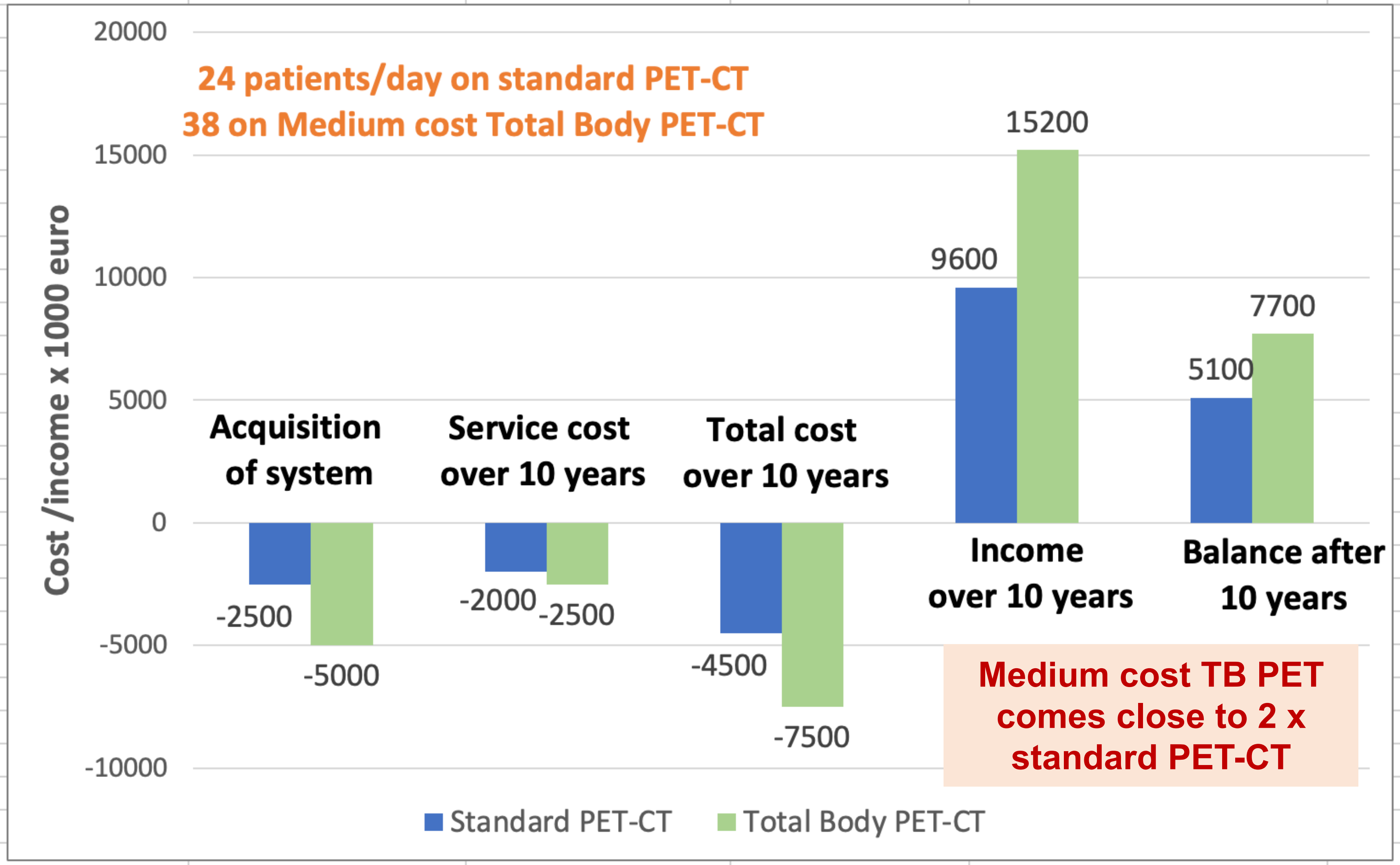
Patient transfer	Scout/CT time	PET scan time	scans/day	
seconds	seconds	seconds		
360	240	600	24	PET-CT
360	240	150	38	TB-PET-CT

Limiting factors for very fast TB-PET

PET-CT and TB-PET-CT:
150 euro/dose
350 euro reimbursement



10 M euro Total Body PET-CT system



5M euro Total Body PET-CT system (same 150s acq time)

STATE-OF-THE ART — TOTAL BODY PET

A UNIQUE DESIGN — FLAT PANEL TOTAL BODY PET

SIMULATIONS OF SYSTEM

COST OF SYSTEM

MOCKUP

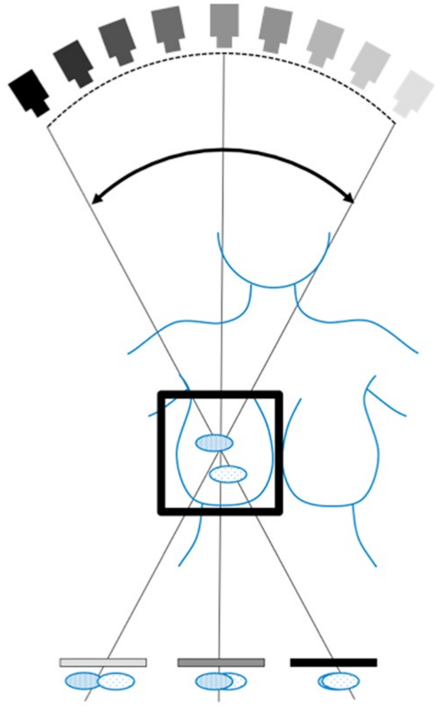
SUMMARY

SCANNERS WITH PATIENTS STANDING

Very old X-ray systems

1950
Krakow
Jagiellonian university

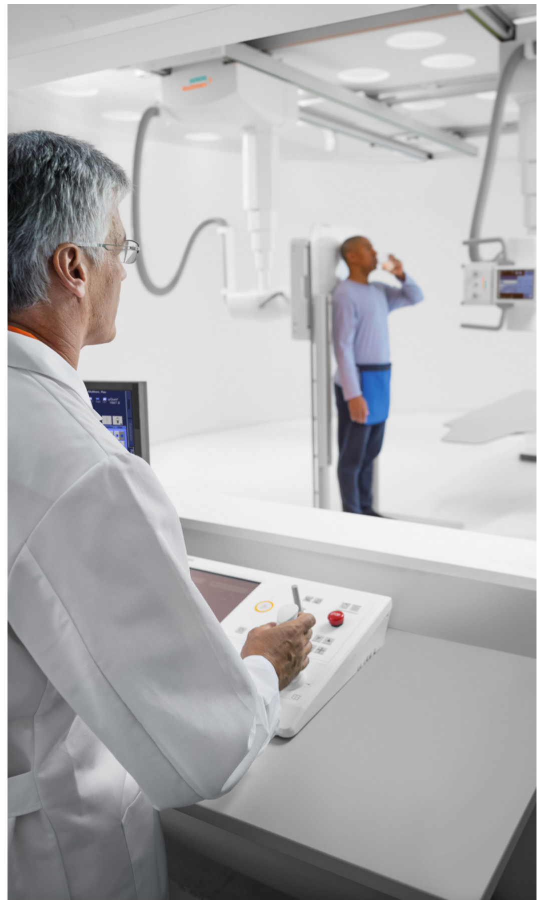
Breast tomosynthesis



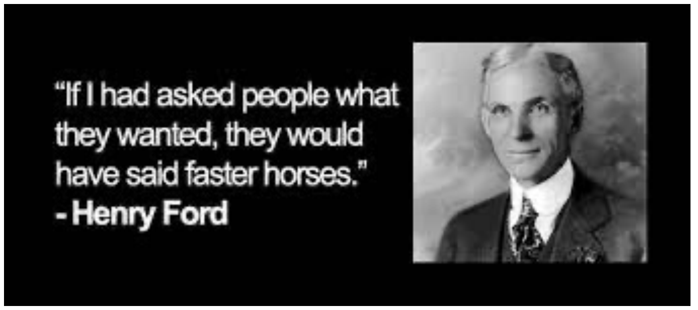
RX

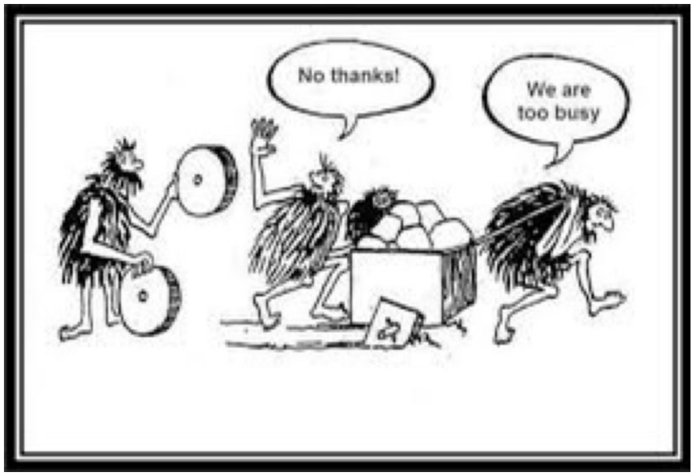
CT

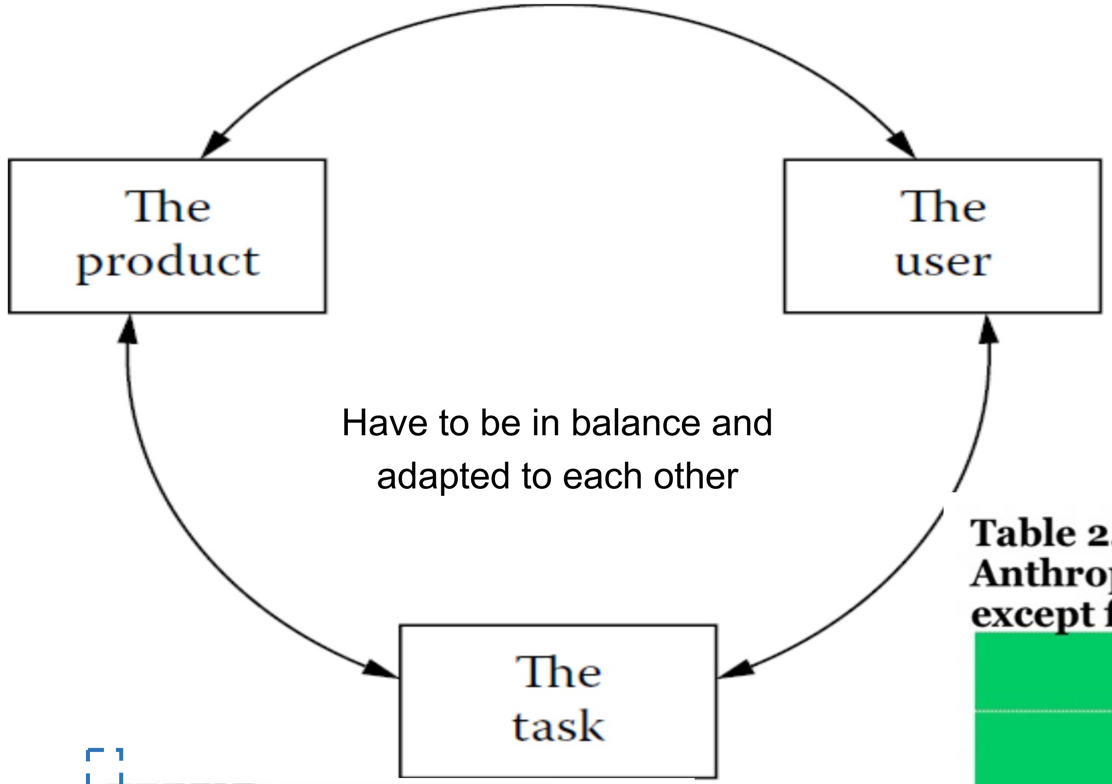
Siemens MultiTom X-ray 2016-2022



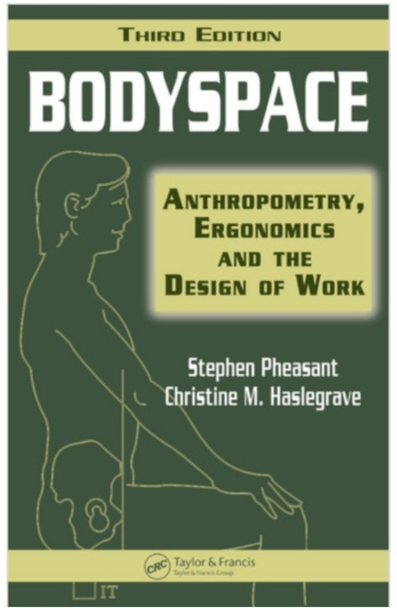
PATIENT-CENTERED DESIGN







hannes van Dierendonck,
Friend from Brugge,
ergonomist, industrial
designer



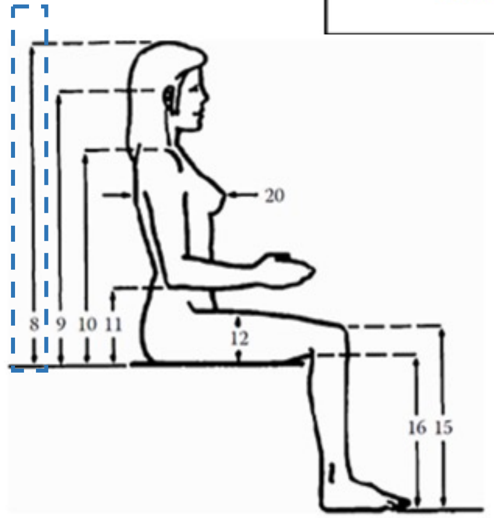
Bodyspace

Anthropometry, Ergonomics and the Design of Work, Third Edition

door Stephen Pheasant, Christine M. Haslegrave

Synopsis

In the 20 years since the publication of the first edition of **Bodyspace** the knowledge base upon which ergonomics rests has increased significantly. The need for an authoritative, contemporary and, above all, usable reference is therefore great. This third edition maintains the same content and structure as previous editions, but updates the material and references to reflect recent developments in the field. The book has been substantially revised to include new research and anthropometric surveys, the latest techniques, and changes in legislation that have taken place in recent years.



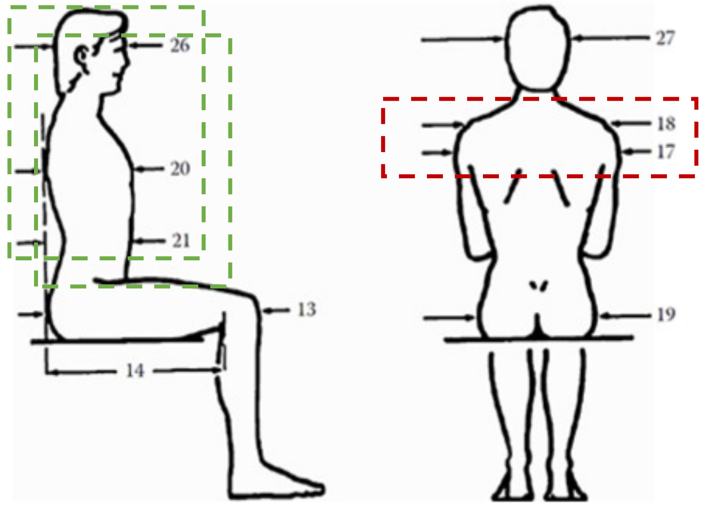


Table 2.5
Anthropometric Estimates for British Adults Aged 19 to 65 Years (all dimensions in millimetres, except for body weight, given in kilograms)

	Men				Women			
Dimension[a]	5th %ile	50th %ile	95th %ile	SD	5th %ile	50th %ile	95th %ile	SD
1. Stature	1625	1740	1855	70	1505	1610	1710	62
2. Eye height	1515	1630	1745	69	1405	1505	1610	61
3. Shoulder height	1315	1425	1535	66	1215	1310	1405	58
4. Elbow height	1005	1090	1180	52	930	1005	1085	46
5. Hip height	840	920	1000	50	740	810	885	43
6. Knuckle height	690	755	825	41	660	720	780	36
7. Fingertip height	590	655	720	38	560	625	685	38
8. Sitting height	850	910	965	36	795	850	910	35
9. Sitting eye height	735	790	845	35	685	740	795	33
10. Sitting shoulder height	540	595	645	32	505	555	610	31
11. Sitting elbow height	195	245	295	31	185	235	280	29
12. Thigh thickness	135	160	185	15	125	155	180	17
13. Buttock–knee length	540	595	645	31	520	570	620	30
14. Buttock–popliteal length	440	495	550	32	435	480	530	30
15. Knee height	490	545	595	32	455	500	540	27
16. Popliteal height	395	440	490	29	355	400	445	27
17. Shoulder breadth (bideltoid)	420	465	510	28	355	395	435	24
18. Shoulder breadth (biacromial)	365	400	430	20	325	355	385	18
19. Hip breadth	310	360	405	29	310	370	435	38
20. Chest (bust) depth	215	250	285	22	210	250	295	27
21. Abdominal depth	220	270	325	32	205	255	305	30
22. Shoulder–elbow length	330	365	395	20	300	330	360	17

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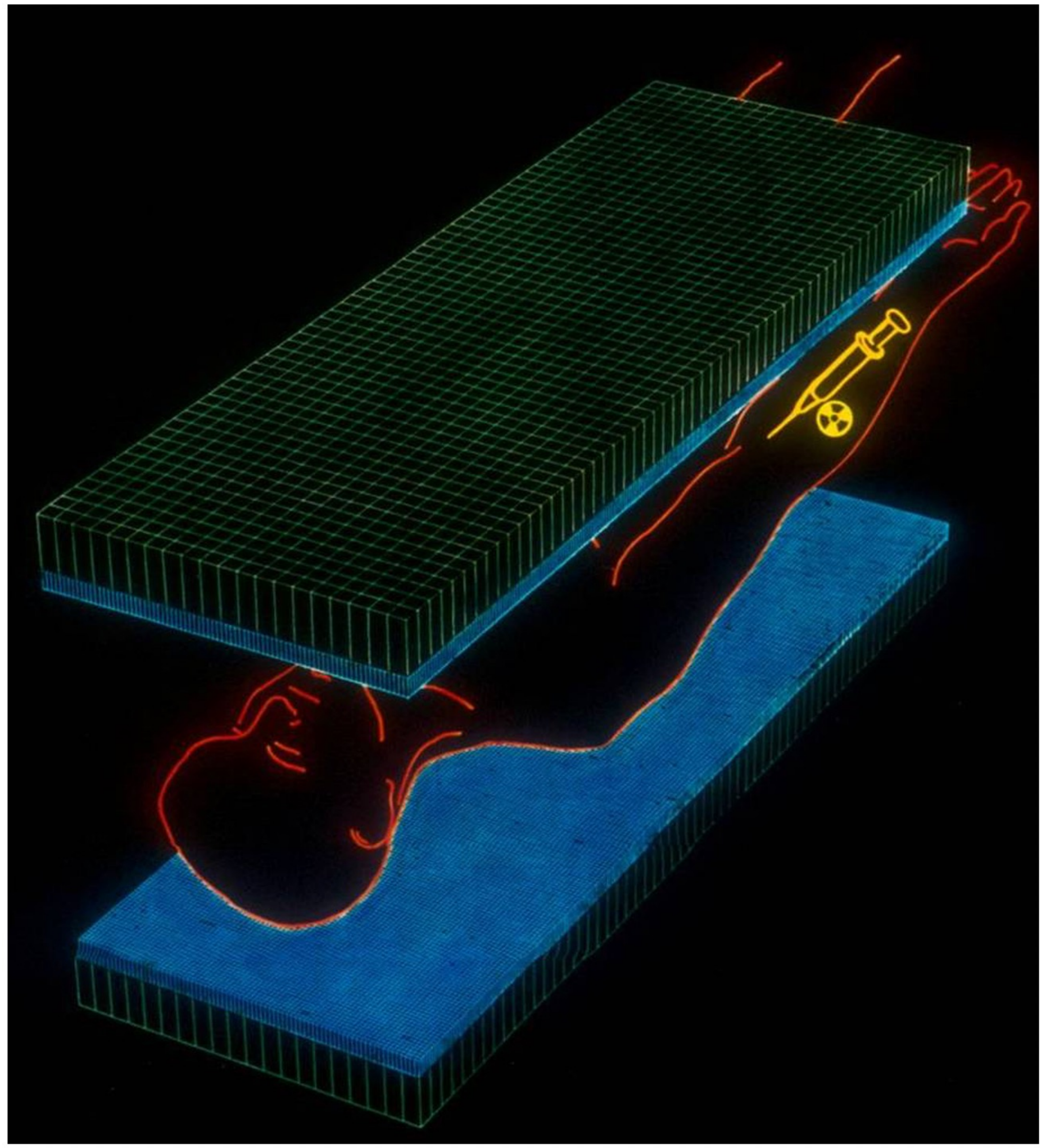
FLAT PANEL PET: OLD IDEA

