



SIMBOL-X High Energy Detector CdTe / CdZnTe developments in Saclay

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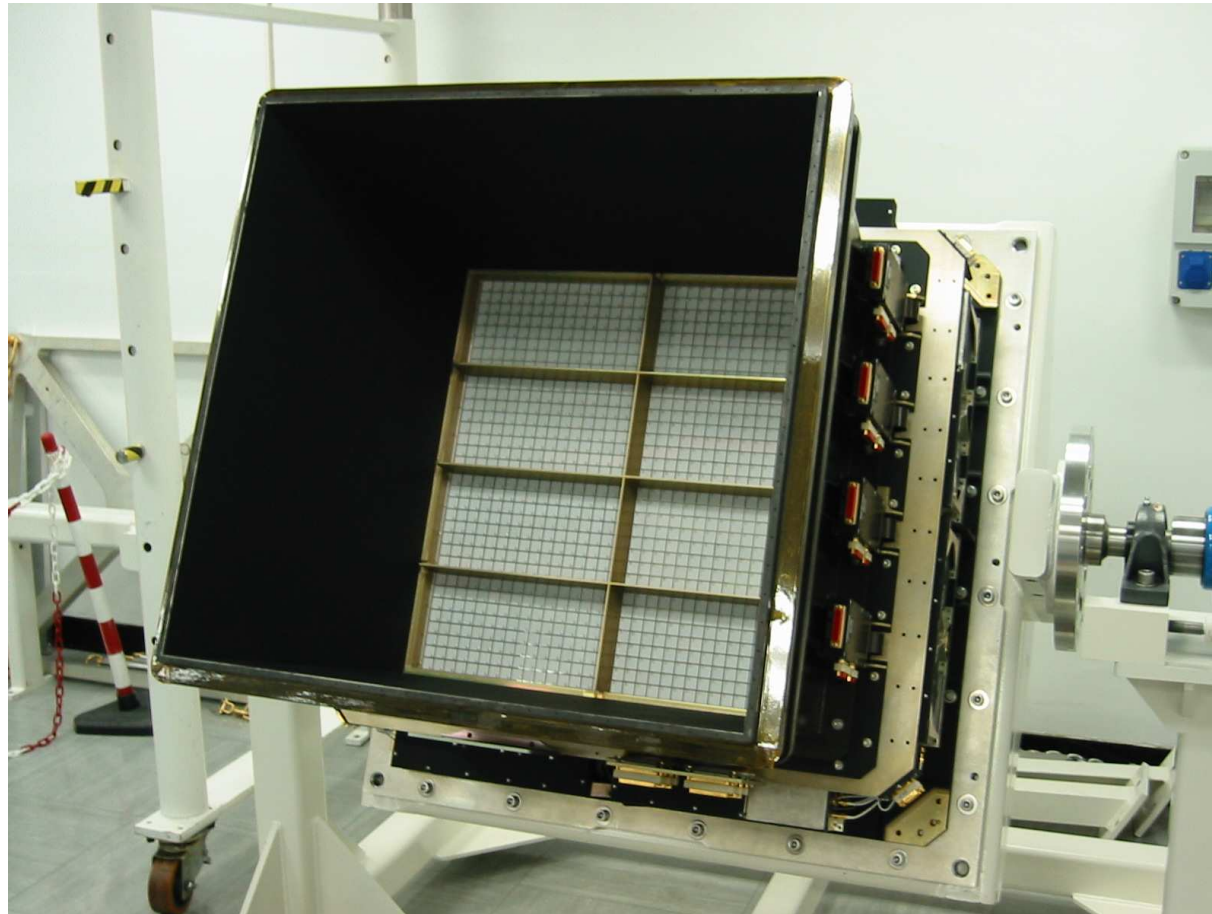
Summary ...



- CdTe / CdZnTe R&D program in Saclay
- SIMBOL-X High energy detector concept
- A few preliminary results on detectors
- A few preliminary results on IDeF-X ASIC
- Snap-shot on the development plan

Motivations ... *first of all*

- Successful launch of *INTEGRAL* satellite with **ISGRI CdTe Imager** on board



Motivations ...



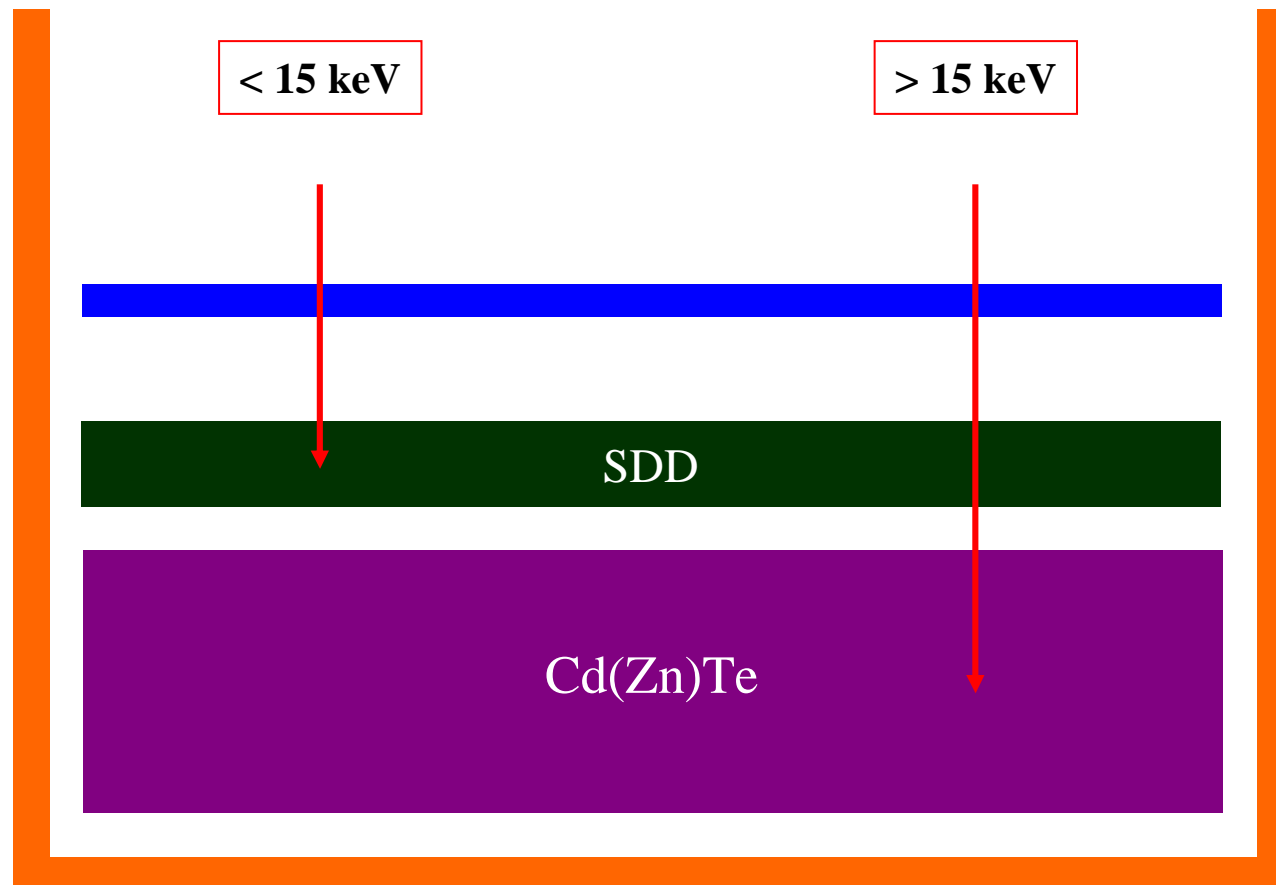
- Increasing demands for new semiconductor detectors for X and γ -rays (**medical, space, nuclear and physics applications**)
- Recent progress in technology of producing Cd(Zn)Te (**stability and reproducibility**)
- New techniques to improve simultaneously spatial and energy resolution of CdTe
- Development of integrated front-end electronics technologies (**ASIC**)
- Hybridization techniques in huge development (**ASIC + detectors**)

