GAMPIX: a new generation of gamma camera for hot spot localisation

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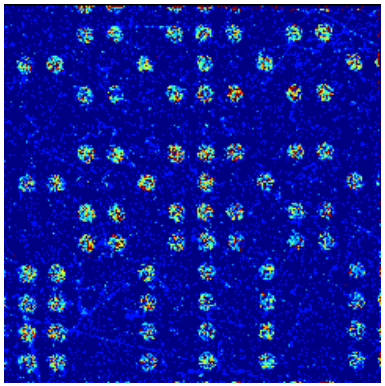
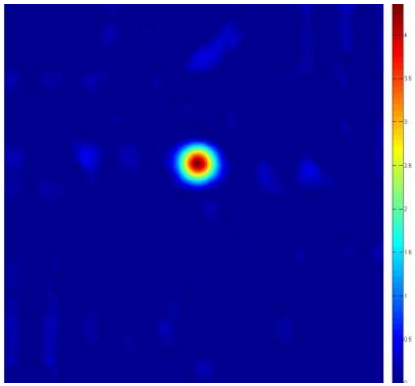




Summary

- Context / State of the art
- The GAMPIX gamma camera: main characteristics
- Experimental performances obtained in laboratory
- Results obtained in CEA DAM Valduc
- Results obtained in Canberra Loches
- Conclusions and future developments

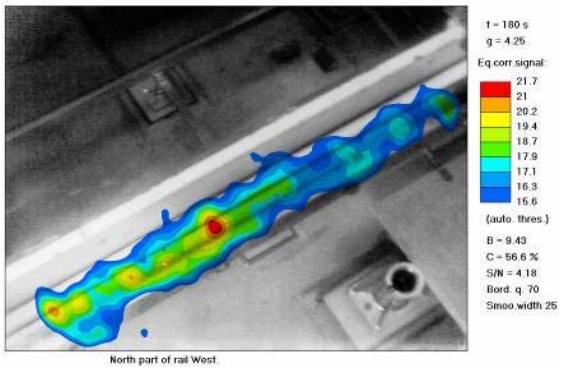
Context of the study

❑ What are the main needs during dismantling operations?

- ➢ **Reduce the dose** received by operating people **(ALARA principle)**
- ➢ Optimize the **dismantling procedure**
  - **Reduce the volume of wastes**
  - **Minimize the cost of distmantling**

❑ Why is gamma imaging a powerful technique?

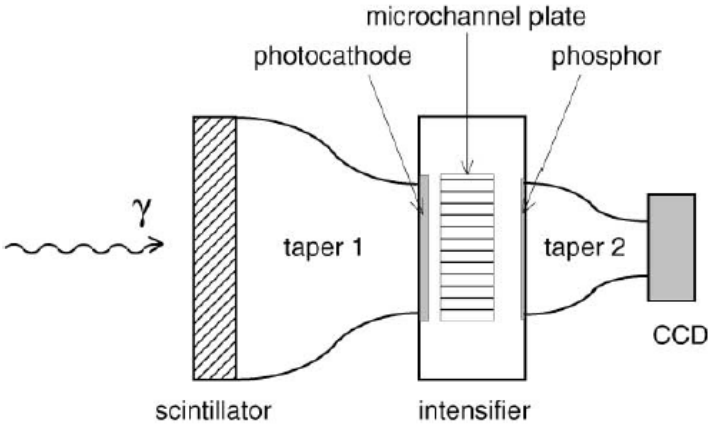
- ➢ **Superimposition of a gamma image with a visible image**
- ➢ **Locate radioactive hot spots** inside a given area



Need for performing gamma cameras

State of the art

❑ CARTOGAM: an industrial standard



➡ Developed by **CEA**[(1)], industrialized by **AREVA CANBERRA**

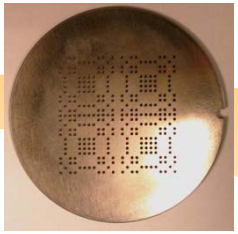
Performing but:

- **Sensitivity** has to be improved at low-energy
- **Weight** is too high for a portable use
- Improve the interface

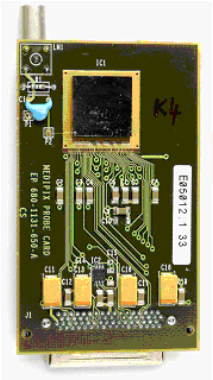
[(1)] **O. Gal *et al.*, *Nucl. Instr. and Meth A* 460 (2001) 138**

