MPGD2009 – Kolympari - Creta

Advancements of labelled radio-pharmaceutics imaging with the PIM-MPGD

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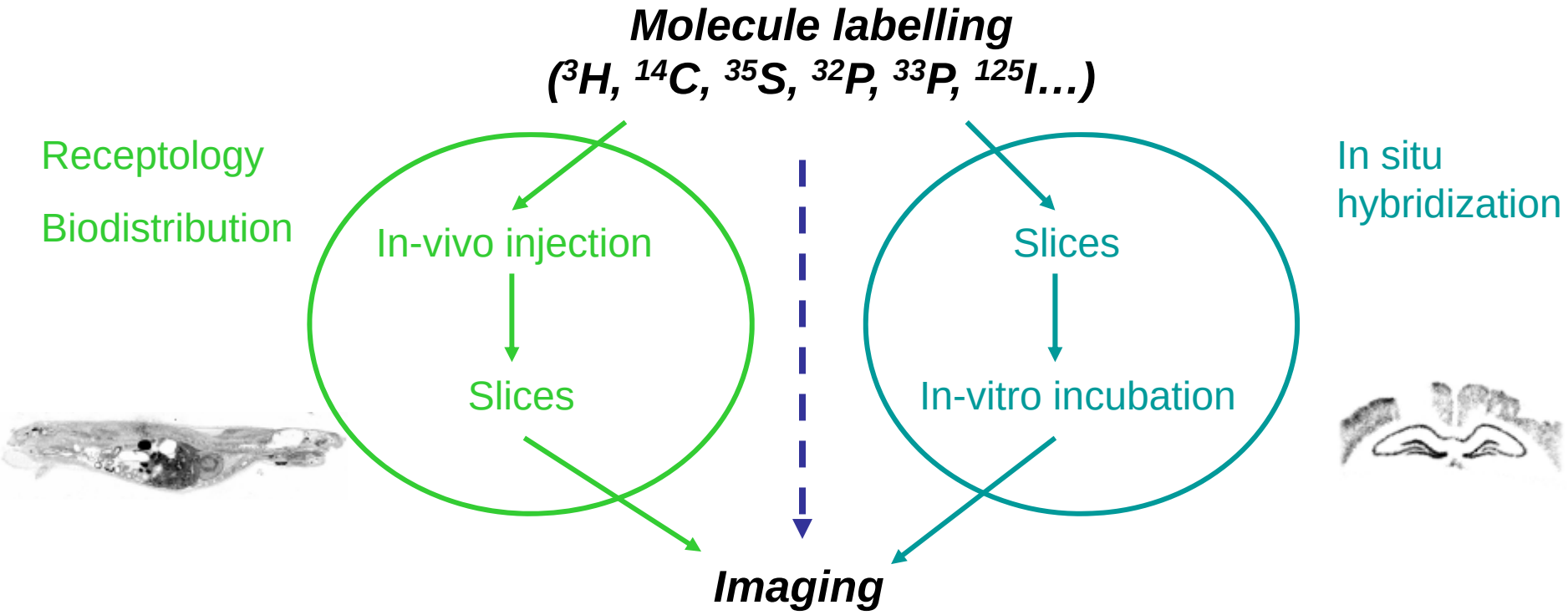
What is β autoradiography

Imaging technique able to locate in 2 dimensions molecules labeled with β radioactive emitters



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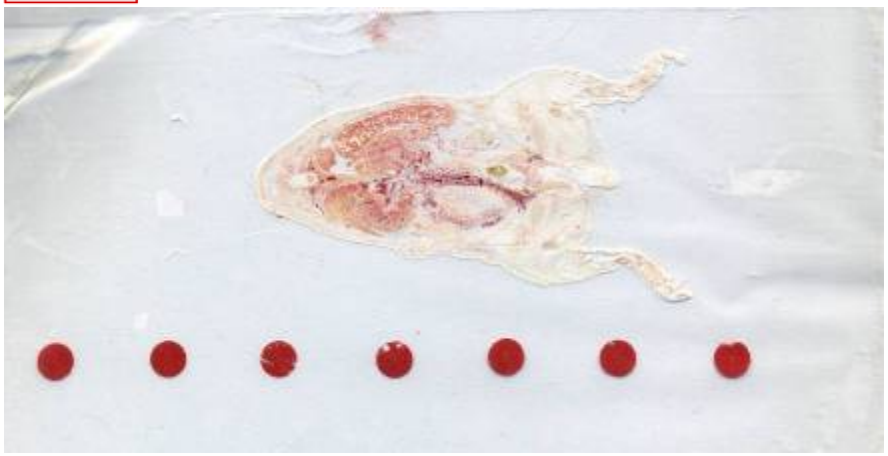
Just to give an idea of the samples…

