Results of the ClearPEM scanners in clinical environment

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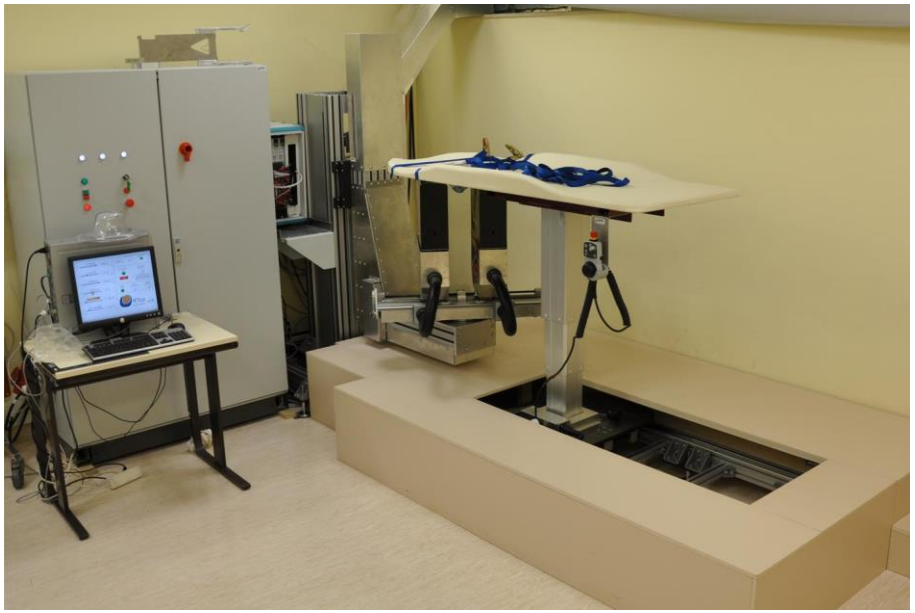
The ClearPEM scanners



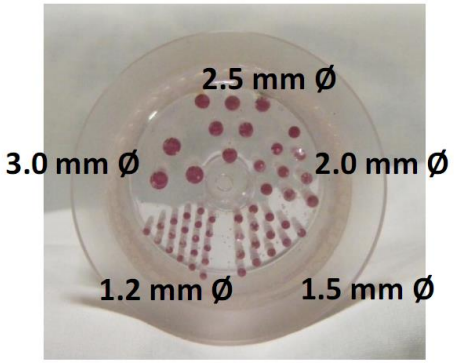
ClearPEM (prototype) in Coimbra

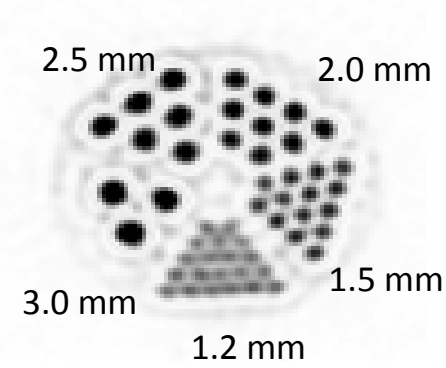
ClearPEM-II in Monza (Italy)

- Spatial resolution : 1.3 mm

Obtained with Derenzo phantom (Na22 rods)

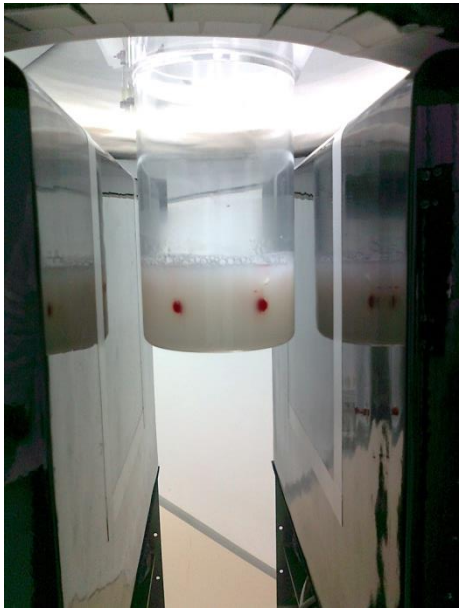
- Sensitivity: 2 to 5%, depending on the configuration





Main Activities @ ICNAS

Instituto de Ciências Nucleares Aplicadas à Saúde. Coimbra.



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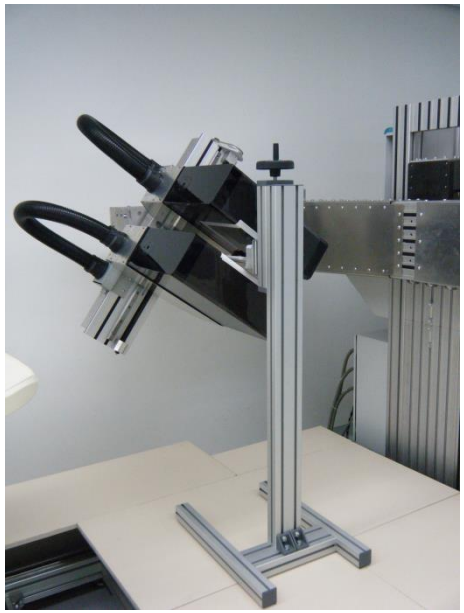


2

3

1. Several studies with phantoms
2. Small Animal Imaging
3. Clinical Exams and Training (positioning)

Clinical Trials

ClearPEM Exam Conditions:

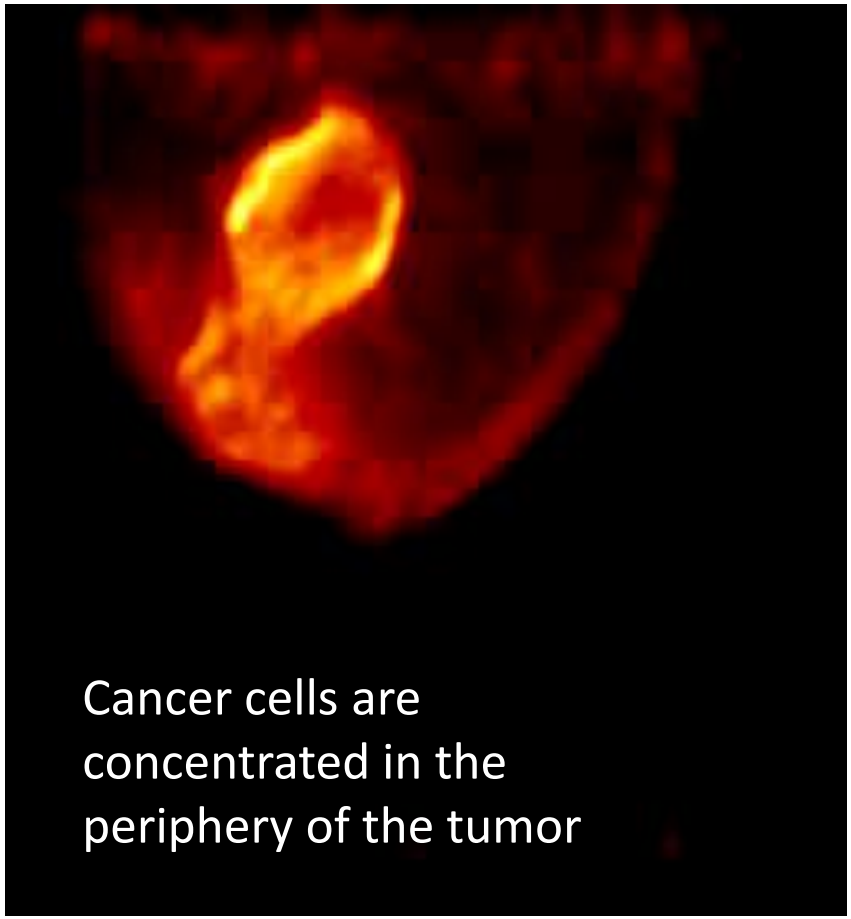
- The patient does PET/CT 40 min after FDG injection
- The PET/CT is 25 to 30 minutes long
- The ClearPEM exams are performed 1 hour and 10 minutes after de FDG administration
- No extra dose is required for the ClearPEM exam
- Patients perform a complete ClearPEM exam: breast (left and right) and axilla (left and right), starting with the side where the lesion was detected (in the clinical report file).
- Acquisition times:
  - 20 min for each breast (4 angles);
  - 12 min for each axilla (3 angles)

Clinical exams performed @ ICNAS:

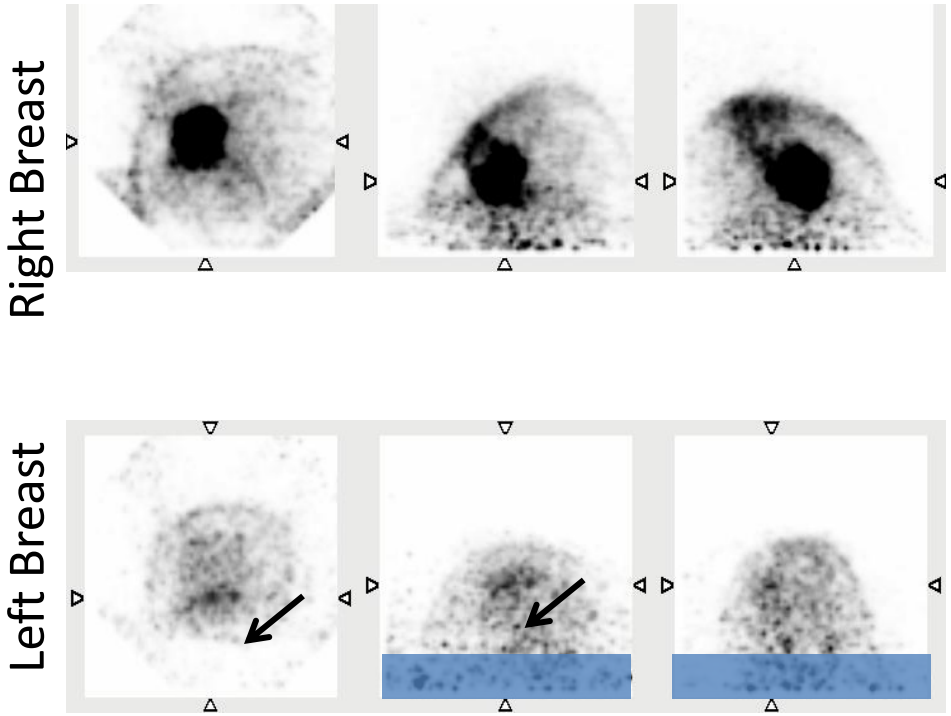
#	Date	Age (yr)	Weight (kg)	FDG [mCi]	Detector Heads Distance (mm)			
					Breast-R	Breast-L	Axilla-R	Axilla-L
1	2011.11.25	39	73.5	9.30	160	160	450	460
2	2011.12.09	65	82	10.03	200	200	530	530
3	2011.12.27	39	54	6.65	130	130	430	400
4	2012.01.13	36	74	9.30	150	160	440	410
5	2012.02.10	76	81	10.20	--	170	--	480
6	2012.03.09	62	74	9.30	170	165	480	485
7	2012.03.09	77	64	8.60	150	130	450	430

Eligibility:
Patients with indication for biopsy
Patients for a PET scan (staging)