GAMPIX: a new generation of gamma camera

Coded Mask



Medipix 2 / Timepix

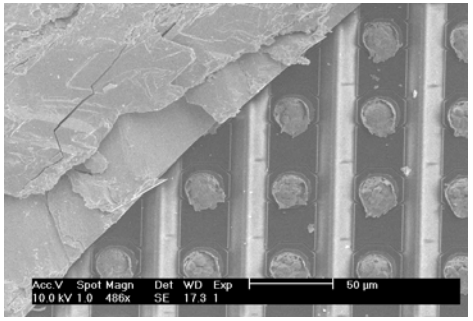


USB interface

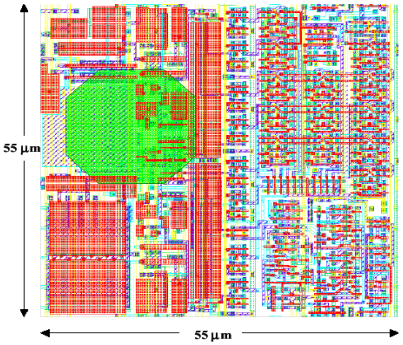
Camera's body

GAMPIX: main characteristics

❑ Medipix2/Timepix: the GAMPIX's heart



- Matrix of **256 x 256 pixels** (side **55 µm**)
- Hybridization with **CdTe** (thickness **1 mm**)
- **Direct conversion** from gamma-ray to electrical signal
- Developed by **CERN**, commercialized by **XIE**



❑ MURA coded mask: a multi-pinhole collimator

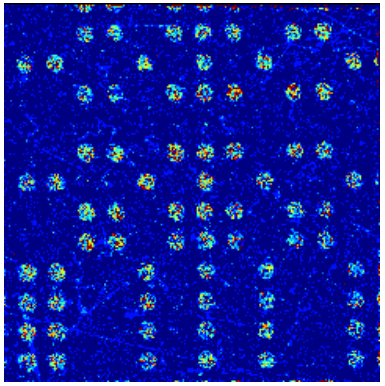
- Great improvement of the **sensitivity** in comparison with a pinhole
- Need for a **decoding step**
- **Optimization** of the coded mask **(thickness/rank)** for a dedicated application

❑ USB interface: highway to flexibility

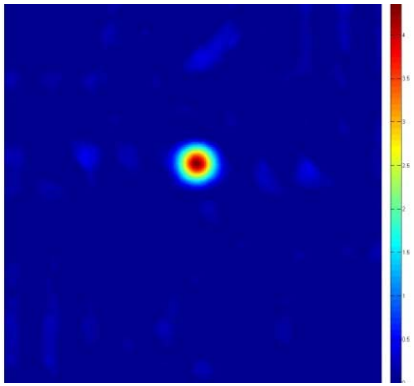
Take your laptop and use GAMPIX!

Principle and main benefits

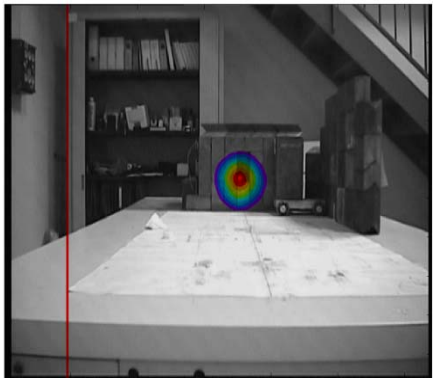
❑ Principle of gamma imaging using GAMPIX



Raw gamma image



Decoded gamma image



Superimposition gamma image / visible image

❑ What are the main benefits of GAMPIX?

- Low weight (~ 1 kg)
- High sensitivity
- Plug-and-play system

Experimental performances

❑ Sensitivity: current performances

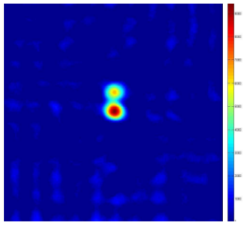
Source	Dose rate@1 m (µSv.h^{-1})	Minimal counting time
^{241}Am	0.25	1 s
^{137}Cs	2.50	20 s
^{60}Co	3.84	60 s

Optimal for ^{241}Am

Can be improved (thicker substrate, high voltage)