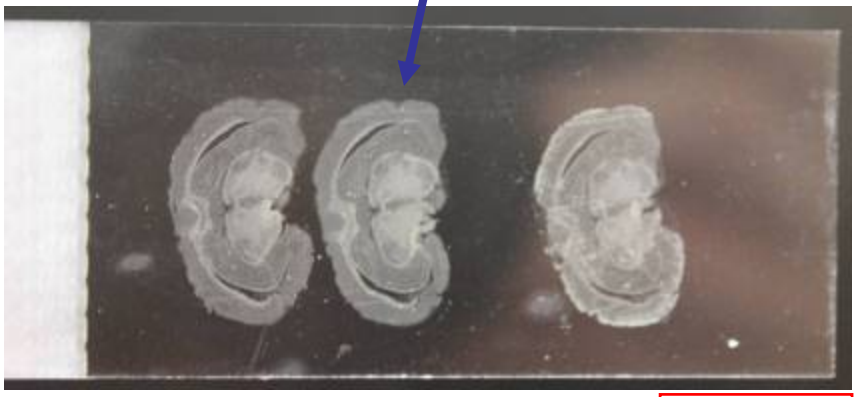
INSERM U892
CRCNA
(Centre de Recherche en Cancérologie Nantes/Angers)



Biodistribution ^{131}I labeling
Mounted on scotch

Different kind of samples for different studies

Mouse brain



In situ hybridization ^{3}H labeling
Mounted on microscope slides

Unité 930

Images performed on thin slices of entire rat or organs because of the range of β rays!!

Inserm

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Why a MPGD structure?

An imaging in proportional counting mode → No time integration

- A disintegration = 1 point in the image
- No notion of contrast or saturation
- No bad exposition possible
- Linear response
- Real-time Imaging

→ Low cost large area possible

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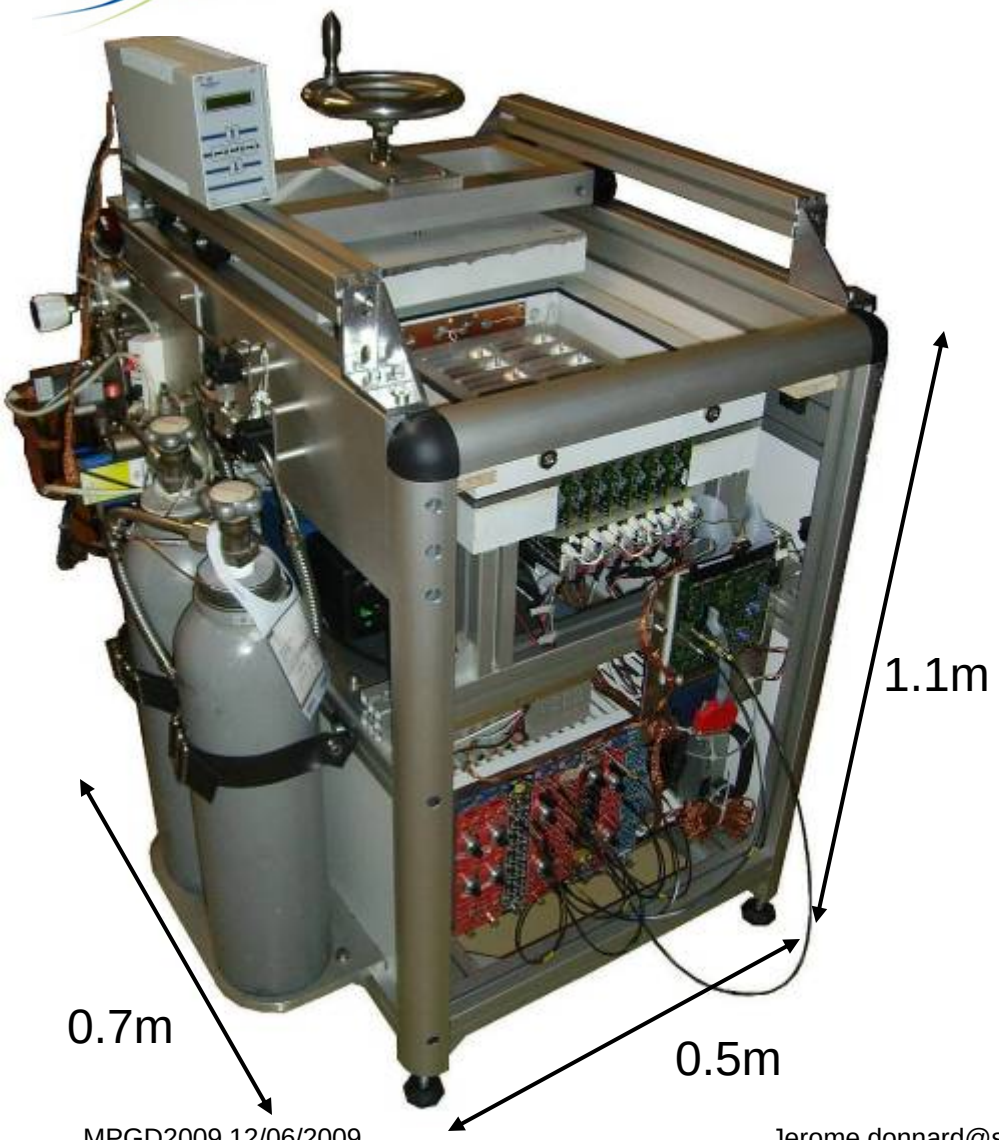
The development of a new detector