Clinical case: bilateral breast cancer



click for 3D animation

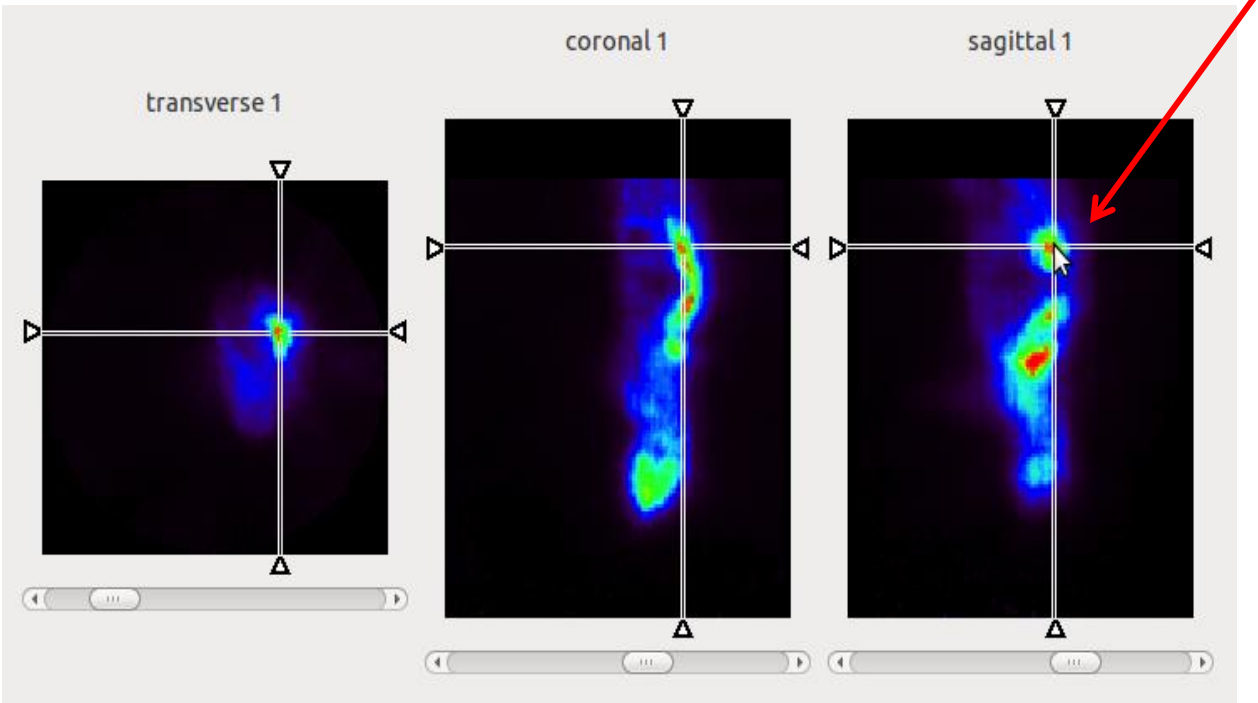


Small lesion in the left breast seen in PEM, but not in the whole body PET

Small Animal: Colon tumour detection

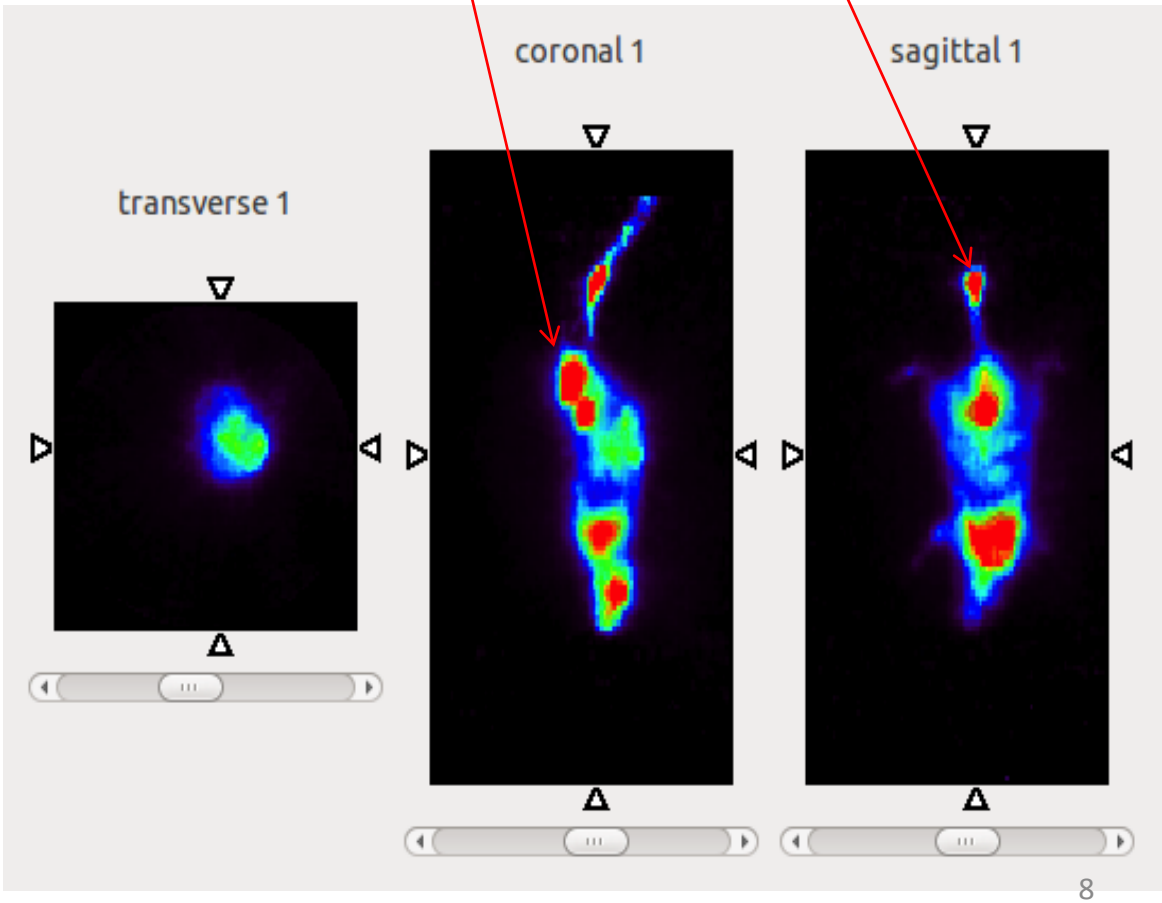
- FDG scan
- A = 1,2 mCi
- Weight = 180g
- Colon tumor