Terry Jones
1990
first IEEE MIC
Conference
Washington



Patient on bed between 2 flat panels

The coincidence gamma camera time: 1997-2002

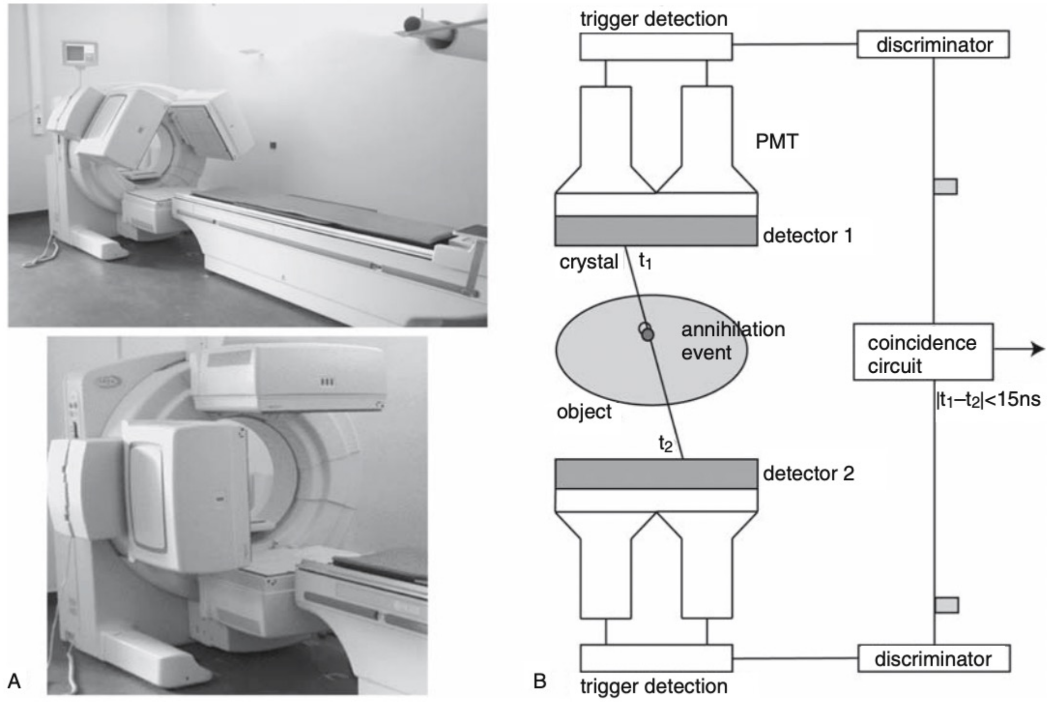
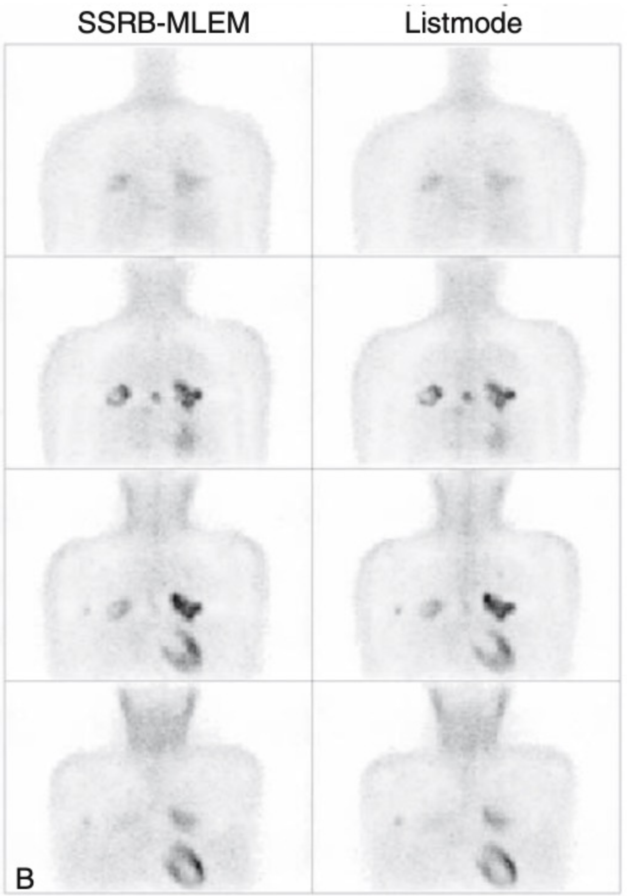


Figure 10.1. A: A three-head gamma camera–based positron emission tomography (GCPET)system (Philips Irix 3000). The three heads can be placed at different gantry angles with respect to each other and can be used for both routine SPECT as well as for coincidence imaging. B: A schematic representation of the coincidence circuit used in a GCPET system. For a coincidence event to be detected, the two photons must be detected within the 15-ns timing window and should lie within the specified energy range.



Practical Pediatric PET Imaging

Pediatric PET Imaging pp 135–171 | Cite as

Coincidence Imaging

Girish Bal, Stefaan Vandenberghe & Martin Charron

Ph D S. Vandenberghe, Ugent
Iterative listmode reconstruction for coincidence gamma camera
Ph D Y.D'Asseler, Ugent
Coincidence detection with a gamma camera

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Other coincidence/gamma camera researchers: Jarritt PH, Acton PD, Lewellen, Turkington, Delbeke, …

WHY NOT 'WALK THROUGH PET'?

Concept
- Limit in PET-CT throughput becomes patient positioning on the bed
- What if we let the patient keep the natural positioning ?

Technology
- Detectors become very fast + high sensitivity
- TOF has reduced the need for complete angular info
- Scatter and attenuation correction can be done with DL (Elba Insel-Bern, Song Xue)

Aims
- High throughput like in airports (mm-wave scanners)/Planar X-ray
- This would work very well for most patients (especially screening)

→ **Lowest cost per scan !**

Eindhoven (NL, close to Belgium) Airport

- Luggage: C3 standard CT scanners. 3D-screening of hand luggage items allow passengers to keep their liquids and large electronics in their carry-on bags.
- Body: mm-wave, Infra-red thermal conductivity or even very low dose x-ray (?)
- Higher throughputs, more efficient, less noise, and ergonomic design.
- limited available footprint
- Throughputs as high as 5.4 passengers per minute.

Patient positioning

Time consuming

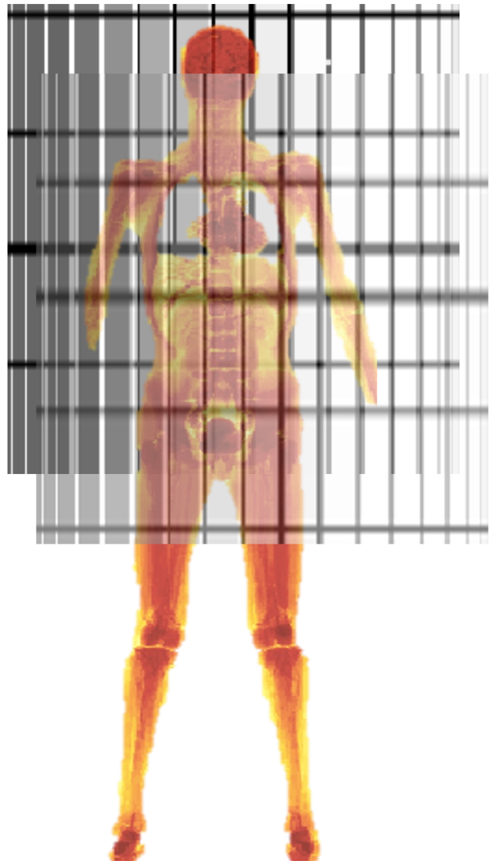
Personnel costs

Dose to personnel

Only for some patients needed

Less needed for short scans

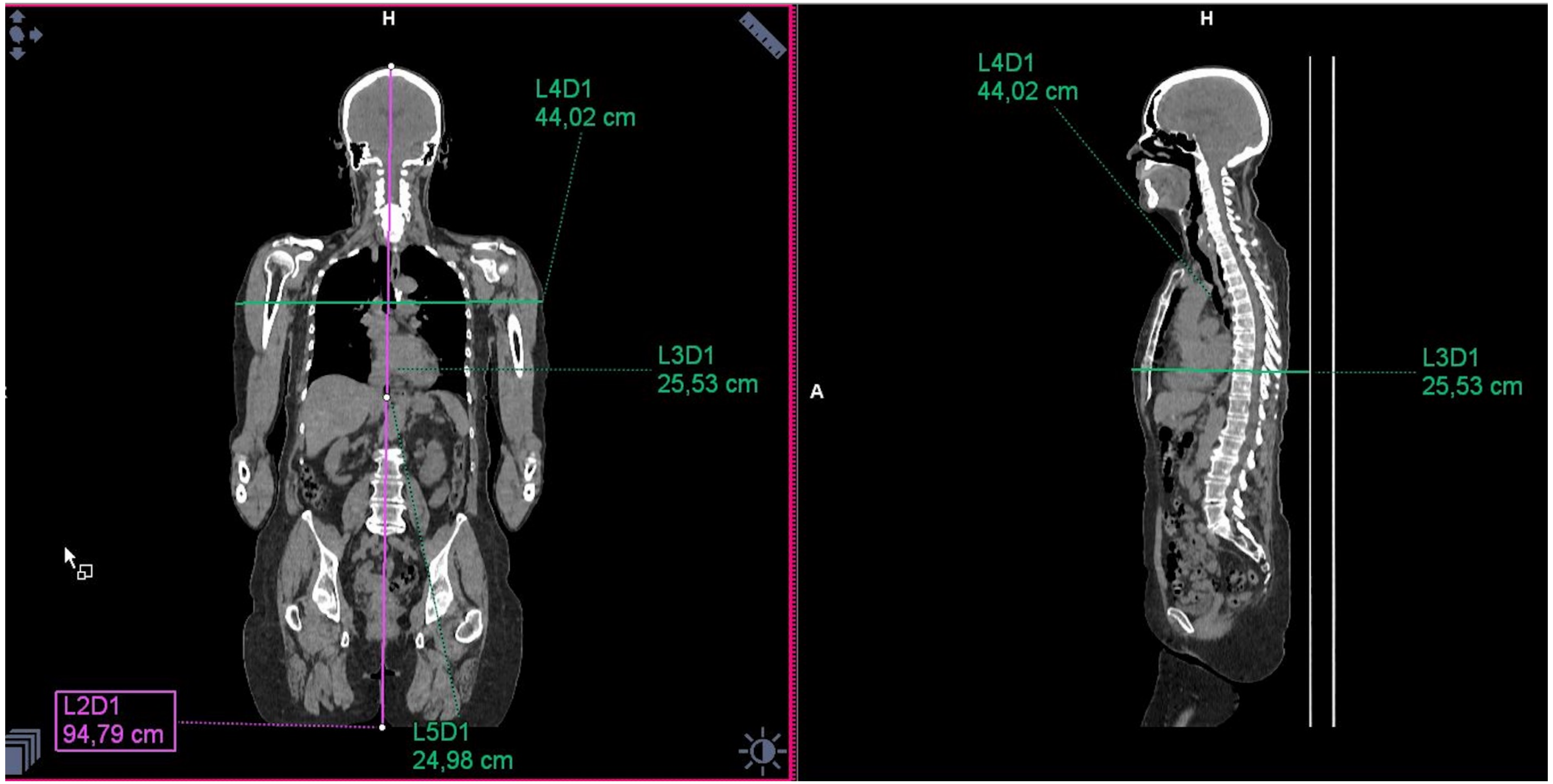
30sec on Quadra

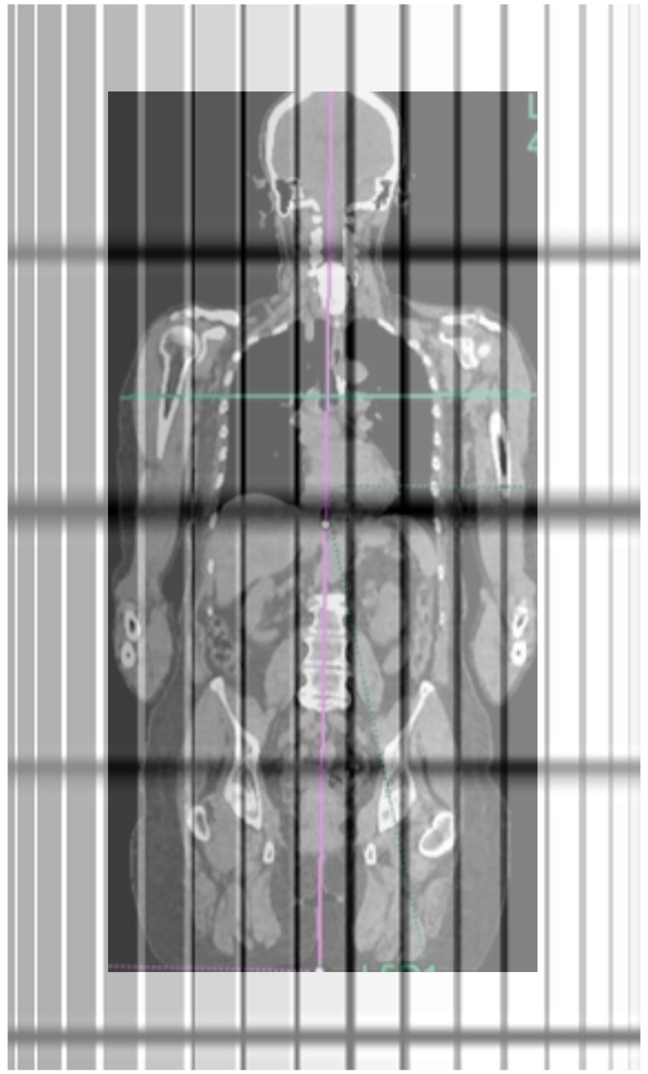


WT-PET design project started on 1st June 2022

‘WALK THROUGH PET’ DESIGN BASED ON PATIENTS

- +/-40 PET-CT patients -→ top patient size on CT determines the size of detector





+ 10 cm extra detector

Prof N.Withofs
NM CHU

average/max width/height/depth of 40 patients
52/65, 85/95 and 32/38 cm

70 cm wide
110 cm high
50 cm gap

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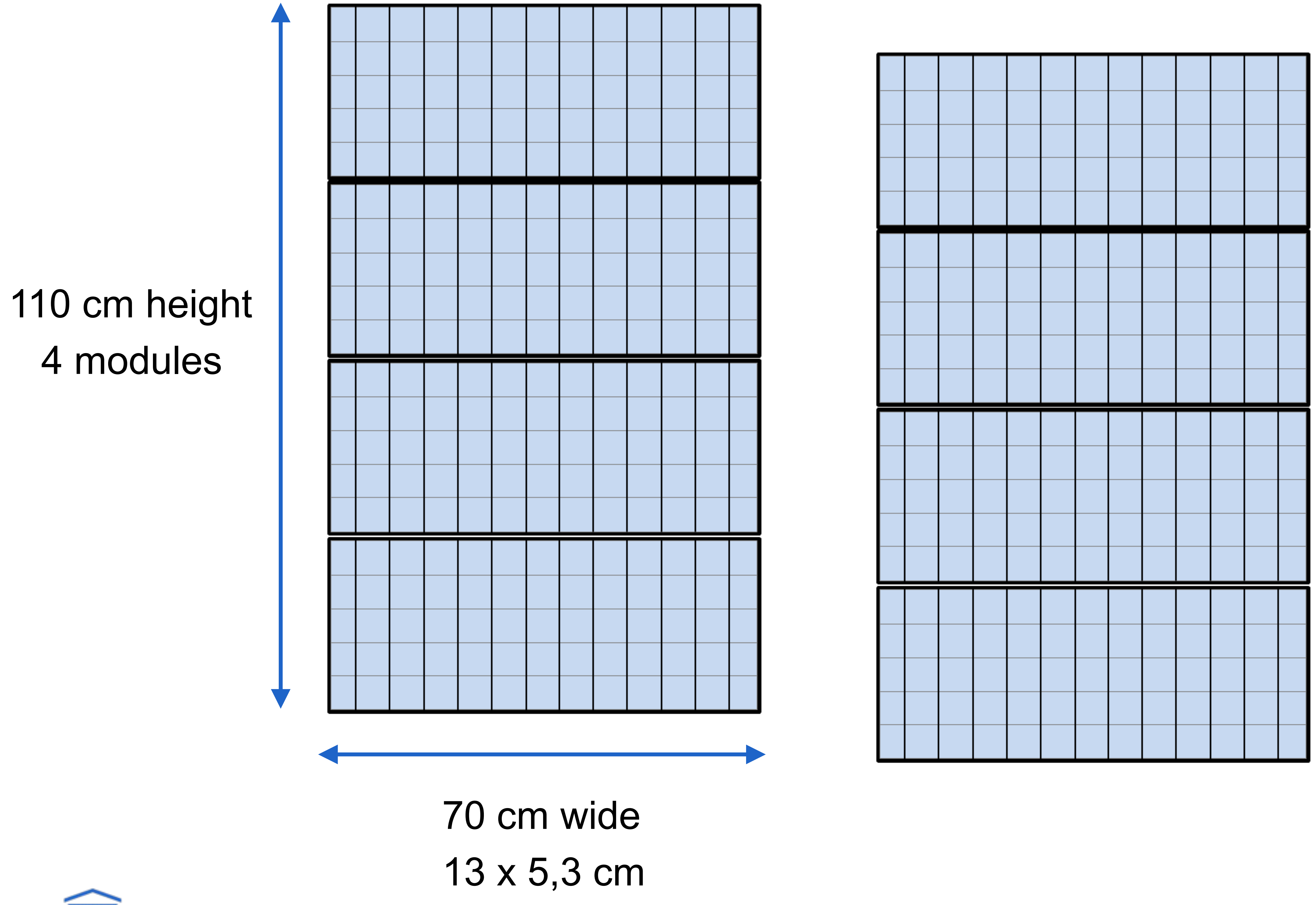
DETECTOR MODULES



1 module 14 x 5 array

1Block = 50x50x12/16 mm thick BGO

Modular approach/upgradeable
8 panels of reasonable weight
(about 50 kg from first estimate)
Easier for service

Flat panels are also easier to calibrate

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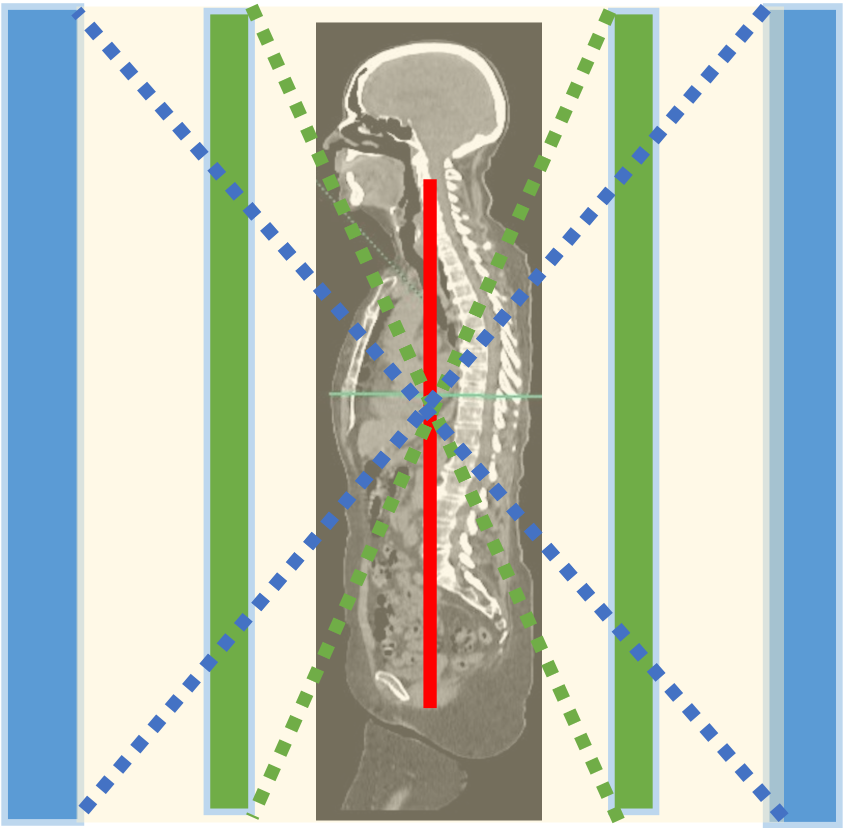
SOLID ANGLE/POINT SENSITIVITY

