PIXEL DETECTOR COLLABORATION MEETING

Castelldefels 27th & 28th September 2007

Participants

- DESY
- SLS
- DECTRIS
- ESRF
- DARESBURY/DIAMOND
- SOLEIL
- CPPM-Marseille
- ELETTRA
- ALBA

Guest:

- CNM

ALBA Beamline Scientists Round Table

- Powder Diffraction
- SAXS
- PX

SUGGESTED AGENDA FOR THE PIXEL DETECTOR COLLABORATION MEETING
September 27th and 28 th, 2007

27 th September

- 09.50 h – 10.00 h Welcome.
- 10.00 h – 10.15 h General Status of ALBA Beamlines (S. Ferrer)
- 10.15 h – 10.30 h Solid State Developments at National Center of Microelectronics, Barcelona (M. Lozano)
- 10.30 h – 11.00 h What the PIXEL Detector Collaboration is and Different European Developments (H. Graafsma)
- **11.00 h – 11.30 h COFFEE BREAK**
- 11.30 h – 11.45 h Dectris News (PILATUS Detector spin-off) (C. Broenniman)
- 11.45 h – 12.00 h Round Table: questions and suggestions from ALBA scientists to developers.

END OF GENERAL INFORMATION.

STARTING OF THE MEETING FOR DEVELOPERS.

- 12.00 h – 12.30 h Discussion on the future of the consortium: proposal for a Network Activity. Actions to be taken. Chairman: H. Graafsma
- 12.30 h – 12.45 h Presentation on JRA-19. New sensors for Solid State Area Detectors, I. High Z (R. Farrow)
- 12.45 h – 13.00 h Presentation on JRA-19. New sensors for Solid State Area Detector, II. CZT projects (P. Seller)
- **13.00 h – 15.00 h LUNCH**
- 15.00 h – 15.15 h Presentation on JRA-19. New sensors for Solid State Area Detectors, III. Edgeless sensors (J. Morse)
- 15.15 h – 15.30 h Presentation on JRA-19. New sensors for Solid State Area Detectors, IV. GaAs (C. Ponchut)
- 15.30 h – 15.45 h Presentation on JRA-19. New sensors for Solid State Area Detectors, V. High Z and 3D (J.C. Clemens)
- 15.45 h – 16.00 h Presentation on JRA-19. New sensors for Solid State Area Detectors, VI. Se (R. H. Menk)
- 16.00 h – 17.00 h Discussion on JRA-19. Chairman: H. Graafsma

- **17.00 h – 17.30 h COFFEE BREAK**
- 17.00 h – 19.30 h Discussion on JRA-19. Chairman: H. Graafsma

- **20.30 h – 22.30 h DINNER IN CASTELLDEFELS**

28 th September

- 09.00 h – 09.15 h Presentation on JRA-8. High Resolution Scintillators for detection of high energy X rays (T. Martin)
- 09.15 h – 11.00 h Discussion on JRA-08. Chairman: P. Fajardo
- **11.00 h – 11.30 h COFFEE BREAK**
- 11.30 h – 11.45 h Presentation on JRA-5. Development of APD based 2D X-Ray detectors with nanosecond time resolution (P. Fajardo)
- 11.45 h – 12.30 h Discussion on JRA-5. Chairman: P Fajardo
- 12.30 h – 13.00 h If it is necessary, More Discussion on the future proposal for a Network Activity (old JRA-18). Actions to be taken. Or extra time for discussions
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JRA-19. NEW SENSORS FOR SOLID STATE AREA DETECTORS

- Chosen by all synchrotrons like priority.
- Hybrid Pixel Array Detectors present problems
  - Dead areas. 500 microns (edge of de diode) -> 50 microns. Edgeless structures
  - Energies higher than 15 keV -> bigger efficiency materials. GaAs, Cd(Zn)Te, Ge and Se. Processing techniques (pixellated diode, interconnection to bump-bond these new sensors…)
  - 3D
- GOALS
  - Large pixel area detector. Lower dead areas
  - Large pixel area detector. Up to 60 keV.
- More data

  4 years, 2.5 Meuros.

  Proposal done by DESY. Participants: Daresbury/Diamond, ESRF, Electra, Soleil (CPPM-Marseille) and SLS.

  ALBA could participate through CNM, with experience in edgeless structures and high Z sensors.
- Presentations

JRA-08. High resolution scintillators for detection of high energy X rays

- X ray detectors based on indirect detection of visible light emitted by scintillating screens + CCD. Nowadays: the workhorse 2D detectors in synchrotrons. For high energy (>30 keV) aiming high spatial resolution, very low quantum efficiency at present detectors.
  - Development of new scintillator screens. High density materials, porous silicon matrix…
  - Validation of new methods
- ESRF/Diamond/Desy
- Although it will be discussed independently, maybe it will be merge with jra-19.
- Speech. Fajardo

Jra-18. Exploitation and infra-structure for existing detectors and detector technologies. Now Networking activity

Jra-5. Development of APD based on 2D X-ray Detectors with nanosecond time resolution

- Only ESRF and Desy

Our ALBA in-house interest

- Fast on-time resolved experiments
  - RAPID. Gas Detectors
  - NO SOLID STATE DEVICE DEVELOPMENT PROPOSALS
  - Our developments…

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Round table

- General questions
- ALBA scientists needs

-M. Knapp/I. Peral POWDER DIFFRACTION
-A. Svensson/I. Sics SAXS
-Jordi Juanhuiz/ J. Benach PX

(Technical) priorities of ALBA MX beamline regarding the detector

1. Large area (>300x300 mm)
2. Low background (1 count/pixel??)
3. Large dynamic range (18 or 20 bits)
4. Pixel size not larger than 200 um (100 um better)
5. Fast read-out (1 ms, i.e. $t_{exposure}/t_{read}$ >1000)
6. High quantum efficiency 6-25 keV (close to 100%)
7. (Able to detect direct mono beam???)
8. No dead areas

Our current dilemma: CCD or pixel detector?
Is there any other option?

Any development in detectors for powder diffraction must aim at "Rietveld refinement quality patterns" where "Rietveld refinement quality patterns" mean that the powder diffraction pattern profile can be reliably fitted to a structural model.

If the powder diffraction data quality is such that Rietveld refinement is impossible then it is not worth the effort because there are already solutions that are able to obtain/track the peak positions, that is the lattice parameters.

What we need today.
Today there is a need in powder diffraction on fast detectors such that is possible to get a "ready to perform Rietveld refinement" in the second range (and of course, everything that goes lower than 1s will be even better because it will open new fields) with good angular resolution.

Improvements on detectors (wish list)
-"Fast readout Image plate with energy discrimination", that is, a detector with no dead areas, with good dynamic range , good resolution and with energy discrimination (suppress fluorescence and inelastic events)
-"CCD with high dynamic range", that is, fast readout with good dynamic range.
- Energy sensitive range > 20 keV will benefit material science.
- Curved areas fit better to the powder diffraction technique.

Non Crystalline Diffraction, NCD, beam line

Detector Requirements - Summary

σ_{psf}	$(50\text{ -}100)^2\ \mu m^2$
Active area:	$(15\text{ - }30)^2\ cm^2$
Dynamic range	$> 10^5$
Local count rate	$> 10^5$ photons/sec/mm^2
Global count rate	$> 10^8$ photons/sec
Detection	Single Photon Counting
Full 2D read-out/refresh time	< 0.1 ms
Parallax	None

[1] X-ray beam size on detector is negligible compared to detector point spread function σ_{psf}

[2] High temporal resolution required to study fast dynamic processes such as conversion of chemical energy into force and motion in muscle tissue.