❑ Angular resolution for a FOV of 30°

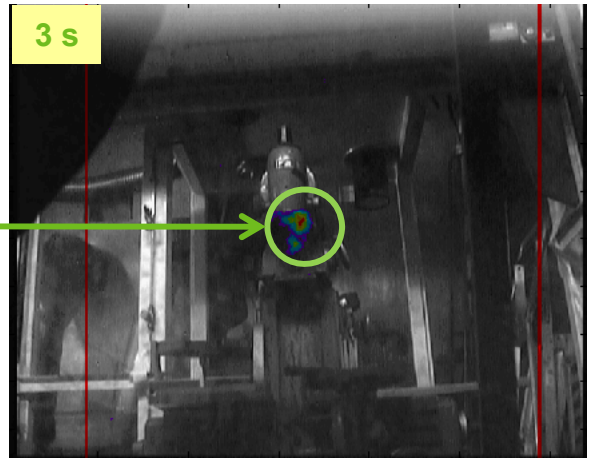
Source	Coded Mask Rank 13	Coded Mask Rank 11
^{241}Am	1.38°	2.12°
^{137}Cs	1.35°	2.06°
^{60}Co	-	2.57°



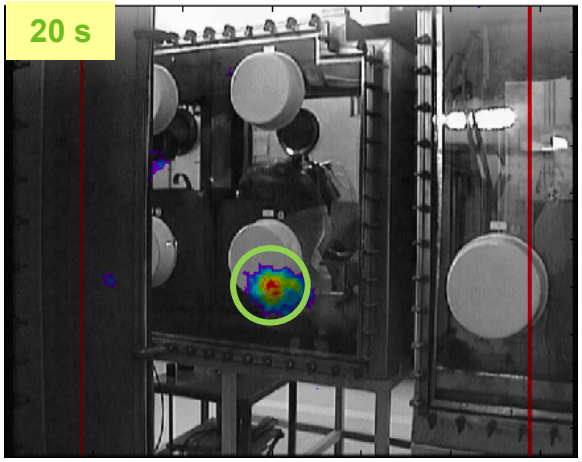
The greater the rank of the mask, the better the angular resolution

