

EasyPET: A new concept for democratize the use of axial preclinical PET

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universidade de aveiro



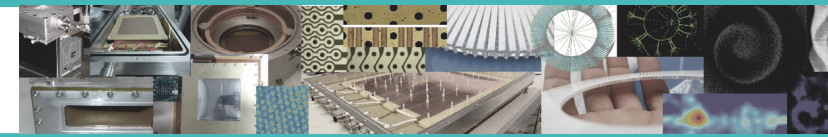
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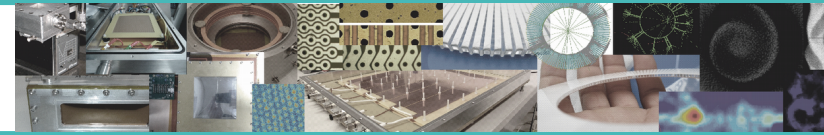
PET medical imaging techniques used in nuclear medicine for diagnostic

Preclinical(micro-PET)

...ALLOWS

- small animal imaging
- R&D of new radiopharmaceuticals and methods of diagnostic

70 to 80% of small animal PET concentrated in academic research laboratories



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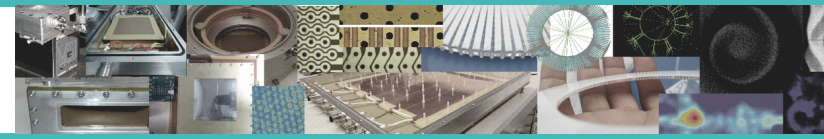
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Problem



High complexity and cost **limit access!!**

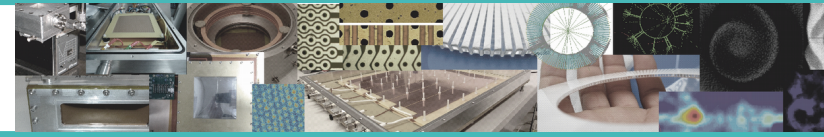


**RESEARCH AND DEVELOPMENT
CENTERS**



**HEALTH SCHOOLS AND
UNIVERSITIES**

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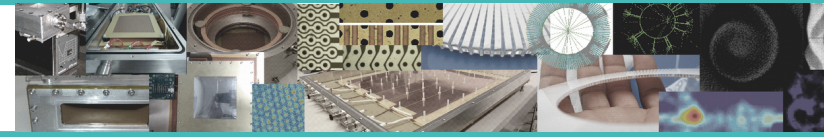


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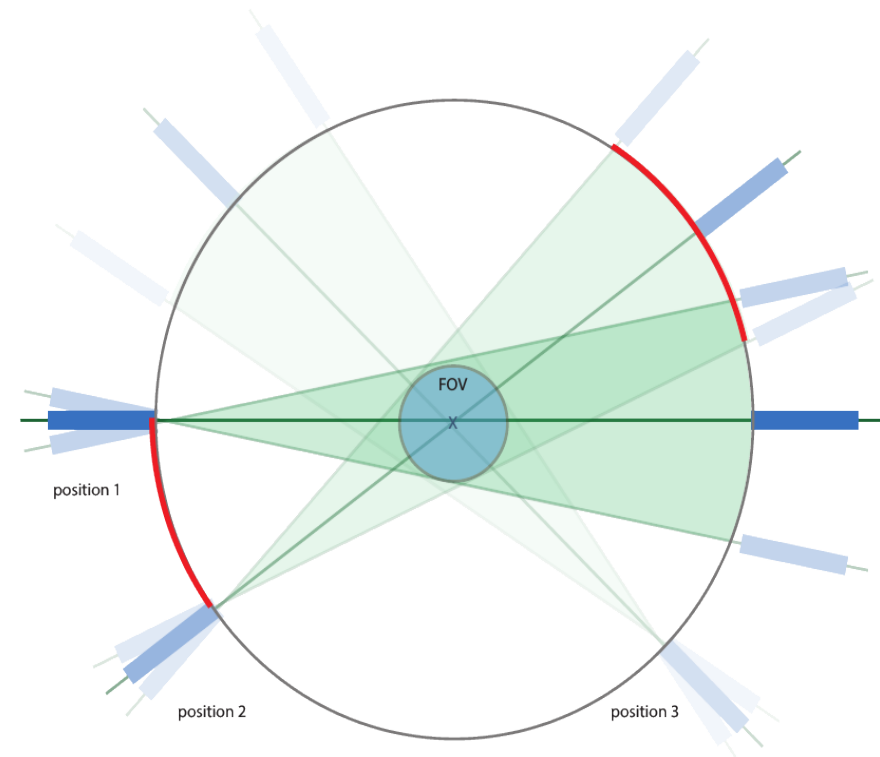
DEMOCRATIZE PET TECHNOLOGY



=> Strongly reduce preclinical PET costs

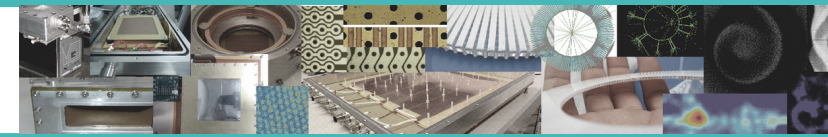
easyPET – the new PET concept

- **ACQUISITION METHOD** - based on **2 ROTATION AXES** for the movement of detector modules
- **Allows FULL AXIAL IMAGING** (full animal body) with a small number of crystals
- **HIGH SPATIAL RESOLUTION AND UNIFORMITY** over the **whole FOV**
- **ELIMINATE THE PARALLAX ERROR** due to depth of interaction (DOI):
 - does not impose limitations on the proximity of the detector elements to the FOV;
 - favours system sensitivity.



