# CLEARPEM AND ENDOTOFPET-US

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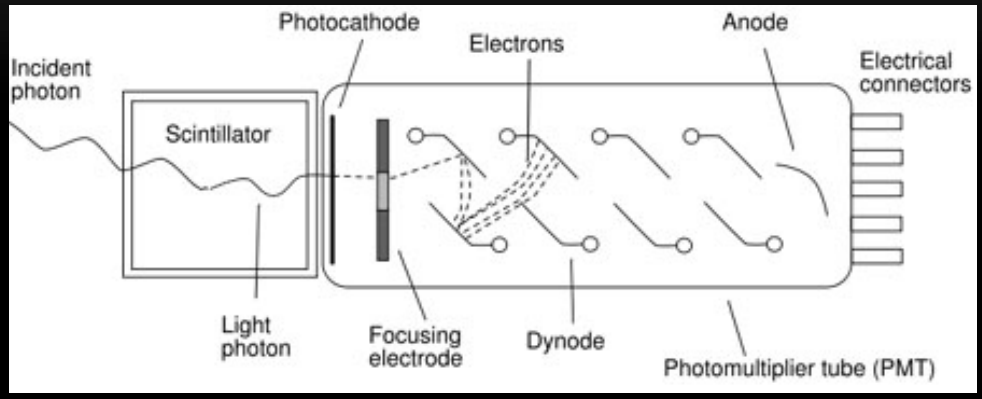
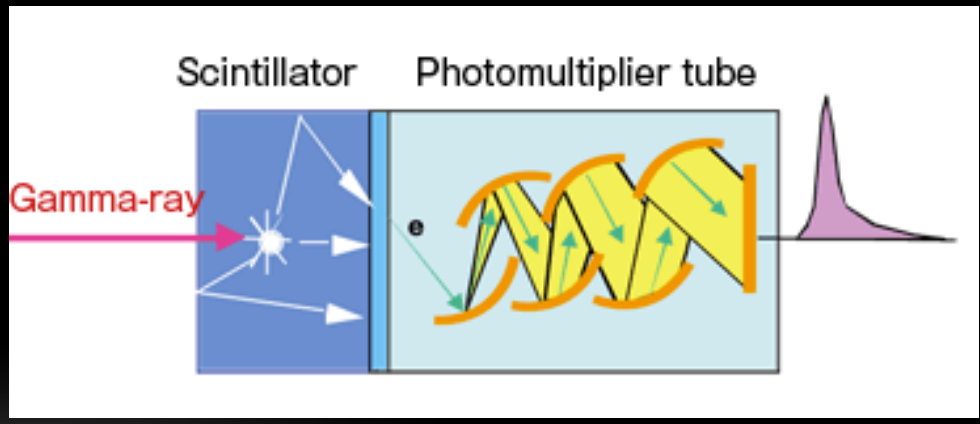
Crystal Clear Collaboration

May 26, 2014

# HOW THE MEASUREMENTS WORK

- There is a radioactive Cs-137 sample sitting 30mm above the PMT. It releases gammas into the LYSO (Cerium-doped Lutetium Yttrium Orhosilicate) crystal. The scintillator reemits the gammas in the form of optical photons. These photons are then detected by the PMT.
- The PMT absorbs the light emitted by the scintillator and reemits it in the form of electrons via the photoelectric effect. Those get converted into an electronic signal.
- Desirable characteristic: high scintillation light yield (number of photons emitted per eV of radiation energy absorbed).