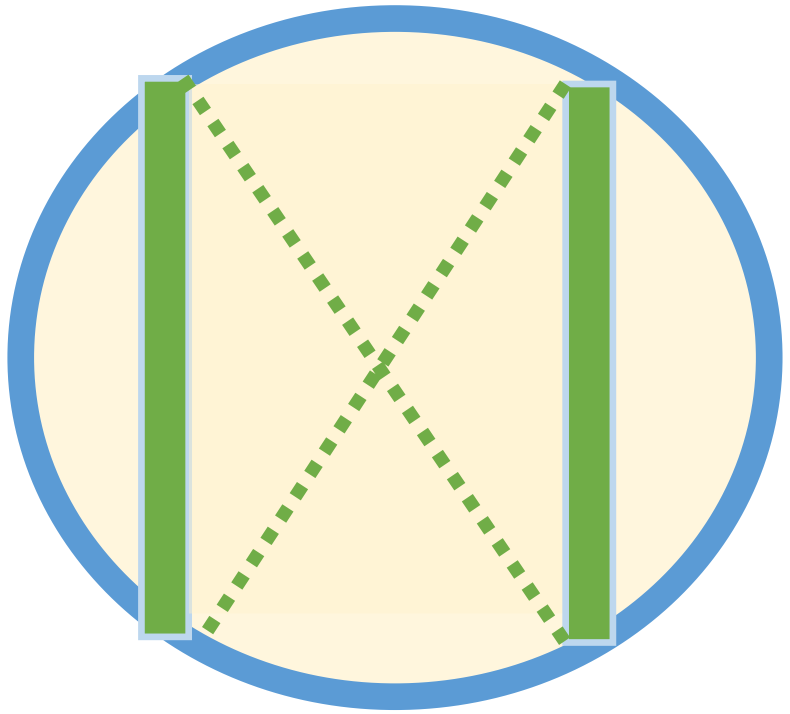
50 cm gap
+/- 260 degrees
opening

106cm
Axial
length



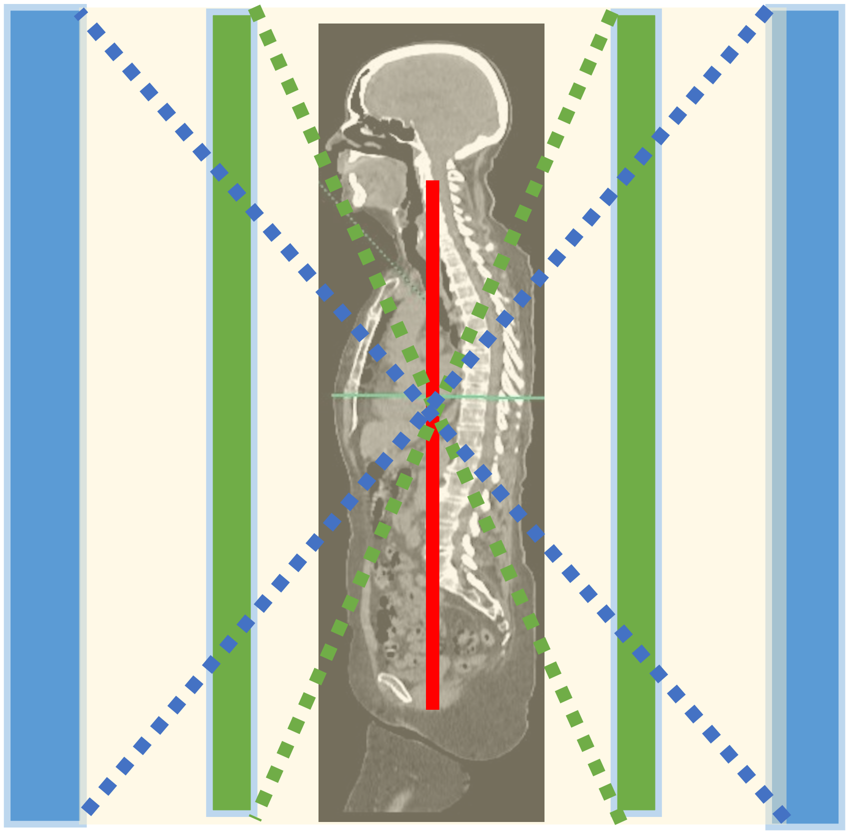
D= 85 cm diameter
+/- 204 degrees

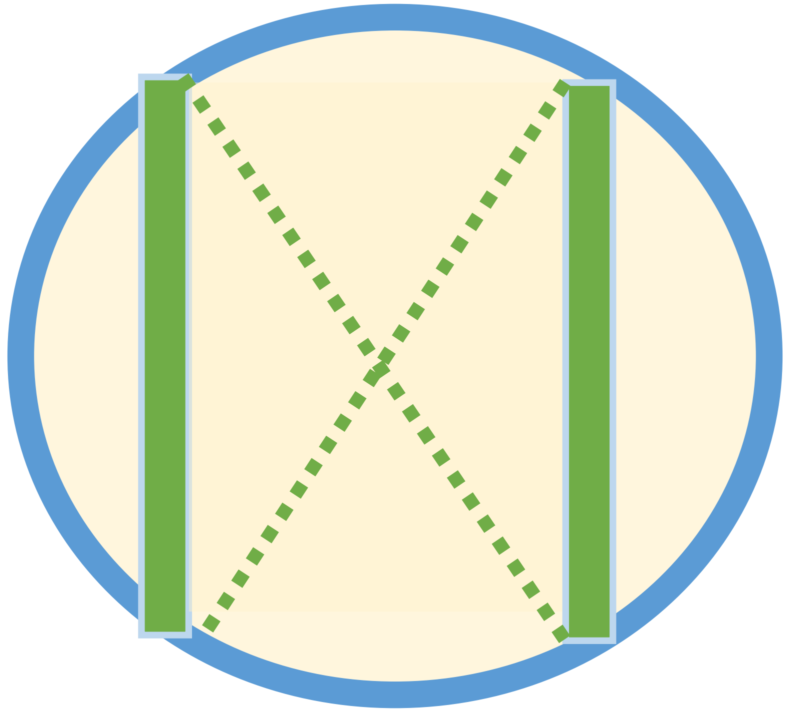
50 cm gap
216 degrees



L= 70 cm

D= 85 cm diameter
360 degrees





We gain some
+ 25%
Patient orientation
Limits attenuation/scatter

We lose a bit more
- 40%
Patient orientation
limits effective loss

Higher average incidence angle
on detector in flat panels will boost sensitivity
Calc (MC) effective gain → 46% higher absolute sens
→ **2,77 x more coincidences for equal detector area**

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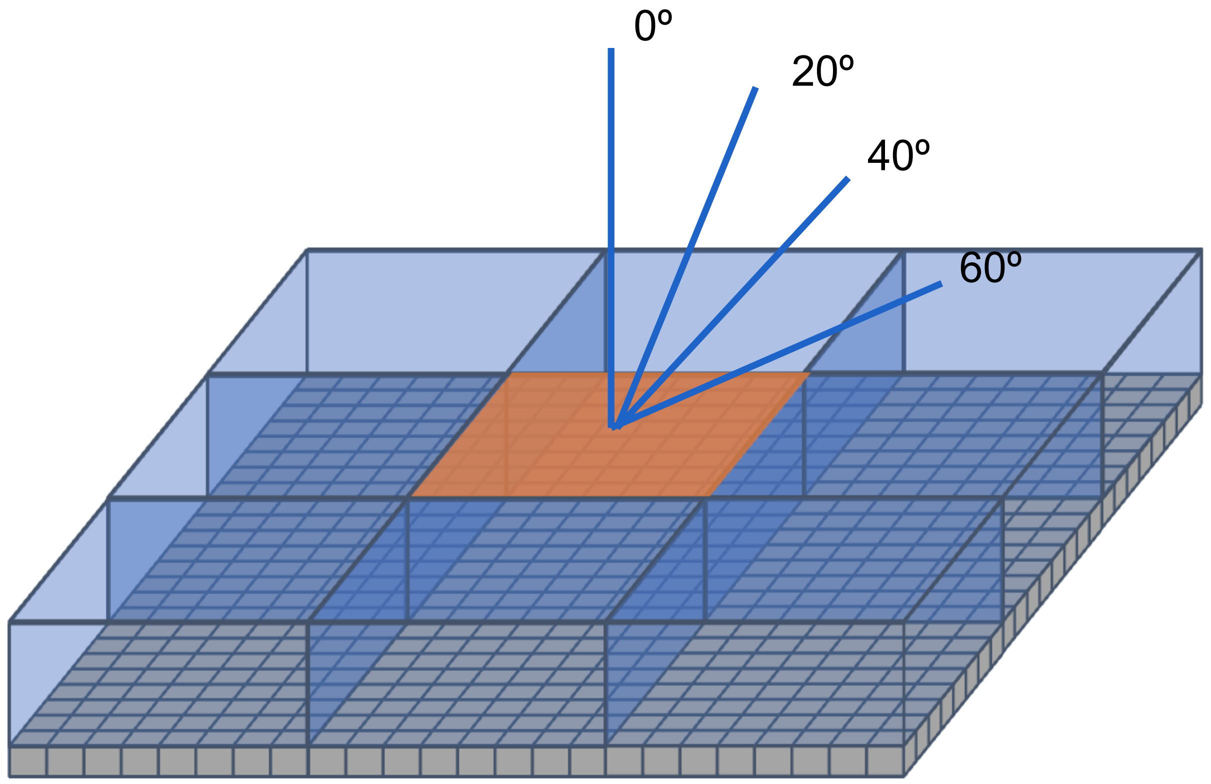
WHY BGO INSTEAD OF L(Y)SO

- **3 x cheaper**: More bang for the buck-More bounce to the ounce
- BGO-TOF is lower than LYSO (factor 2 ?) but has become possible (Cherenkov + SiPM)→ 300-400 ps at system level seems feasible (Pisa-UTOFPET results)
- No intrinsic activity
- Higher photofraction and sensitivity

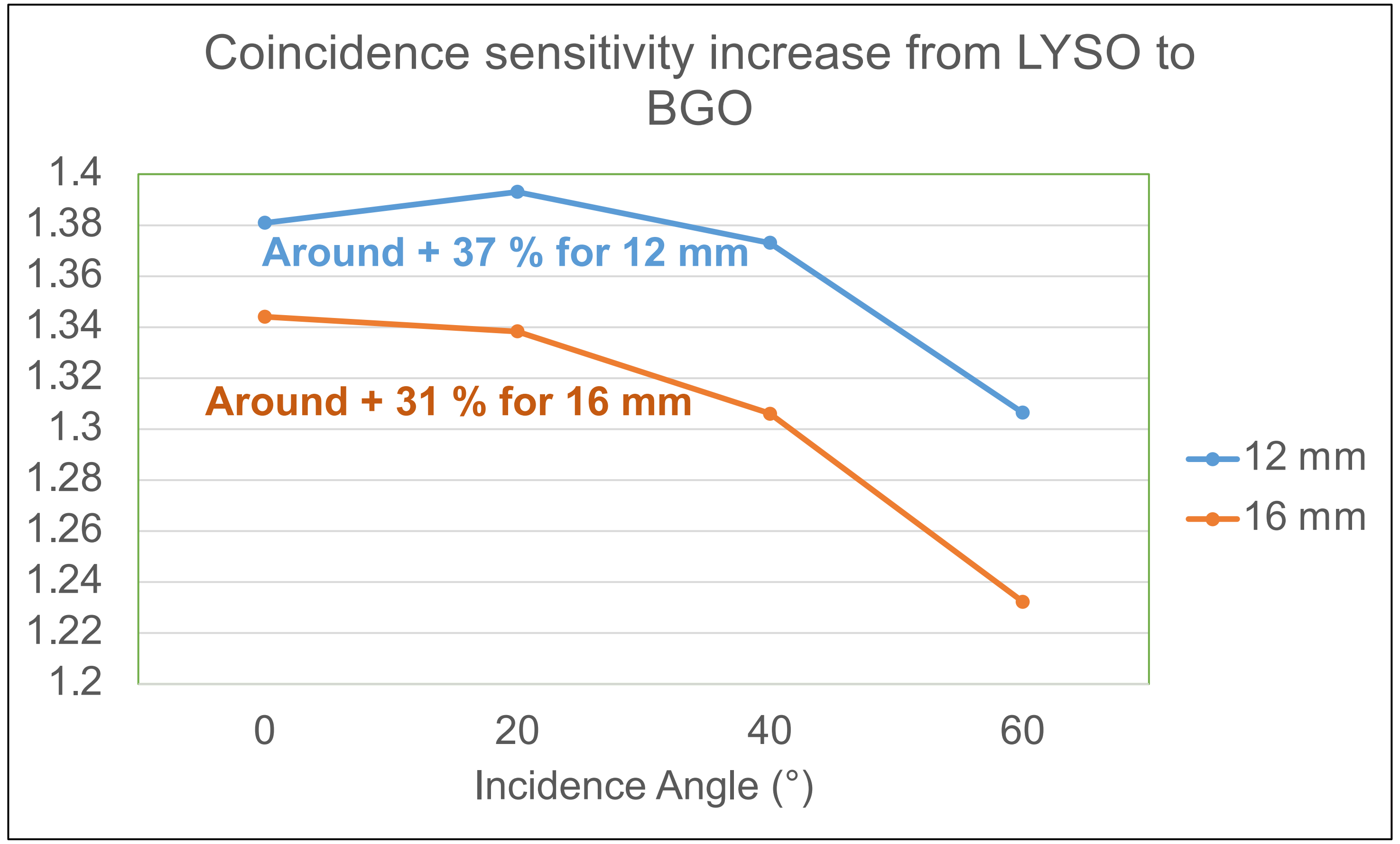


- geometry: 3x3 array of 50x50x-- mm monolithic detectors
  - 2 materials: LYSO & BGO
  - 2 thicknesses: 12 mm & 16 mm
- source: uniform rectangular source (see orange plane) covering the central detector
  - 4 incidence angles (w.r.t. surface normal): 0, 20, 40 and 60 degrees

Properties	BGO	LYSO
Density (g/m³)	7.13	7.3
Melting Point (°C)	1050	2047
Index of Refraction	2.15	1.82
Radiation Length (cm)	1.10	1.16
Attenuation (cm-1)	0.96	0.87
Decay Constant (ns)	300	50
Light Yield (%) NaI (Tl)	25	75
Photofraction (%)	40	30
Energy Resolution (511 kev,%)	16	20
Radioactivity	No	Yes

	Sensitivity	TOF gain vs 800 ps	Relative Cost (1.9 x more blocks with BGO)
LYSO-200 ps	100	400	400 x1x 1=400
BGO-400 ps	135	270	202 x 1,9x1,9=729

Cost of readout and SiPM taken into account !



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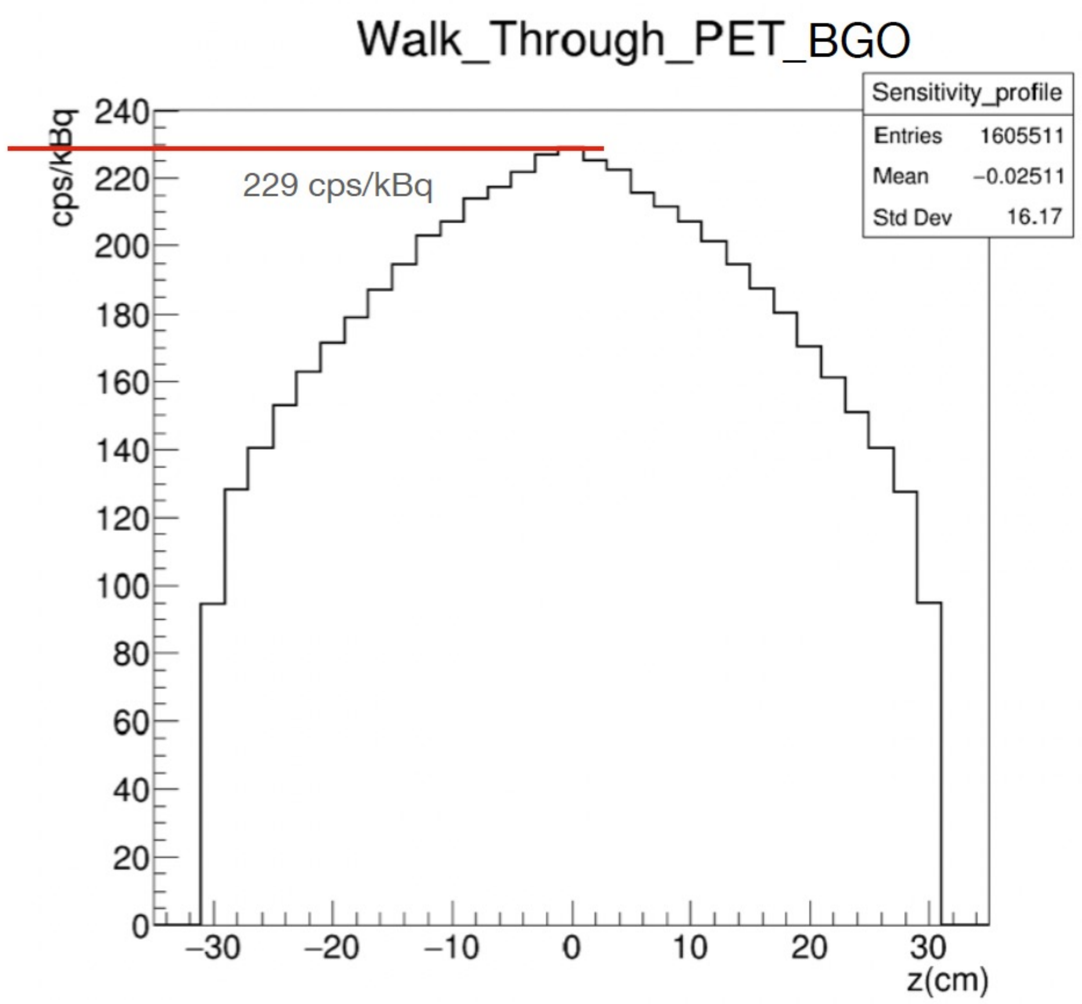
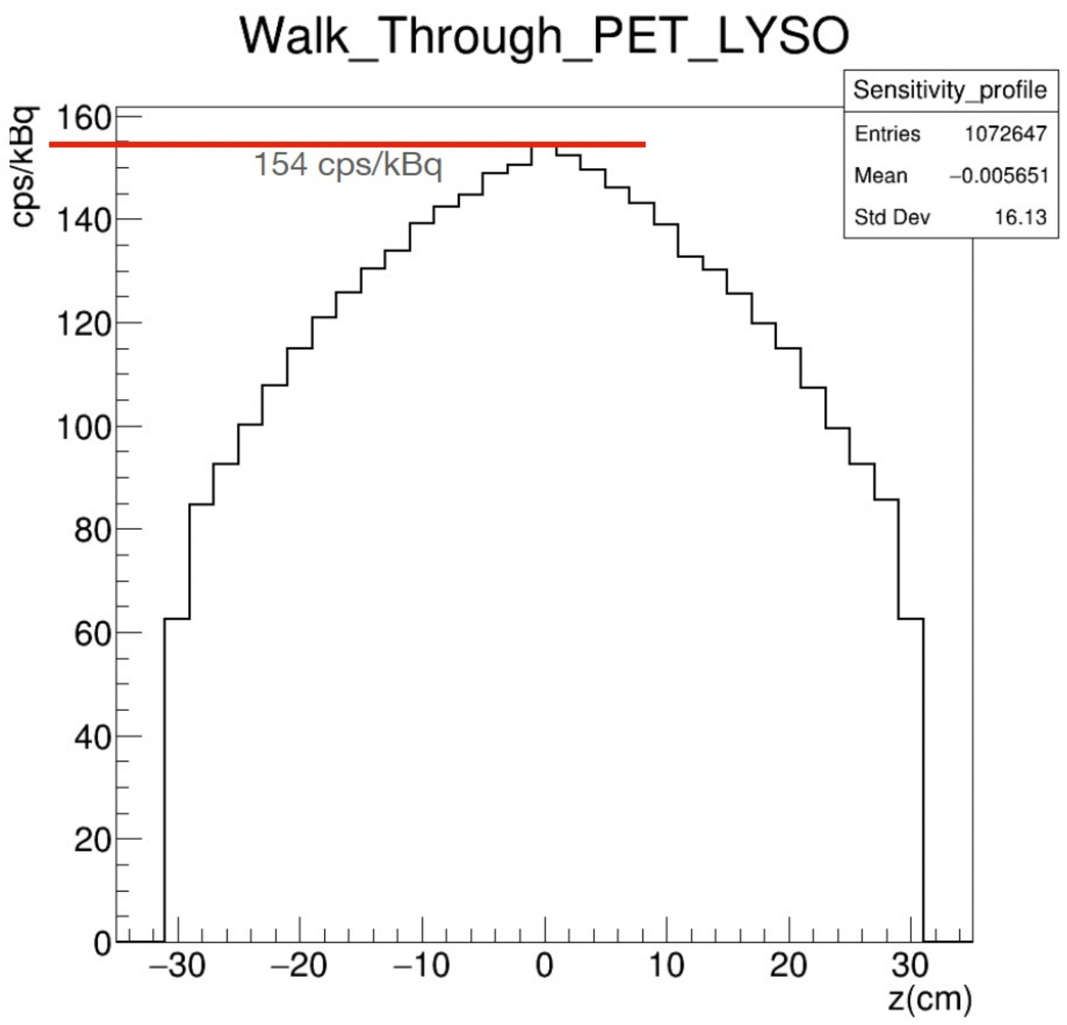
Deep learning for Total Body PET
PhD Jens Maebe

BGO VS LYSO WITH FLAT PANELS

50 X 50 X 16 mm^3





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Radioactivity	No	Yes

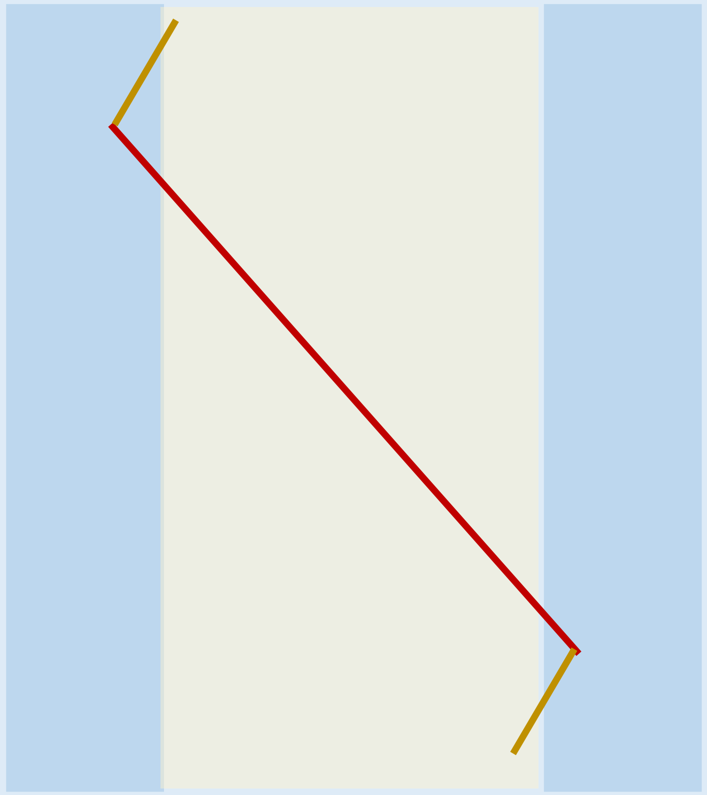
Ratio BGO/LYSO~ 1.48

LYSO has 30 % and BGO 40 % photofraction
Sensitivity increase is much higher than expected from perpendicular single detector incidences (about 25 % increase BGO vs LYSO, simulation Jens Maebe)