Colon tumour

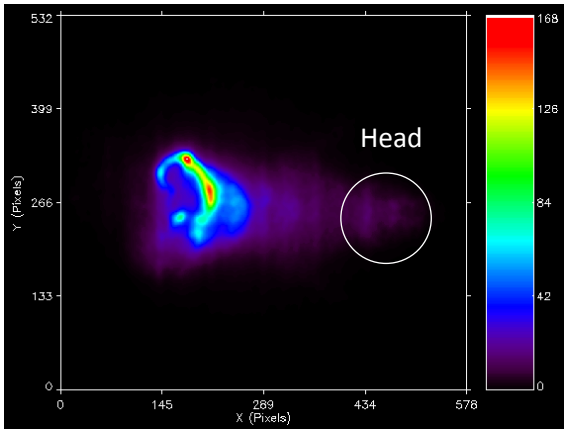


Small Animal: Melanoma detection

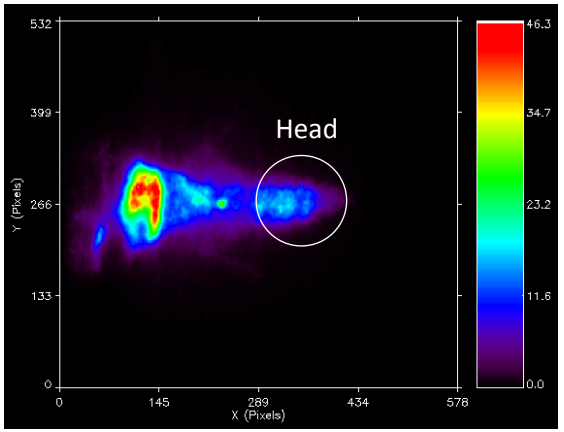
- FDG scan
- A = 170 µCi
- Weight = 18g
- Melanoma



^{11}C-Raclopride PET on the ClearPEM scanner



morning

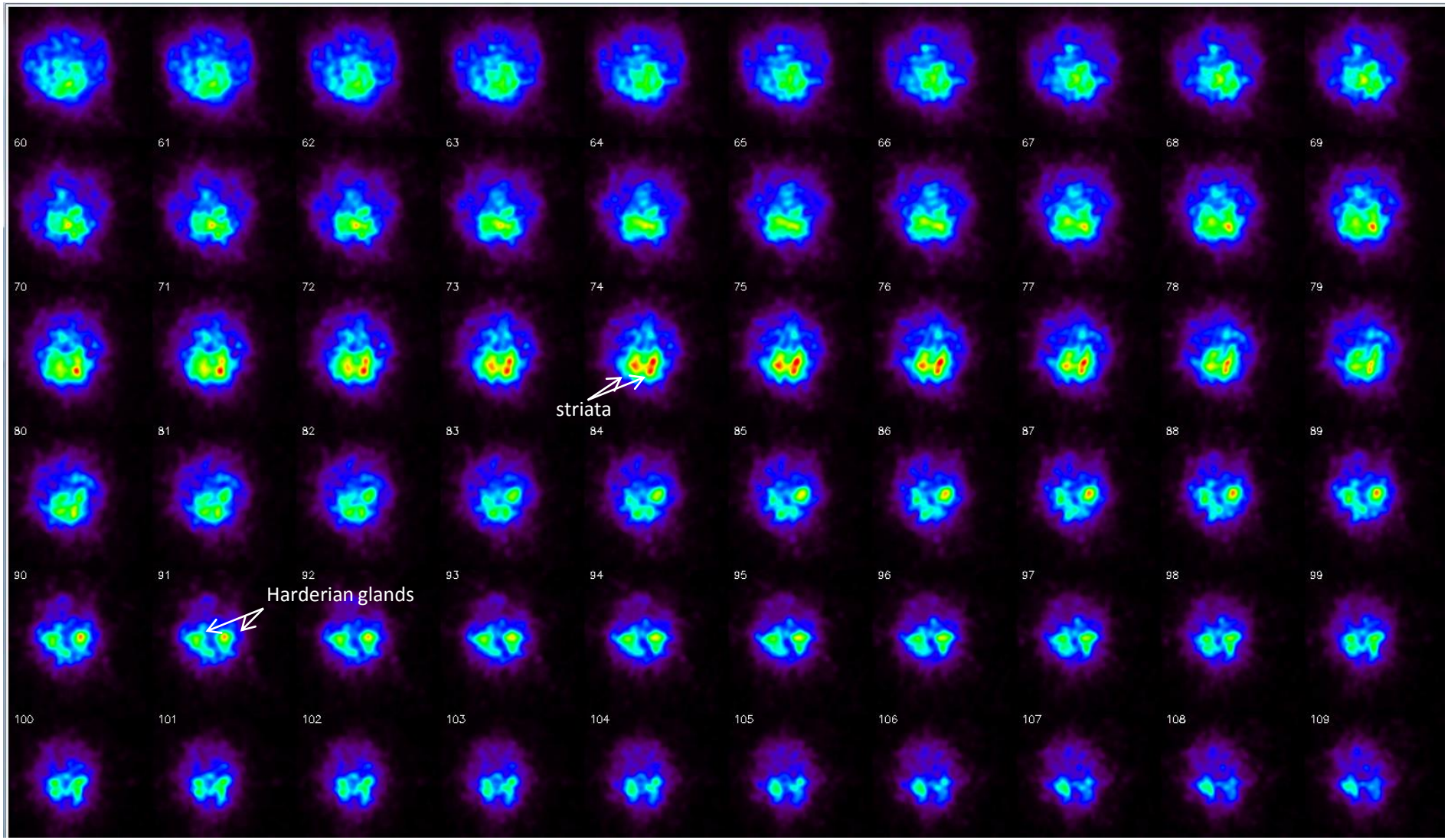


(Sum of all slices and all frames)

afternoon

- **Morning**: 2 time frames: 4x5 min, 4x5min
  (4 angles x 5 min per angle on each frame)
- **Afternoon**: 3 time frames: 4x5min, 4x5min, 4x2.5min