- User friendly design
- 3 different configurations
  - High energy on microscope slides (10 slides)
  - Low energy on microscope slides (10 slides)
  - Entire rat slice (3 slices)
- All the β emitters frequently used

- Active area of 18x18 cm²
- 896 readout channels
- 400 µm width pixels
- Integrated gas supply and electronics

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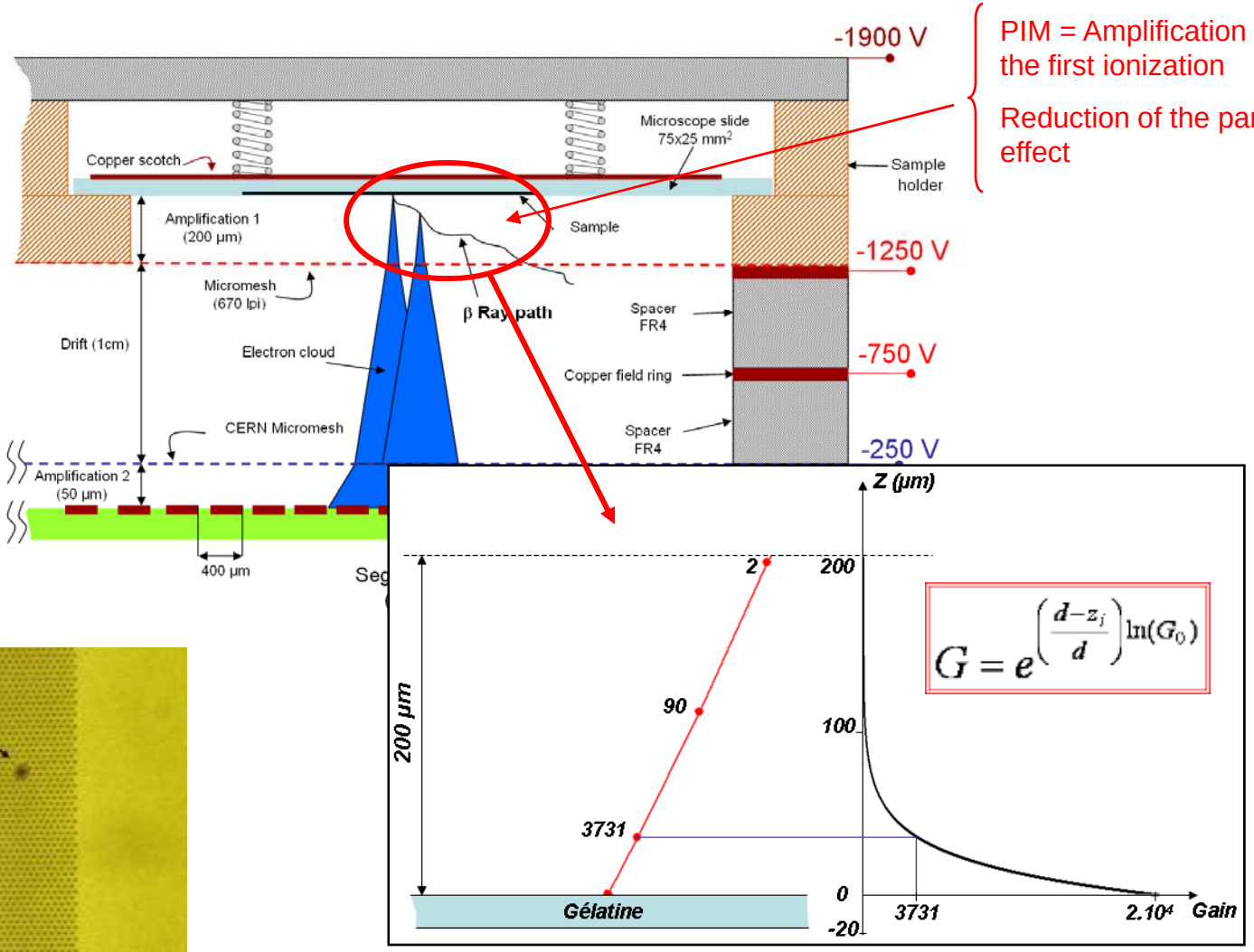
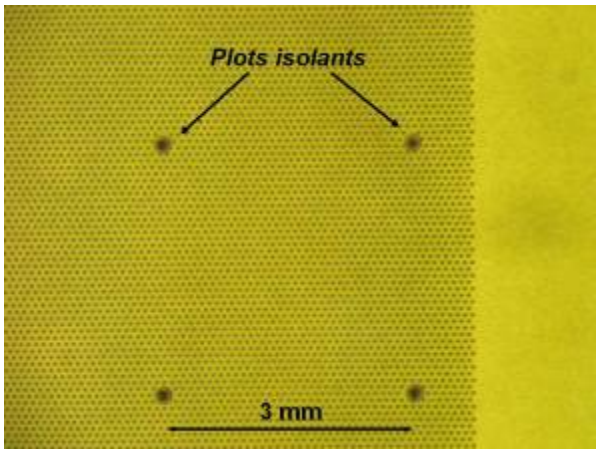
The PIM-MPGD structure