PATENT: WO201/147130
PCT/IB2016/051487

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- Allow to explore technological aspects of PET

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SP5700 EasyPET



- Gamma Spectroscopy and System Linearity
- Positron Annihilation Detection
- Nuclear Imaging
- Two-dimensional Reconstruction of a Radioactive Source
- Source Spatial Resolution
- Efficiency measurements

coming soon

Coming Soon Products

* Product Specification is a draft version only. The content is still under internal review and subject to formal approval, which may result in modifications or additions.

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Printable data sheet

Overview Documentation Ordering Option

CAEN realized different modular Educational Kits. The set-up are all based on Silicon Photomultipliers (SiPM) state-of-the-art sensor of light with single photon sensitivity and unprecedented photon number capability. The goal is to inspire students and guide them towards the analysis and comprehension of different physics phenomena with a series of experiments based on state-of-the-art technologies, instruments and methods.

What's Inside



EasyPET is a simple, user friendly and portable didactic PET system developed for high-level education, which allows exploring the physical and technological principles of the conventional human PET scanners, using the same basic detectors of state-of-the-art systems. The Positron Emission Tomography (PET) scanner is the state-of-the-art medical imaging system, capable of providing detailed functional information of physiological processes inside the human body. Functional imaging has a great impact in cancer diagnostics, monitoring of therapy effects and cancer drug development. The underlying principle to PET systems is the detection of high energy radiation emitted from a chemical marker, a molecule labelled with a radioisotope, administered to a patient. The radioisotope emits positrons which, after annihilating with atomic electrons, result in the isotropic emission of two photons back to back with an energy of 511 keV. The two photons are detected by a ring of detectors, which allows a pair of them to detect two back to back photons in any direction.

Experiments

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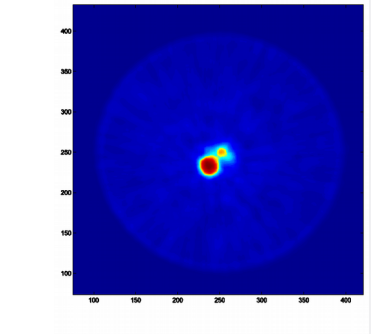
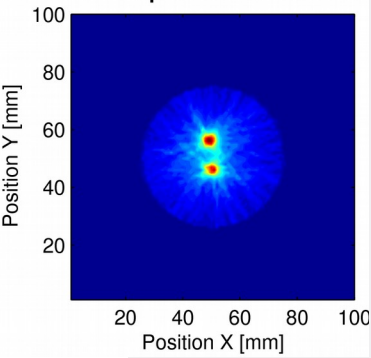
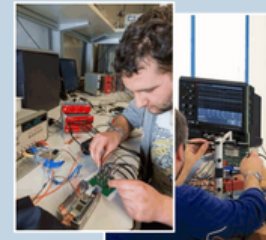
Explore

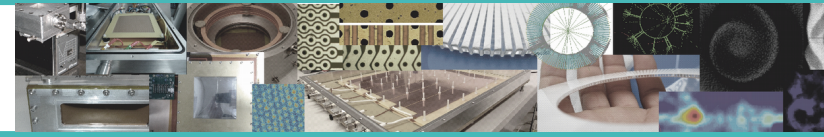
- Webcast & Tutorial resources
- News from Products Catalog
- Coming soon