Motivations ...

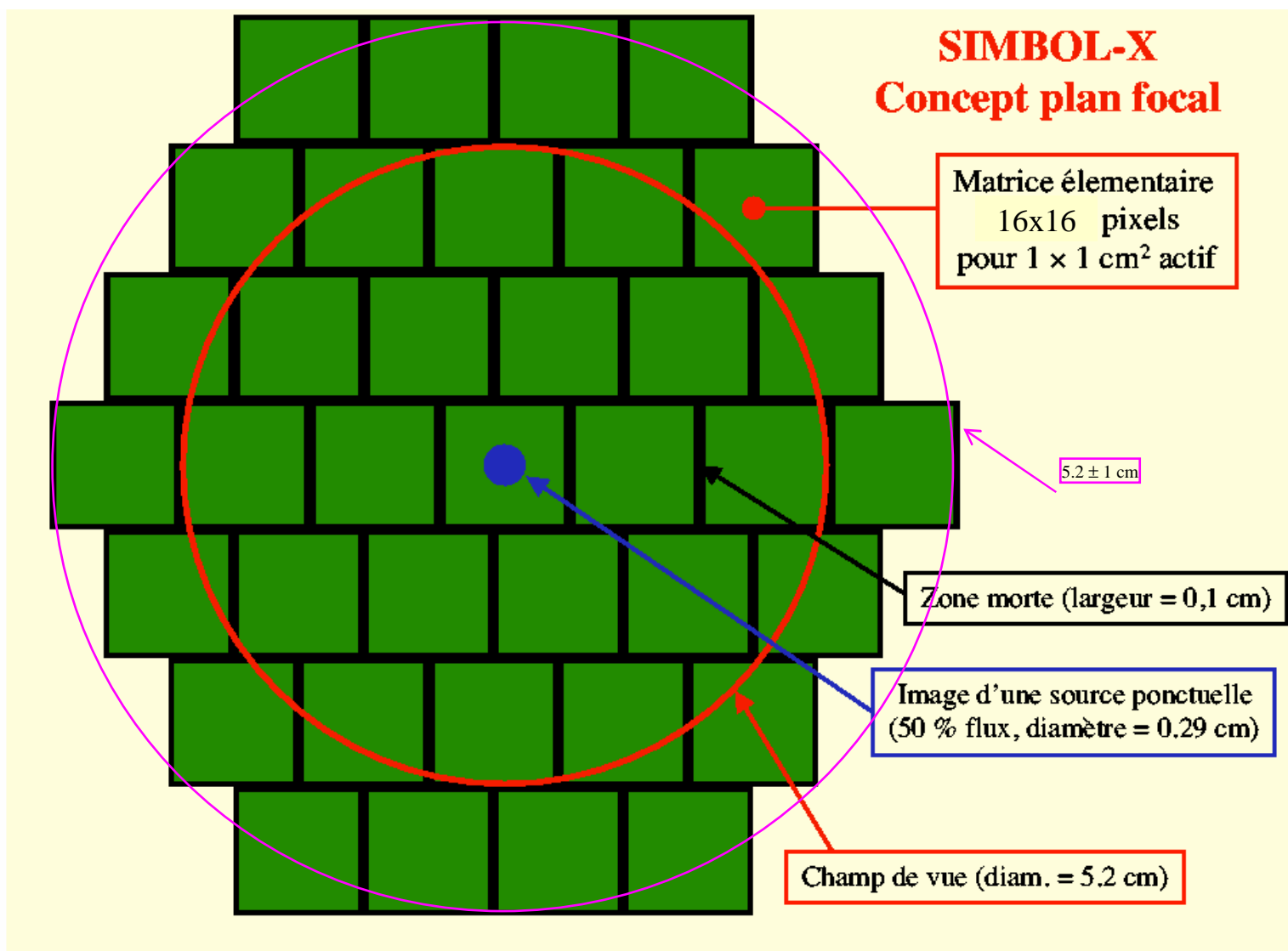


- New generation of hard X-Ray telescopes will be based on focusing designs
- We want to further develop CdTe for such telescopes focal planes
- Because CdTe offers :
 - Room temperature operations
 - High **spatial** resolution
 - High **energy** resolution
 - High detection **efficiency**
 - Good **timing** resolution

Simbol-X detector unit concept ...



Simbol-X CZT detector unit ...

