The Hybrid Pixel Single Photon Counting Detector XPAD

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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

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

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Main parameters of the storage ring

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
<td>2.75 GeV</td>
</tr>
<tr>
<td>Circumference</td>
<td>354 m</td>
</tr>
<tr>
<td>Number end lengths of straight sections</td>
<td>4 x 12 m; 12 x 7; 9 x 3.5 m</td>
</tr>
<tr>
<td>Emittance H</td>
<td>3.7 nm.rad</td>
</tr>
<tr>
<td>Emittance V</td>
<td>37 pm.rad</td>
</tr>
<tr>
<td>Current multibunch Lifetime</td>
<td>500 mA</td>
</tr>
<tr>
<td></td>
<td>16 h</td>
</tr>
<tr>
<td>8-bunch current lifetime</td>
<td>90 mA 18 h</td>
</tr>
</tbody>
</table>

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

Beamlines

10
15
10
16
10
17
10
18
10
19
10
20

9 eV
10 eV
100 eV
1keV
10keV

Photon Energy

Brilliance

Synchrotron building
Technical buildings
Control building
Restaurant

First photons on the beamlines : summer 2006

Results with XPAD2

1. Si detector + 8 chips
2. X-ray imager, 8 x 8 chips, 68 x 68 mm^2

Characteristics :

• threshold between 10 and 25 keV (pixel dispersion!)
• pixel size : (330 µm)^2, 24 x 25 pixels / chip, AMS 0.8 µm
• 0.01 to 10^6 photons/s/pixel
• 2.10^6 photons/pixel/exposure
• readout time : 2ms
• detector : Si (500 µm)

Lineararity / Saturation

No influence of saturation on the neighboring pixel

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

SAXS : Comparison with (Scinti + FO + CCD)

Better results on « low scatterers » (water)

Small animal imaging : Computed tomography for 3D reconstruction

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

Common features

• Pixel size : 130 x 130 µm^2, IBM 0.25 µm
• 120 x 80 pixels / chip : 17 x 10.4 mm^2
• 10^7 photons/s/mm^2
• Read out time < 2 ms
• 12 bit counters
• Counter overflows continuously read out

The next generation : XPAD3

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Planning

First prototype : end of 2006

1 Si imager, 8 x 7 chips, 12 x 8 cm^2
+ small size CdTe detectors 2.5 x 2.5 cm^2

Final detectors : mid 2007

3 imagers, Si or CdTe depending on application