CAEN Product Catalog 2016 / 2017

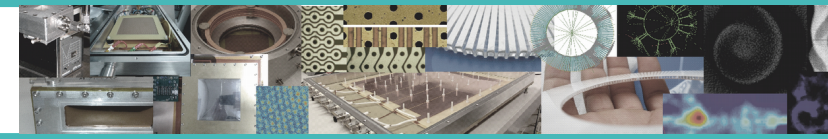


CAEN Educational

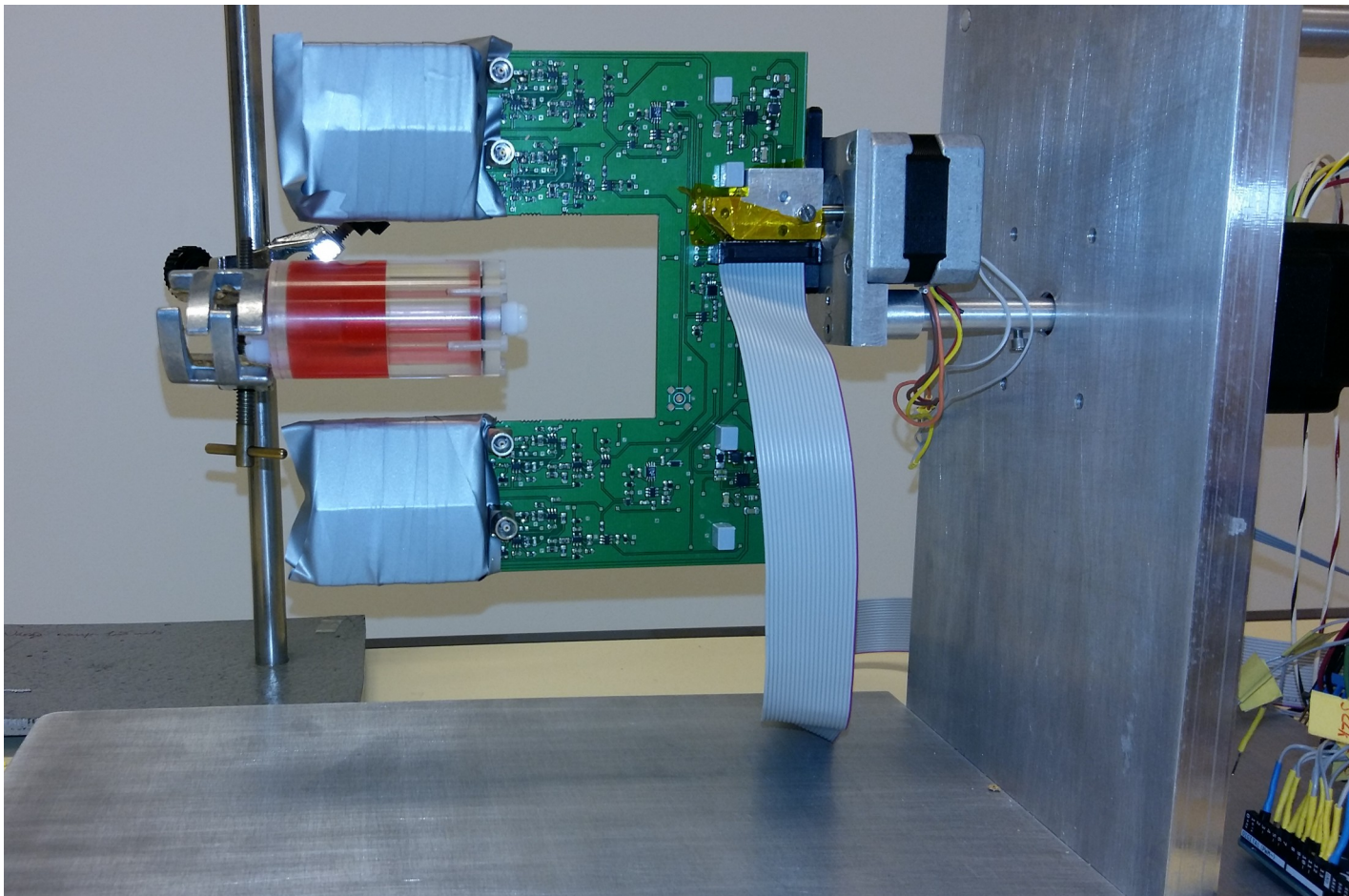


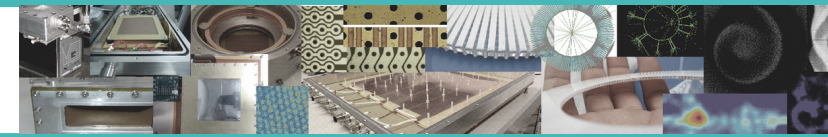


- easyPET demonstrator:
 - model validation with 16+16 cells
 - 3D imaging
 - experimental results



