

Summary Report of Meeting "X-ray Spectroscopy Detectors for Present and Future Synchrotron Storage rings: Opportunities for Horizon 2020"

held at the Sheraton Conference Center, CDG Airport, Paris, 16 March 2015.

Organizing Committee:

Stephanie Hustache (Soleil), Thierry Martin, John Morse, Edward Mitchell (ESRF) and Prof. Laszlo Vincze (Univ. Ghent)

Administrative Secretary: Valerie Bergerioux (ESRF)

Purpose:

A chapter of the EU-funded Calipso programme is specifically related to detector development initiatives¹ and within this framework a meeting was organized to bring together beamline scientists from the X-ray synchrotron community and industrials involved in the fabrication of semiconductor detector systems. The meeting objectives were to:

- stimulate discussion around future spectroscopy detector systems and exchange ideas on how to solve challenging new spectroscopy applications at synchrotrons
- prepare the ground for partnerships to develop spectroscopy detector systems beyond the present state of the art, considering this in the context of the Horizon 2020 timescale and funding framework.

The number of participants in the meeting was limited (40 final attendees), and only by invitation of the Organizing Committee. The participants (see list given in Annex) included scientific staff representing seven of the major European synchrotron facilities plus representatives from European (11) and American (1) companies producing spectroscopy detectors or their related readout electronics. The presentations made at the meeting (some amended for a public audience) are now posted on the ESRF web pages devoted to this meeting here:

<http://www.esrf.fr/x-ray-spectroscopy-detectors-meeting>

Summary

The meeting was organized as follows (see detailed Agenda in annex):

- brief welcoming introductions setting the context of the meeting
- presentations concerning:

¹ see <http://www.calipso.wayforlight.eu/Sections.aspx?section=382.620>

- i. The opportunities for developing and funding partnerships between industrial providers and synchrotrons (two talks) ;
 - ii. The present state of the art of synchrotron beamline spectroscopy and the requirements for future detectors (seven talks), primarily by synchrotron beamline scientists;
 - iii. Currently available commercial spectroscopy detectors and new systems under development, by industrials of their (ten 'clip' talks);
- a meeting review talk, followed by a round table discussion session.

Outcomes:

The presentations and round table discussion were focused on three topics:

- i. High rate detector systems. The status is that in most beamline applications the spectrum acquisition (i.e. primarily the 'counting' rates) of available fluorescence spectroscopy detectors is woefully inadequate, and the situation will be further dramatized with the conclusion of ongoing machine upgrades (e.g. at ESRF) that will add a further factor ~ 100 to beam-on-sample fluxes. Cost considerations aside, the present detection situation could be significantly improved based on straightforward engineering of new detectors based on proven, existing technology (i.e. silicon drift detectors); the recently established CMOS preamplifiers (e.g. the Cube device); and the new generation of digital pulse processors (XSPRESS and Falcon-based systems. New, compact geometry multi element systems are nevertheless urgently required and such a scheme was presented by Prof Carlo Fiorini², who invited new collaborators.
- ii. The challenge of 'high' X-ray energies, i.e. above $\sim 20\text{keV}$ which is the typical limit of currently available silicon based systems as regards detection efficiency. There was a large demand for systems capable of operating beyond this 'energy barrier'. In this role, germanium based detectors are the only proven technology, although other high Z, wider bandgap semiconductors may have a future role.
- iii. The burgeoning interest in 'imaging' spectroscopy systems, i.e. detectors which offer spatial resolution while maintaining near-Fano limited spectroscopic energy resolution. Presentations on this were based on both MOS and p-n based CCD systems. This naturally led-on to the need for 'complete' detector systems to include efficient detector optics/collimation to optimize coupling to the sample.

² Dipartimento di Elettronica e Informazione, Politecnico di Milano.