Expanded view of the brain slices (in time)



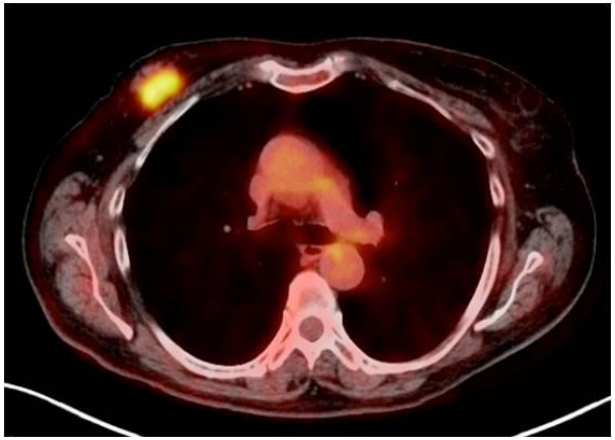
Medical Study with ClearPEM @Marseille

- **Clinical Study in Marseille**:
  - Patients with breast cancer confirmed
  - FDG injection for whole-body PET
- **Goals**:
  - Prove feasibility and safety
  - Patient tolerance
  - Compare with other modalities (US, X-ray, MRI, WB-PET)
  - Optimize clinical protocol

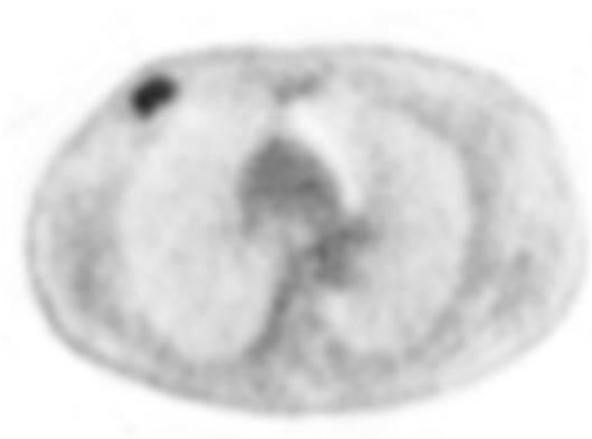
Patient exam on the Marseille ClearPEM

Case Study 1

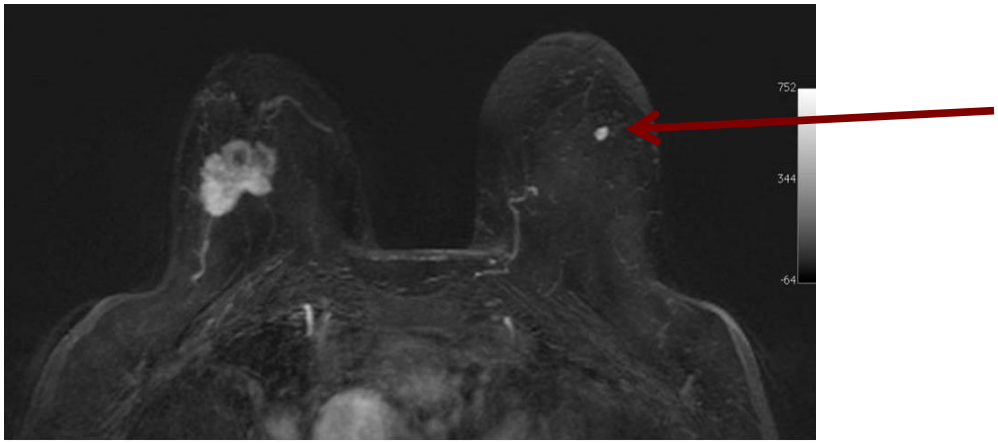
Right Breast: Tumour visible, Left breast: possible lesion only on MRI