- easyPET demonstrator

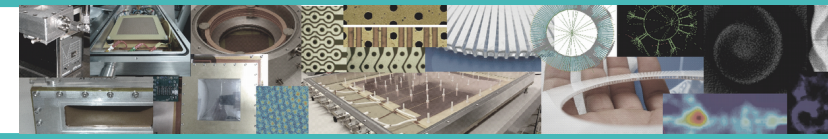




• easyPET demonstrator

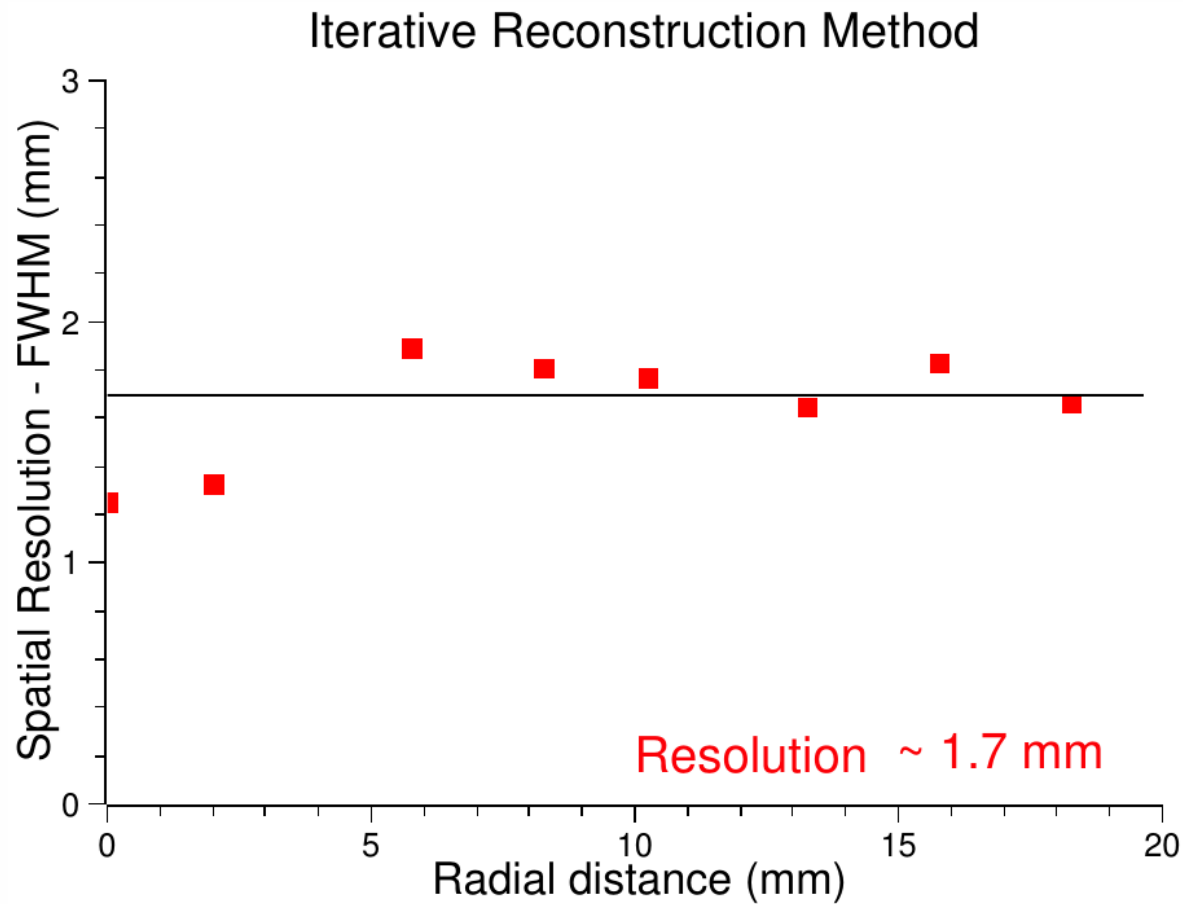
- model validation with 16+16 cells
- experimental results
- 0.25 mm \varnothing ^{22}Na source in a 1 cm³ PMMA - NEMA NU 4-2008

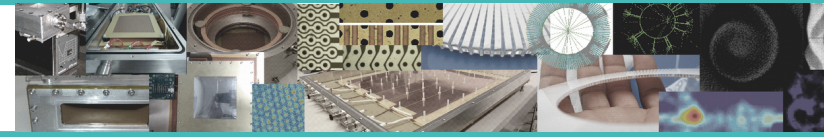
| | | Distance to center (mm) | | | | | | | |
|-----------------------------|---|-------------------------|---------|---------|---------|---------|---------|---------|-------|
| | | 0 | 2 | 5.75 | 8.25 | 10.25 | 13.75 | 15.75 | 18.25 |
| Raw No filtered | <p>FOV = 57.7 mm FWHM = 2.50 mm</p> | | | | | | | | |
| | | 2.53 mm | 2.57 mm | 2.82 mm | 2.63mm | 2.69 mm | 2.73 mm | 2.64 mm | |
| Iterative Reconstruction | <p>FOV = 57.7 mm 1.25 mm</p> | | | | | | | | |
| | | 1.33 mm | 1.89 mm | 1.81 mm | 1.77 mm | 1.65 mm | 1.83 mm | 1.66 mm | |