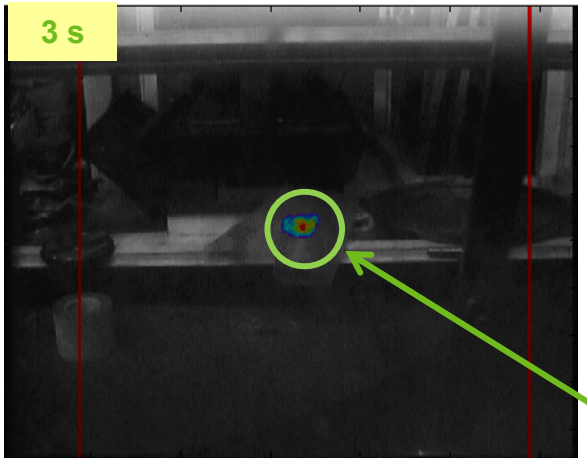
Results obtained in CEA DAM Valduc

- Results obtained during dismantling operations in CEA DAM Valduc

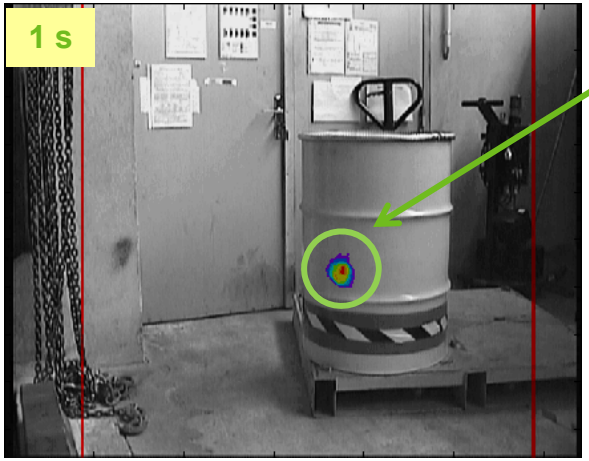


~600 mg Pu





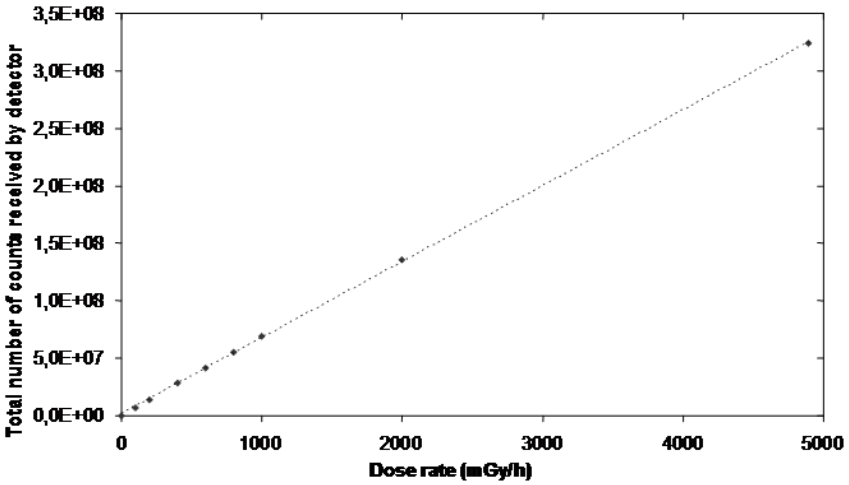
300 µSv.h^{-1} contact



Fast and accurate localization of plutonium hot spots

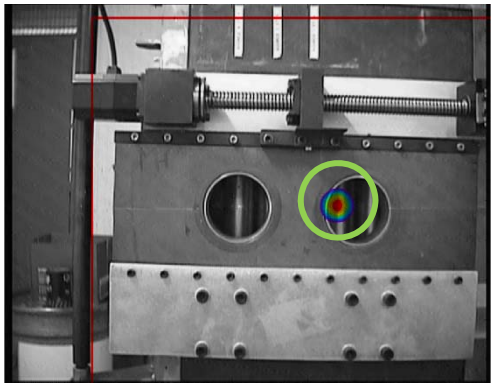
Results obtained in Canberra Loches

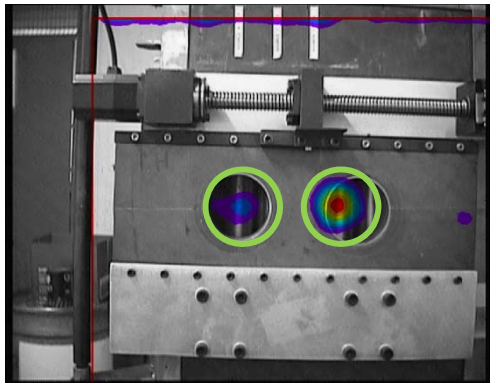
❑ Experimental results obtained in Canberra Loches



Linearity of the signal according to the dose rate (evaluated from 100 mGy.h^{-1} to 4.895 Gy.h^{-1})

Results obtained in the **Canberra's irradiator (^{137}Cs sources)**





Industrial transfer

CANBERRA

- Signature of the **industrial transfer agreement** is coming very soon
- Future GAMPIX's product manager: **Roger Abou Khalil**

[roger.aboukhalil@canberra.com]

Conclusions and future developments

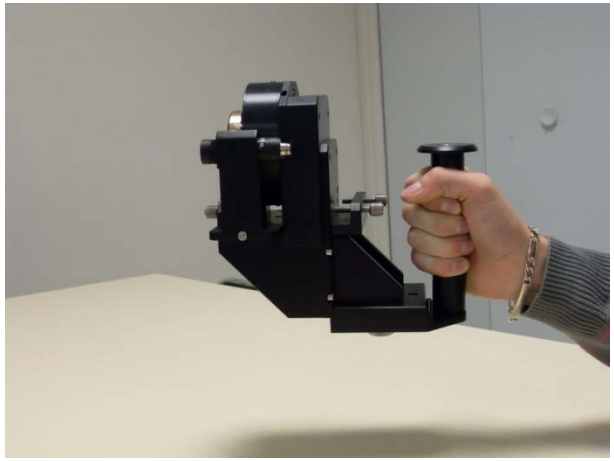
❑ Conclusions

- **GAMPIX:** a new generation of gamma camera based on the **Medipix 2 technology**
- **Low weight, high sensitivity, plug-and-play system**
- Optimal tool for the **plutonium detection**

❑ Future developments

- Improvement of the sensitivity at **high-energy** (^{137}Cs, ^{60}Co)
- Address the problem of **partially coded source** (software/hardware solutions)
- Improve the **portable aspect** to create **a new type of radioprotection tool**

Developments carried out in the frame of a collaboration with EDF



Thanks a lot for your attention