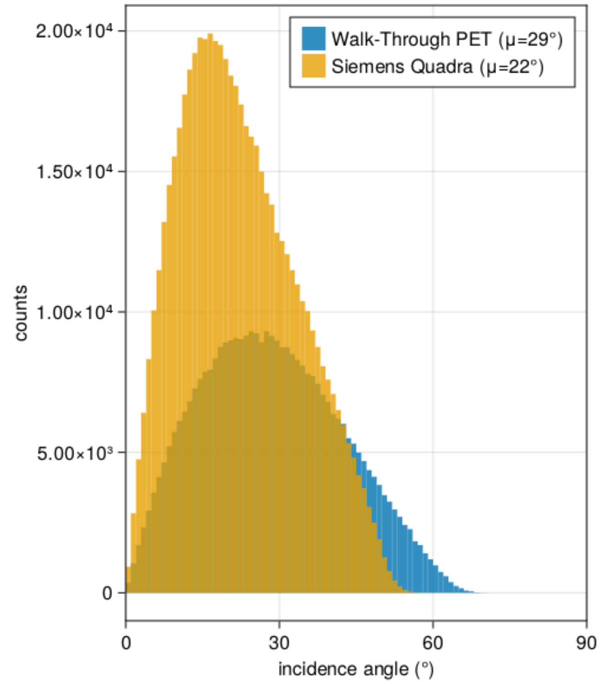
Possible reasons

BGO 40 % photofraction/60% compton

LYSO 30 % photofraction/70% compton



1. Higher photo-fraction of BGO
2. Escape of photon (non-photopeak detection) after first Compton interaction more likely with LYSO at oblique incident angles

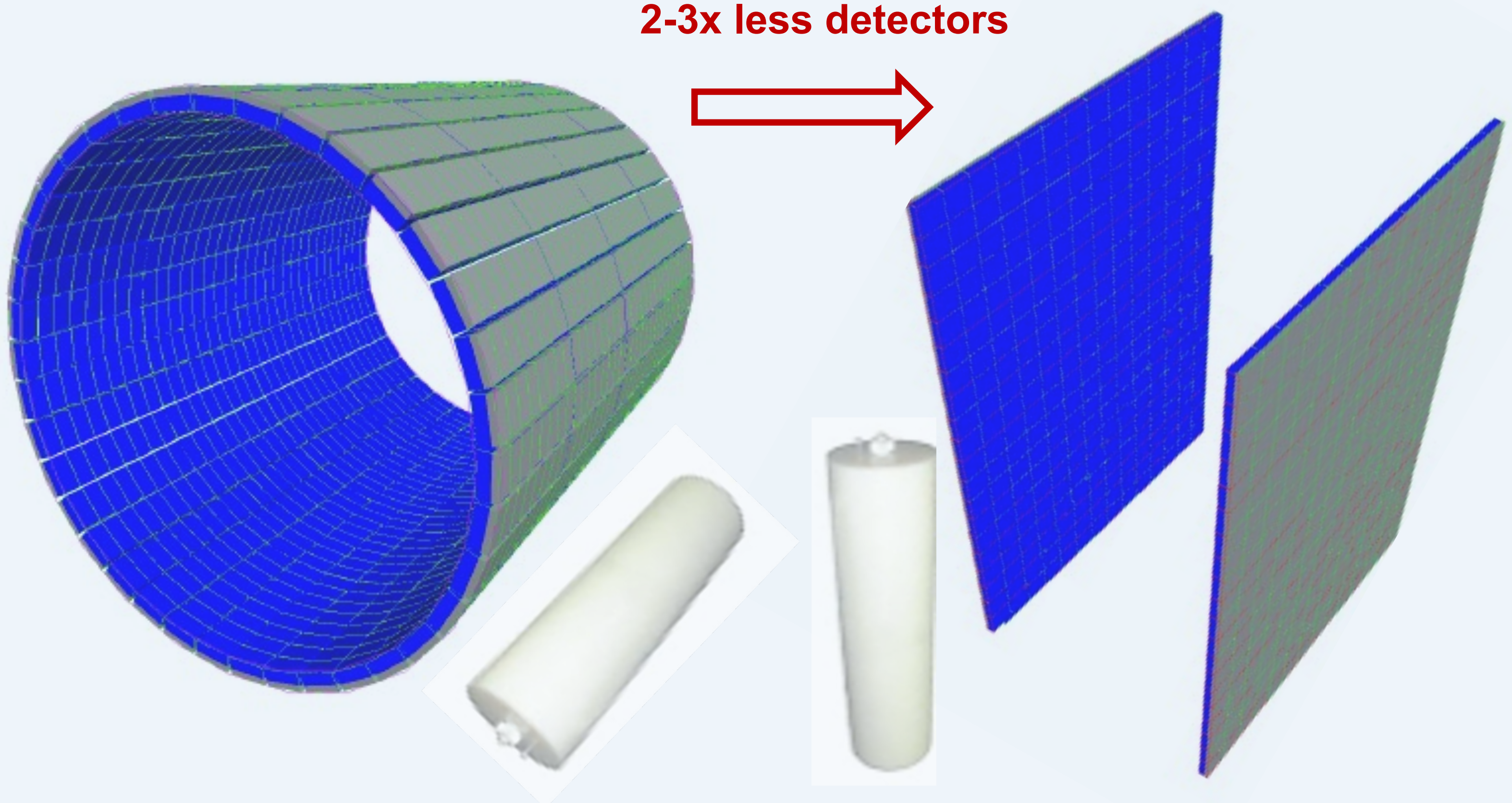


Higher average incidence angle (body phantom)

SYSTEM SIMULATIONS

Siemens Quadra	WT-PET
Pixelated 3.2x3.2 mm LYSO	5x5 cm Monolithic BGO
20mm thick	12/16mm thick

2-3x less detectors



85 cm diameter, 106 cm axial FOV	50 cm gap, 70 cm wide,106 cm high

Scatter Fraction:
Quadra 32.5%
WT-PET 31.19%

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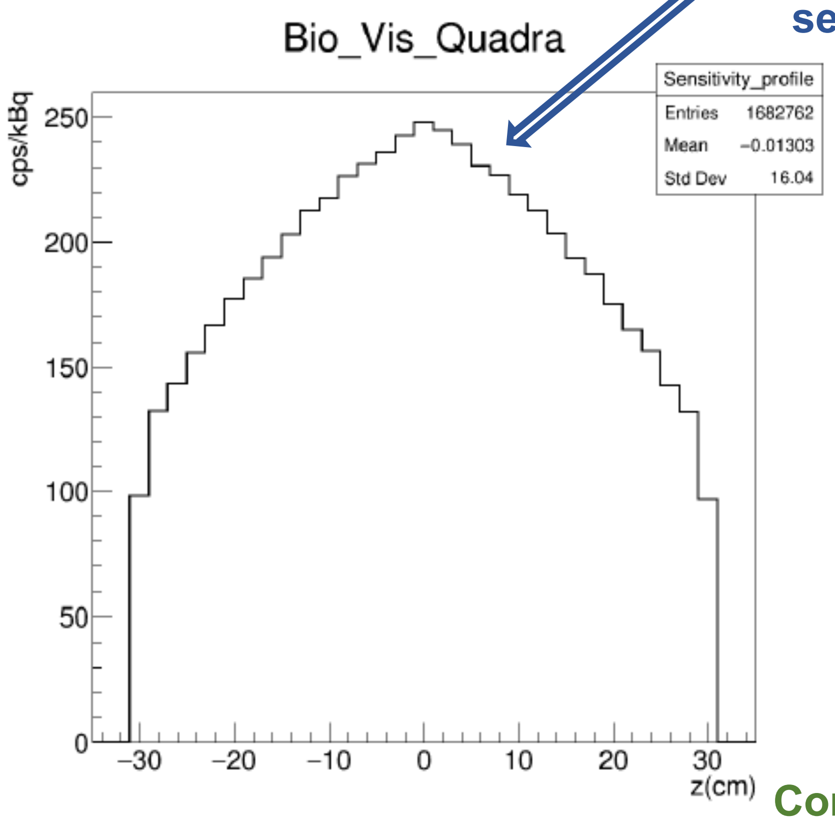
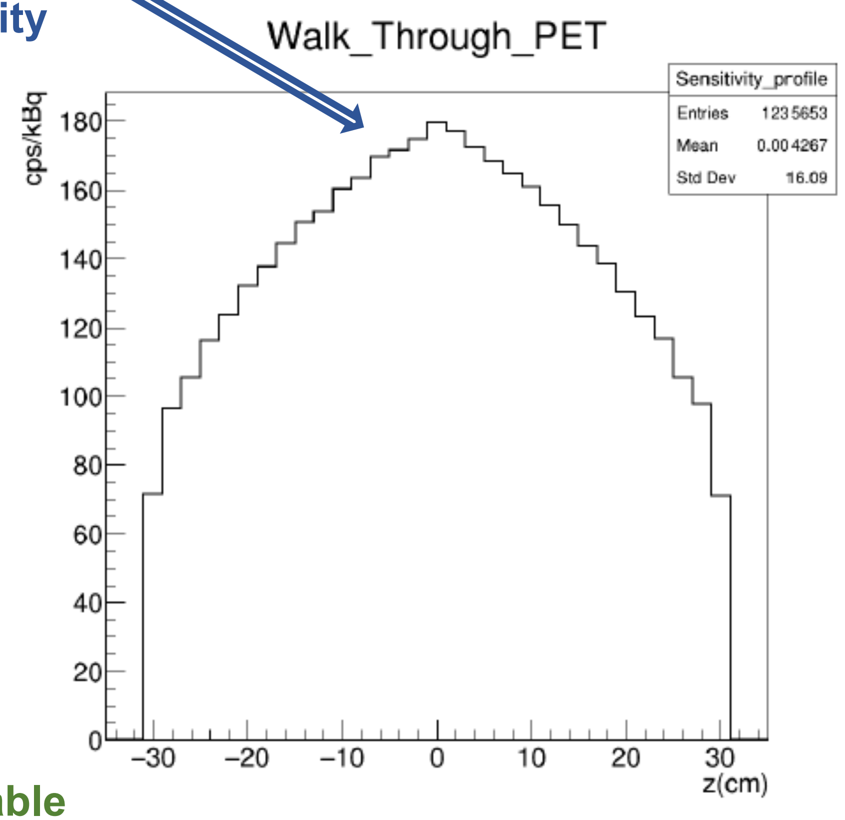
Line source at center

Only 33% lower sensitivity

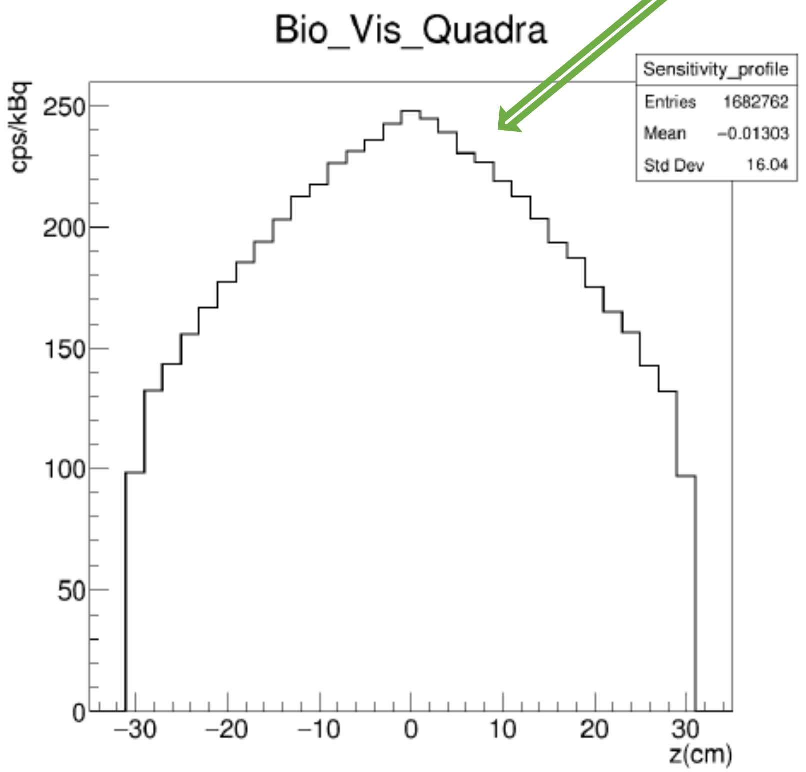
50 X 50 X 12 mm^3

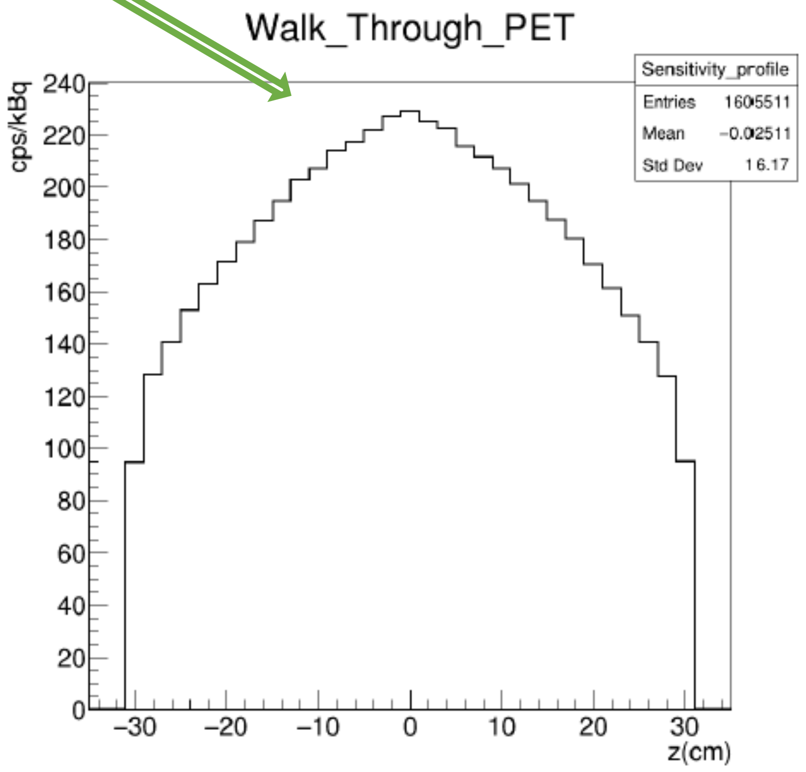




Comparable sensitivity

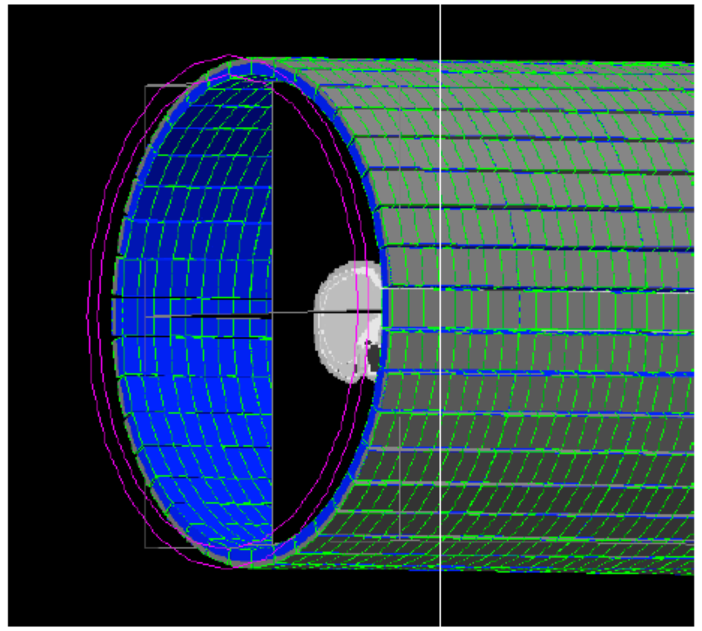
50 X 50 X 16 mm^3

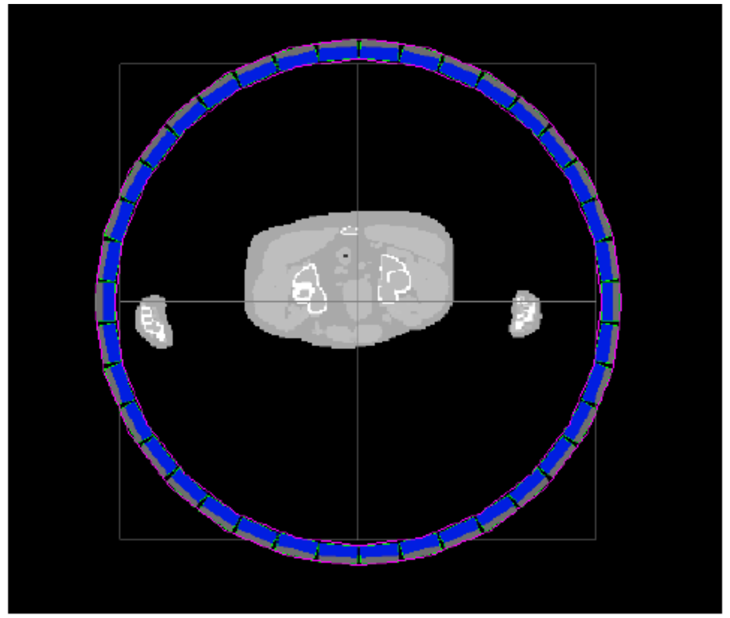




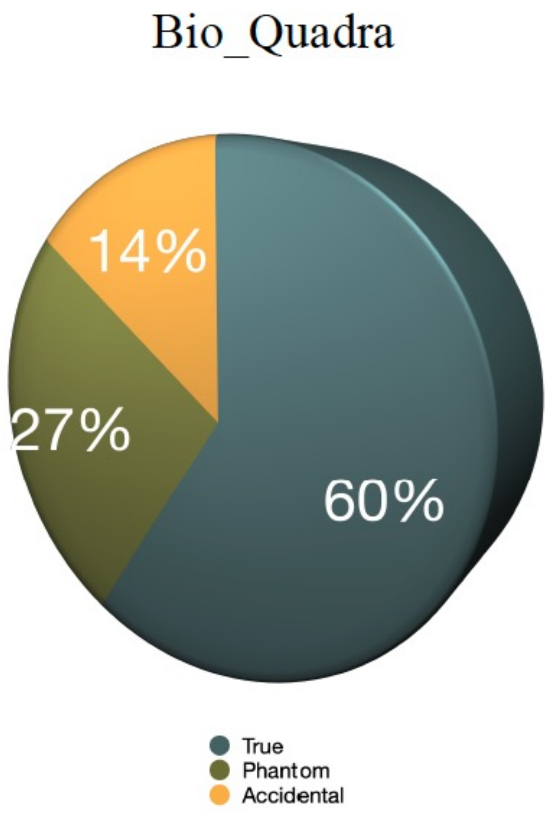
Results from Quadra in full angular acceptance mode, not yet active

RANDOMS AND SCATTER/XCAT PHANTOM

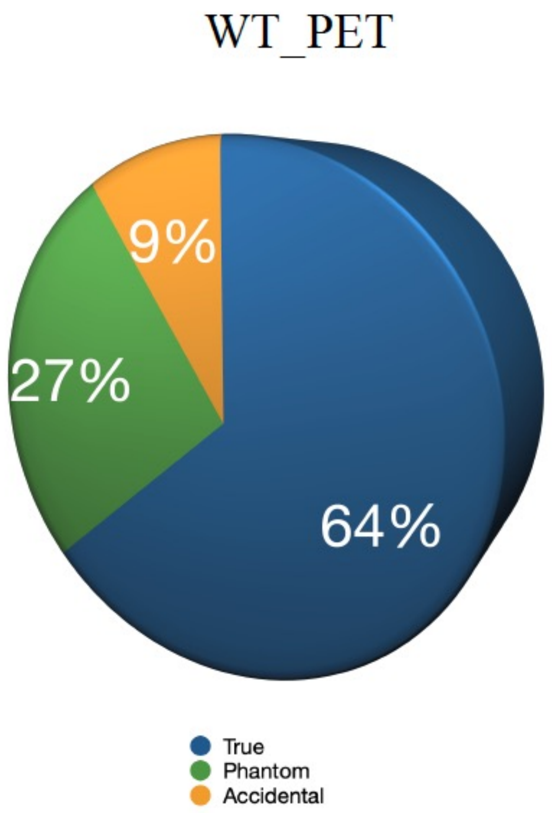




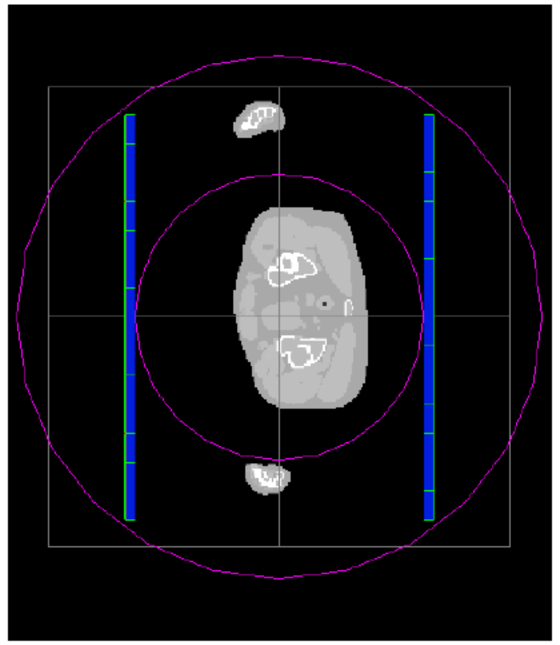
3.7 MBq/kg• Male of 183 cm
Image size of 150x150x600
(cropped in frontal direction)
Voxel size of 3.125 x 3.125 x 3.125 mm^3