PIM = Amplification to the first ionization

Reduction of the parallax effect



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The gas supply

An integrated gas supply chain

- Pressure regulated (1.1 bar) and flow regulated (1 Ln/h)
- Premixed Ne+10%CO_2
- 2 month autonomy

Acquisition can be started in less than 5 minutes!
Ensure a good reproducibility of results and no variation over long exposure time

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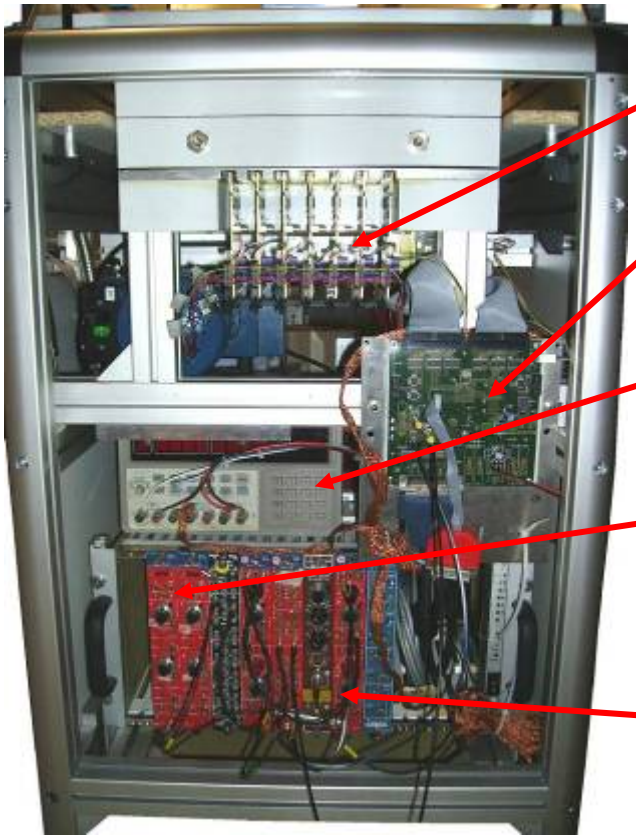
The electronic chain

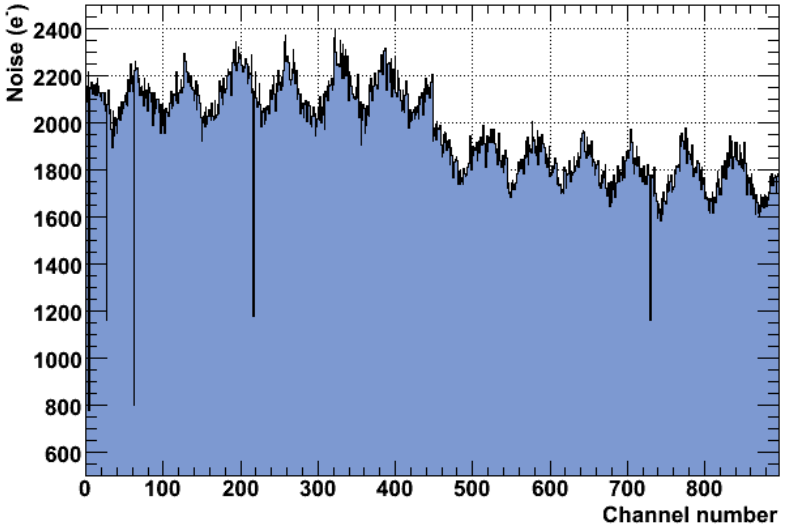


Front End Readout electronic based on Gassiplex chip with home made cards

Low voltage supply

High voltage supply

Trigger



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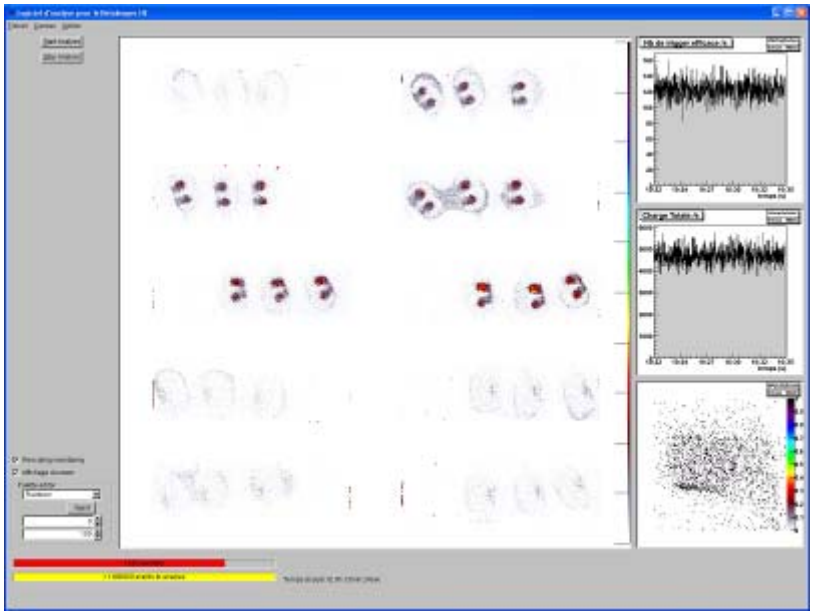
The analyzing software



Written in C++ with the environment ROOT

- Control of the FE electronics
- Automatic calibration at the beginning of a new acquisition (threshold and pedestal)
- Collects and treats data from a NI card
- Monitoring of different parameter during the acquisition

Real time imaging!