PET/CT



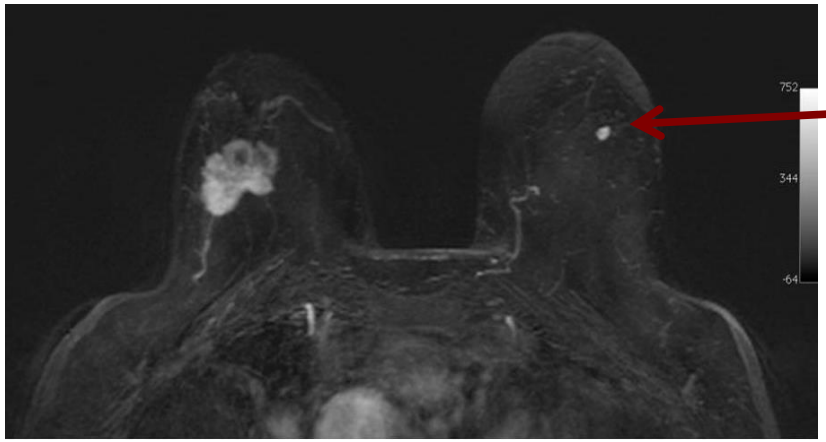
whole-body PET



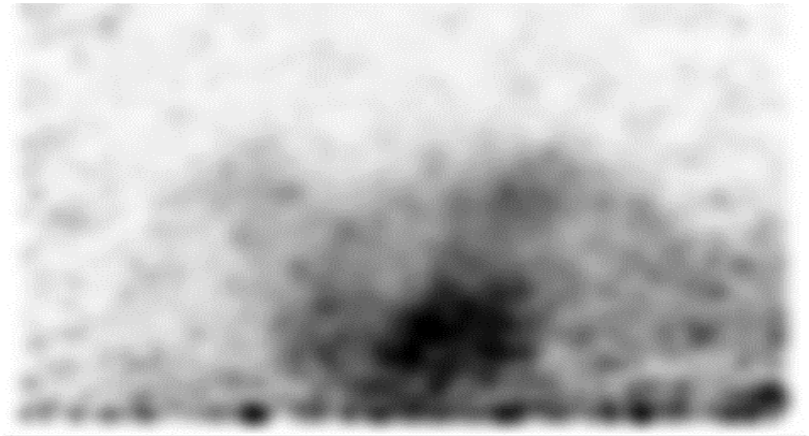
MRI

Case Study 1

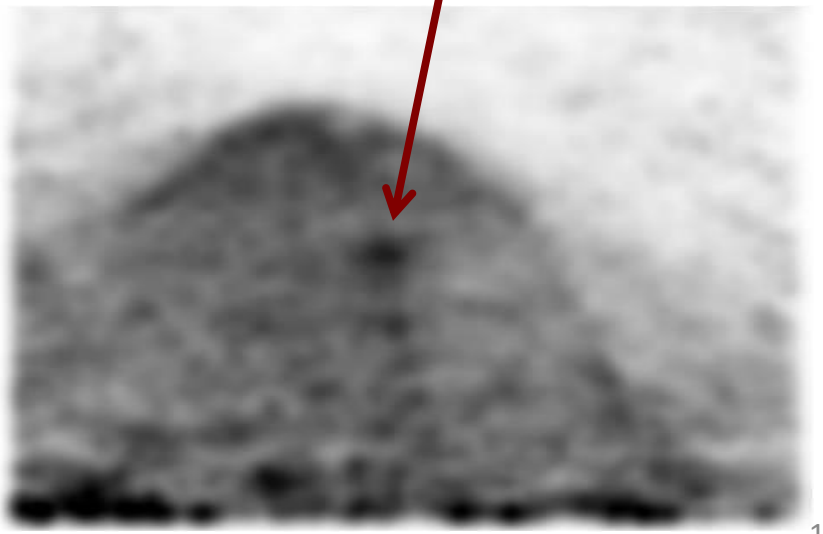
ClearPEM sees both the big tumour and the small tumour!



MRI



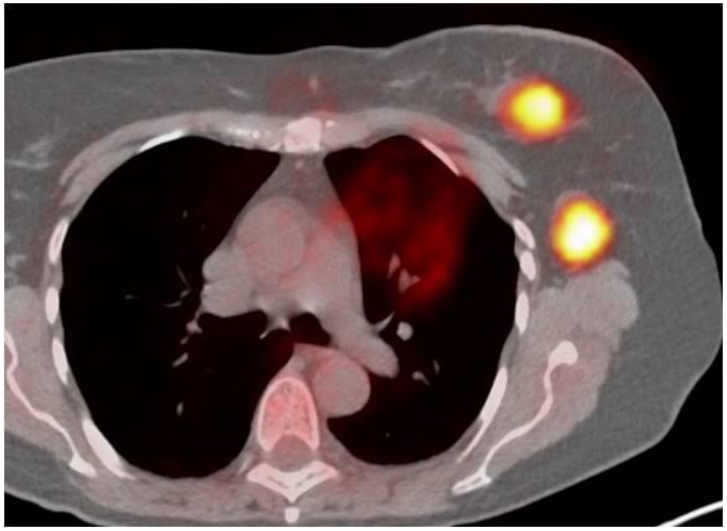
ClearPEM right breast



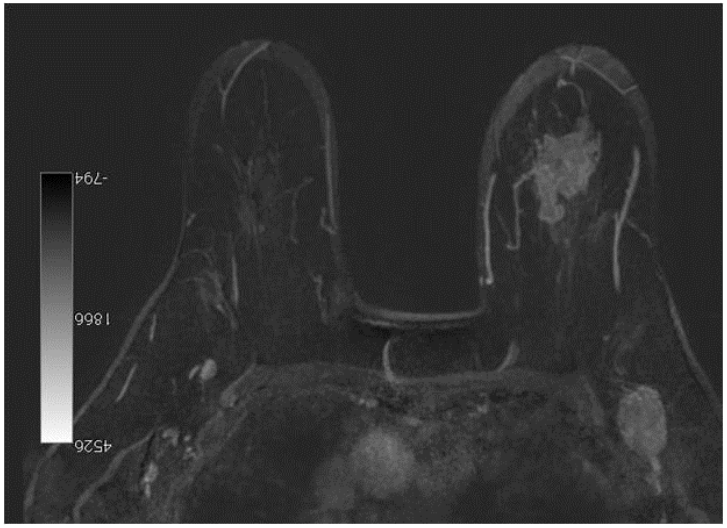
ClearPEM left breast

Case Study 2

PET/CT shows two lesions in the left breast
MRI shows both lesions, but the one in the breast could be multifocal!