Scatter Fraction:
Quadra 31.03 %
Randoms fraction
WT-PET 14 %



Scatter Fraction:
WT-PET 29.6 %
Randoms fraction
WT-PET 9%



Lower scatter due to object orientation
Lower randoms likely due to higher trues/singles of WT-PET (object closer to detector)

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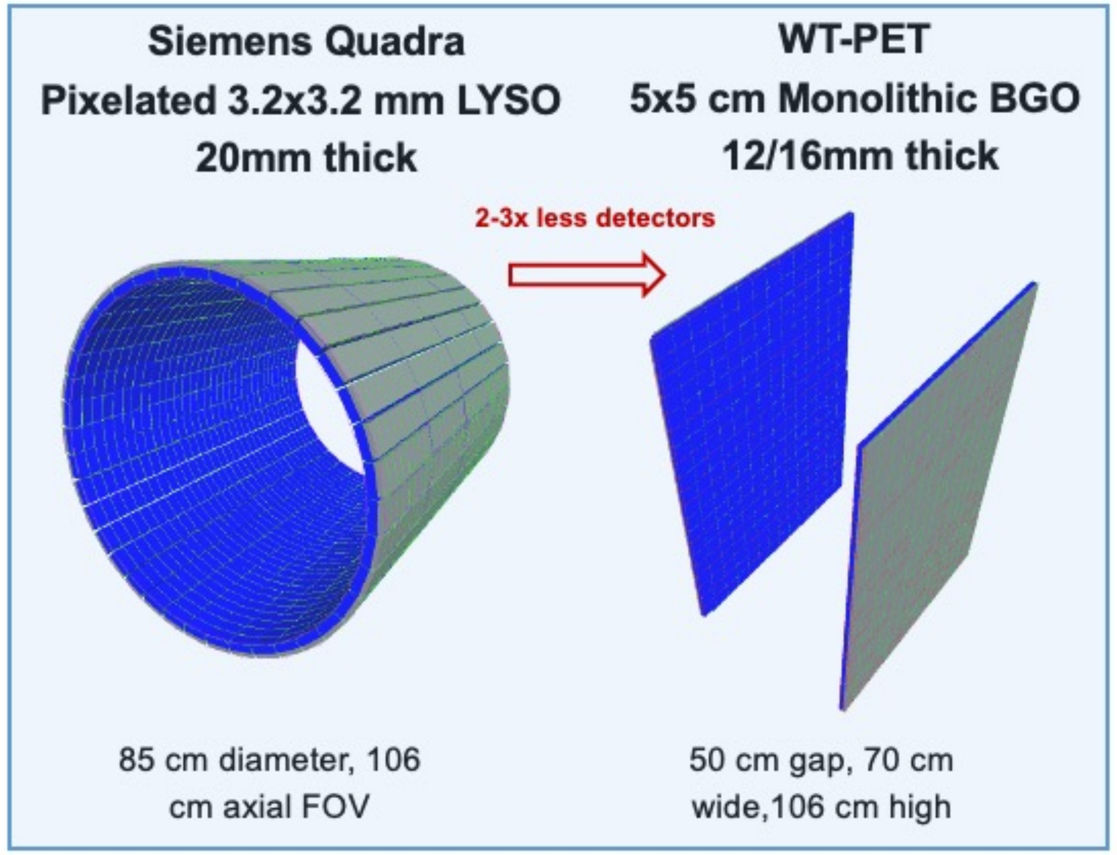
System component cost without electronics/bed/CT

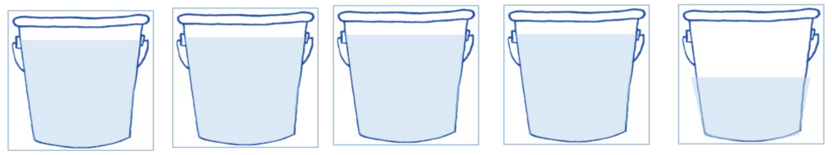


56 Liter
=
408 kg LYSO

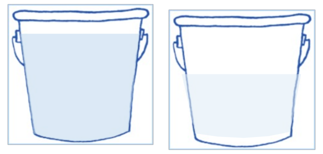
10,5-14 Liter
=
75-100 kg BGO
520 blocks

1680 k euro — LYSO (30 Euro/cc)

BGO (10 Euro/cc) — 105k-140k euro



Scintillator: 7-10x lower in cost !



985 k euro

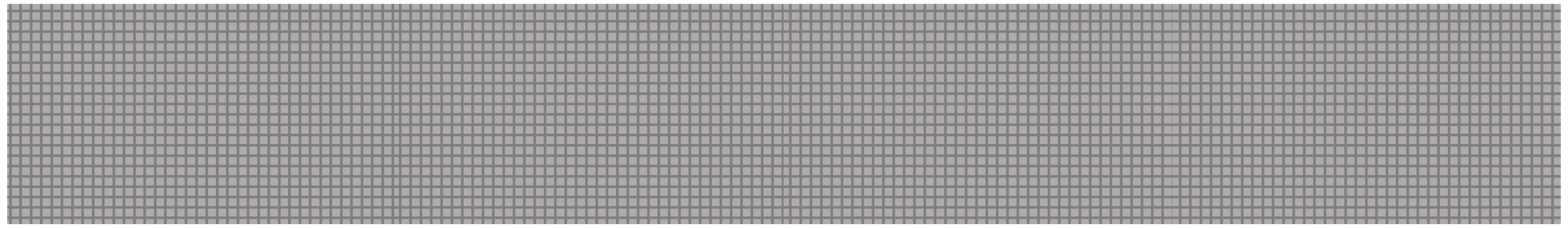
3,64 m^2 SiPM
Same surface cost

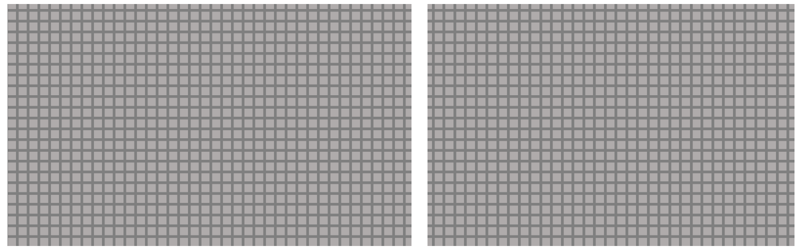
SiPM: 1,9x lower in cost !

1,92 m^2 SiPM
520 arrays 8x8 6x6mm
1000 Euro/array

520 k euro

Quadra 2665 k euro

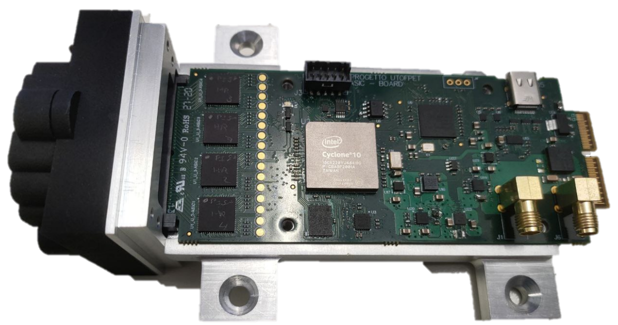


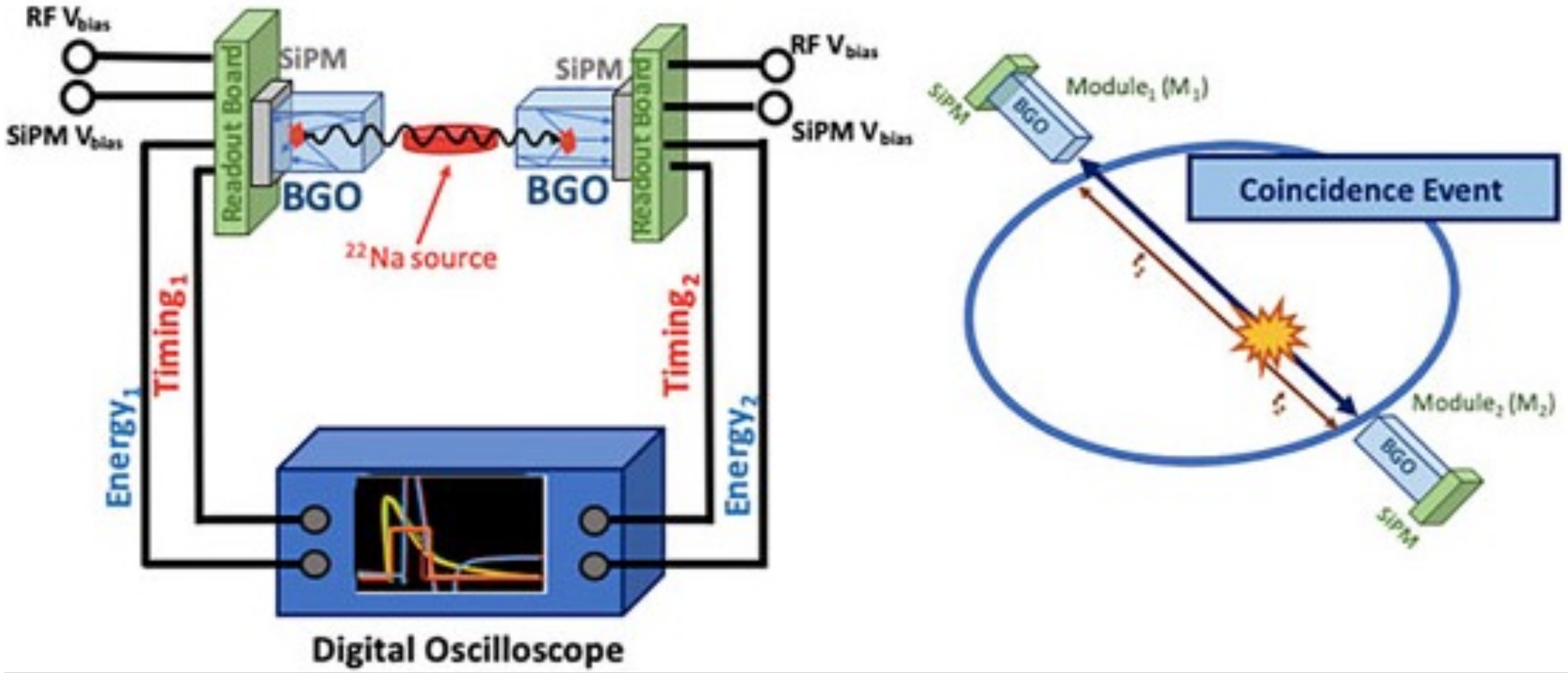


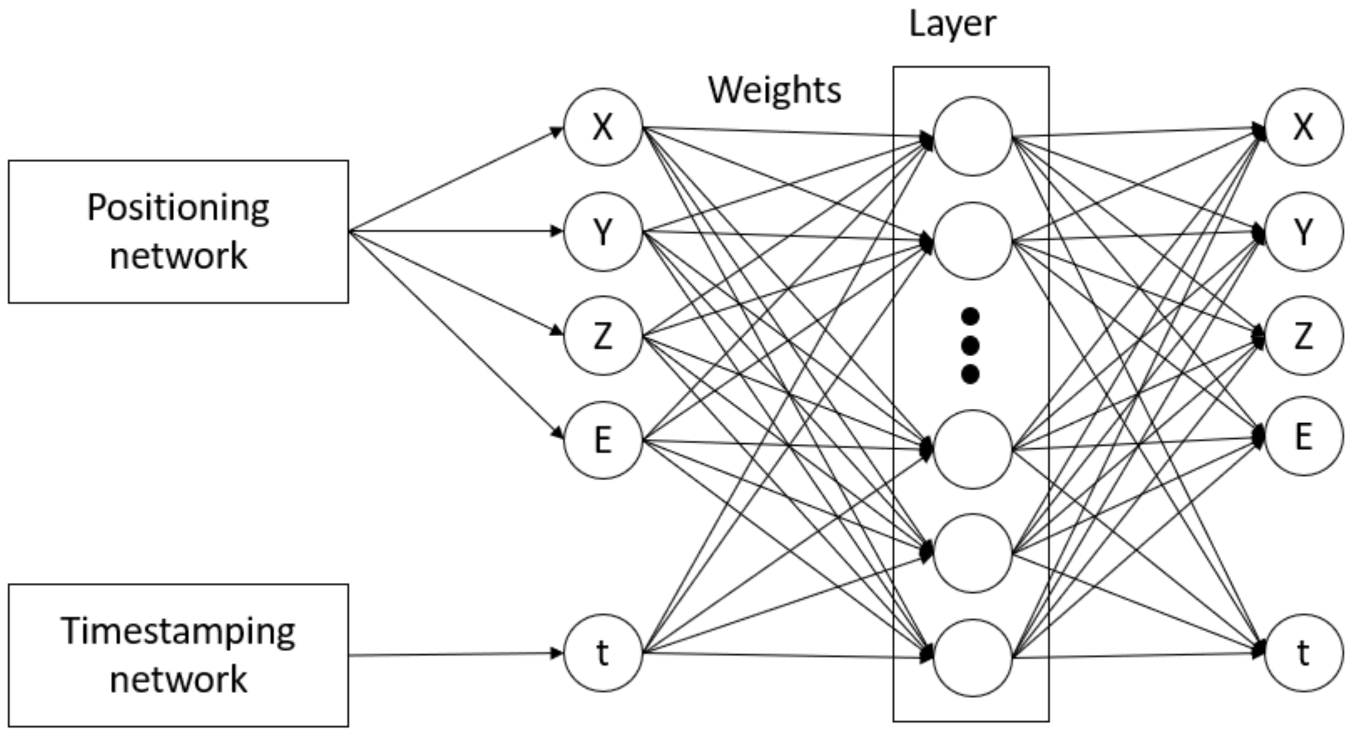
WT-PET 625-660k euro

System: Factor 4x lower in cost !

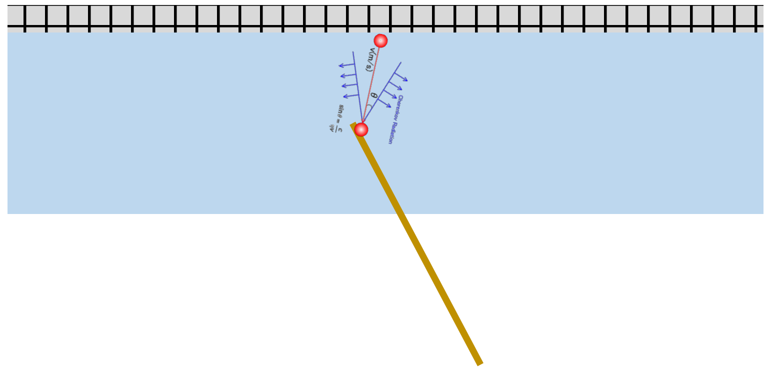
TOF FROM BGO







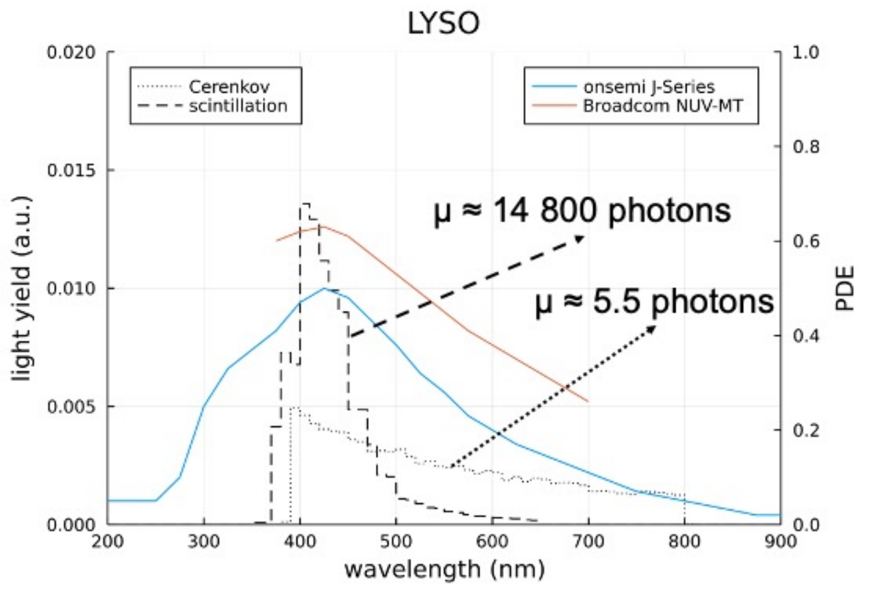
Cherenkov light = only 0.2% of the scintillation light
But instant light (20 photons)
SiPMs around 50-60 % PDE
Low noise SiPMs



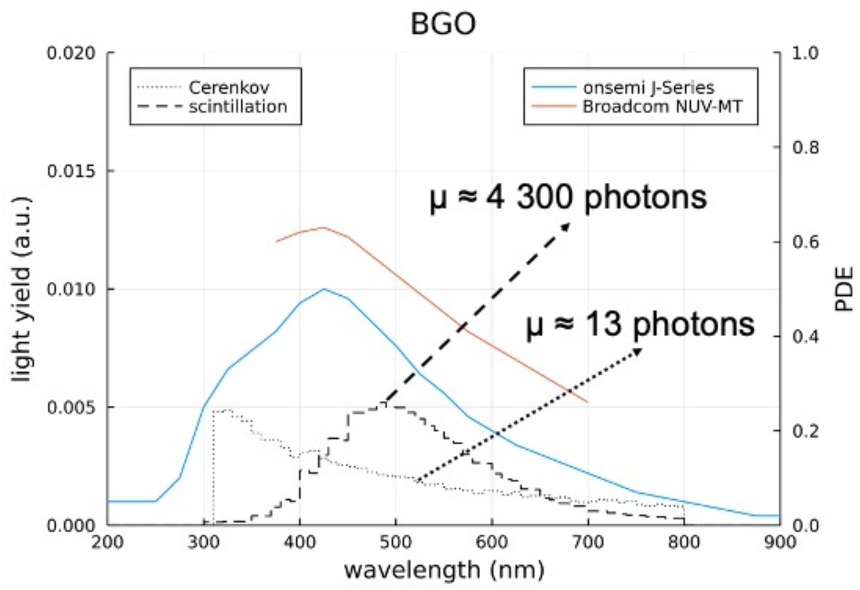
Deep learning based TOF and position
15 % energy resolution
1.3 mm spatial resolution
327 ps TOF
6x6 mm SiPMs → less channels
12 mm BGO: 3 x cheaper
ASIC Barcelona

BGO/LYSO CHERENKOV

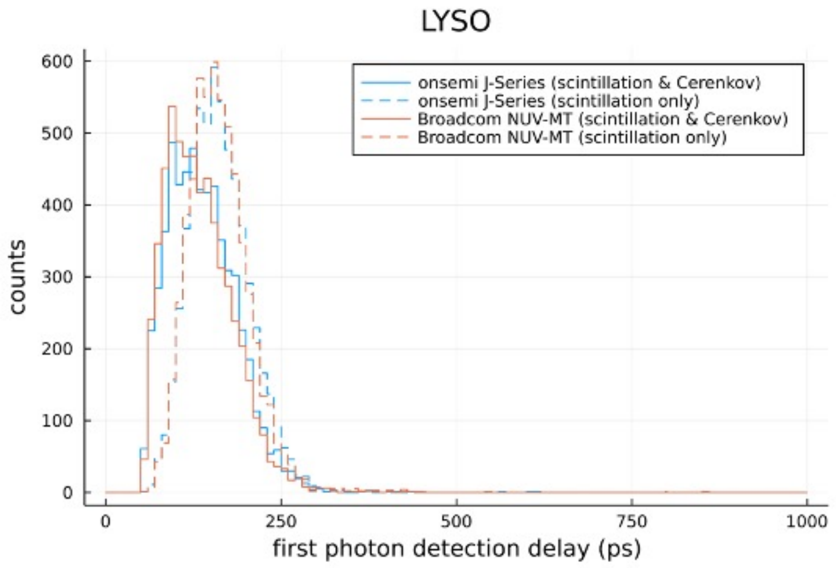
EMISSION

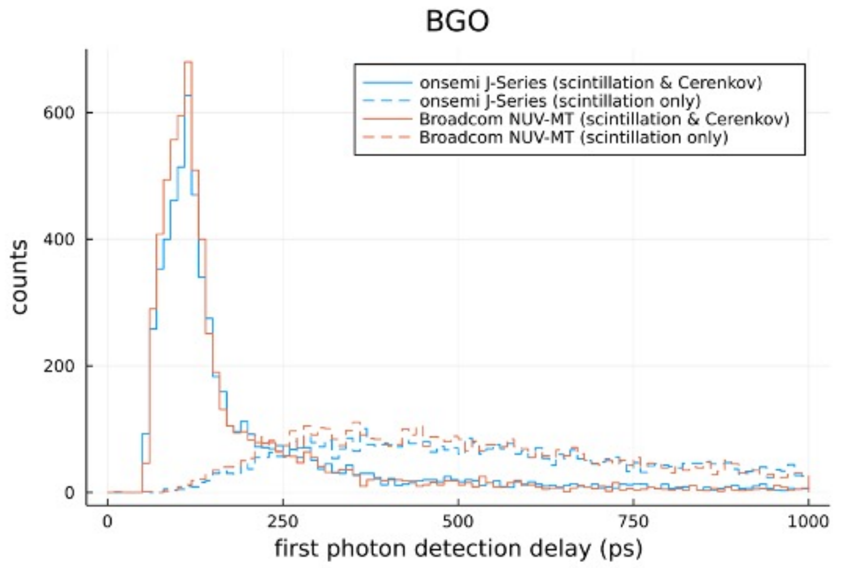


LYSO Cerenkov contribution ≈ 0.04 %



BGO Cerenkov contribution ≈ 0.3 %





→Contribution of Cerenkov light makes a small difference for LYSO and a large difference for BGO.