The consensus from the final round table discussion was that the community is at present too individualistic in its approach to the detector challenges: there is no history of broad collaborations between the various European synchrotron institutes on the development of detector spectroscopies. Sylvie Niessen³ argued that a direct approach for funding in the context of Horizon 2020 was thus premature, and a first step by the community should be the formulation of some mutually agreed, detailed (i.e. >30 pages) 'roadmap' for the desired detector developments. This proposal was supported by Christer Fröjdh⁴ who offered to provide a previous roadmap produced within the Erdit initiative which could serve as a model document. Another suggestion for a model document was given by Burkhard Beckhoff⁵, who proposed the roadmap titled 'International initiative on X-ray fundamental parameters' as a potential example. There was general agreement on this as an immediate action, and the following attendees volunteered to participate in working groups to start on the process of formulating such a roadmap:

WG1: High-Rate Spectroscopy Systems:

Ch. Frieh (SLS) *Chair*
D. Fernandez (ALBA)
S Mangold (ANKA)
P Cloetens (ESRF)
C Cohen (ESRF)
C Fiorini (Politecnico di Milano)
A Niculae (PNdetector)
P Smith (SGX Sensortech)
R Goldsbrough (Quantum Detectors)
P Grudberg (XIA)

WG2: High Energy Spectroscopy Systems:

J Morse (ESRF) *Chair*
A Dent (DLS)
E Fonda (Soleil)
G Falkenberg (Petra)
A Simionovici (Univ. J. Fourier) .../...

³ Direction Générale de la Recherche et de l'Innovation, Ministère de l'éducation nationale, de l'enseignement supérieur et de la recherche, France.

⁴ Department of Electronics, Mid-Sweden University.

⁵ Physikalisch-Technische Bundesanstalt, Berlin.

M Wilson (Rutherford-Appleton Lab.)

P Benoit (Canberra)

R Goldsbrough (Quantum Detectors)

WG3: Imaging Spectroscopy Systems

L Vincze (Univ. Ghent) *Chair*

J Garrevoet (Univ. Ghent)

Ch. Fröjdh (Mid-Sweden Univ.)

H Graafsma (DESY)

M Radtke (BESSY)

S Mangold (ANKA)

Ch. Frieh (SLS)

A Holland (XCAM)

L Strüder (PNsensor)

Each working group should provide a ~5 page document by end of June 2015: this will be integrated into a draft of collective document by the Organizing Committee members, and subsequently more widely circulated for comment from other concerned parties not present at the Paris meeting. S. Niessen stated her interest and availability to support the progress of this roadmap process and offering her continued assistance regarding access to the European funding programmes.

Annexes:

i. List of Participants at the Meeting

Beckhoff	Burkhard	Physikalisch-Technische Bundesanstalt
Bombelli	Luca	XGLab
Caminade	Jean-Pierre	Dir. Gén. de la Recherche et de l'Innovation, Ministère de l'éducation nationale, de l'enseignement supérieur et de la recherche, France
Cloetens	Peter	ESRF
Cohen	Cedric	ESRF
Dent	Andrew	DLS
Falkenberg	Gerald	Petra-DESY
Fernandez Carreiras	David	ALBA CELLS
Fiorini	Carlo	Politecnico di Milano
Fonda	Emiliano	SOLEIL
Frieh	Christophe	SLS-PSI
Fröjdh	Christer	Mid Sweden University
Garrevoet	Jan	Ghent University
Goldsbrough	Roger	Quantum Detectors
Graafsma	Heinz	DESY
Grudberg	Peter	XIA LLC
Hofmann	Martin	KETEK GmbH
Holland	Andrew	Open University
Krings	Thomas	SEMIKON Detector GmbH
Mangold	Stefan	ANKA
Martin	Thierry	ESRF
Menk	Ralf	Elettra
Mitchell	Edward	ESRF
Morse	John	ESRF
Nessi	Marzio	CERN
Niculae	Adrian	PNDetector
Niessen	Sylvie	Dir. Gén. de la Recherche et de l'Innovation, Ministère de l'éducation nationale, de l'enseignement supérieur et de la recherche, France
Osorio	Vicente	BrightSpec N.V.
Piemonte	Claudio	Fondazione Bruno Kessler
Pirard	Benoit	Canberra France
Radtke	Martin	BESSY
Raffo	Claudio	CAEN
Reul	Thomas	Bruker Nano GmbH
Simionovici	Alexandre	ISTerre-Maison des Geosciences
Smith	Peter	SGX Sensortech
Strüder	Lothar	MPI-HLL
Tartoni	Nicola	DLS
Vincze	Laszlo	Ghent University
Wilson	Matthew	Rutherford Appleton Laboratory

The following registered persons were not able to attend the meeting for unforeseen personal reasons.