Everything the detector needs to work is fully integrated in the same structure

This transportable device would be installed in a near future into the INSERM building

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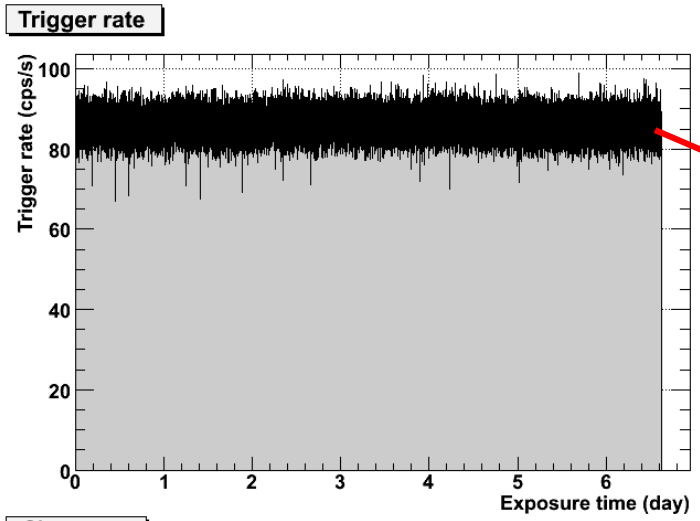
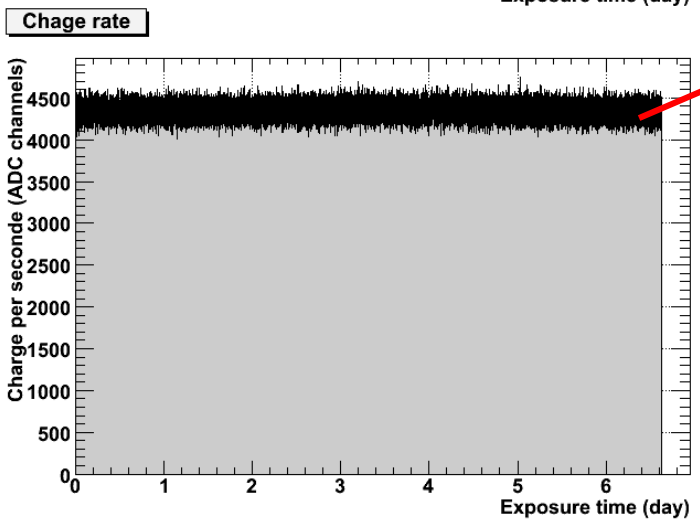
Stability over a long period

^{3}H: Half life of 12 years



No efficiency variation



No gain variation

^{3}H labeling on microscope slides

Very good stability over a week running!