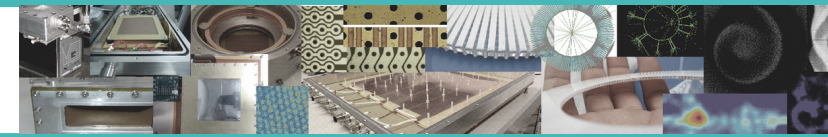
- Spatial resolution

- Crystal size = 2 x 2 x 30 mm

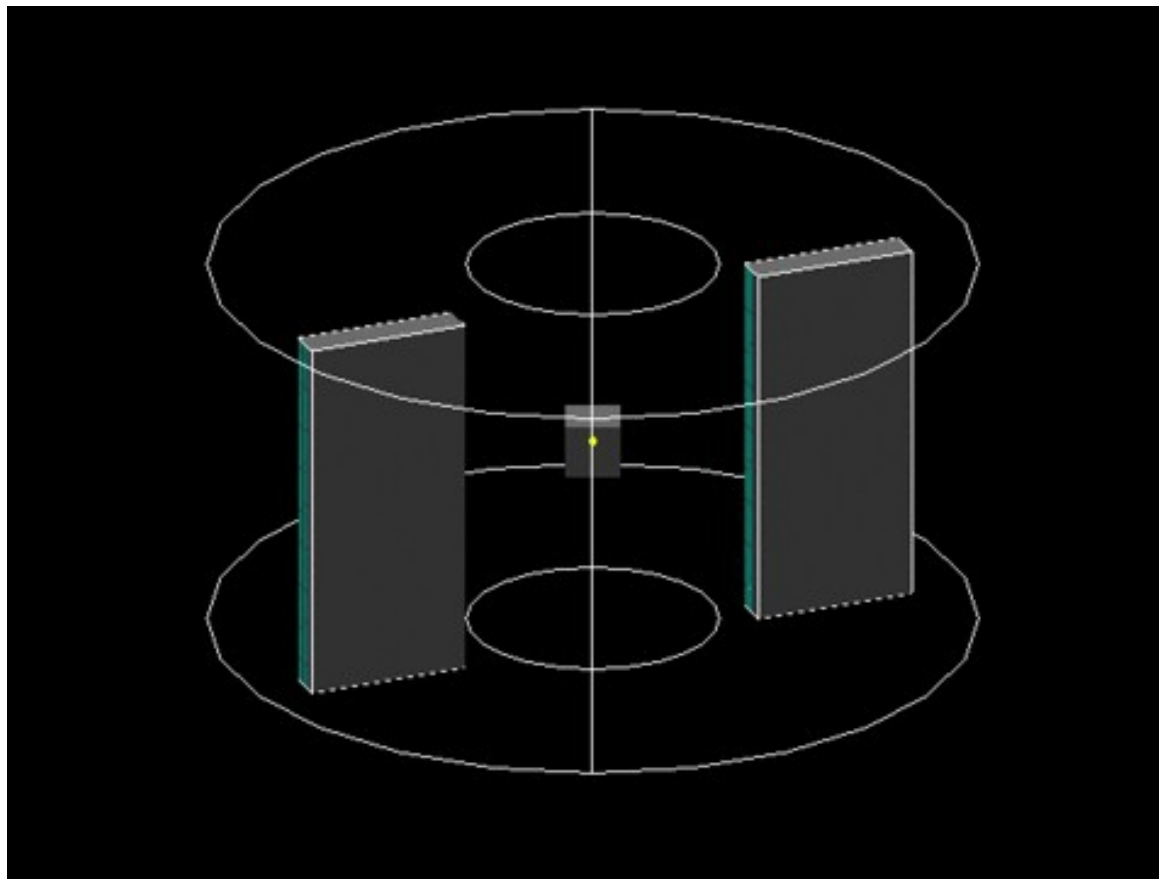


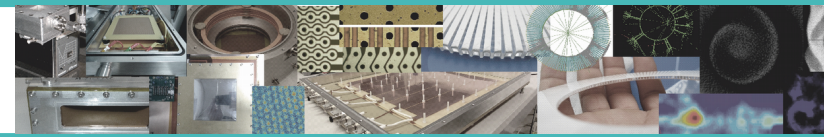


- Simulation using GATE (GEANT4)
 - model validation with 16 + 16 cells
 - evaluate a scalable version

