

International Forum on Detectors for Photon Science

Les Tresoms Hotel, Annecy, 11 – 13 March 2018

Motivation and Goals

Organisers

Takaki Hatsui *RIKEN SPring-8 Center*

Gabriella Carini *Brookhaven National Laboratory*

Pablo Fajardo *ESRF - The European Synchrotron*

Science at “accelerator based” photon sources

Relativistic charged particles in high magnetic fields

SYNCHROTRON RADIATION

```
graph TD; SR[SYNCHROTRON RADIATION] --> FEL[FREE-ELECTRON LASERS (LINACs)]; SR --> SRING[STORAGE RINGS (synchrotrons)];
```

FREE-ELECTRON LASERS (LINACs)

- Pulsed sources ~ 100 Hz
 - SC is making \sim MHz
- Extreme peak brilliance
- Femtosecond resolution
- "Fully coherent" radiation

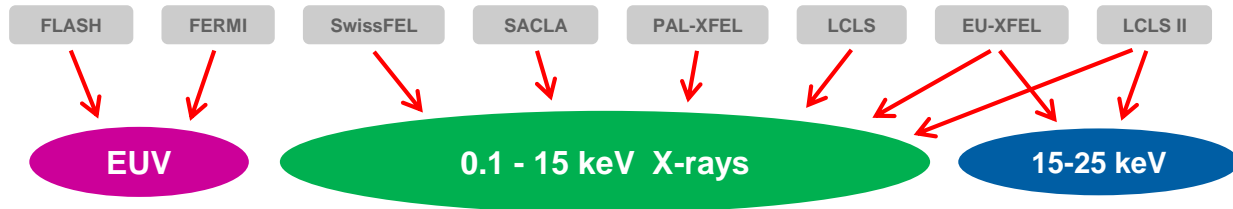
STORAGE RINGS (synchrotrons)

- Quasi-CW sources
- High average brilliance
- Wide and flexible energy range
- Very high beam stability
- High experimental capacity

Current and upcoming detection challenges

Free-electron lasers

- High-dynamic range integrating detectors are mandatory



- Every photon pulse needs full and independent data recording
- Moving toward higher pulse repetition rates
 - European XFEL: 10 Hz with 4.5 MHz pulse trains
 - LCLS-II, Shanghai XFEL: up to 1 MHz repetition
- Among the key challenges to address:
 - Speed/power/noise tradeoffs at the detector front-end
Especially for high pixel densities and high S/N ratio
 - Data management related bottlenecks
Data reduction techniques (e.g. vetoing, compression, ...) ?

Current and upcoming detection challenges

Storage rings

- Wide range of applications and photon energy (0.1 – 100keV)
- Diffraction limited storage rings (DLSR)

Increase the beam brilliance by 1 to 2 orders of magnitude

Higher photon fluxes at the sample

- *Shorter times, higher frame rates*
- *Extended dynamic range*
- *Photon counting will be challenged*

Boost coherence experiments

- *High angular resolution*
- *High sensitivity*
- *Even with hard X-rays*

- Key areas insufficiently covered by current detectors:
 - **Time:** explore efficiently the 0.1 μ s – 1ms range
 - **Spatial resolution:** single photon sensitivity with 10 – 50 μ m resolution
 - **Count rate:** energy dispersive detectors with $> 10^7$ cps capabilities
 - **Photon energy:** the 20 – 100keV range

Why another detector event?

- **Context**
 - Few international detector events dedicated to photon science
- **Goals:**
 - initiate a **dedicated** event on detection for photon science
 - better **sharing** of understanding of **key technology** aspects
 - promote discussion and reflection on **future** strategies
- **How:**
 - Short but intense event in a **secluded** location
 - Focus on **pre-selected technical areas** including one 'highlight' topic
 - **Invite** participants and speakers as experts in the selected topics
 - Make the event **visible** to photon science facilities

International Forum on Detectors for Photon Science (IFDEPS2016)

Feb. 28th to March 2nd 2016, Kawaguchi lake, Japan



Organizers (& program committee)