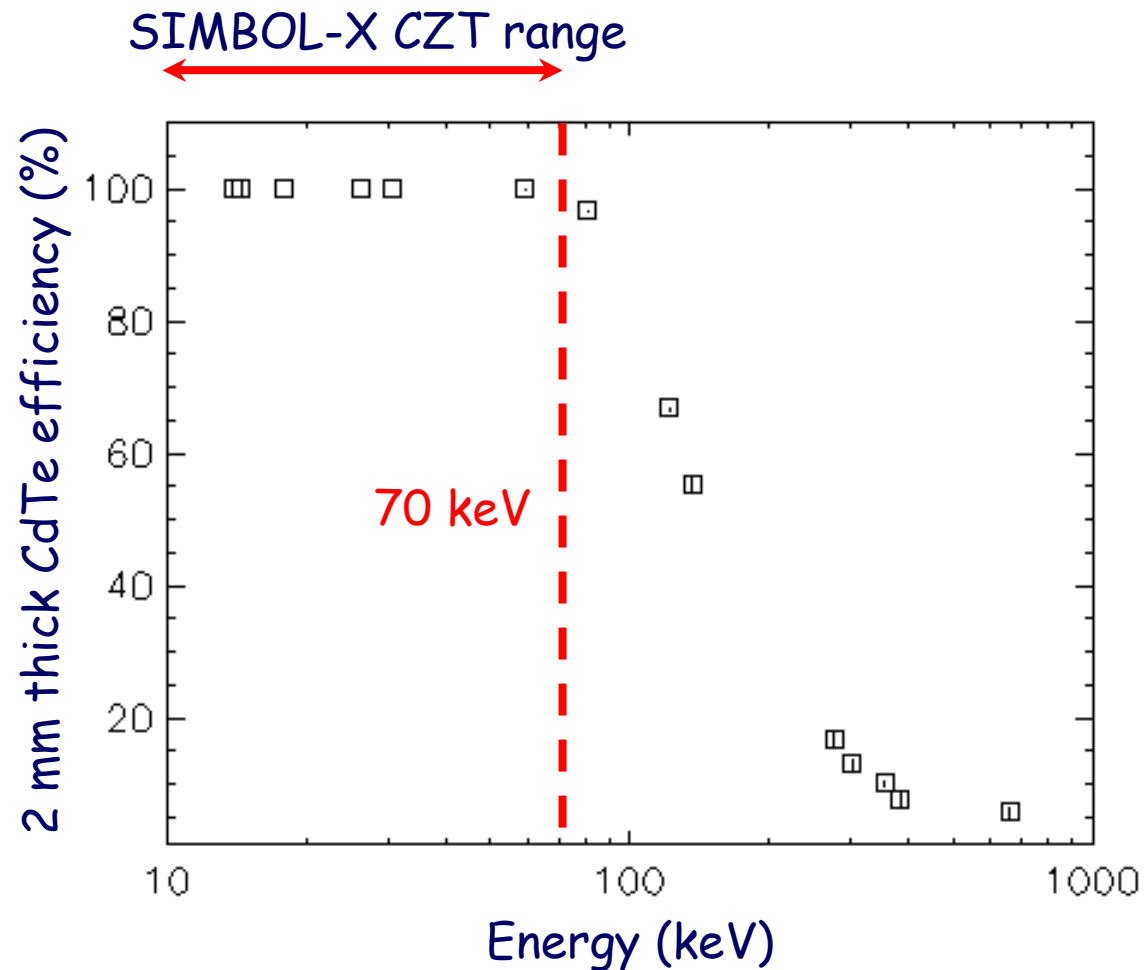


Spatial resolution ...



- SIMBOL-X PSF needs $750 \times 750 \mu\text{m}^2$ pixel size (max. size)
- 1 cm^2 detectors available on the market of CdTe and CdZnTe today
- The spatial resolution doesn't seem to be challenging regarding current technology
- Limitations will come from ASIC circuit design and hybridization capabilities

CdTe detection efficiency ...

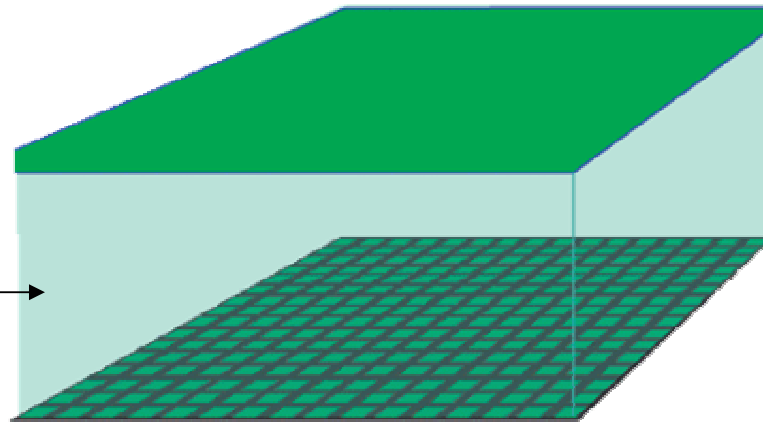


- CdTe is **100% efficient** in the SIMBOL-X energy range for 2 mm thickness

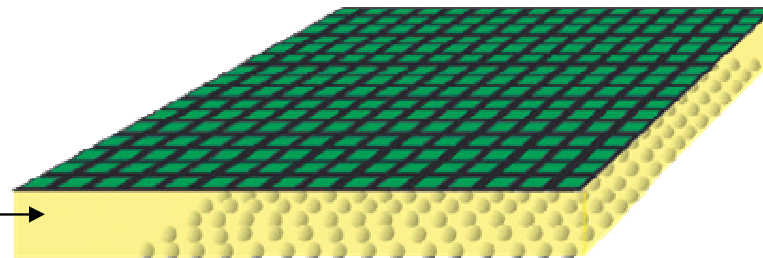
256 pixels CZT system ...