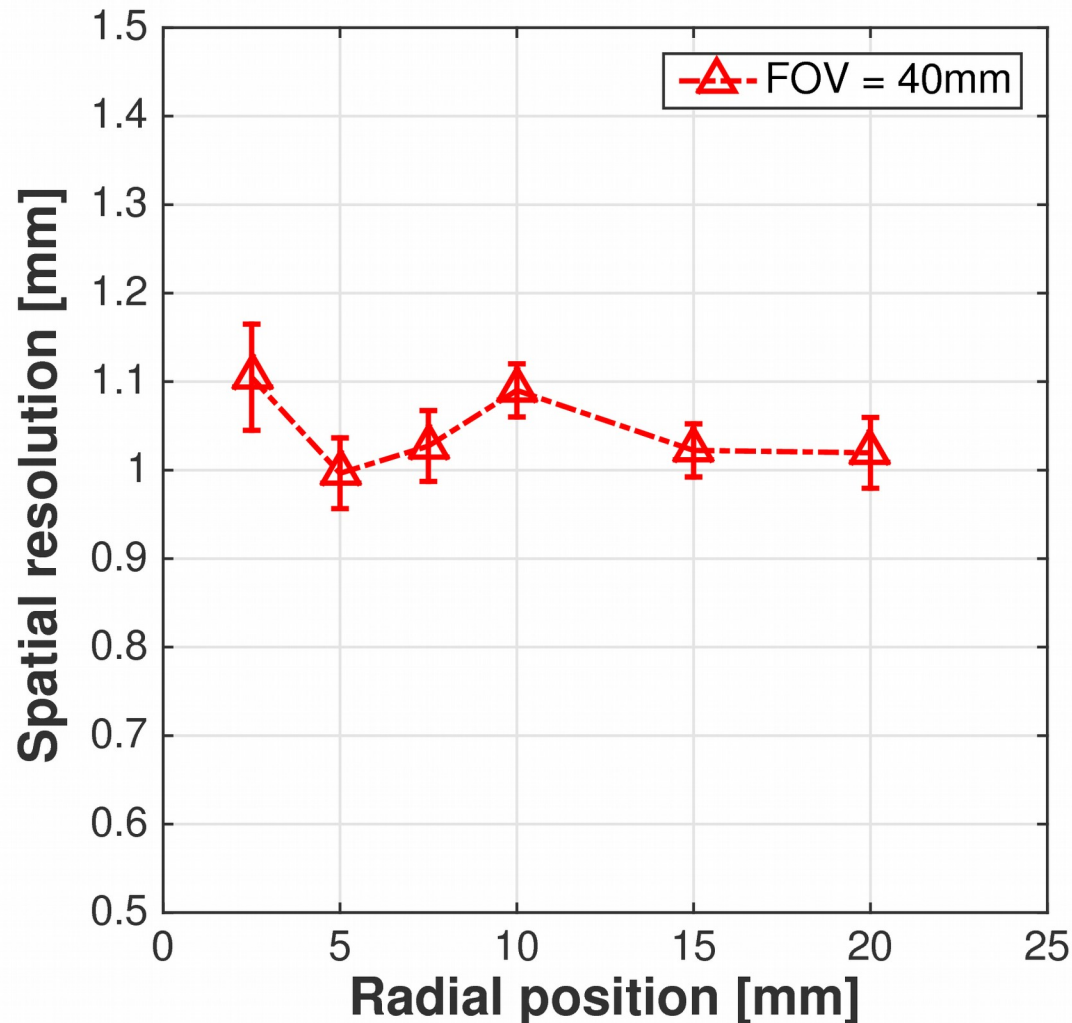


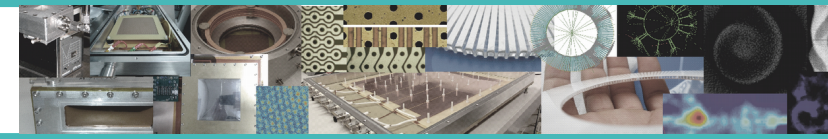
- System configuration:
 - $50 \times 5 + 50 \times 5$ ($1.5 \times 1.5 \times 20$ mm crystals)



