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Goal of the project

To develop an X-Ray imager (5-60 keV)

- For
- Diffraction
 - Small angle X-ray scattering
 - Macro-molecules crystallography
 - Small animal imaging

On third generation synchrotron

with

- photon counting
- high rate capability : 10^7 photons/s/mm²
- large dynamic range from : 0.01 to 10^6 photons/s/pixel
- high speed read out : 2 ms
- energy window

CT integrated in a PET scanner

Synchrotron SOLEIL

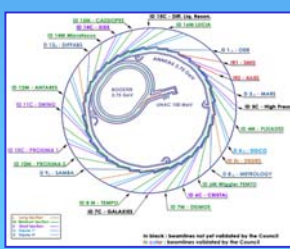
Main parameters of the storage ring

| | |
|---|-----------------------------|
| Energy | 2.75 GeV |
| Circumference | 354 m |
| Number end lengths of straight sections | 4 x 12 m; 12 x 7; 8 x 3.5 m |
| Emittance H | 3.7 nm.rad |
| Emittance V | 37 pm.rad |
| Current multibunch Lifetime | 500 mA |
| | 16 h |
| 8-bunch current lifetime | 90 mA 18 h |

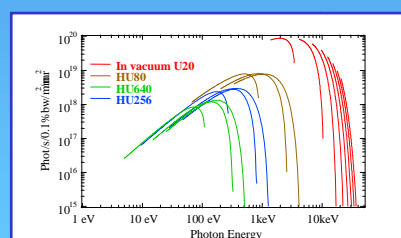
Location: St-AUBIN
 (20 km SW of Paris)



Beamlines



Brilliance



First photons on the beamlines : summer 2006

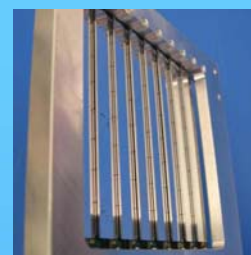
Results with XPAD2

Characteristics :

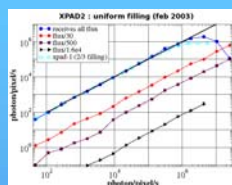
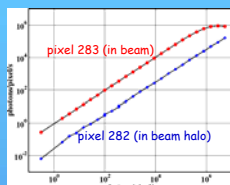
1 Si detector + 8 chips

X-ray imager, 8 x 8 chips, 68 x 68 mm²

- threshold between 10 and 25 keV (pixel dispersion!)
- pixel size : $(330 \mu\text{m})^2$, 24 x 25 pixels / chip, AMS 0.8 μm
- 0.01 to 10^6 photons/s/pixel
- $2 \cdot 10^9$ photons/pixel/exposure
- readout time : 2ms
- detector : Si (500 μm)



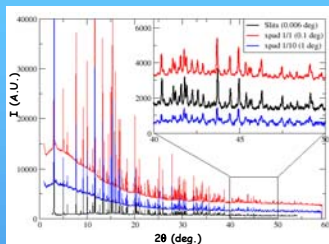
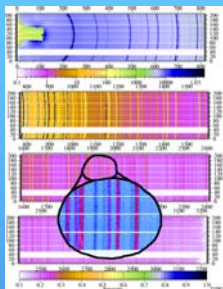
Linearity / Saturation



No influence of saturation on the neighbouring pixel

Linearity up to $>10^6$ photons/pixel/s

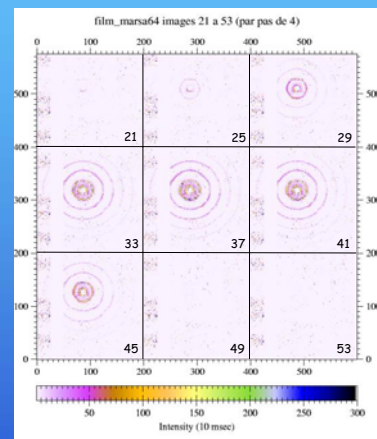
Powder Diffraction (Zeolite CaSrX)



Reconstructed Debye Scherrer film

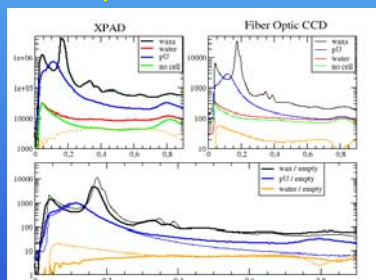
Gain in acquisition time : ≈ 20 / conventional setting (Scinti+PM+slits), same data quality

Capabilities for kinetics study



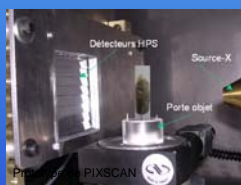
SAXS on Ag behenate (sample moving across the beam)
 exposure : 10 ms, time between images : 2ms,
 64 images, 1 image/4 shown here (21 to 53)

SAXS : Comparison with (Scinti + FO + CCD)



Better results on « low scatterers » (water)

Small animal imaging : Computed tomography for 3D reconstruction



Images of a mouse reconstructed with 360 projections

The next generation : XPAD3

Design of two different circuits

XPAD3 S

XPAD3 C

Collection of holes

Collection of electrons

Single threshold

Energy window

5-35 keV

10-60 keV

Common features

- Pixel size : $130 \times 130 \mu\text{m}^2$, IBM 0.25 μm
- 120×80 pixels / chip : $17 \times 10.4 \text{ mm}^2$
- 10^7 photons/s/mm²
- Read out time < 2 ms
- 12 bit counters
- Counter overflows continuously read out

Planning

First prototype : end of 2006

- 1 Si imager, 8 x 7 chips, $12 \times 8 \text{ cm}^2$
- + small size CdTe detectors $2.5 \times 2.5 \text{ cm}^2$

Final detectors : mid 2007

3 imagers, Si or CdTe depending on application