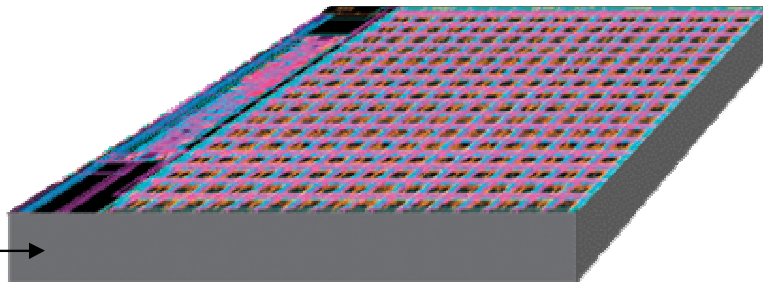
Segmented anode
Detector



Platform

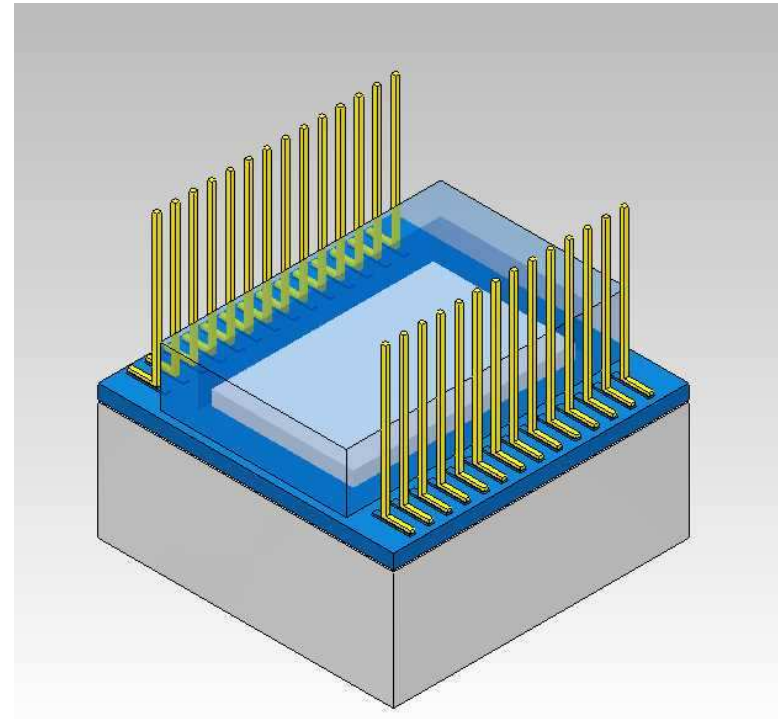
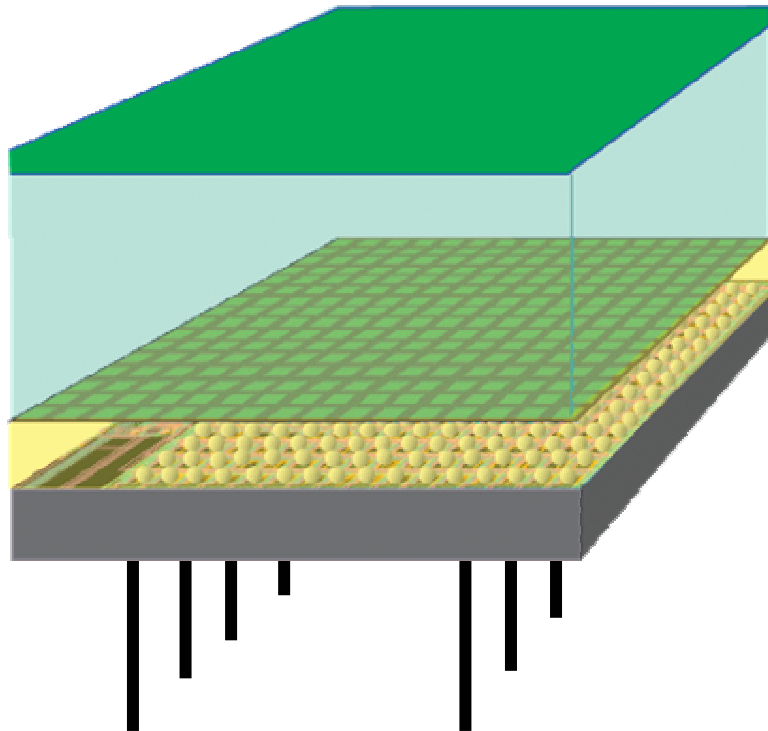


ASIC:
256 readout
channels

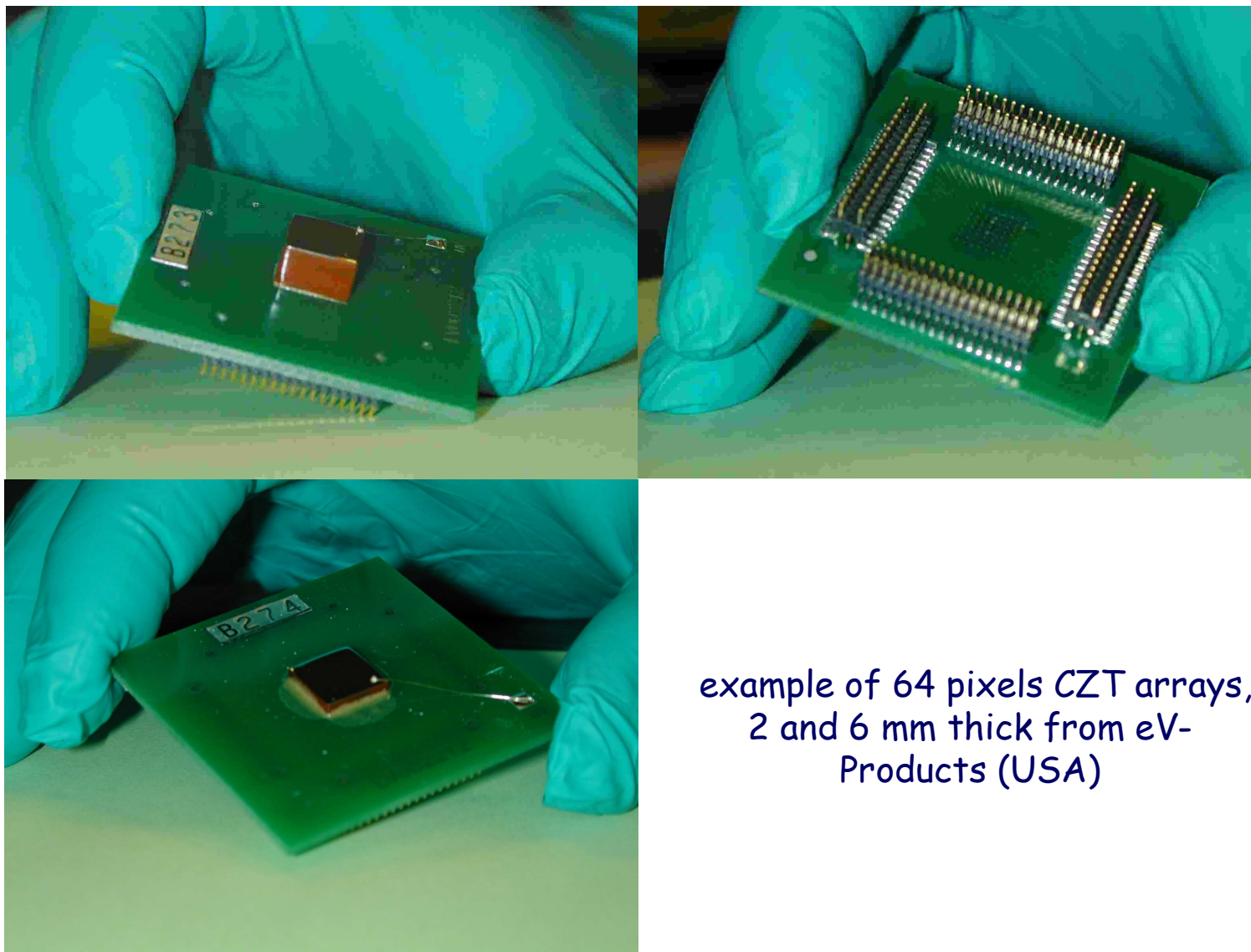


256 pixels CZT system ...