DETECTION

# Cerenkov photons per event	LYSO	BGO
Emitted	**5.5** (8.8 / 3.6)	**13.1** (17.3 / 10.4)
Detected (onsemi J-Series)	**0.7** (1.0 / 0.4)	**1.7** (2.3 / 1.3)
Detected (Broadcom NUV-MT)	**0.8** (1.3 / 0.6)	**2.2** (2.9 / 1.7)

any 511 keV events (non-scattered 511 keV events / scattered 511 keV events)

Deep learning for Total Body PET
PhD Jens Maebe

GHENT UNIVERSITY

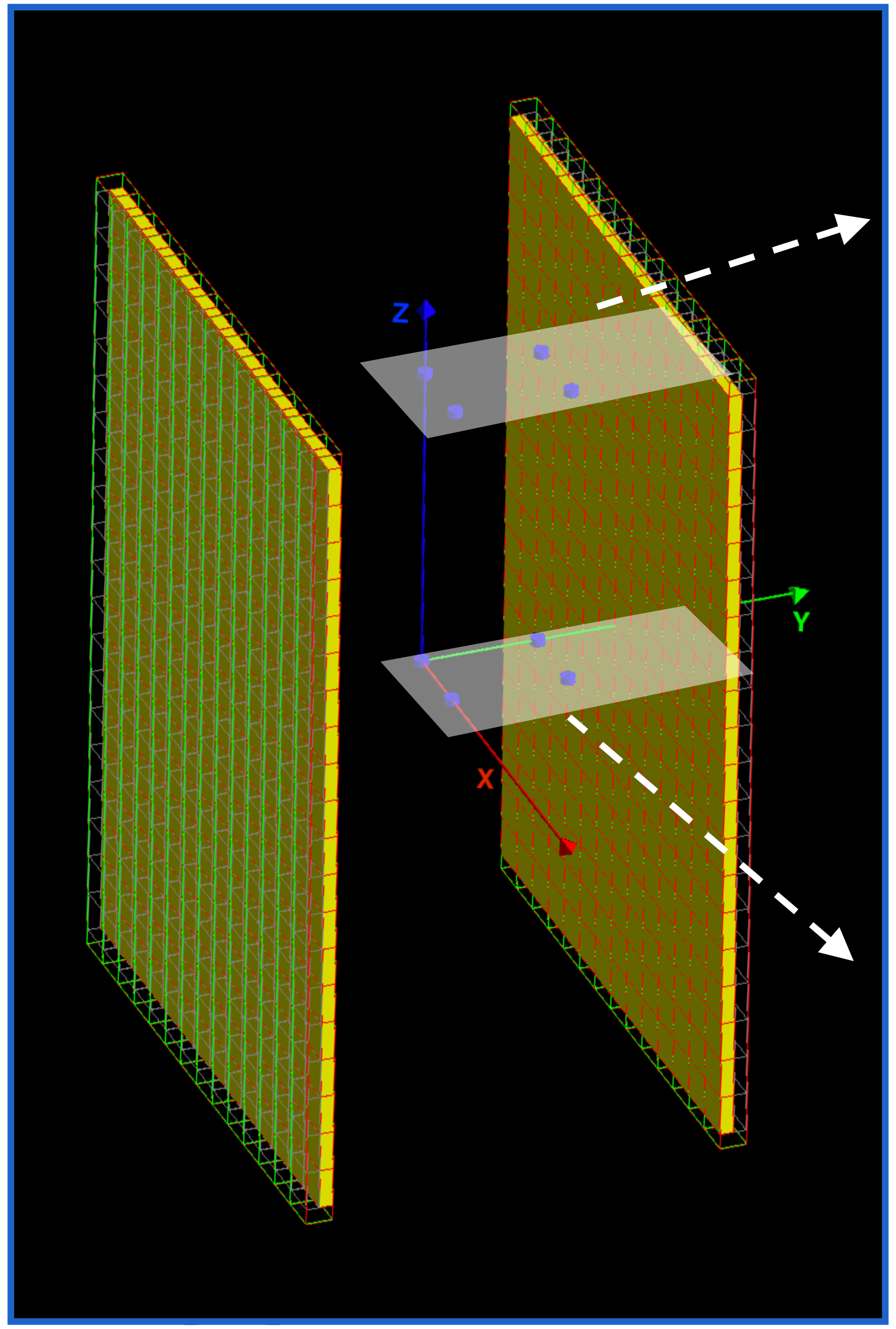
More details in poster by Jens Maebe, Ugent

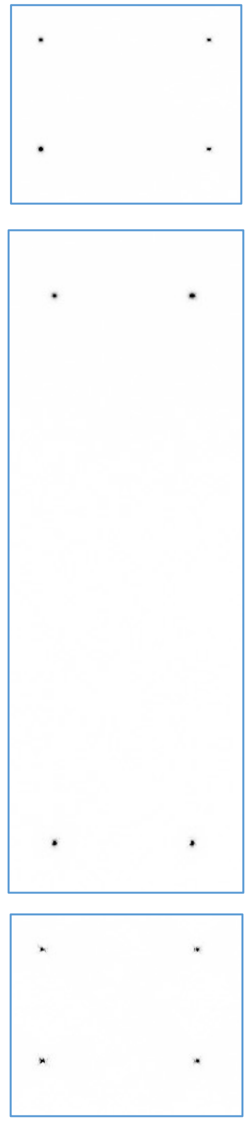
→When relying on Cerenkov for timing, non-scattered events will provide better time resolution.

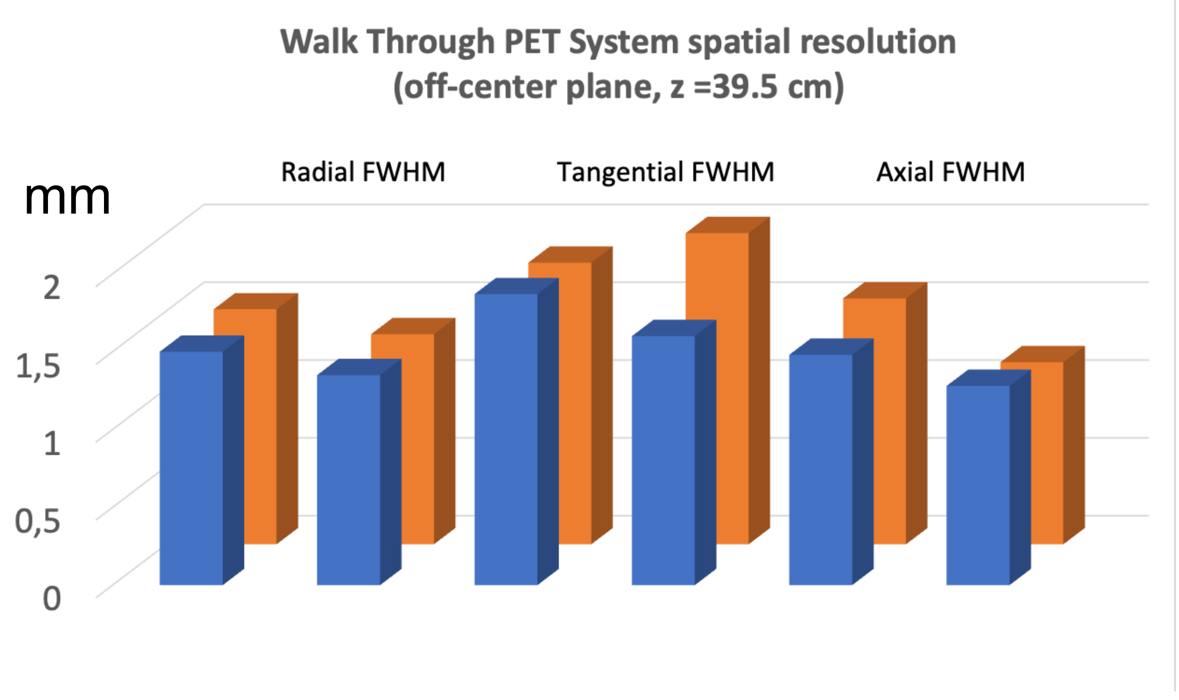
→Unlikely for multiple Cerenkov photons to hit the same SiPM in large monolithic detectors.

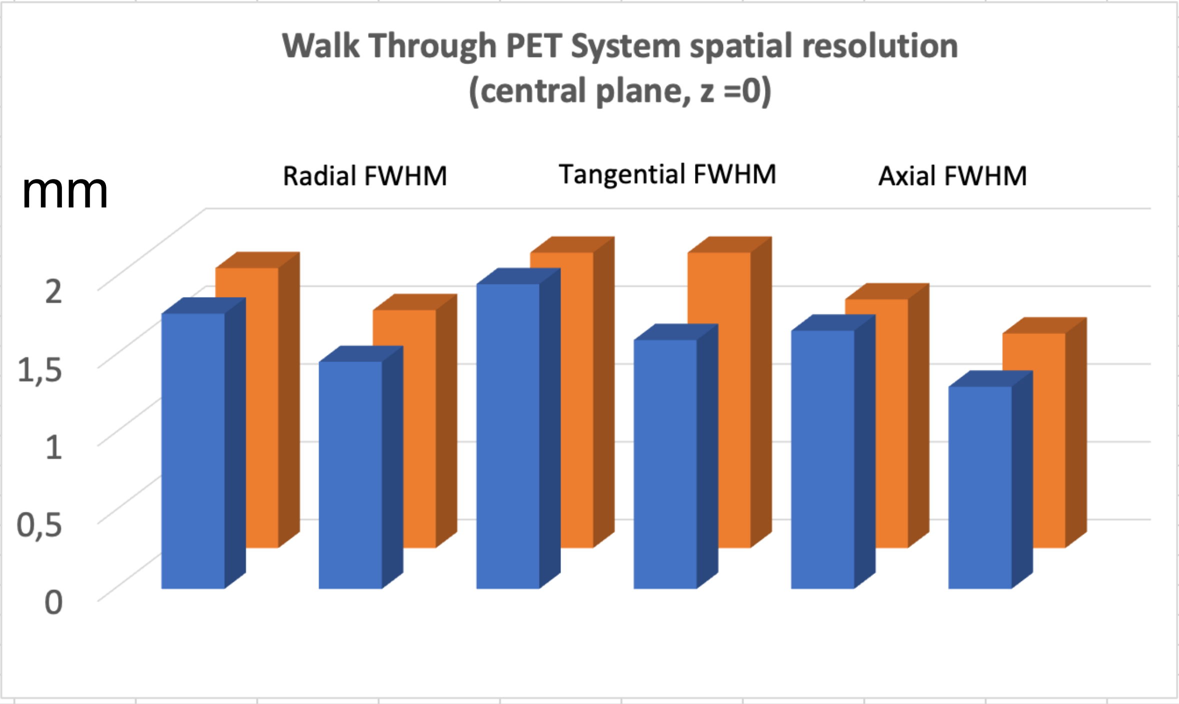
SYSTEM SPATIAL RESOLUTION

GATE simulation of eight F-18 sources
Listmode MLEM reconstruction









Siemens Vision

Radial Distance (cm)	Direction	FWHM (mm)
1	Radial	3.5
1	Tangential	3.7
1	Axial	3.6
10	Radial	4.6
10	Tangential	3.9
10	Axial	4.3

WT-PET
2-3x
Better !

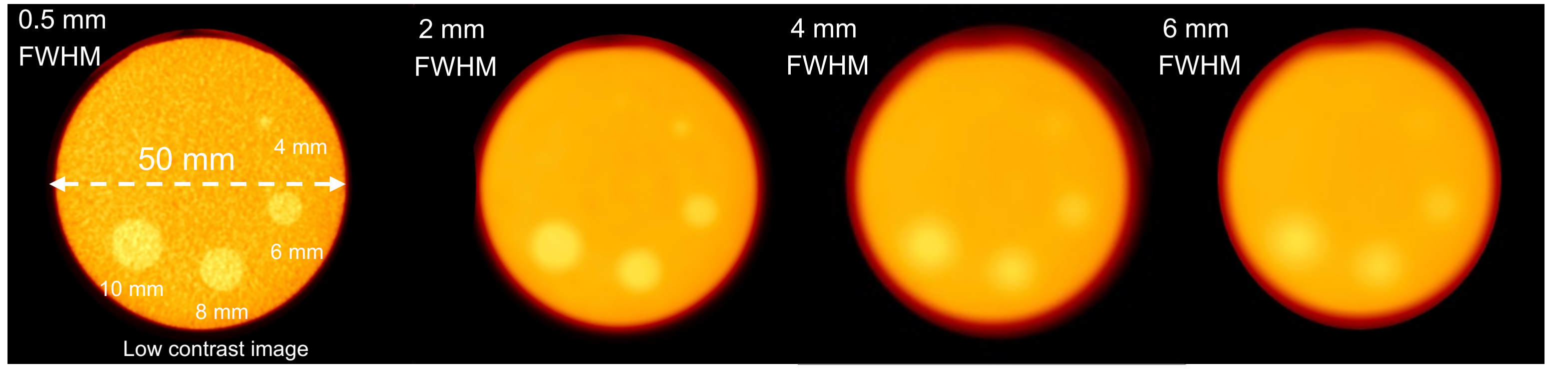
Monolithic detectors
6-layer DOI
High intrinsic spatial resolution
No rebinning nor sinograms
Iterative list mode recon
(2 subs, 10 it, non-TOF)

Nearly for all points
in all directions
between
1.5-2 mm
spatial resolution

Meysam Dadgar
Postdoc Ugent
WT-PET

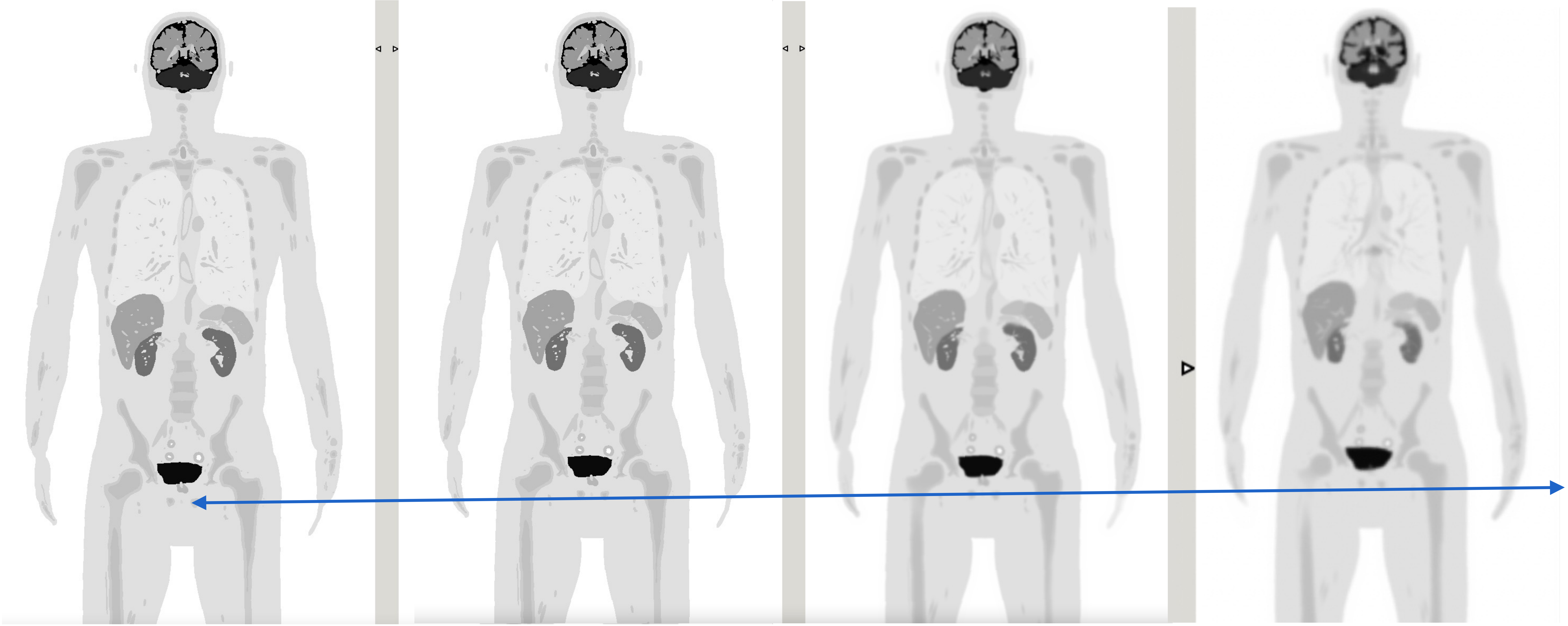
Maya Abi Akl
PhD Ugent- Texas A&M Qatar
Cost-effective Total Body PET design

RESOLUTION DIFFERENCES

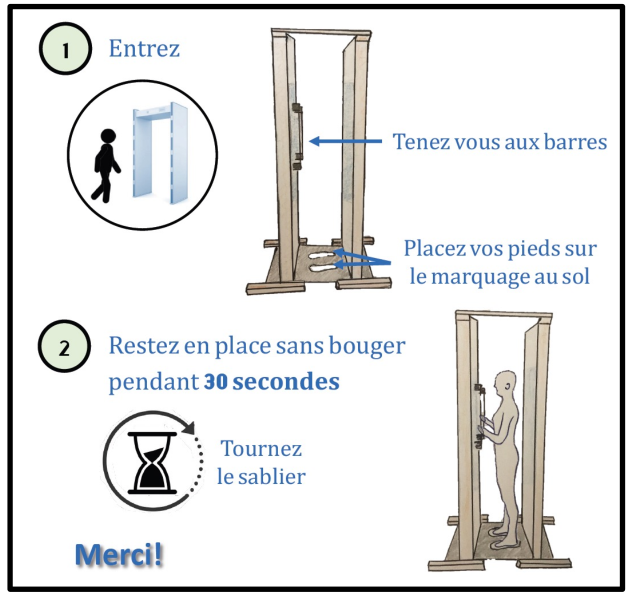


Amide

Xcat input 1x1x1 mm voxels	Noise-free 2 mm FWHM Gaussian blur	Noise-free 4 mm FWHM Gaussian blur	Noise-free 6 mm FWHM Gaussian blur

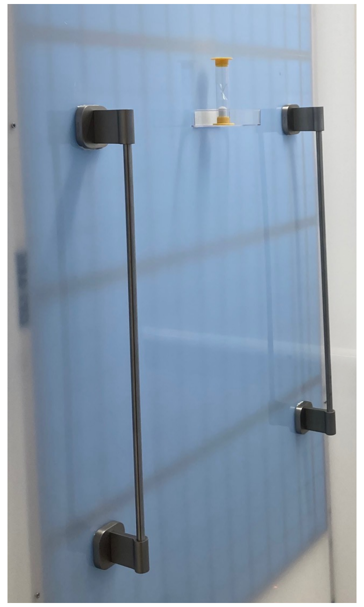


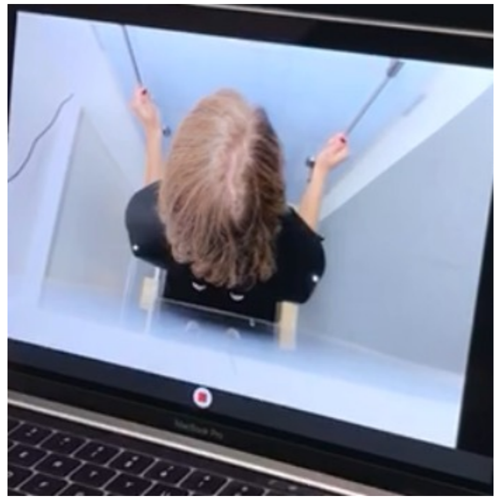
MOCKUP TEST CHU-UGENT



- 20 regular PET-CT patients
- Pictogram instruction sheet before acquisition
- Procedure:
  - Patient gets a cutting collar with 2 white markers
  - Steps into scanner (on the white feet)
  - Holds 2 bars with hands
  - Watches 30 sec hourglass
  - Ask for breath-hold
- Motion tracking inside scanner webcam and 2 white markers on shoulders
- Simulates a 30 sec ‘acquisition’

Webcam

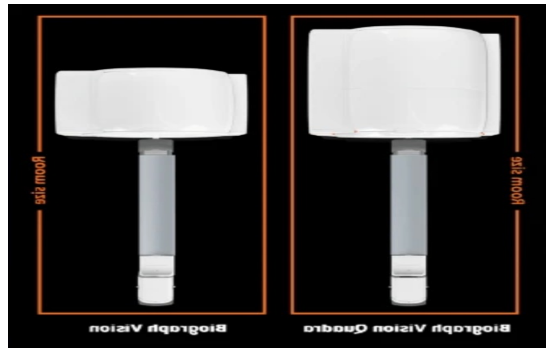




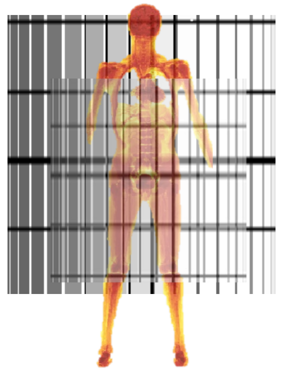
(more details see poster F-M. Muller Ugent)