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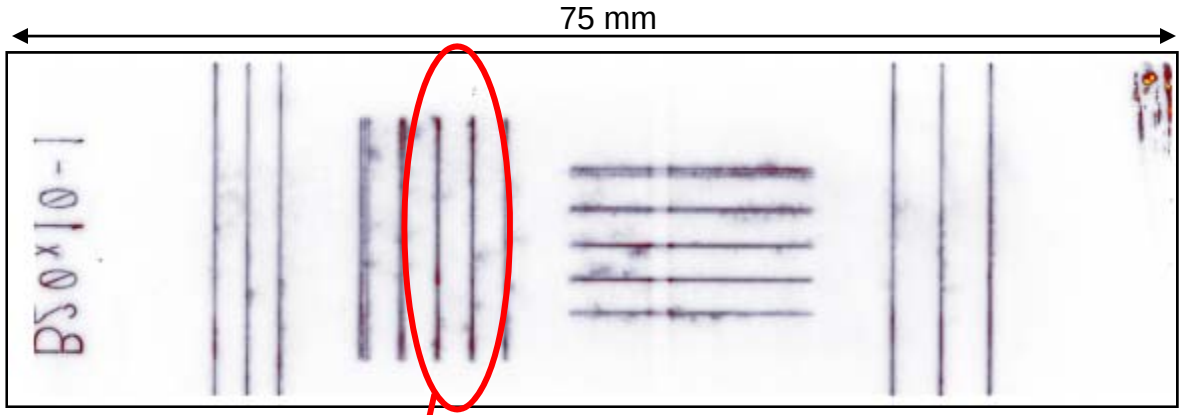
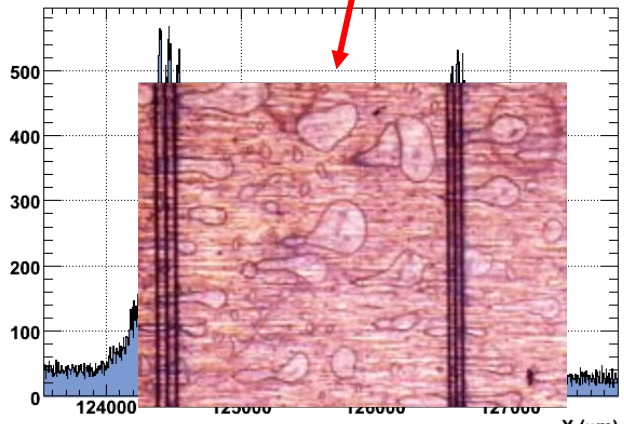
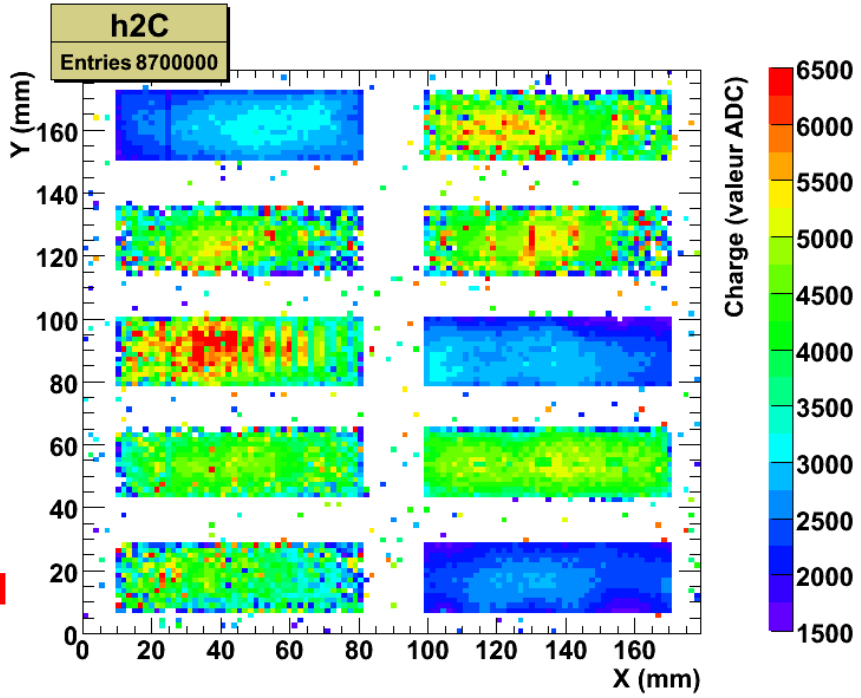
Results



Spatial resolution of 30 µm (FWHM 2D)