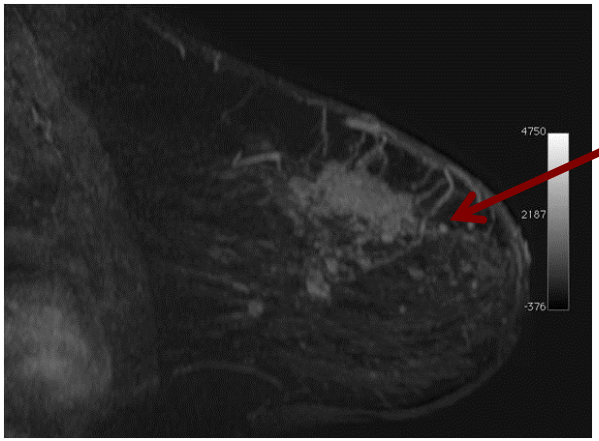
Whole-body PET/CT



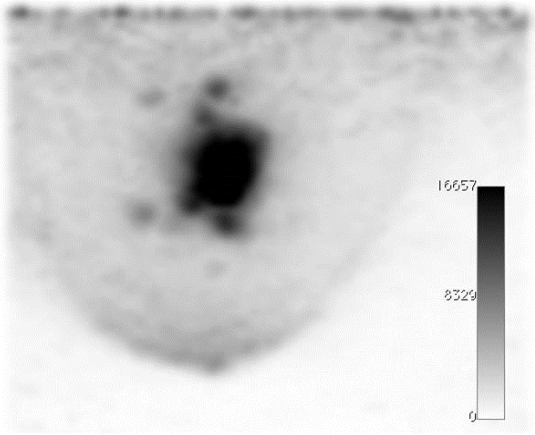
MRI

Case Study 2

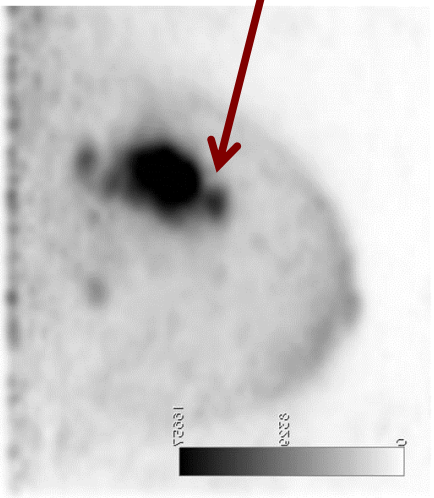
ClearPEM confirms multifocality!