cea



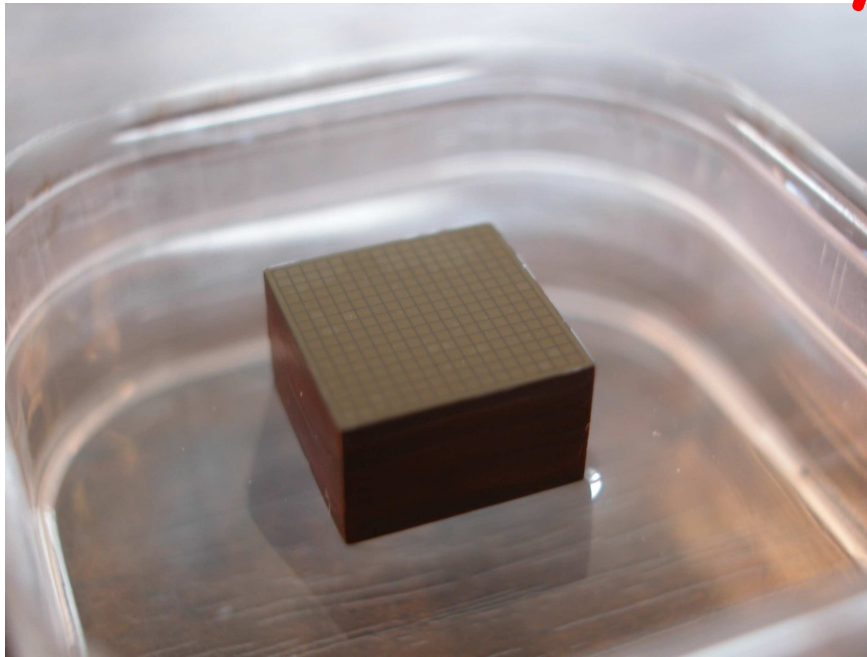
CZT detectors arrays in Saclay ...



example of 64 pixels CZT arrays,
2 and 6 mm thick from eV-
Products (USA)

CZT detectors arrays in Saclay ...

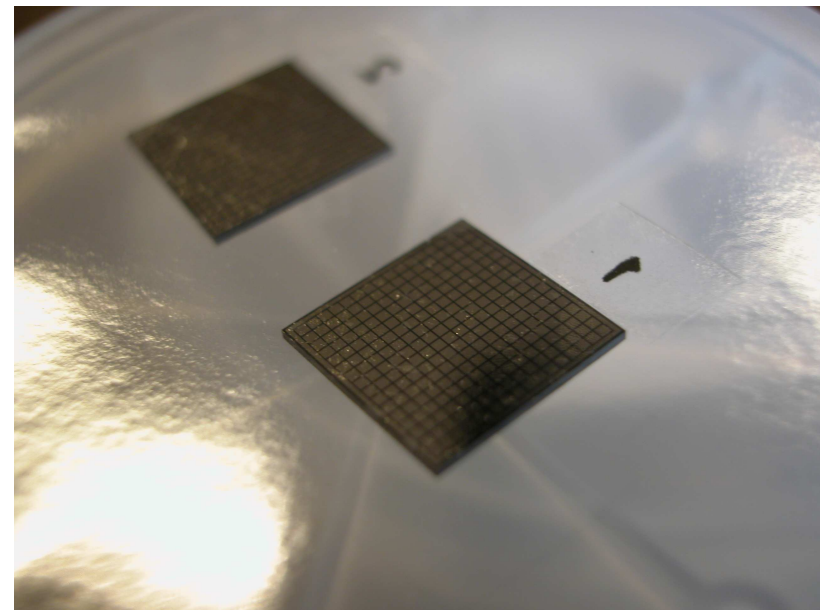
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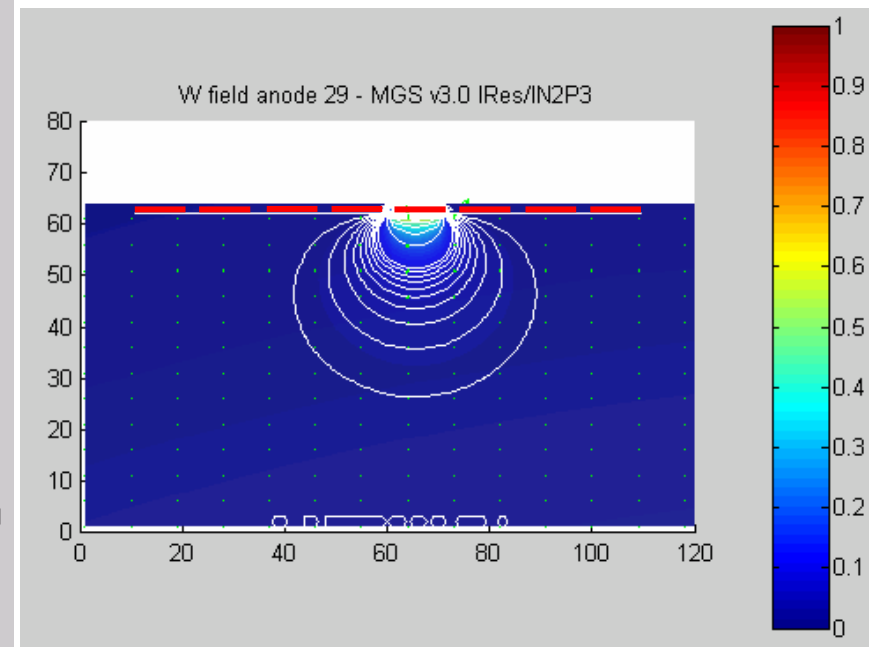
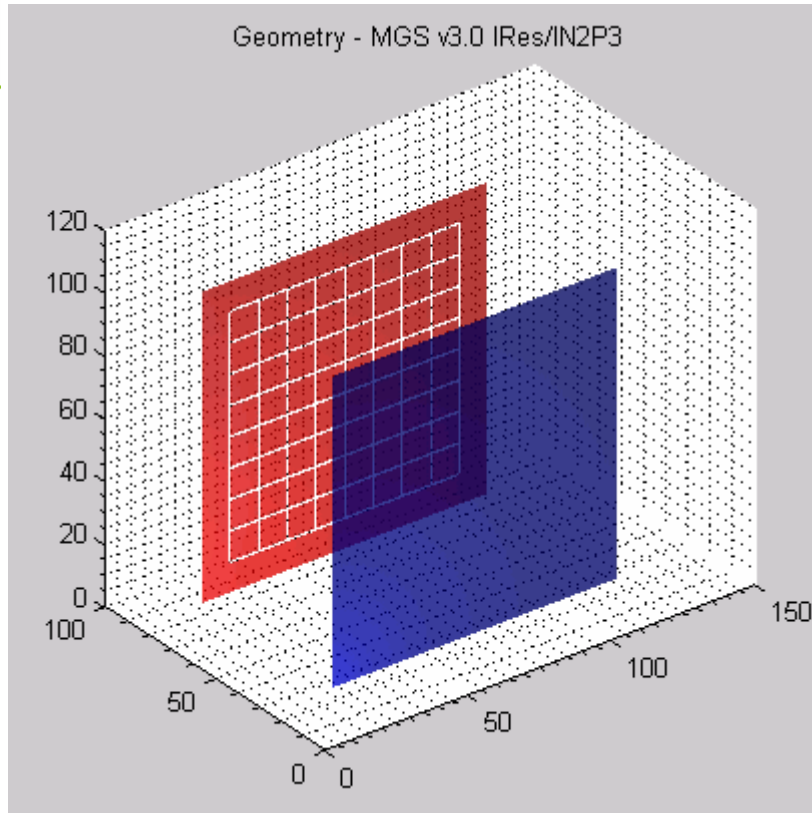
example of 256 pixels CZT arrays,
6 mm thick from eV-Products
(USA)