COST OVER LIFETIME WT-PET

Siemens Vision



Siemens Quadra

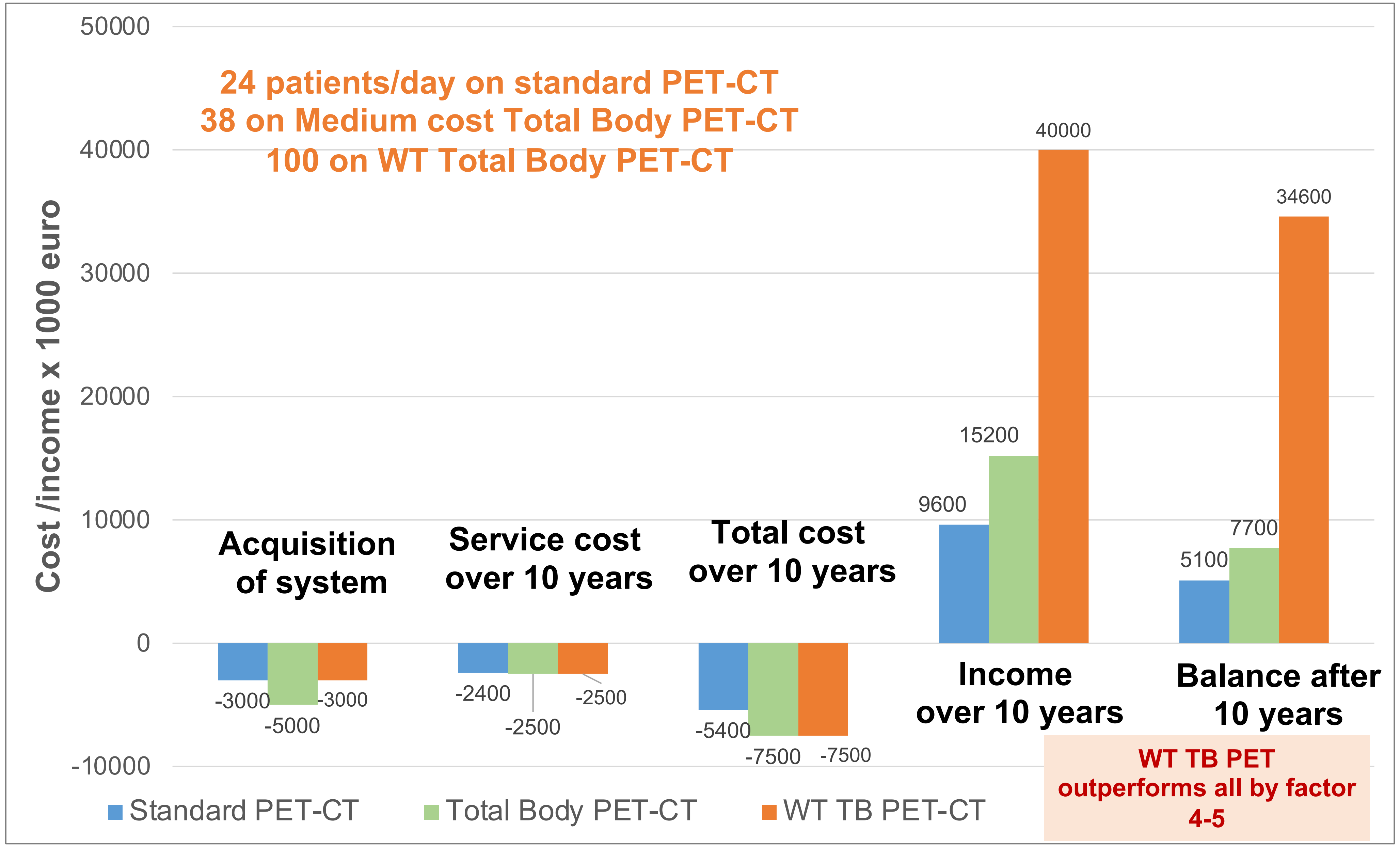


Assumptions

Patient transfer	Scout/CT time	PET scan time	scans/day	
seconds	seconds	seconds		
360	240	600	24	PET-CT
360	240	150	38	TB-PET-CT
228	30	30	100	WT PET-CT

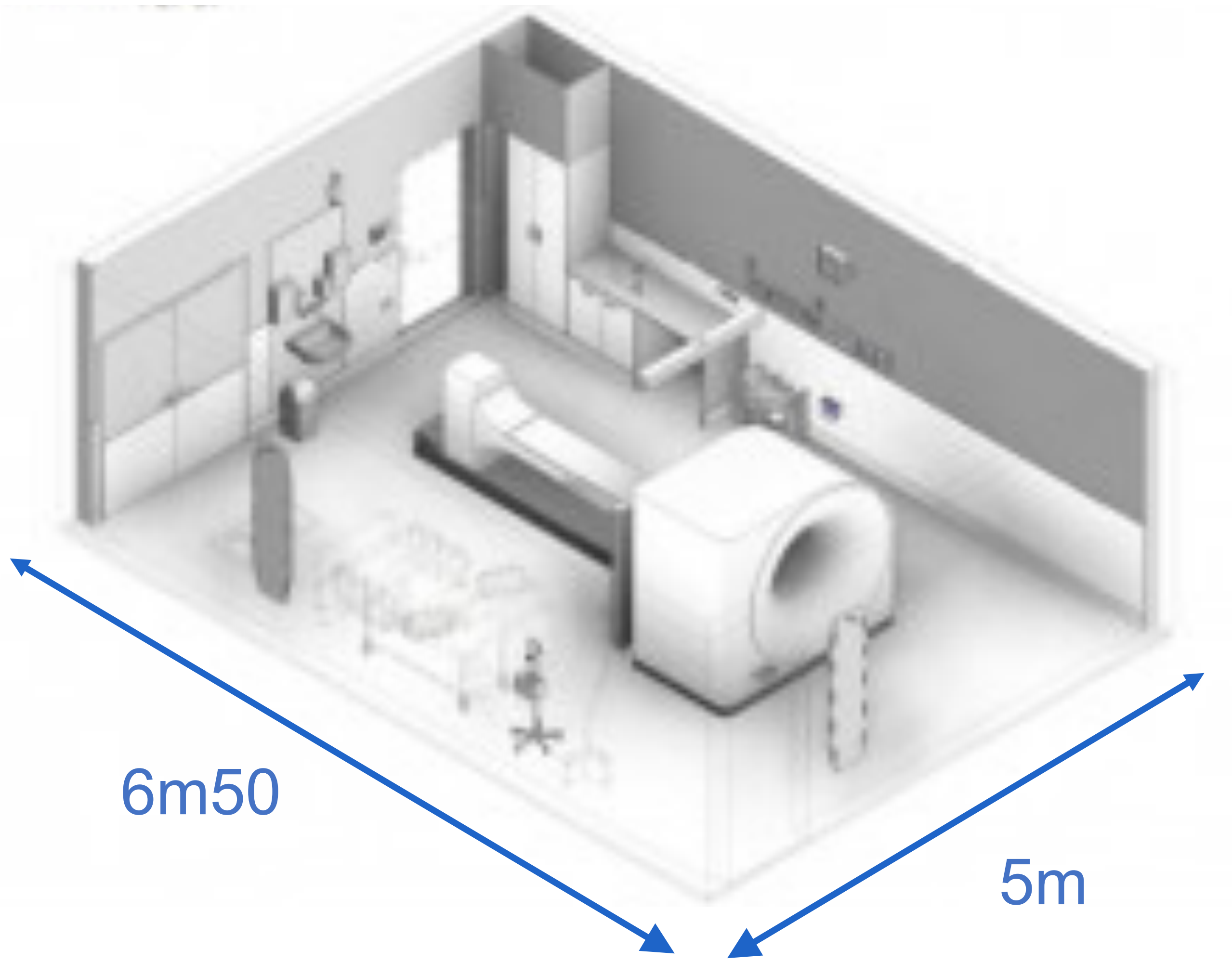
Limiting factors
for medium TB-PET
reduced in Flat panel

PET-CT/TB-PET-CT/WT-PET
150 euro/dose
350 euro reimbursement



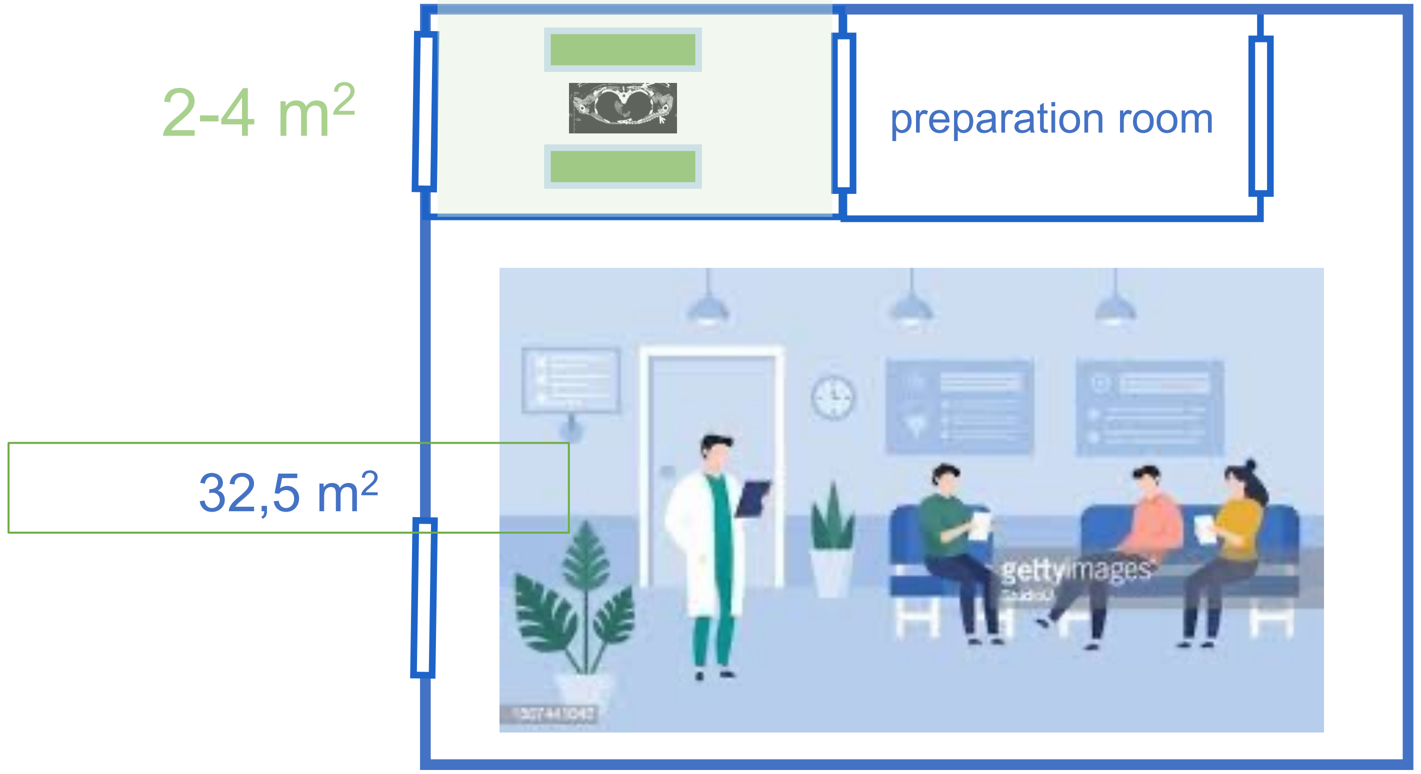
3M Euro standard PET-CT/5M euro Total Body PET-CT/ 3 M WT-PET

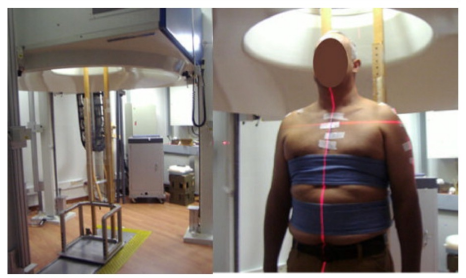
COMPACT FOOTPRINT SAVES SPACE IN NM DEPT



32,5 m^2

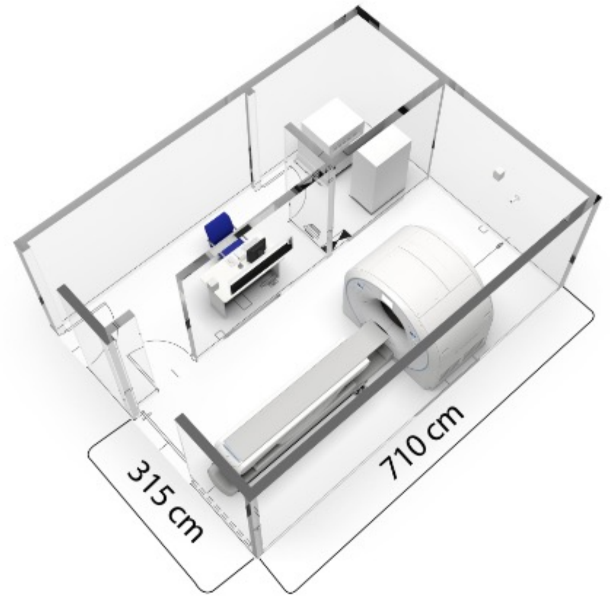
Transform conventional PET-CT room to a waiting + imaging room





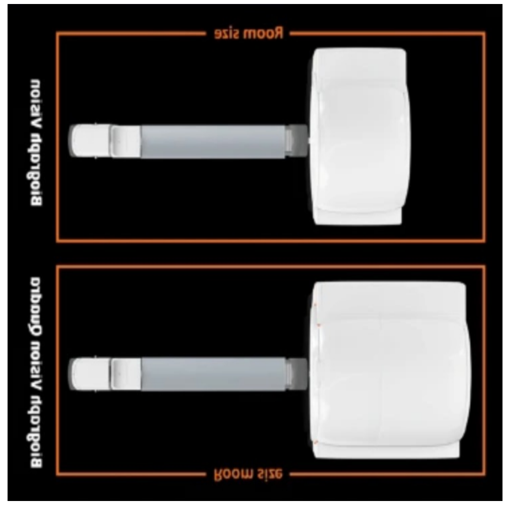
Download : Download high-res image (394KB)
Download : Download full-size image

Fig. 3. Vertical CT scanner at Fermilab (left). Patient supported in vertical CT scanner with a belt to assist in stabilization (right).

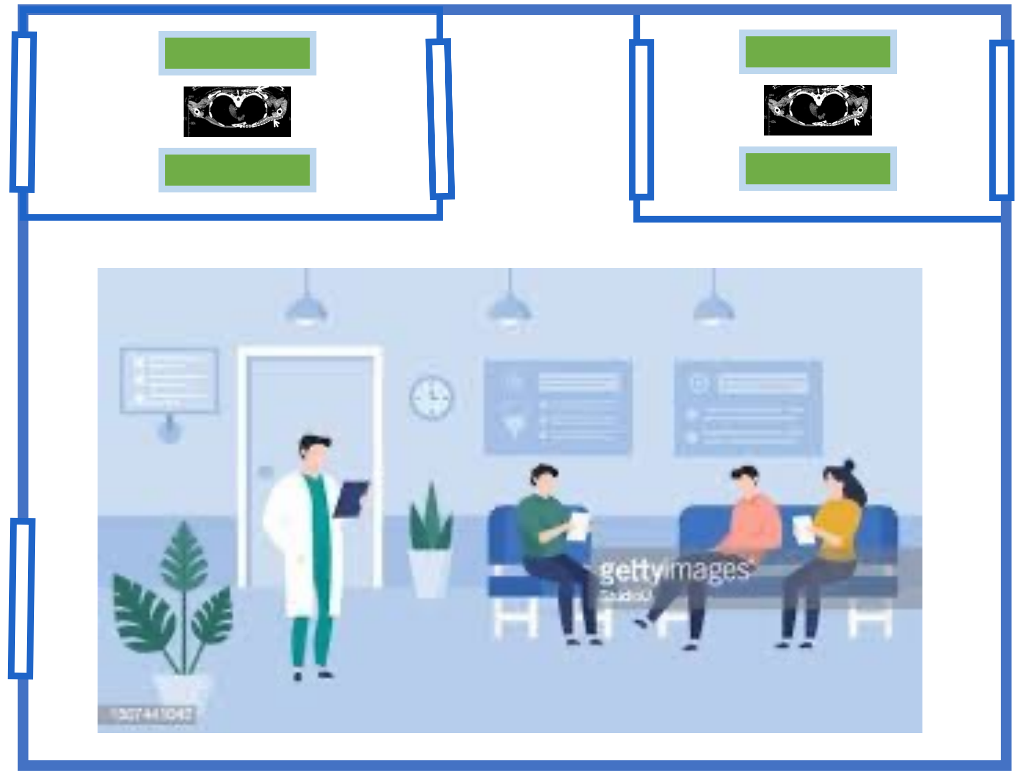


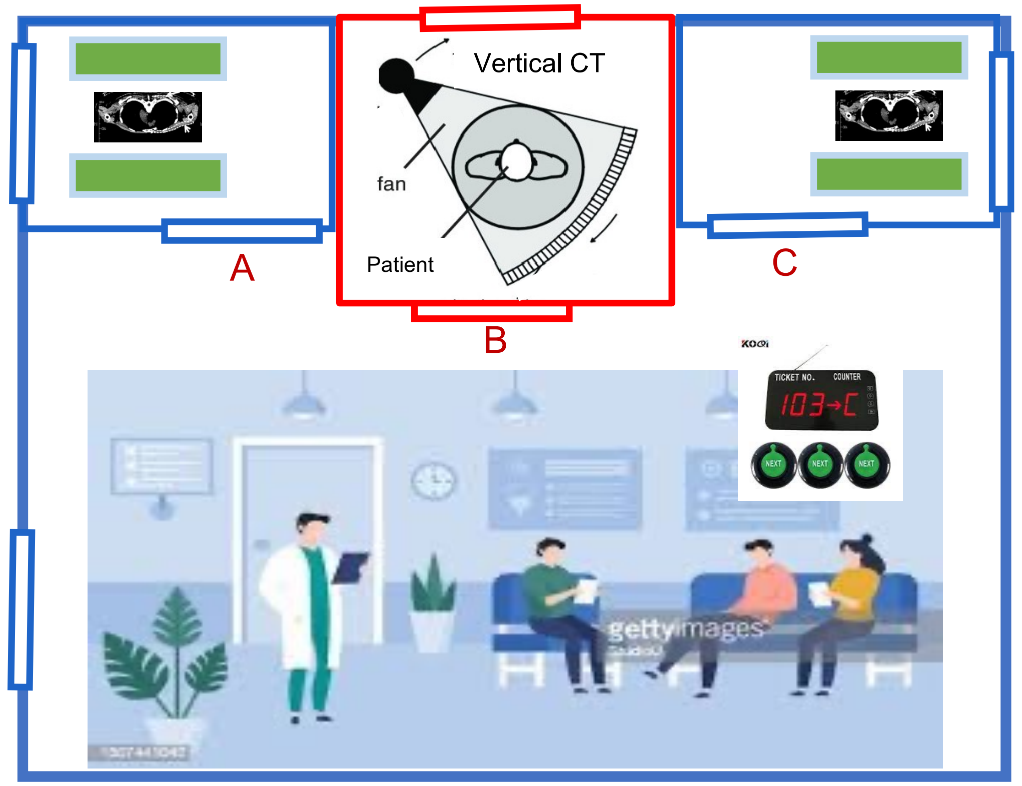
Compact Canon PET-CT

Siemens Vision



Siemens Quadra





SUMMARY

Unique design

- **High Performance**
  - High resolution: <2mm invariant instead of > 3.5 mm variant over FOV
  - Comparable sensitivity as TB-PET due to close detectors and oblique incidences
  - Minimize motion effects with fast scanning (see poster F-M. Muller)
- **Low Cost**
  - Low cost based on Cherenkov-BGO
  - ½ detector surface, 3-4 x less scintillators: component only 1-2x conventional PET TB-PET for price of standard PET-CT feasible → Lower cost scans
- **High Throughput**
  - Alternative configuration without bed (walk-through flat panel PET)
  - Patient throughput can be 4-5 x higher than conventional PET-CT → 100 patients/day

We could (should) have built such design 20-25 years ago (BGO + PS-PMTs)

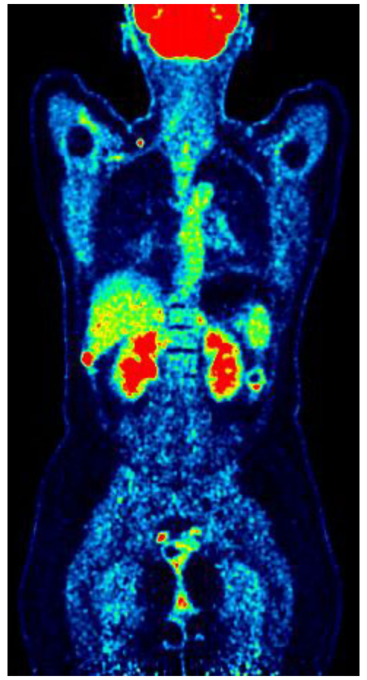
ATTENUATION/SCATTER WITHOUT CT

Elba PSMR meeting 2022 : Deep learning for CT-free correction for ultra-long axial field of view PET scanners, S Xue*, R Guo*, J Hu, H Sari, C Mingels, K Zeimpekis, G Prenosil, Y Wang, Y Zhang, M Viscione, R Sznitman, A Rominger, B Li, K Shi