MRI sagittal

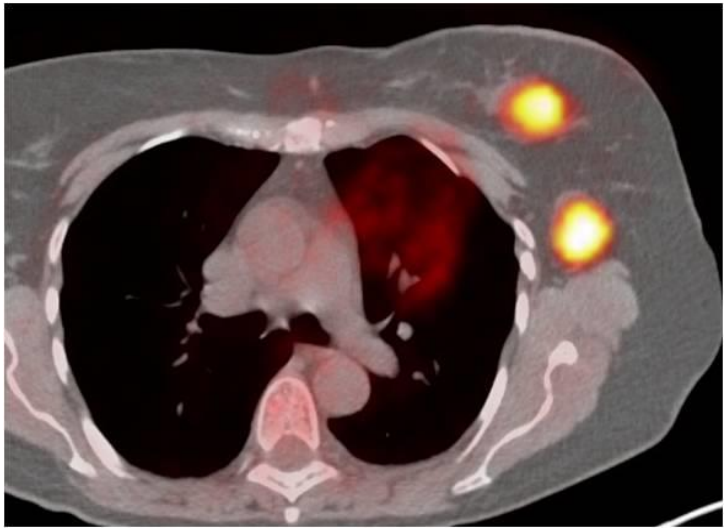


ClearPEM coronal

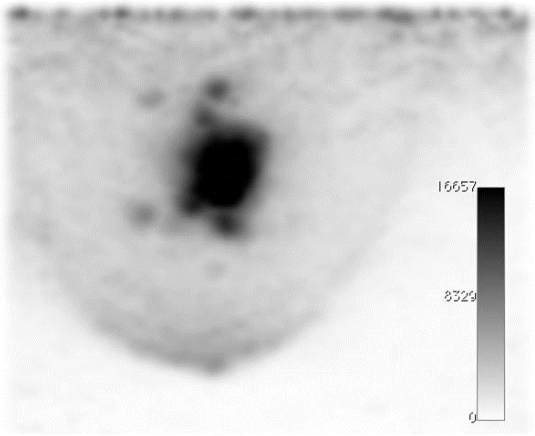


ClearPEM sagittal

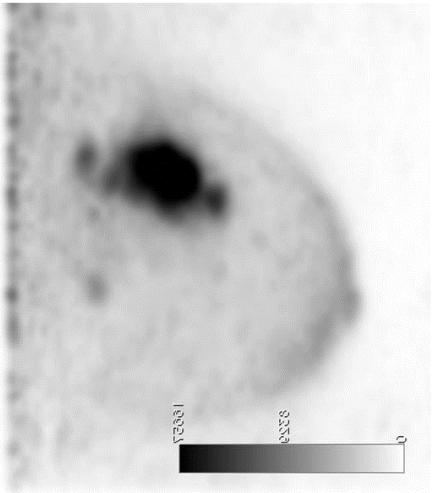
The invisibility of posterior lesions



Whole-body PET/CT



ClearPEM coronal



ClearPEM sagittal

ClearPEM-II transferred to Monza

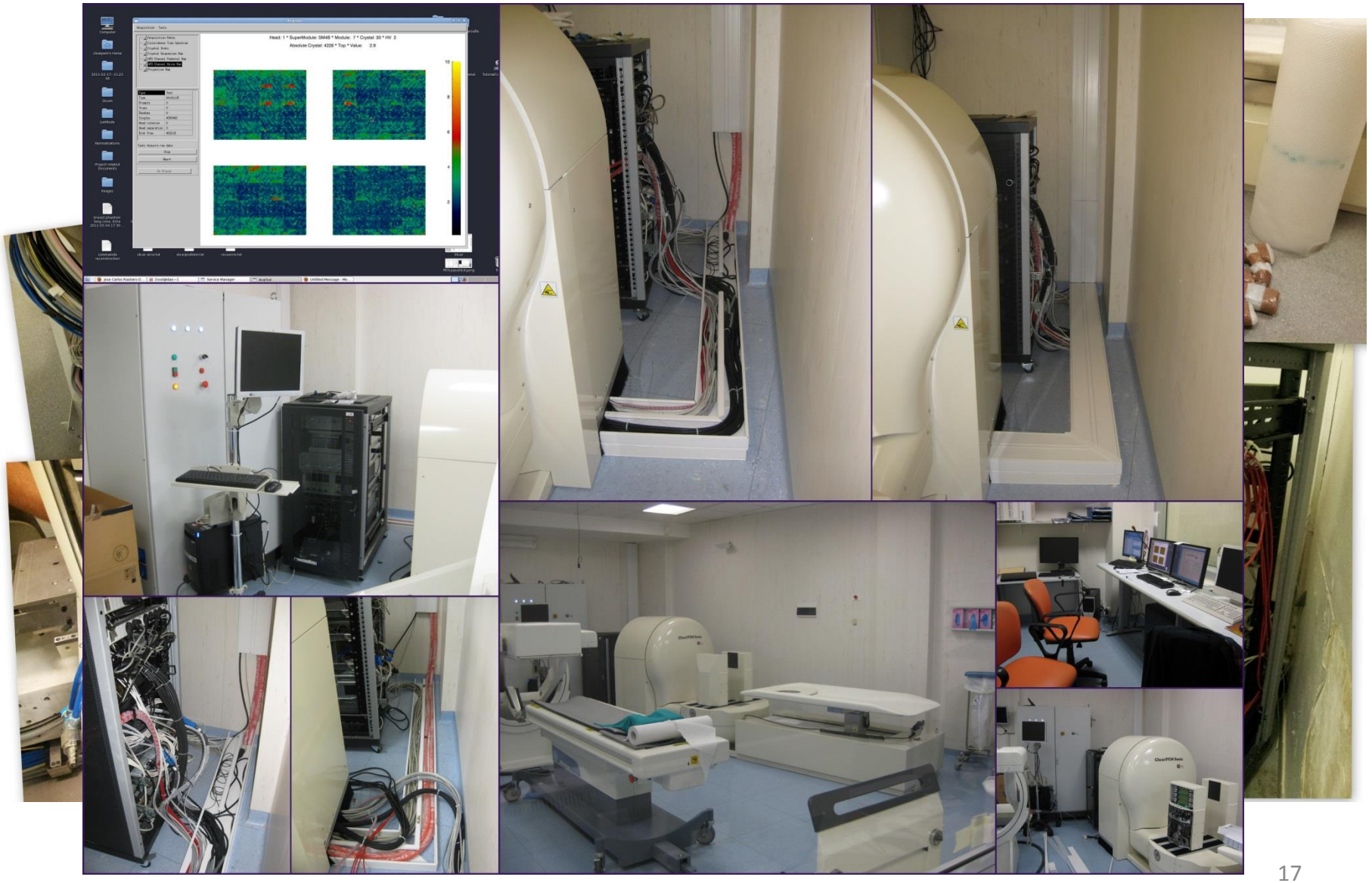


Photo credits: J.C. Silva

State of the Activities

- **ClearPEM @ ICNAS**
  - Clinical trials with ^{18}F-FES
    - ^{18}F-FES - 16α-(18)F-fluoro-17β-estradiol ((18)F-**FES**)

    offers the possibility to study the presence of estrogen receptors in both primary and tumour metastasis, and may be a useful tool in the therapeutic management and prognostic evaluation of breast cancer.
    - Contacts with hospital (HUC) and IPO-Coimbra already established
    - Clinical protocols are being defined for ethical committee approval
  - Small animal platform
    - As part of a multimodal facility for small animal imaging

- **ClearPEM-II @ Monza**
  - Clinical trials with FLT
    - 3′-deoxy-3′-[^{18}F]fluorothymidine (^{18}FLT)

    biomarker for in vivo imaging of cell proliferation, it may play an important role in the staging, monitoring, and prediction of response to therapy agents
    - Clinical protocol was approved by the ethical committee

Back up slides

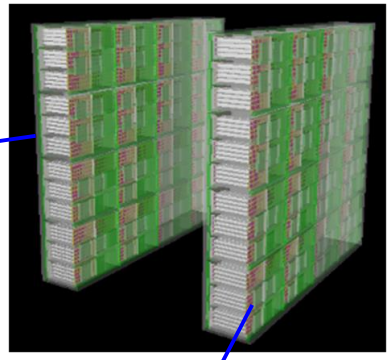
Positron Emission Tomography

- PET is the medical imaging modality of reference in cancer detection.
- The commercial equipments allow images of the entire body (whole body systems) but have low resolution (> 5mm) and low sensitivity (~1%), requiring long scans (~ 30 min) and expose the patient to significant radiation doses (~ 5-7 mSv).
- The research in new PET detectors is intended to improve these two parameters (sensitivity and resolution).

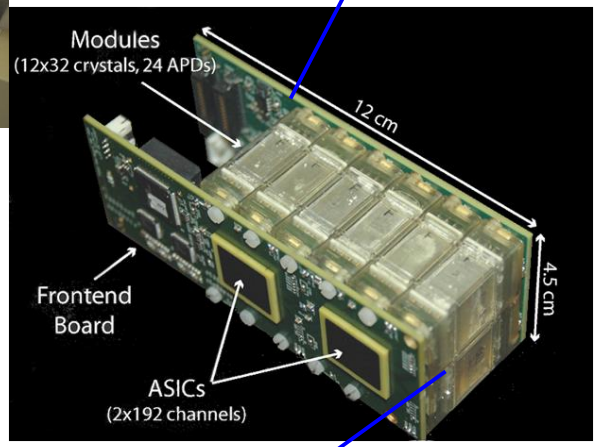
Technology

- 2 parallel rotating detector plates
- Detector Plate:
  - 8 modules
- Modules:
  - 12 submodules
  - 4 192-channel ASICs
- Submodule:
  - 32 crystals: LYSO, 2x2x20 mm^3
  - 2 APD arrays for individual double-sided readout

➡ In total: 6144 crystals, 12288 APD channels, 32 ASICs

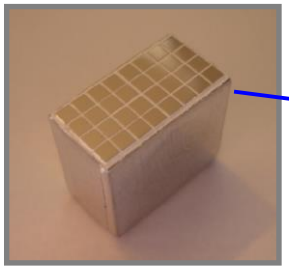


Plates

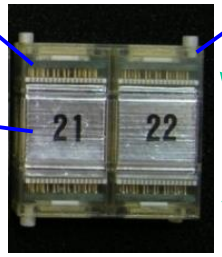


Module

APD array



Crystal matrix



2 submodules

Front-back readout