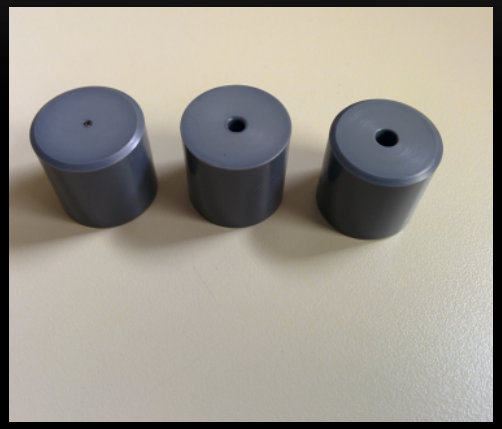



# MEASURING SCINTILLATING CRYSTALS

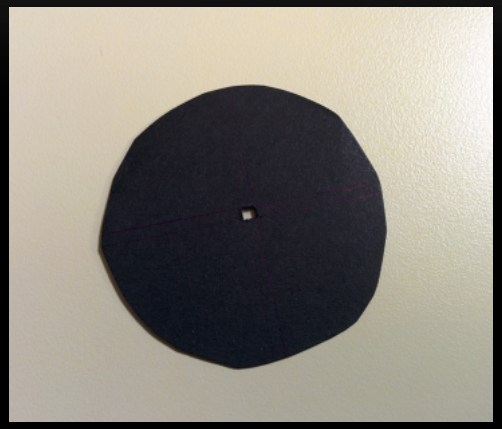
- Test various lengths of crystals wrapped in different materials (Teflon, Vikuiti) in addition to naked configurations for comparisons

Goals:

- Understanding which wrapping material produces more light
- To see whether or not our experimental results could be reproduced by simulations, and vice versa.