70 µm 50 µm



Good homogeneity over the whole area

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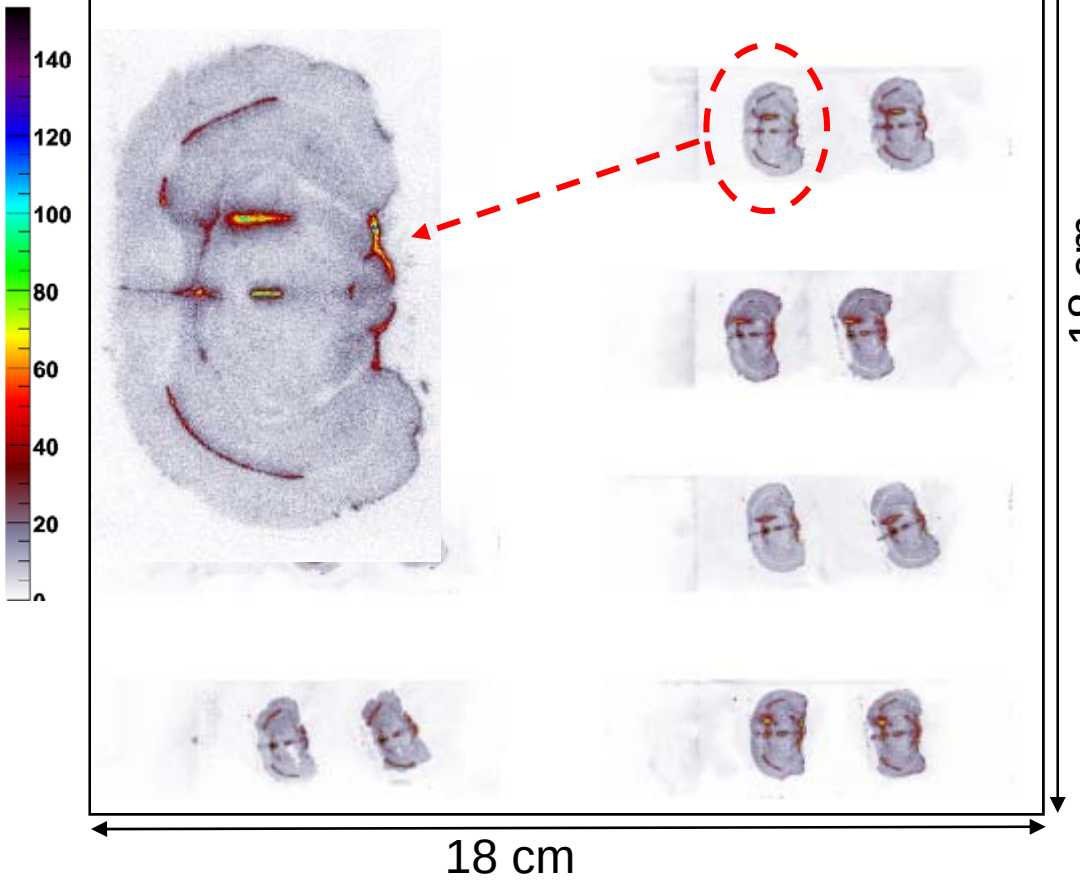
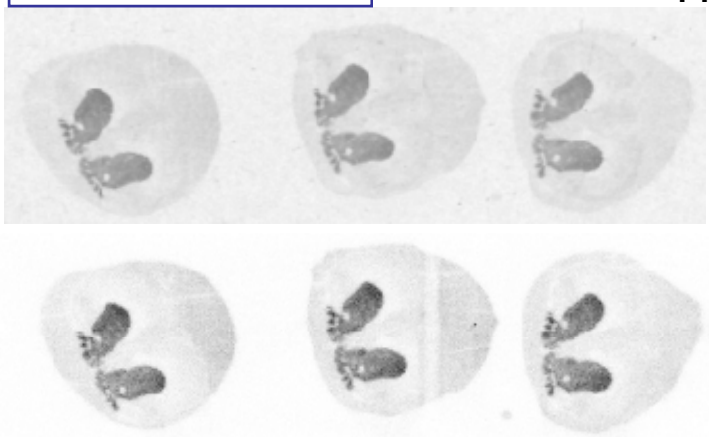
Collaboration with INSERM