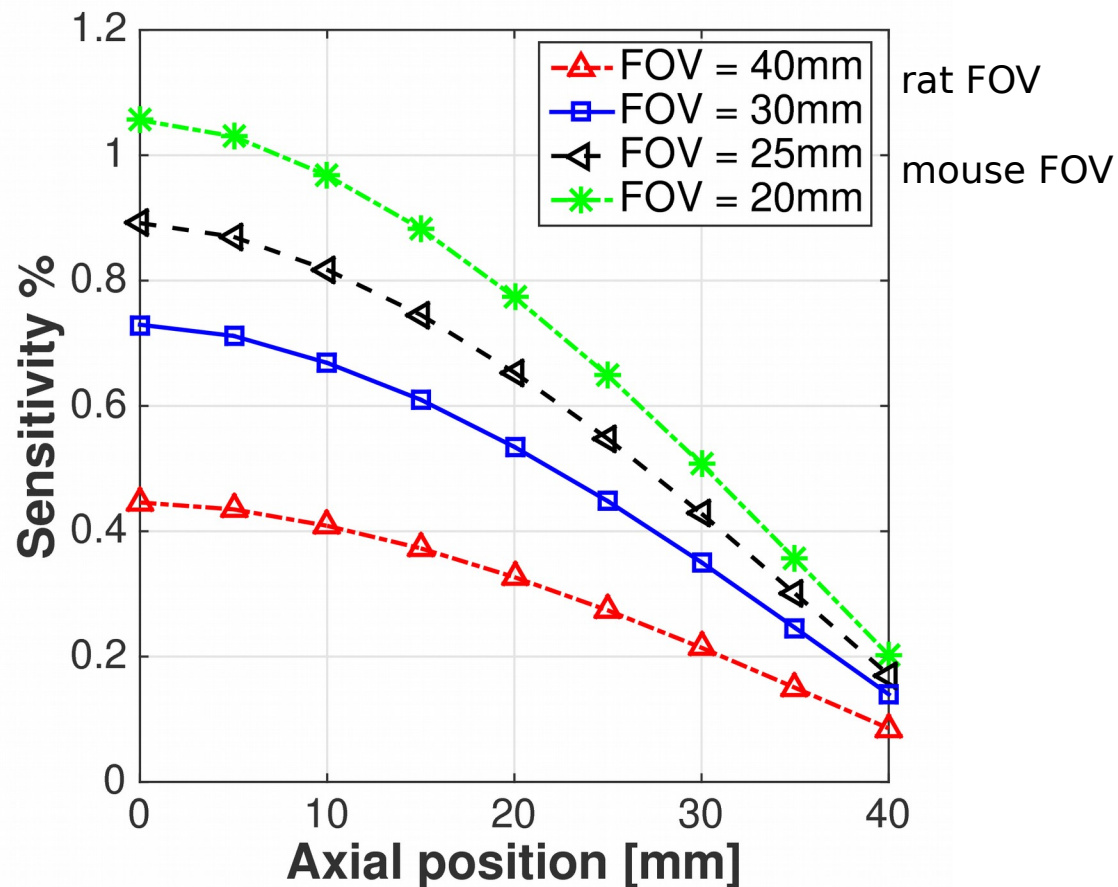


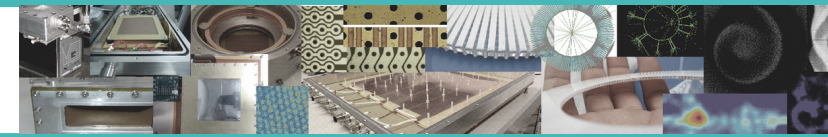
- Simulated position resolution (iterative reconst.)
- Following the norma NEMA NU 4-2008





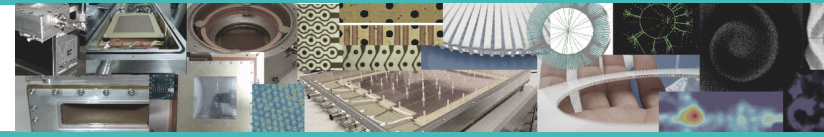
- Configuration: 50x5 + 50x5 (1.5x1.5x20 mm crystals)
- Following NEMA NU 4-2008 - **FOV - 80 x 50 mm**





- Following NEMA NU 4-2008

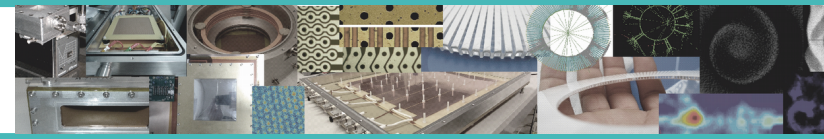
| System | Sensitivity (%) | Transaxial FWHM (at 5 mm) | Transaxial FWHM (at 25 mm) | Resolution/crystal size | Crystal size (mm) |
|---------------------|-----------------|---------------------------|----------------------------|-------------------------|-------------------------|
| microPET P4 | 0.61 | 2.24 | 2.61 | 1.02 | 2.2 x 2.2 x 10 |
| microPET R4 | 1.10 | 2.20 | 3.3 | 1.00 | 2.2 x 2.2 x 10 |
| microPET Focus 220 | 1.18 | 1.74 | 2.07 | 1.15 | 1.51 x 1.51 x 10 |
| microPET Focus 120 | 1.82 | 1.78 | 2.53 | 1.18 | 1.51 x 1.51 x 10 |
| Inveon | 2.80 | 1.64 | 2.49 | 1.08 | 1.51 x 1.51 x 10 |
| ClearPET | 1.87 | 2.02 | 2.55 | 1.01 | 2 x 2 x 10 + 2 x 2 x 10 |
| Mosaic HP | 1.77 | 2.34 | 2.59 | 1.17 | |
| VrPET | 1.09 | 1.61 | 2.03 | 1.15 | 1.4 x 1.4 x 12 |
| LabPET 8 | 1.42 | 1.64 | 2.56 | 0.82 | 2 x 2 x 11.9 |
| easyPET - PC | 1 | 1.0 (simu) | 1.03 (simu) | 0.67 | 1.5 x 1.5 x 20 |