Holders



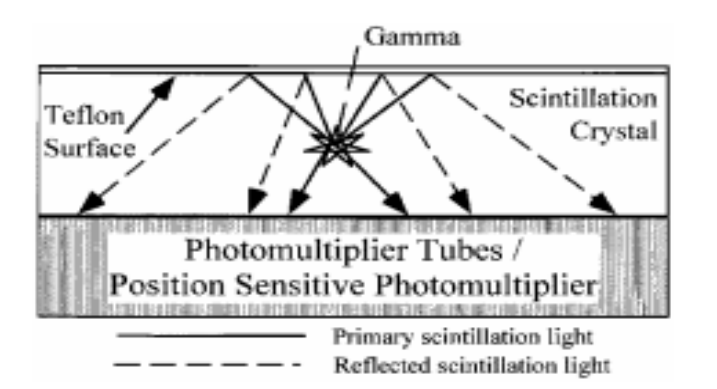
Mask

Teflon

Vikuiti

# MATERIALS

Teflon tape:
light reflector; minimizes light loss

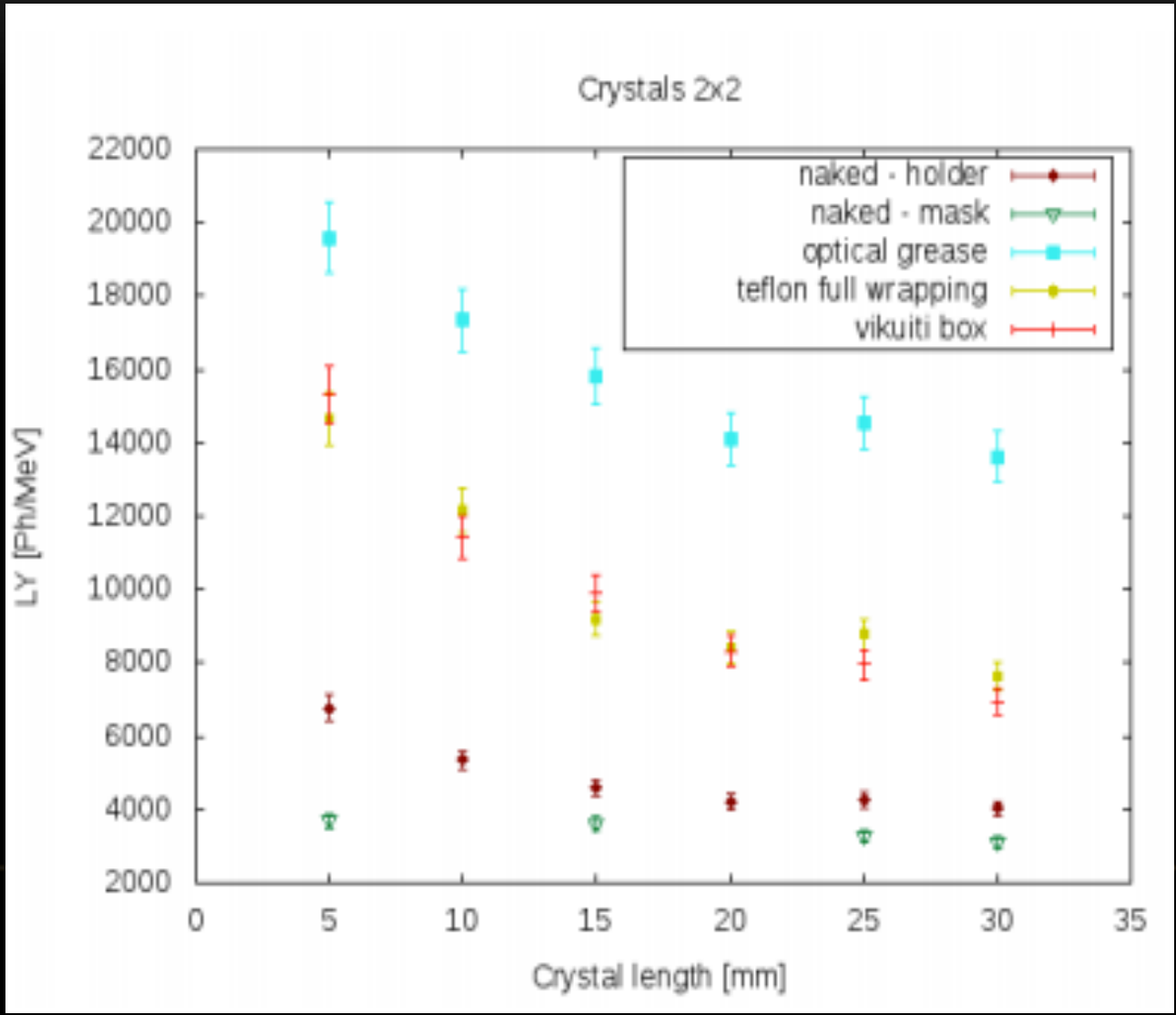




Optical grease:
coupling agent used to eliminate air space between the crystal and the PMT

Vikuiti:
brand that makes prismatic brightness enhancement films for LCD screens

# RESULTS


Crystals 2x2
naked - holder
naked - mask
optical grease
teflon full wrapping
vikuiti box
LY [Ph/MeV]
Crystal length [mm]
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
5
10
15
20
25
30
35

# CURRENT TASKS

While working with the crystals, I will continue to collect data with different forms of wrapping to be sure that our simulations are accurate.

# CLEARPEM DETECTOR FOR BREAST CANCER

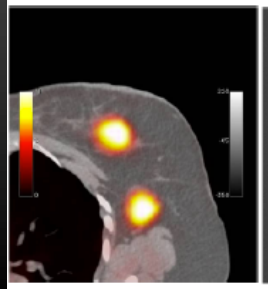
- Developed by Crystal Clear Collaboration
- ClearPEM module consists of a compact PET scanner designed for breast analysis with high spatial resolution
- The simulations that are currently being done are all for improving the detectors in ClearPEM in order to make future models are more efficient while having lower production costs

# CLEARPEM ADVANTAGES

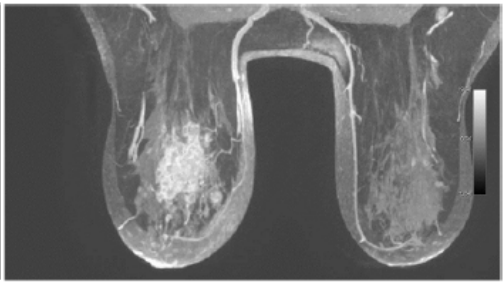
From MRI, high rate of false positives leads to unnecessary biopsies (60-85%) = high costs and risks