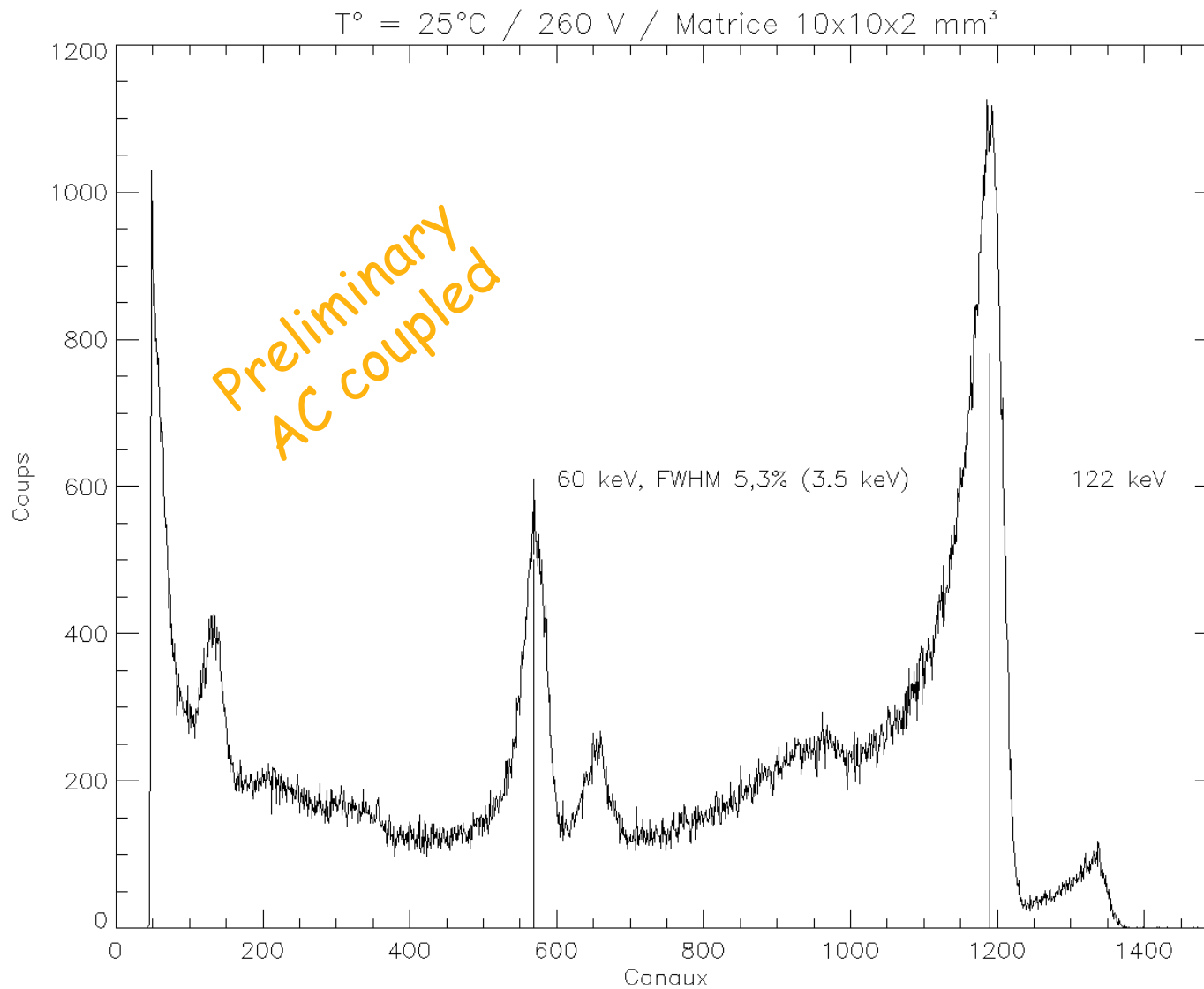
example of 256 pixels Schottky
arrays, 0.5 mm thick from
ACRORAD (Japan)