UNIVERSITÄT BERN

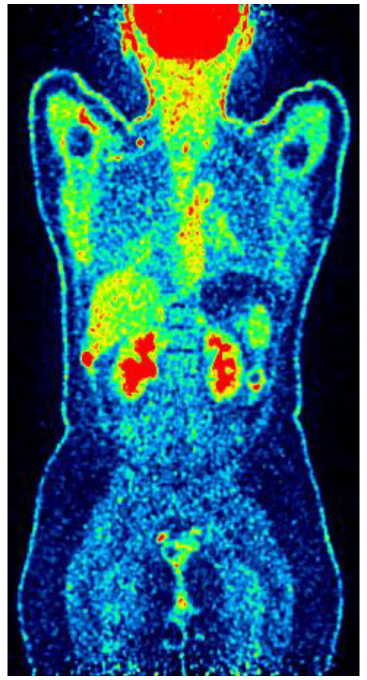
INSELSPITAL
UNIVERSITÄTSSPITAL BERN
HÔPITAL UNIVERSITAIRE DE BERNE

CT Corrected PET | **Non corrected PET** | **DL Corrected PET**



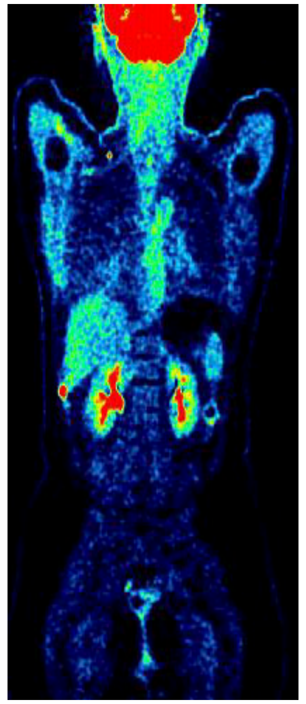
Training

GAN



DL correction

Trained GAN



→ reduced dose to the patient

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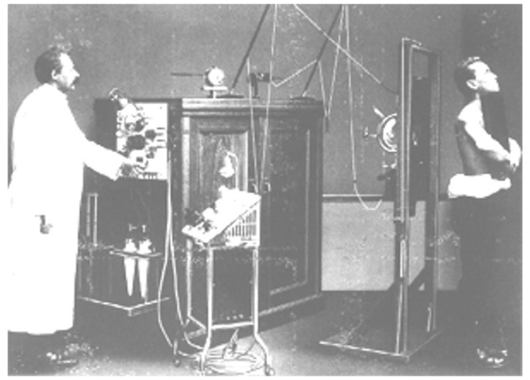
FLEXIBILITY, COMPACT AND EASE OF USE


V1: 2 Bike-boxes

First and second mockup version June 2022

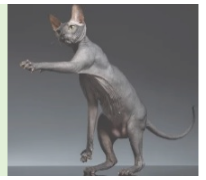

V2: Mat Plexiglass



PATIENT TESTING

SPHYNX

Studying PHYsiology with NeXt generation molecular imaging



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MEDISIP

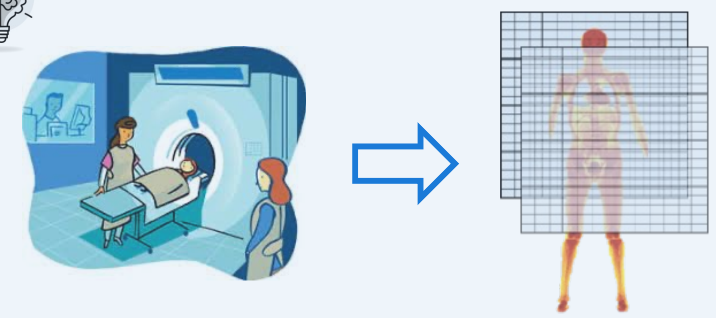
CHU de Liège

infinity

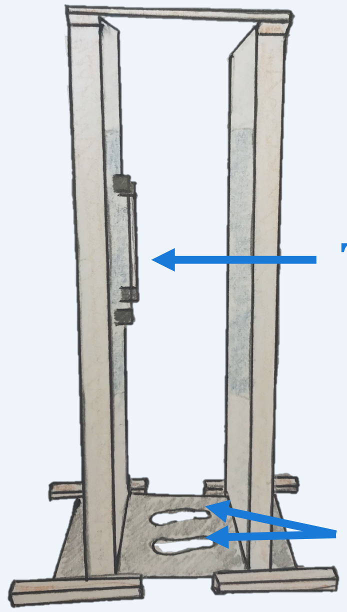
fwo

Info sheet for patients

Walk Through PET



1 Entrez

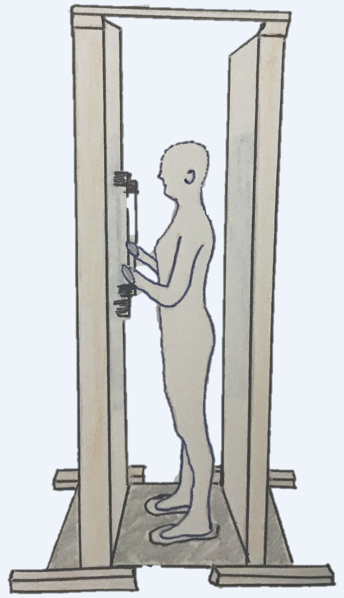


Tenez vous aux barres

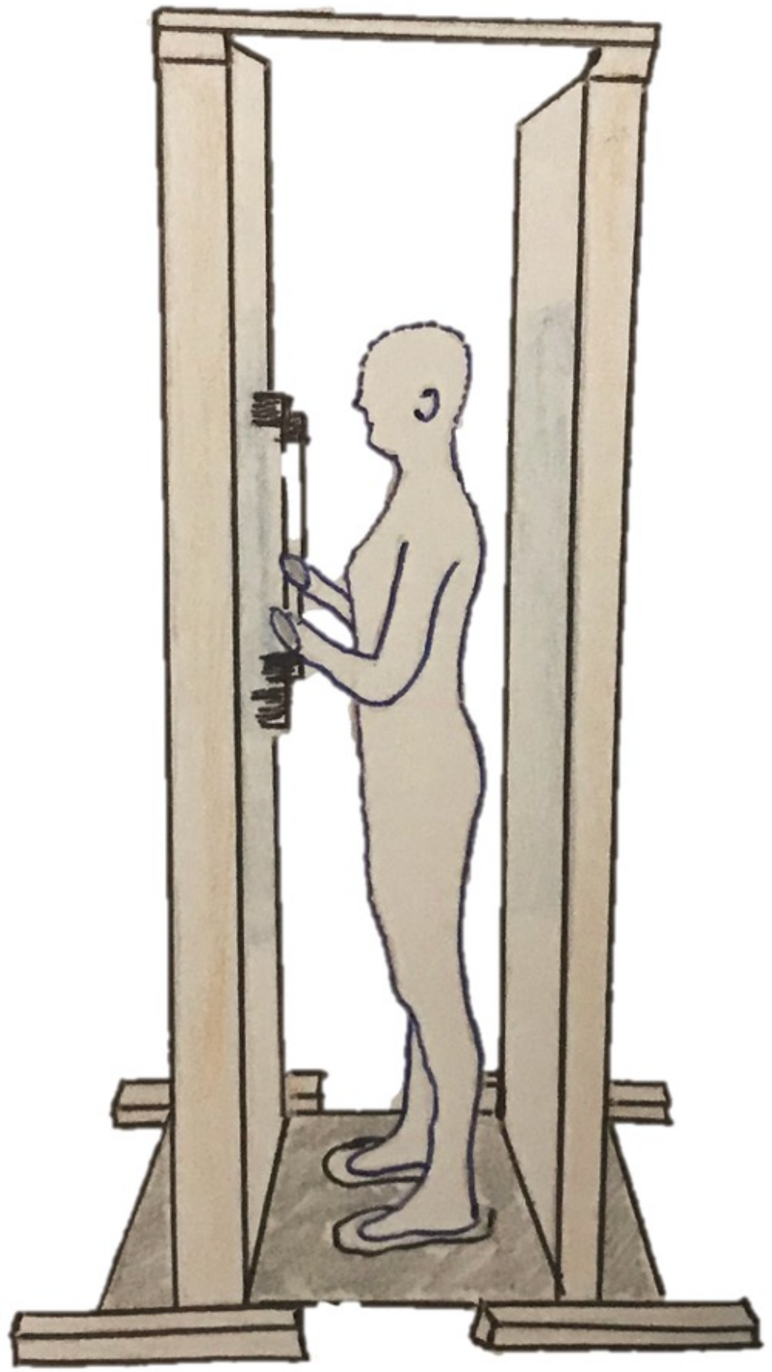
Placez vos pieds sur le marquage au sol

2 Restez en place sans bouger pendant **30 secondes**

Tournez le sablier



Merci!



Aims

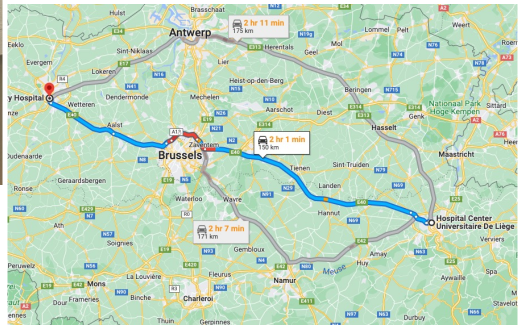
30 sec

Acquisition time

2 mm spatial resolution

MOCKUP INSTALL 1HR

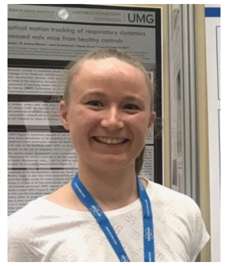
Infinity UZ Gent



CHU Nuclear medicine Liege

CHU de Liège

Prof
N.Withofs
NM CHU



Florence Marie-
Mueller, PhD
Ugent-UPENN

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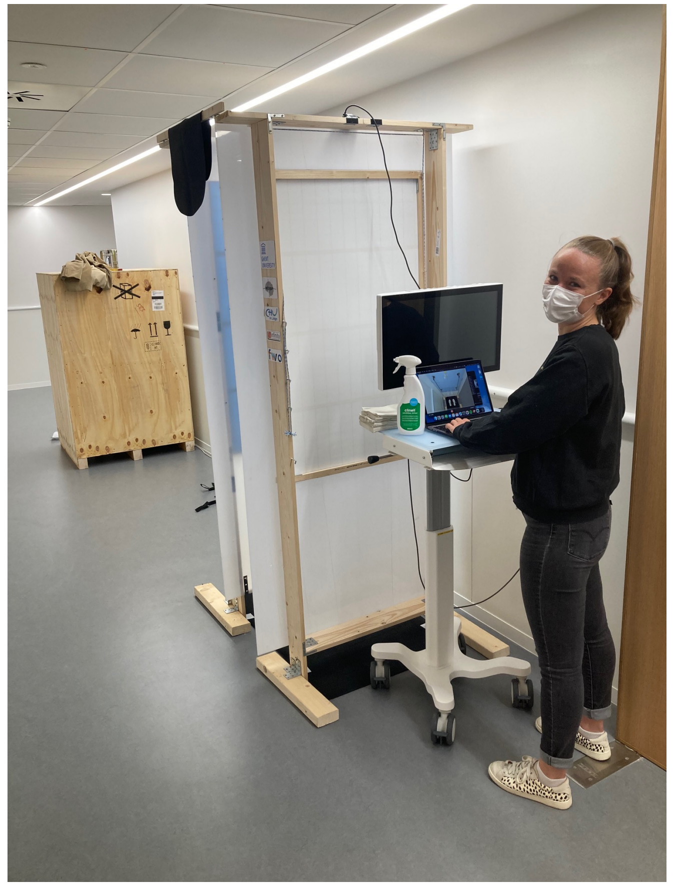
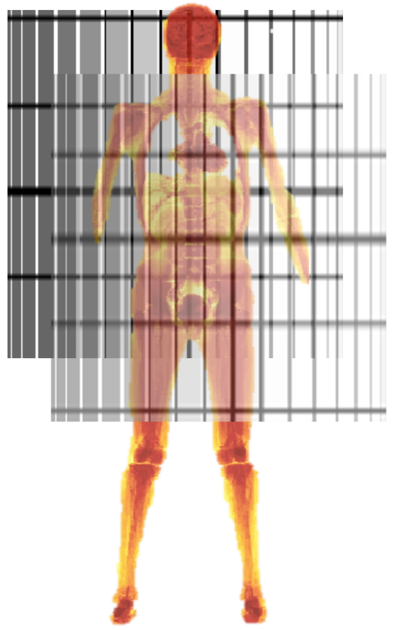


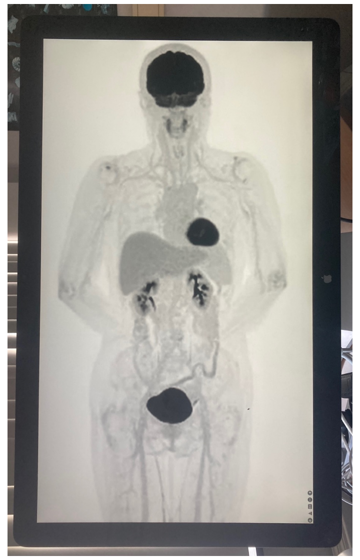
THE FUTURE PET-CT DEPARTMENT

Autonomous driving patient taxi Gent hospital

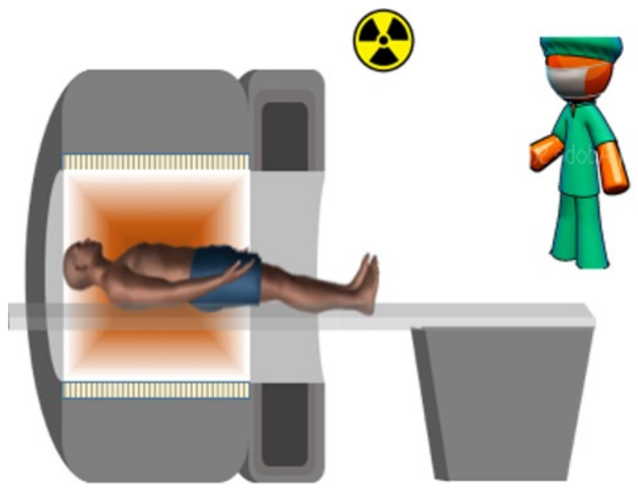
Features:
- Compact space
- Low dose (AI+technology)
- Minimal shielding
- Minimal personnel
- Near realtime recon
- AI driven analysis

80 % 'healthy' patients with reasonable BMI
Screening, bone scans, infections…
Quick PET scan
Quantitative with AI
Standup mode
Semi-automated injection
Walk through the scanner
Does not see a doctor

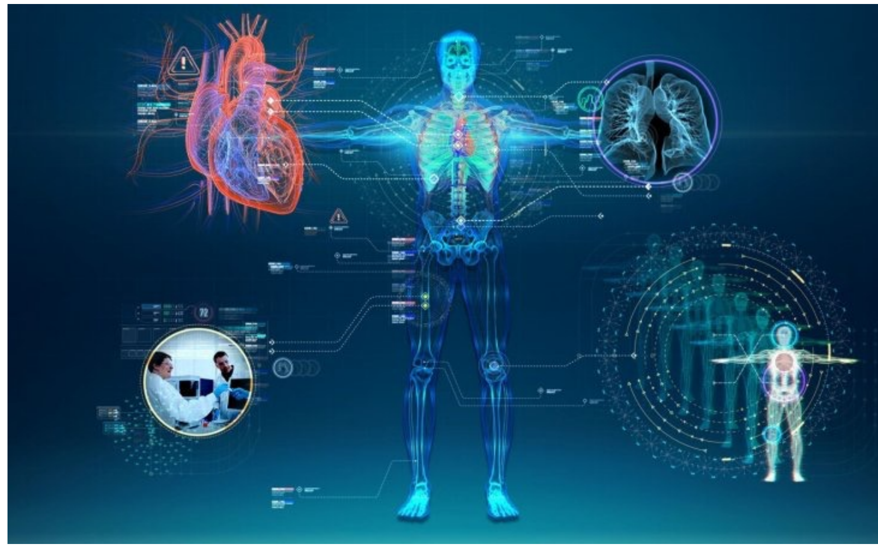




20 % 'unhealthy' patients
Or high BMI
Medium length PET-CT scan
Complex dynamic exams
Supine-bed mode



AI enhanced MD room
Automated review of standard exams



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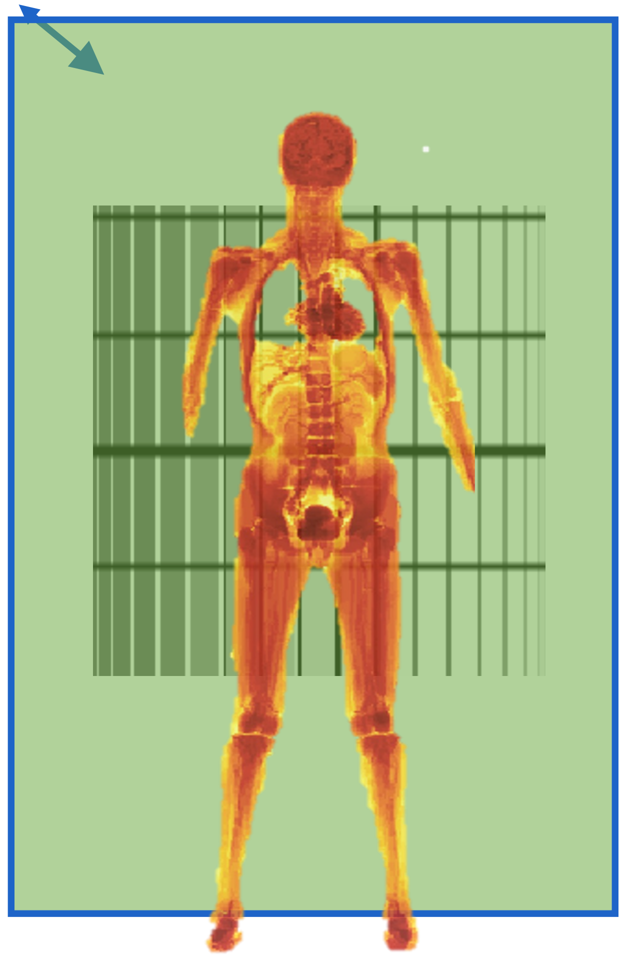
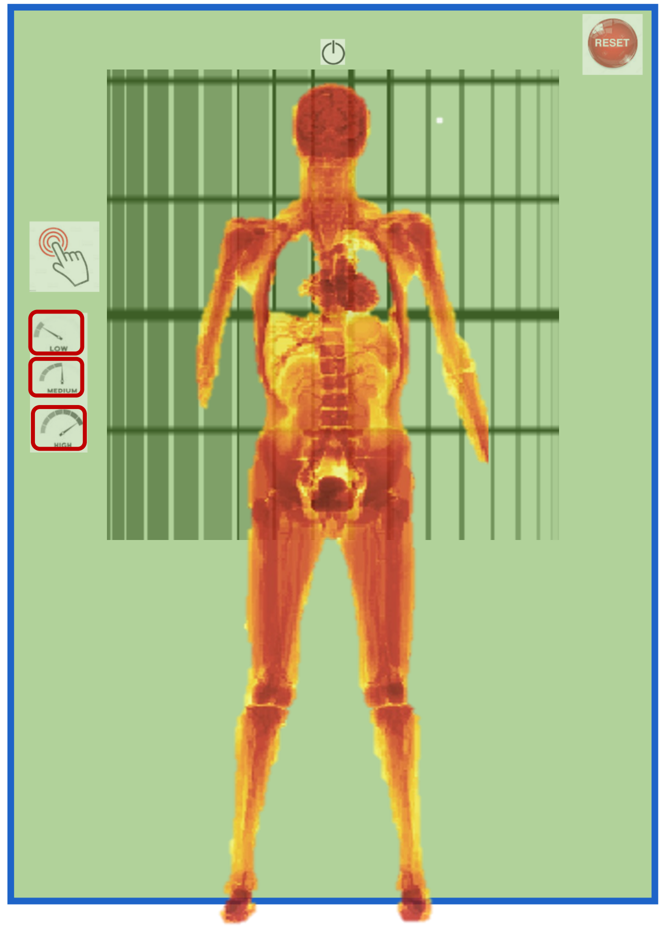
MINIMAL PERSONNEL DIY PET

Step 1:
Patient enters room

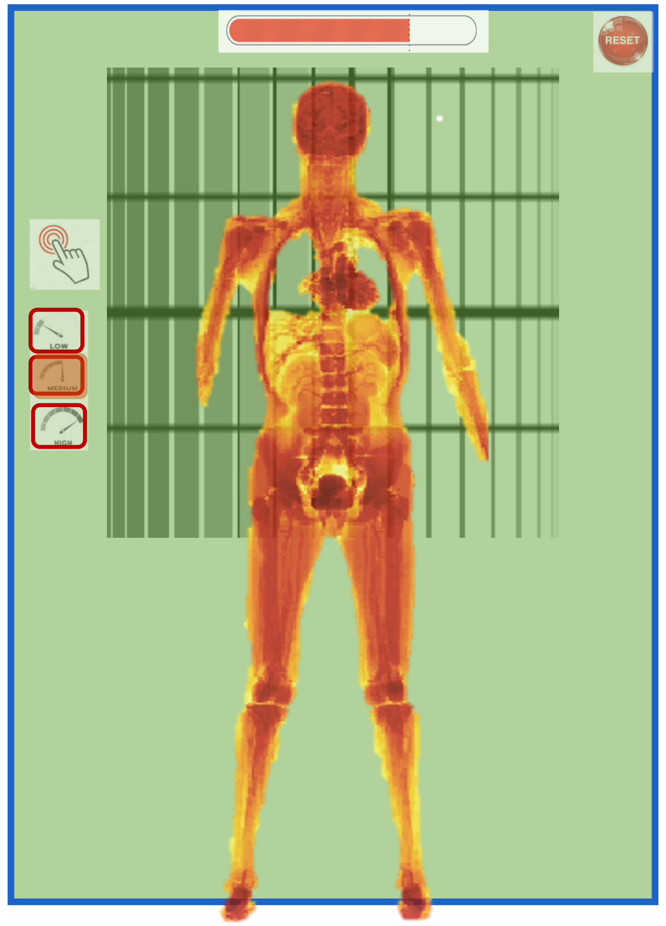


Step 2:
Automatic detector position head to thigh

Step 3:
Scan duration selection
Short-Medium-Long



Step 4:
Scan Procedure



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