Lesions only detected by ClearPEM →

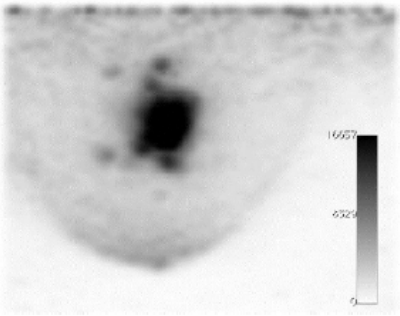
## Multifocal Breast Cancer



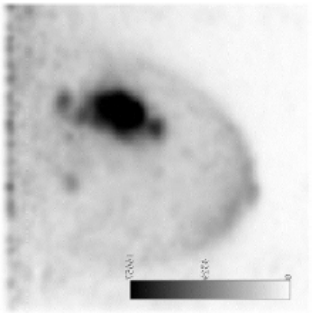
Whole-body PET/CT



MRI



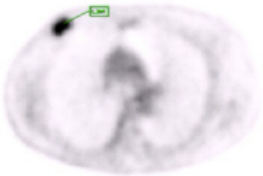
Coronal ClearPEM-Sonic



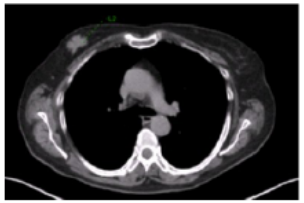
Sagittal ClearPEM-Sonic

## Bilateral Breast Cancer

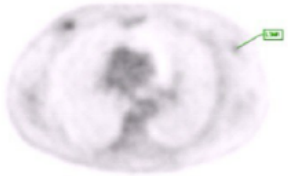
**Right Breast** **Left Breast**



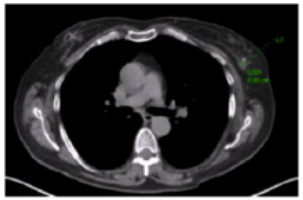
Whole-body PET



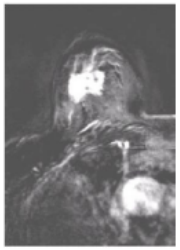
CT



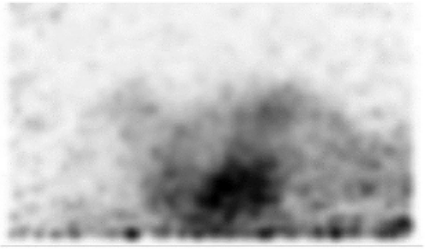
Whole-body PET



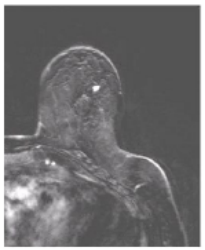
CT



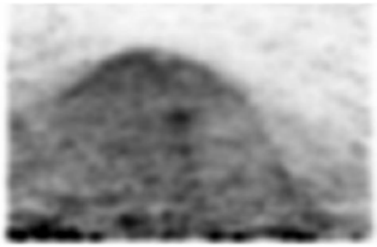
MRI



ClearPEM-Sonic PEM



MRI

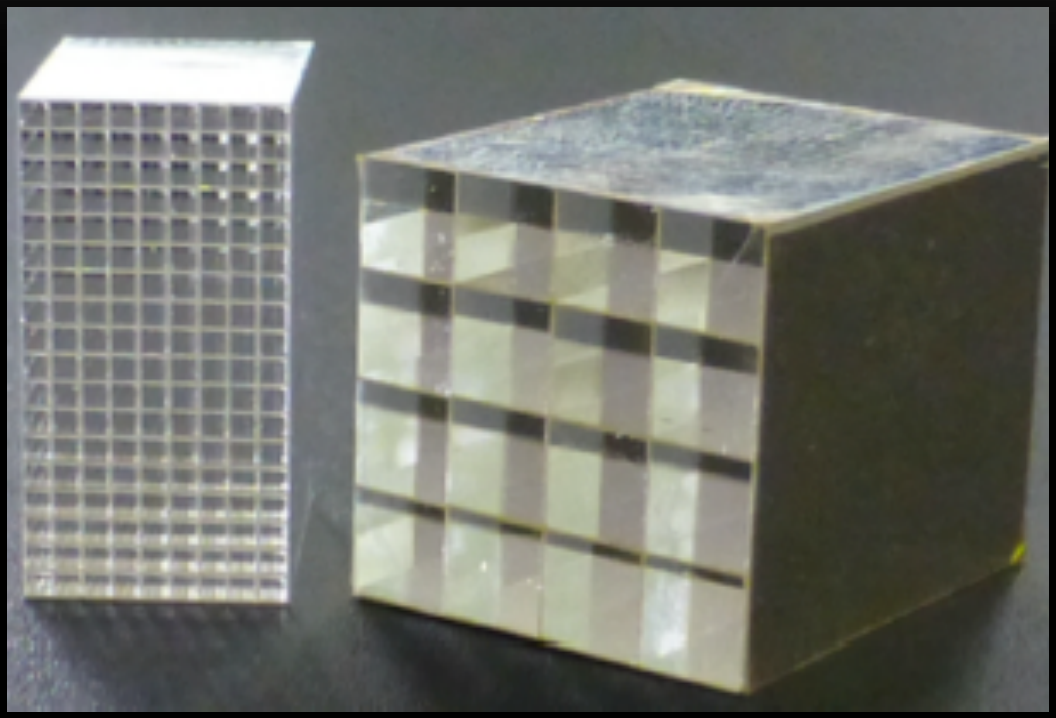


ClearPEM-Sonic PEM

B. Frisch, "Towards Multimodal Positron Emission Mammography and Ultrasonography: the ClearPEM-Sonic Project" IEEE Transaction on Medical Imaging, in review