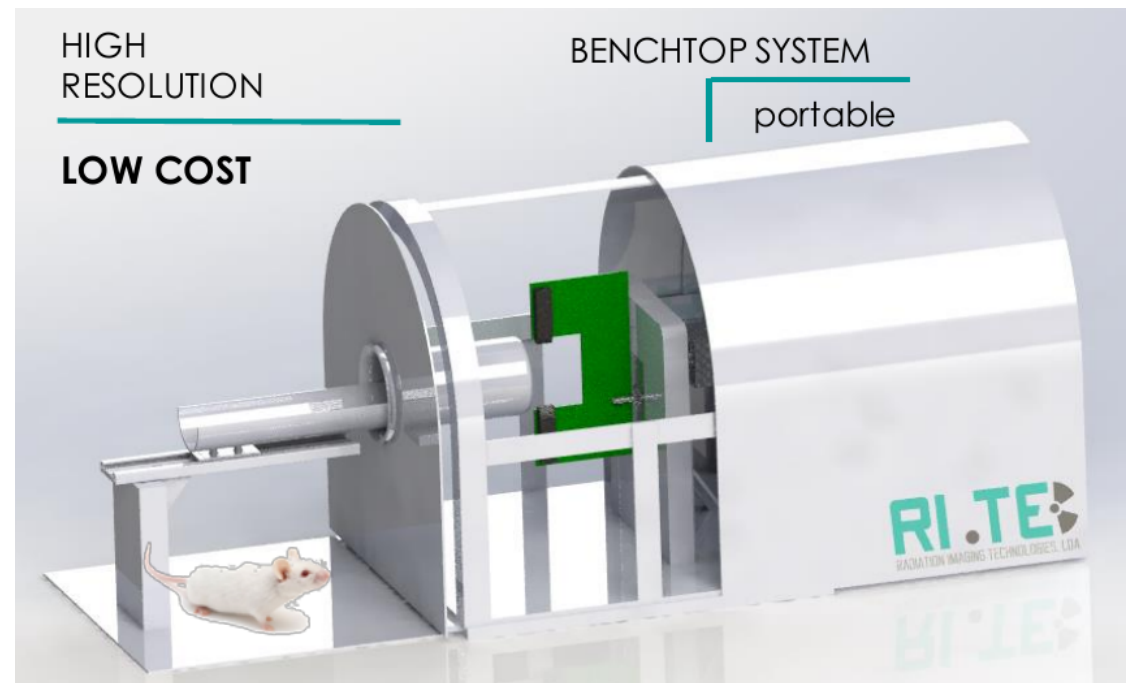
- There is room for improvement:
 - Intelligent scanning:
 - only subject volume will be scanned
 - improve sensitivity
 - background reduction
 - Scanning step smaller than crystal size
 - position resolution improvement

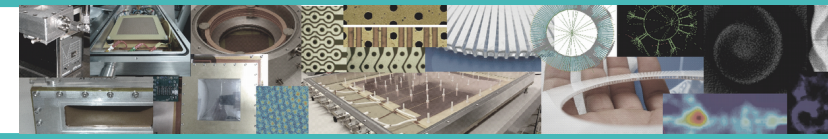
optimization: scanning as a function of imaged subject

We believe that the easyPET concept has a high potential for an entry level low-cost preclinical PET scanner, presenting “state of the art” position resolution over all FOV and fair sensitivity.



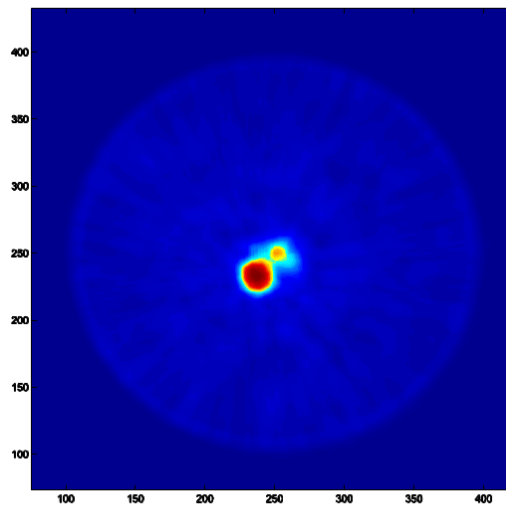
Thank you



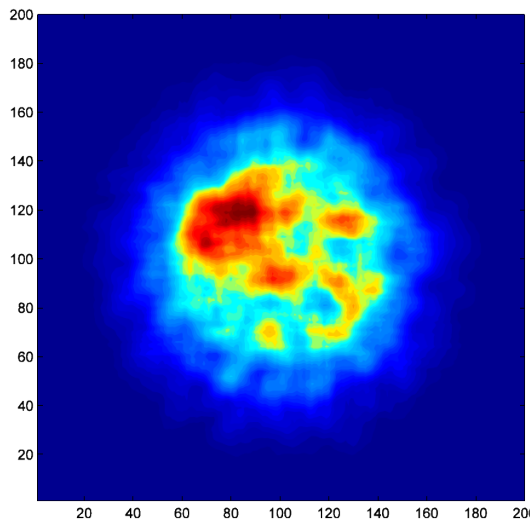


- None of the examples has any type of filtering in the image reconstruction process → only direct forward projection.

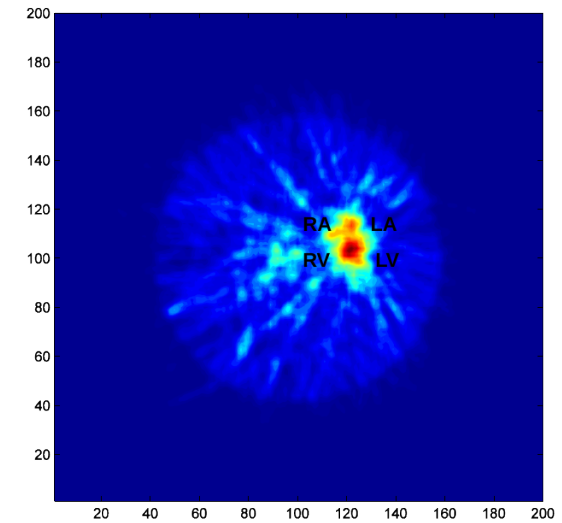
FDG-¹⁸F



5 + 2 mm \varnothing phantom



rat brain - *in vivo*



rat heart - *pos-mortem*