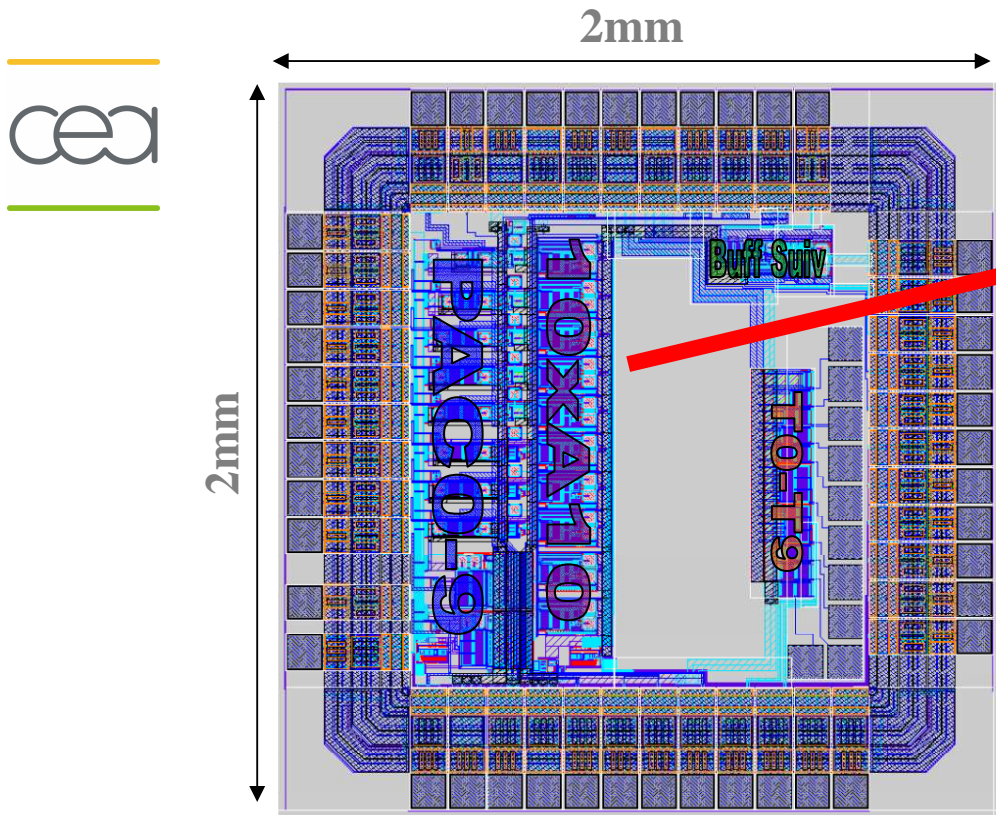
3D modeling, Weighting field ...



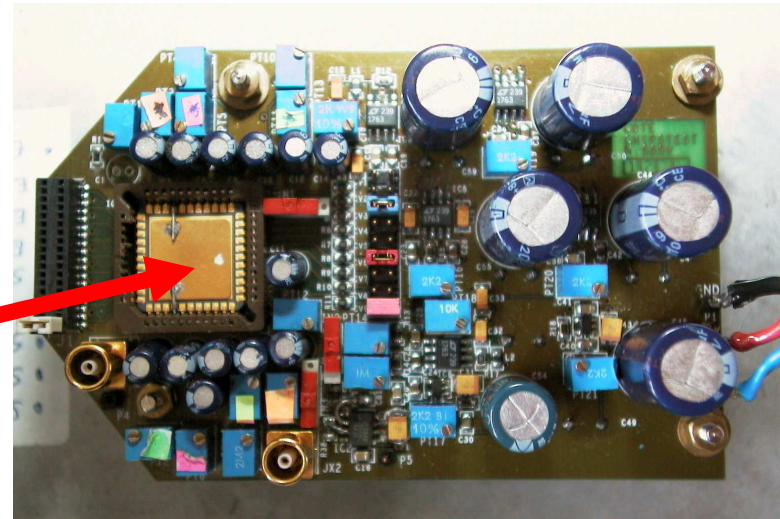
Low energy response, 2mm ...



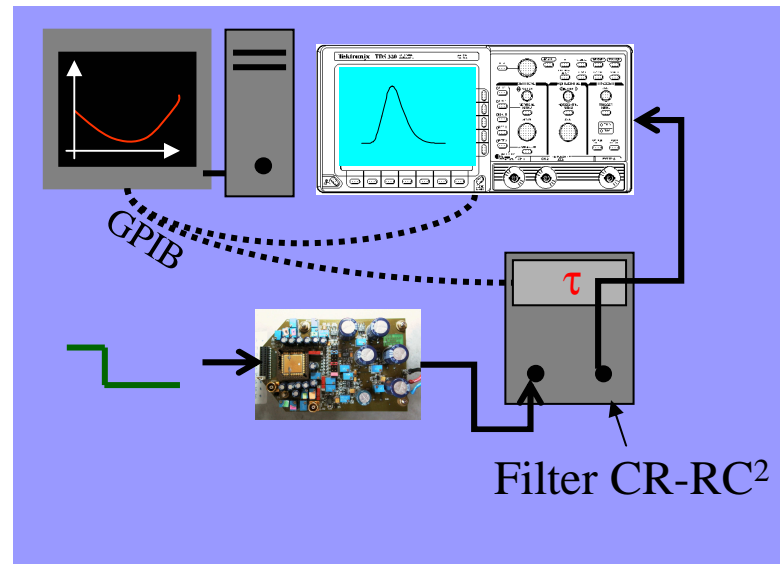
IDeF-X V0, first circuit ...