Pablo Fajardo (ESRF - The European Synchrotron)
Gabriella Carini (SLAC National Accelerator Laboratory)
Takaki Hatsui (RIKEN SPring-8 Center)

42 participants

Feedbacks from questionnaire (1/3)

- Among many suggestions, we took the following actions
- 1) Topic suggestions
 - **Energy resolving detector**
 - “highlight topic”
 - **Calibration of integrating-type** detectors
 - Important and deep topic, and not adequate for single session.
 - *To share the state-of-art & issues, it was merged with*
 - *Session 7 - First operation experiences with new detectors*
 - **DAQ**
 - Important but wide topic.
 - *Create 2 sessions with an emphasis on detector related topics.*
 - *Session 8 - Overview of DAQ general strategies at large facilities*
 - *Session 9 - Technologies for high-throughput data acquisition*

Feedbacks from questionnaire (2/3)

- 2) Program structure
 - Create self-introductory presentation to facilitate networking
 - Addition of Session 2
 - "Update on development activities at photon sources"
 - Short presentations
 - Positive feedback on discussion
 - Make slightly longer slot for discussion (10 -> 15 min.)
 - 2-day workshop is too short & 2 days are adequate
 - Made 3-day workshop

Feedbacks from questionnaire (3/3)

- 3) Program formulation
 - Many volunteers for the program formulation
 - *Invited session conveners*
 - Peter Denes (LBNL, USA)
 - Heinz Graafsma (DESY, Germany)
 - Antonino Miceli (APS, ANL, USA)
 - Matteo Porro (E-XFEL, Germany)
 - Peter Siddons (NSLS-II, BNL, USA)
 - Bernd Schmitt (PSI, Switzerland)
 - Nicola Tartoni (DLS, UK)
 - ***We all thank their enthusiastic contribution.***
 - Give prediction on “*what happens in 10 years*” will be interesting. We can later check our prediction quality.
 - Let the discussion slot to include the ***"prediction"***.
 - Created ***summary session 10*** on Wednesday

IFDEPS 2018 programme at a glance

Opening Talk (Sunday 11/03)

- Michael Krisch – *Detectors for future sources: challenges and opportunities*

Technical Sessions (Monday-Tuesday 12-13/03)

- ❖ Update on development activities at photon sources
- ❖ Highlight Topic: Energy dispersive detection
 - Semiconductor sensors
 - Readout architectures for high count rate detection
 - Multielement and position sensitive detection systems
 - Detection for high resolution spectroscopy
- ❖ First operation experiences with new detectors
- ❖ Data acquisition
 - Overview of general strategies at large facilities
 - Technologies for high-throughput data acquisition

Summary session (Wednesday 14/03)

Among the open questions relevant to photon science:

- ✓ Which aspects of the state-of-the-art or the current trends may primarily impact future photon science?
- ✓ Are there fundamental limitations?
- ✓ Which are the main areas in which we can expect innovations?
- ✓ What happens in 10 years

If you can, please describe quantitatively !

- ✓

IFDEPS 2018 programme: Summary Session

- **Contents: Summary and prediction, " *What happens in 10 years* "**
 - Session 7: Update on development activities H. Graafsma (10 min.)
 - discussion (15 min)
 - Session 8&9: Data Acquisition, P. Denes, B. Schmitt (10 min.)
 - discussion (15 min)
 - Highlight session
 - Session 3: P. Siddons (10 min.)
 - Session 4: M. Porro (10 min.)
 - Session 5: R. Menk (10 min.)
 - Session 6: A. Miceli (10 min.)
 - *Round table discussion with*
 - P. Siddons, M. Porro, R. Menk, A. Miceli, & Nicola Tartoni (30 min.)

After IFDEPS 2018

First steps:

- Willing to receive feedback and suggestions
- Please email the feedback to one of the organizers
 - Changes in scheme of the forum will depend on feedback and the outcome of this year's event.

Future

- The current intention is to organize a similar event in 2020
wish to establish a bi-annual regular event

Next meeting in 2020: Long Island, NY





Thank you