Tumor in Left Breast detected by only MRI and ClearPEM ←

# BACK TO ENDOTOFPET

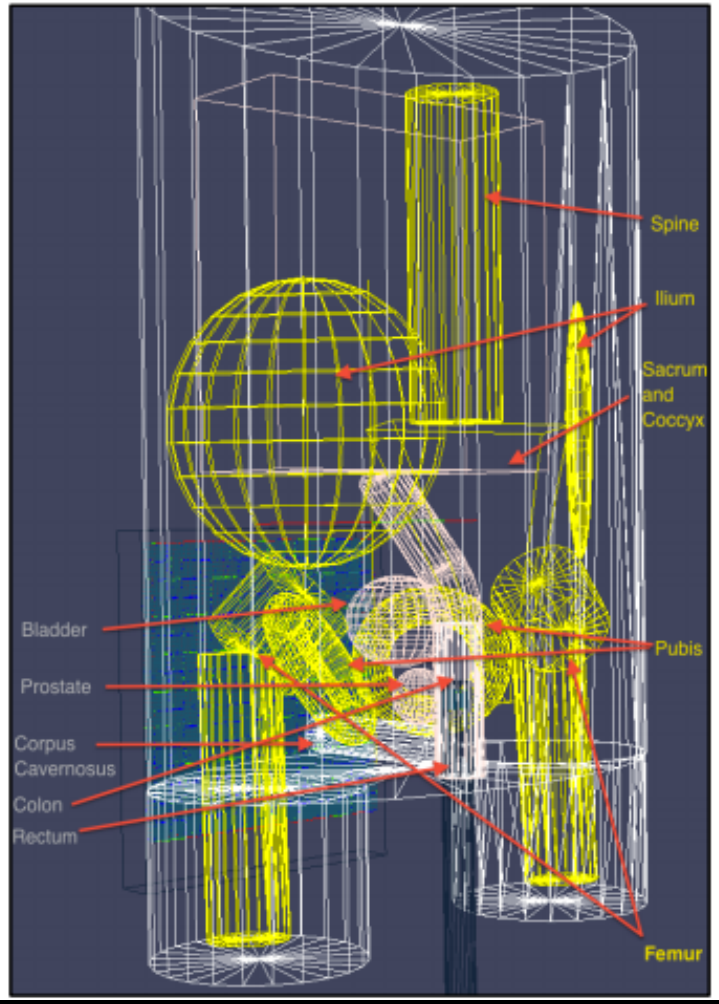


Physical crystals

Left: 2 arrays of 9x18 crystals, 0.17x0.17.15 $mm^3$ each for the internal probe

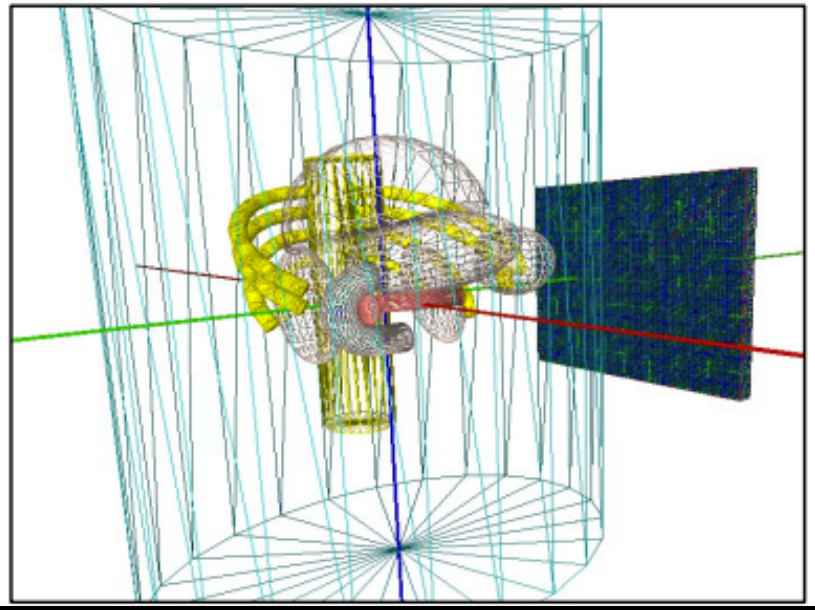
Right: 256 arrays of 4x4 crystals, 3.5x3.5x15 $mm^3$ for the external plate