IDeF-X V0 Circuit : layout



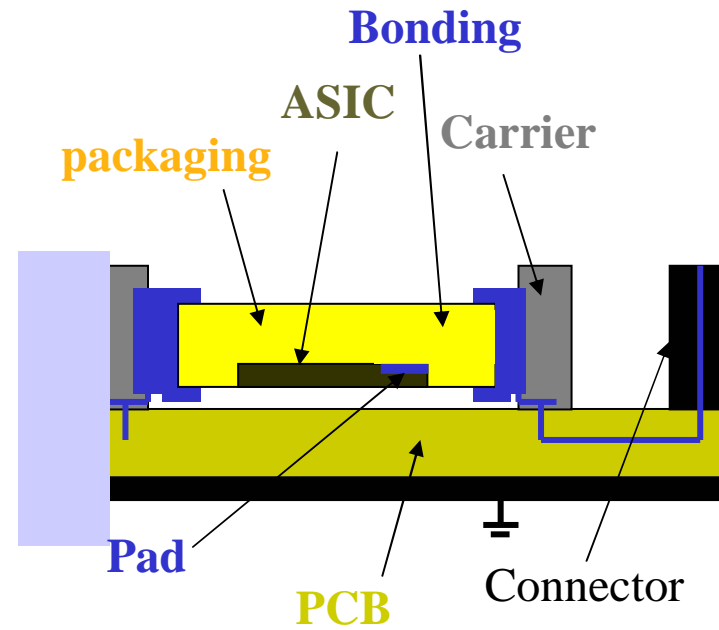
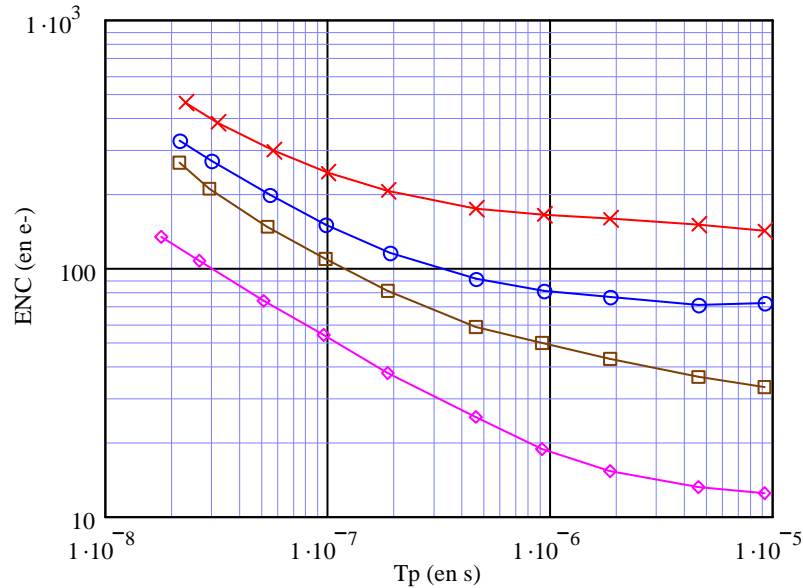
Test board



Results ...



Charge sensitive preamp:



Configuration	ENC (e- rms)
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Pad+Bonding+PCB	140
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Pad+Bonding	71
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Pad	33
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Without pad	12
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Corresponding energy resolution
CdZnTe (FWHM eV)

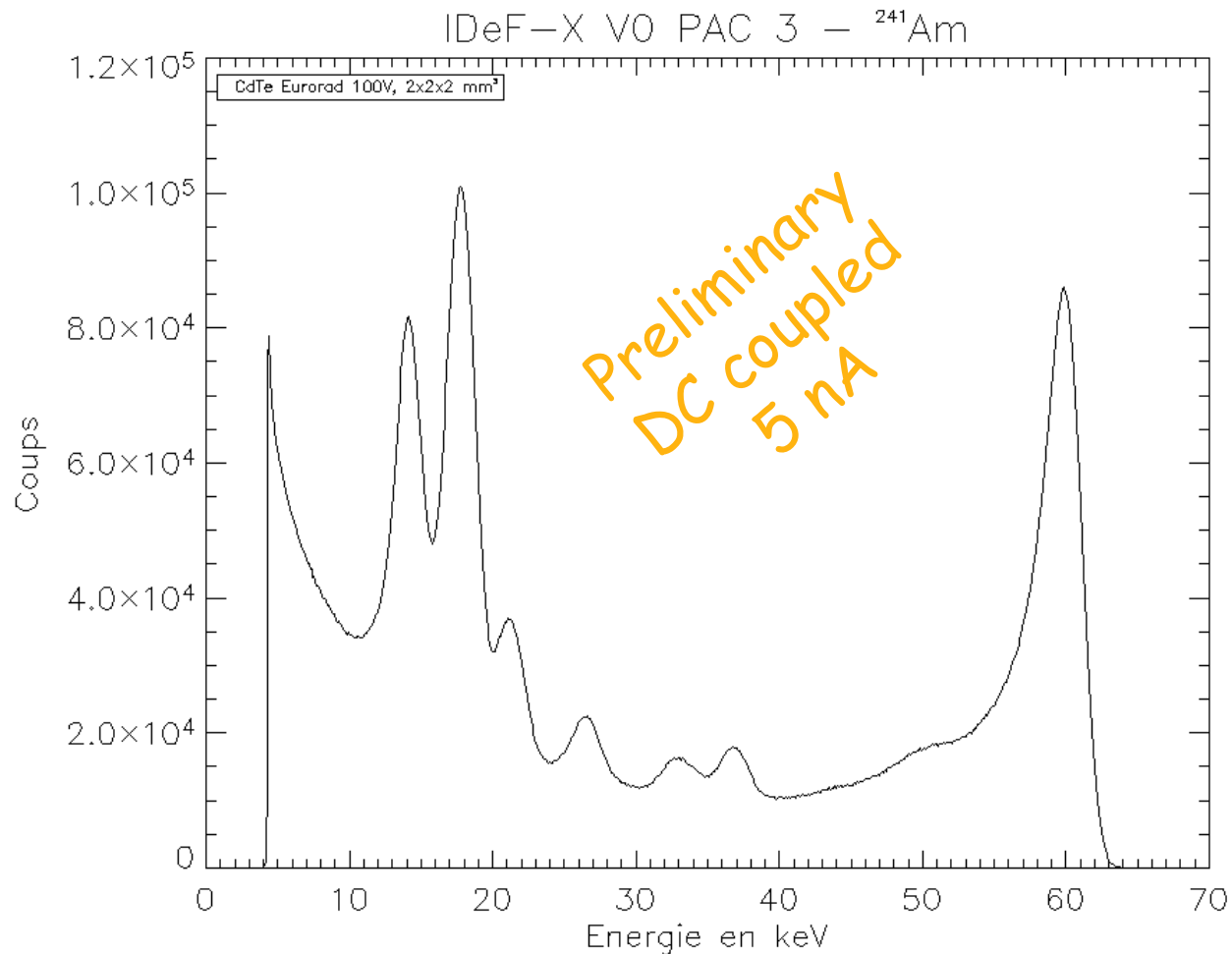
1454

737

342

125

Low energy response, 2mm CdTe ...



- Next step : low current detectors, 1 to 1.5 keV FWHM resolution expected at 60 keV

CZT detectors development plan ...



- Three main steps until 2005-2006
- **2003** : Demo detector, first run of ASIC (CSA cf. Francis Lugiez), mechanical set up
- **2004** : Choice for the geometry, study of the hybridization process, IDeF-X V1.1 and V1.2, study of the digital part
- **2005-2006**: Final design, realization of a complete prototype (256 channels)