Absolute sensitivity threshold :
$7{,}8.10^{-2}$ cps/cm²/min



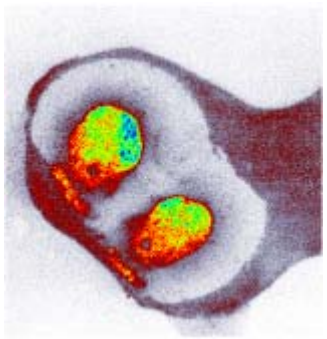
Film: 2 months

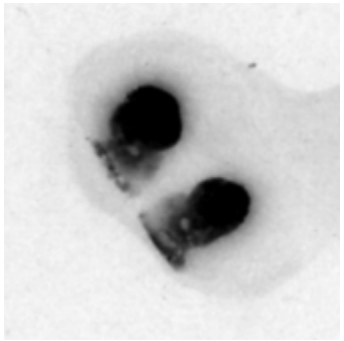
^{3}H



Subatech: 1 day

^{125}I





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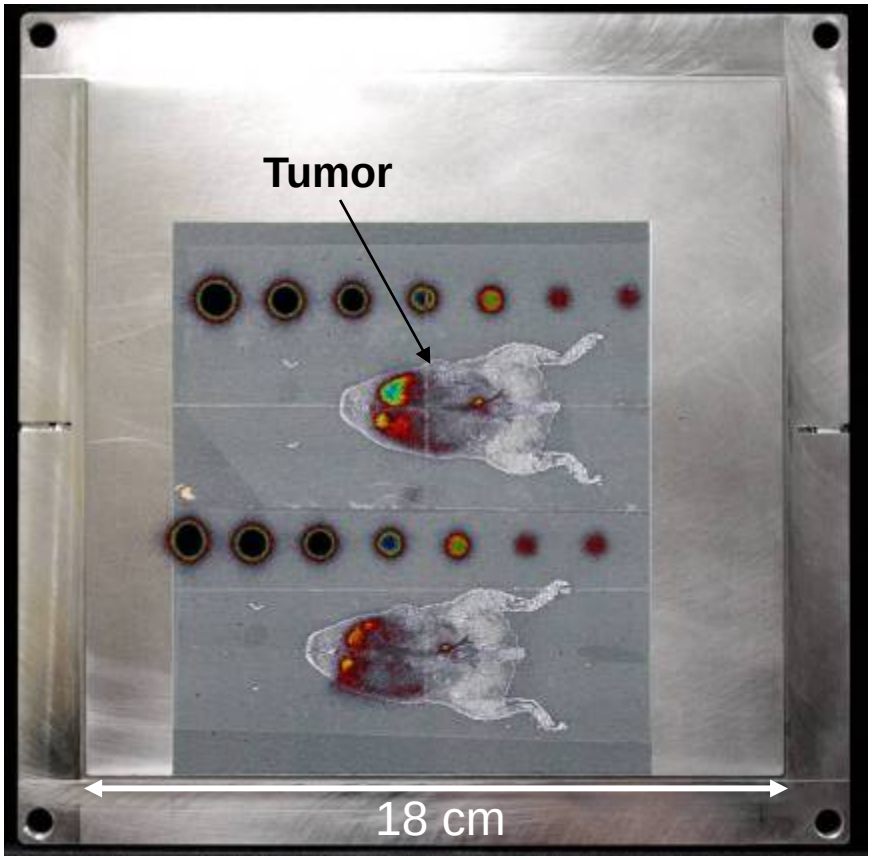
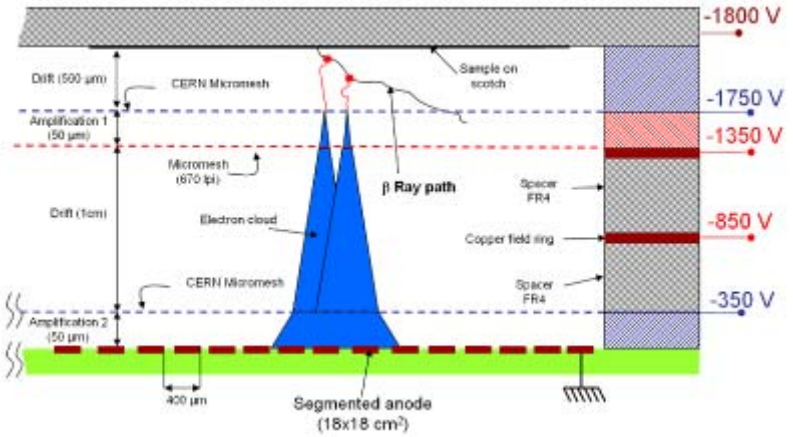
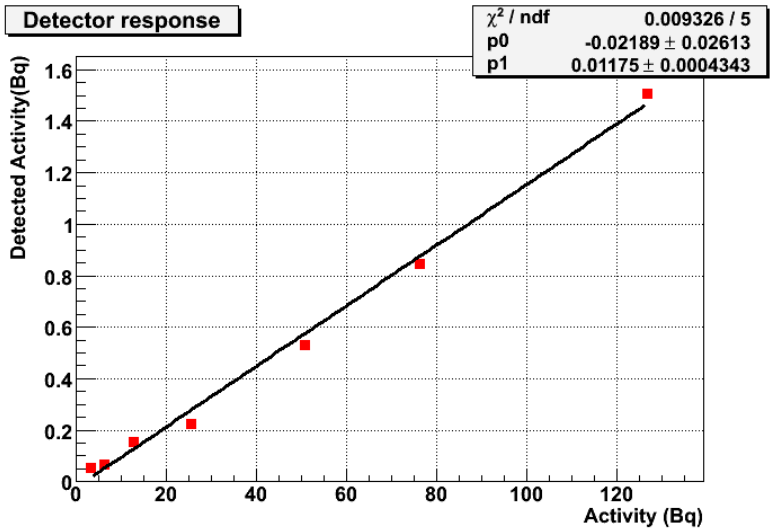
A new modality (first results)

^{131}I labeling (E_{max}= 606 keV, E_{mean}= 192 keV)
Half life: 8.02 days



No dead zone over the whole area of 18x18 cm²





Resolution is expected to be around 200 µm with ^{3}H

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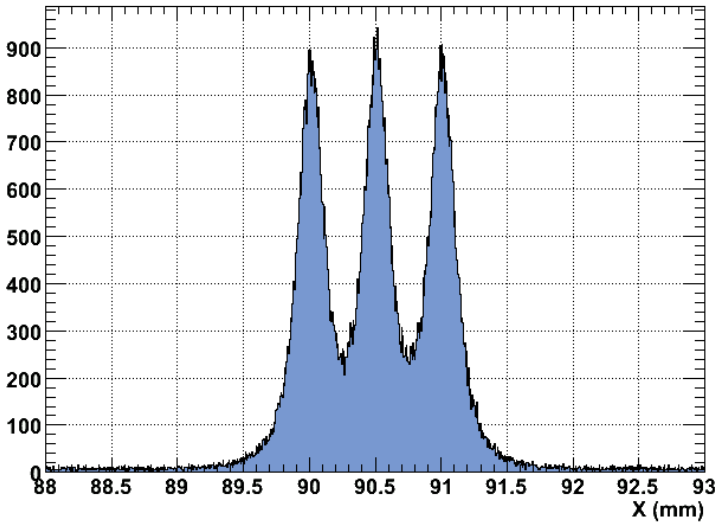
Perspectives

High energy β emitters on microscope slides



Simulation: 3 bars (E_{max} = 356 keV) filled with ^{46}Sc

- **Labeling with ^{46}Sc**
- **Spatial resolution expected to be 200 µm**

- This device will be installed in the INSERM building for real conditions of use
- Labeling with β emitters of higher energies and α emitters ($^{44}Sc/^{47}Sc$, ^{67}Cu et α)

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Conclusions

- Development of an integrated device used for medical imaging is successful
- PIM-MPGD structure is a very good solution for β-imaging
- Very good and very encouraging results on microscope slides and β emitters of low energy (^{3}H / ^{125}I)
- Promising results for entire rat slices samples
- Waiting for samples on microscope slides containing β emitters of high energy and α emitters
- Waiting for entire rat slices labeled with ^{3}H
- This structure will get out our laboratory and will be used by non specialists of detectors

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