# ANALYTICAL PHANTOMS



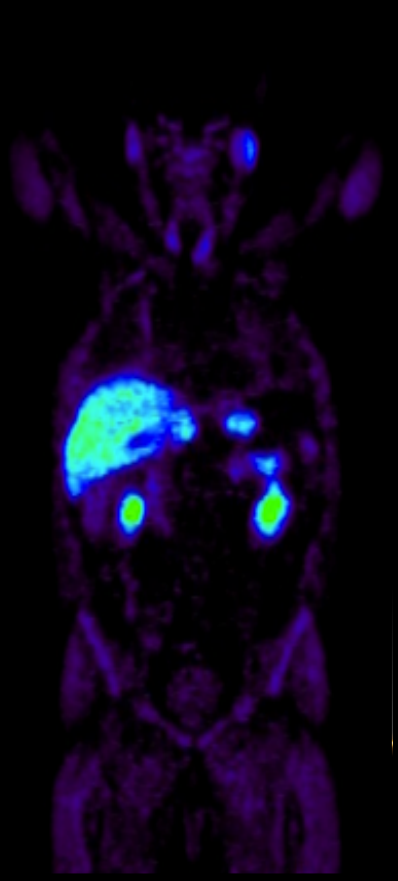

Left: phantom for prostate

Bottom: phantom for pancreas



# VOXELIZED PHANTOMS

DICOM → CONVERSION TOOLS → GAMOS



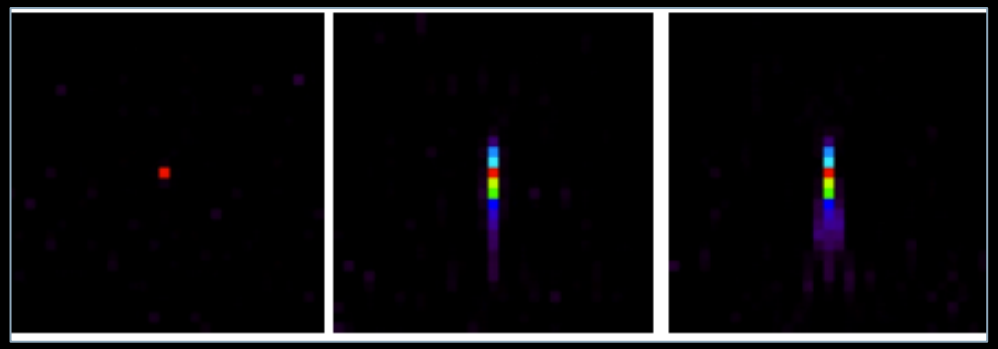
- Real CT and PET scans from dataset of patients in Centre Hospitalier Universitaire Vaudois, Lausanne
- We are able to add a radioactive point source or extended sources to these simulations
- Can easily insert the ENDOTOFPET probe inside the body and plate outside to simulate gamma production and detection (in GAMOS)
- Relatively few problems so far

# PRELIMINARY SIMULATIONS

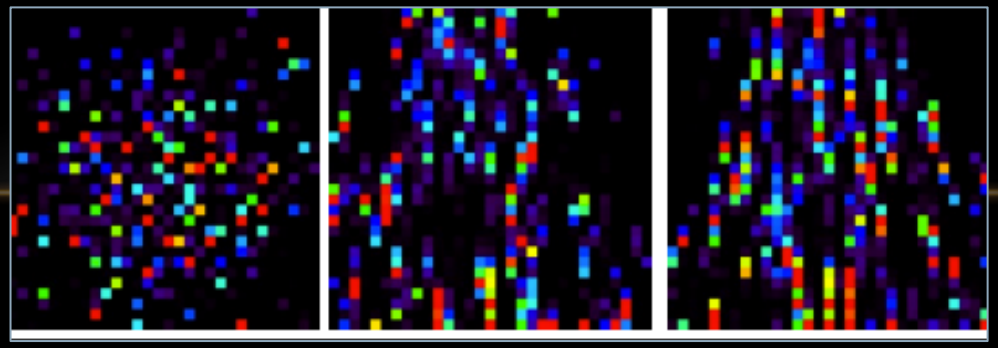
- 3 x 3 x 3 cm of reconstructed area
- Voxels of 1 mm
- Amide software for quantitative analysis

Such a bright source → shows that background noise will not be much of a problem

Lesion with background



Background only



# QUESTIONS?