Stephanie Hustache, Synchrotron Soleil; Giuseppe Bertuccio (Politecnico di Milano);

Martin Rohde (Bruker Nano GmbH); Valerie Bergerioux (ESRF).

ii. Agenda:

Paris Spectroscopy Meeting 16 March 2015

Welcome Address

09h30 Science Director(s), ESRF and/or Soleil Synchrotron(s)
Introductory presentations by Thierry Martin and Ed' Mitchell, ESRF

Horizon 2020 Opportunities

Chairperson: Laszlo Vincze, Univ.Ghent

09h40 Innovation opportunities in H2020 for developing partnerships between industrial providers and synchrotrons
Sylvie Niessen & Jean-Pierre Caminade, Direction Générale de la Recherche et de l'Innovation, Ministère de l'éducation nationale, de l'enseignement supérieur et de la recherche, France

10h00 The Cern ATTRACT initiative
Marzio Nessi, Cern

Synchrotron Spectroscopy: Challenges and proposals:

Chairperson: ~~Stéphanie Hustache, Synchrotron Soleil~~ Laszlo Vincze, Univ.Ghent

10h20 X-ray detectors for the rest of us
Alexander Simionovici, Univ J. Fourier

10h35 Experience with the Color X-Ray at the BAMline
Martin Radtke, BESSY

10h50 Solid state energy resolved detectors for XAFS measurements: limits and issues for present and future applications
Emiliano Fonda, Synchrotron Soleil

11h05 *Coffee break*

Chairperson:	Th. Martin, ESRF
11h15	Spectroscopy detector systems at Diamond Light Source <i>Nicola Tartoni, Diamond Light Source</i>
11h30	Spectroscopy detector needs for X-ray nanoprobe with the ESRF Upgrade <i>Peter Cloetens, European Synchrotron Radiation Facility</i>
11h45	The Maia detector at PETRA III P06 <i>Gerald Falkenberg, PETRA-DESY</i>
12h00	ARDESIA: an X-ray Spectroscopy detection system for synchrotron experiments based on arrays of Silicon Drift Detectors <i>Carlo Fiorini, Politecnico di Milano</i>
12h15	<i>Buffet lunch, sur place</i>

Detectors: Industrial state-of-the-art and future possibilities

Chairperson: John Morse, ESRF

13h10	High speed imaging and spectroscopy with X-rays <i>Lothar Strüder, PNSensor GmbH</i>
13h20	RIXSCam, a sub-pixel high resolution camera for RIXS applications <i>Andrew Holland, XCAM Ltd</i>
13h30	Multi-sensor Silicon Drift Detectors for synchrotron applications <i>Peter Smith, SGX-Sensortech Ltd.</i>
13h40	Multichannels Silicon Drift Detectors for High Speed, High Resolution, High Count Rate X-ray Spectroscopy <i>Adrian Niculae, PNDetector GmbH</i>
13h50	X-ray Spectrometers for science and research <i>Martin Rohde, Bruker Nano GmbH</i>

14h00	High-performance silicon-drift detectors <i>Martin Hofmann, Ketek GmbH</i>
14h10	Future detector technologies for ultimate X-ray spectroscopy applications <i>Benoit Pirard, Canberra France</i>
14h20	Readout Electronics for high-count-rate high-resolution X-ray spectroscopy <i>Luca Bombelli, XGLabs srl</i>
14h30	Yes, There is a Future for Discrete Electronics for Synchrotron High-Rate Spectroscopy <i>Peter Grudberg, XIA LLC</i>
14h40	Quantum Detectors vs attenuators <i>Roger Goldsbrough, Quantum Detectors Ltd.</i>
14h50	Coffee break

Round – table Session: Towards Horizon 2020

15h00	Summary review presentation of previous talks <i>Heinz Graafsma, DESY</i>
15h20	Round table discussion: Animator/chairpersons: <i>Alexander Simionovici Univ. Joseph Fourier, Grenoble</i> <i>Emiliano Fonda, Synchrotron Soleil</i> NB! goals are to get list of project headings; names of people prepared to be involved, outline description of the project proposal(s)...
17h00	Wrap-up of meeting: summary list of proposals with objectives/specifications, proposed technical solution(s) and participants
17h30	End of the Meeting