

Summary review of the presentations.

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3 sessions

- > What are the funding opportunities?
- > What is required / wished ?
- > What exists and what is being worked on ?



3 sessions

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- > What is required / wished ?
- > What are the funding opportunities?



Various systems in operation

- > SDD based systems
- > Multi-element Ge-systems
- > pnCCD based systems
- > CCD and CMOS based systems

- > Bolometers + STJ's for \sim eV resolution range
- > Spectrometers
- > ...



XMAS list:

- **GDD** detectors
- thick. $\geq 1\text{mm}$, $S \geq 100\text{ mm}^2$, SDD, GDD
- **multi-element detectors, annular geometry**
- FAST OCR $\geq 1\text{Mcps}$
- P/B ≥ 2000
- efficient/clean **collimators**
- **reliable (peak drift/OCR)** electronics at high CR
- EDX **PSD**, cheap, demagnified (lenses)



(Fonda)

We are more or less here

100kcps OK x N of pixels (N<100?)
Resolution of Ge/Si: 120eV@Mn K α
Need also 20keV<E<35keV
Counts needed for EXAFS: $N_{\text{eff}} = 10^6 \times n_{\text{pts}}$

Increase Resolution

< 60eV@Mn K α ?
Cryogenic detectors
(\rightarrow TES)?

Increase Solid Angle Acceptance

More compact electronics
Scalable solutions above 100 pixels?

Increase Throughput

Faster electronics?

~~Crystal analyzers
(small acceptance)~~

Increase Beamline flux to 10^{13} ph/s \rightarrow large beam spot or destroy sample

(Fonda)

Objective: reduce noise by increasing acceptance, keeping background steady

Build an X-ray “camera” with $(n \times n)$ pixels and $\leq 120\text{eV}$ resolution
max n ? (MAIA has 384 channels)

Where is larger “market”?

XAFS, time resolved XAFS
Spectroscopic imaging

Where is novelty?

Time resolved RIXS

Keep actual performances, but increase resolving power
What is the limit $\rightarrow 30\text{eV}$? 60eV ?
Technology gap? STJ, TES...?

Objective:

- 1) reduce noise by decreasing background ($< 60\text{eV}$, ideally 30eV)
- 2) opening new possibilities (ideally $1\text{-}5\text{ eV}$ below 6keV)



Detector NEEDS for NANOPROBES

(Cloetens)

	Required*	Achieved**
Energy Range	1-20 keV (1-70 keV)	
Energy Resolution	~ 140 eV	~ 140 eV
Integration Time	1 ms	50 ms
Total count rate	10^7 - 10^8 ph/s	10^6 ph/s @ 1 μ s PT
Solid angle coverage	> 1 steradian	0.5-0.9 sr
Price	?	Known

- Compatible with confined space and environment of nanoprobes
- Robust software well integrated with motion control

* From UPBL04 TDR

** On ID16A-N



- **New pulse processor**
 - Cross talk correction
 - Coincidence detection
- **Detector head miniaturization**



Preliminary requirements list

(contributions are welcome!)

(Fiorini)

- > Energy range: **0.2keV - 25keV** (Si detection region)
- > Energy resolution vs. counting rate:
 - i) **best resolution** (e.g. 123eV@Mn-K α) at moderate rates
 - ii) **maximized throughput** (e.g. $\sim 1\text{Mcps/ch.}$) with $<150\text{eV}$
- > Geometrical constraints:
 - fitting synchrotron exp. chamber (e.g. 60 mm max. flange inner diameter)
 - scattering minimization ("90° geometry")
 - maximize count rate (detector close to the sample, e.g. 1cm)
- > Peltier cooler, better if operations close to room T
- > Operations in vacuum or in air (with window)
- > **Modularity, scalability, easy replacement of units**



What is required / wished for ?

> Photon Energies:

- work at higher energies: $> 25 \text{ keV}$

> Count-rates

- count-rates up to 1 Mcps per element; keeping the energy resolution close to fano-limit. Note: Ultimate Storage Rings will boost the flux on sample by $\sim 100!$

> Geometries:

- special geometries (annular)
- $\sim 1\text{-}2$ steradians angular coverage
- smaller detector heads (get closer to sample in complicated environment)

> Fast and user-friendly data analysis software

> Better than fano energy resolution



Ongoing developments:

1. Optimization of existing systems and technologies:
 - Multi-element Germanium (Cross-talk correction)
 - SDD's with and without integrated FET
 - MAJA-II (not shown)
 - Electronics
 - ...

2. New systems or technologies:
 - SDD's without integrated FET (ARDESIA, simpler sensor, more performing ASIC)
 - DePFET active pixel cameras (briefly mentioned)
 - ...



Questions for discussions:

> Questions:

- How far do these developments meet the requirements ?
- Are there ideas for future developments ?
- How do we deal with the energies above 25 keV? Is germanium a solution? What would be needed to get this working ?
- What about a consorted effort on software for data handling, data processing, data analysis and result presentation ?
- Funding:
 - H2020. Is this attractive? Is it enough ?
 - Are there (other) National funding opportunities ?
 - Can facilities put (enough/significant) money on the table ?

The challenges are common to many SR facilities.

