Short Wavelength Laboratory Sources
MP0601

Start date: 21/02/2007

End date: 01/10/2011 (includes a 6 month extension)

Year: 4

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www.shortwavelengthsources.net

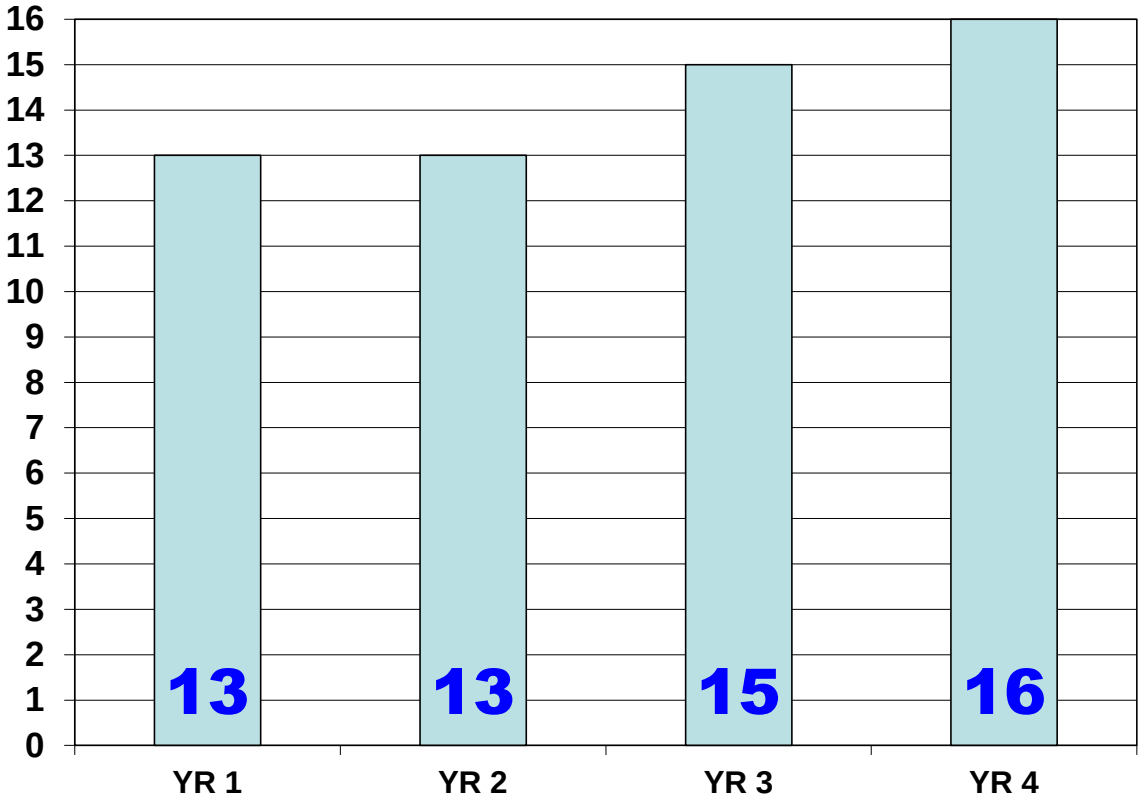
SHORT WAVELENGTH LABORATORY SOURCES

COST MP0601

COST is supported by
the EU RTD Framework Programme

ESF provides the
COST Office through an EC contract

Action Parties



Grant Holder: N/A

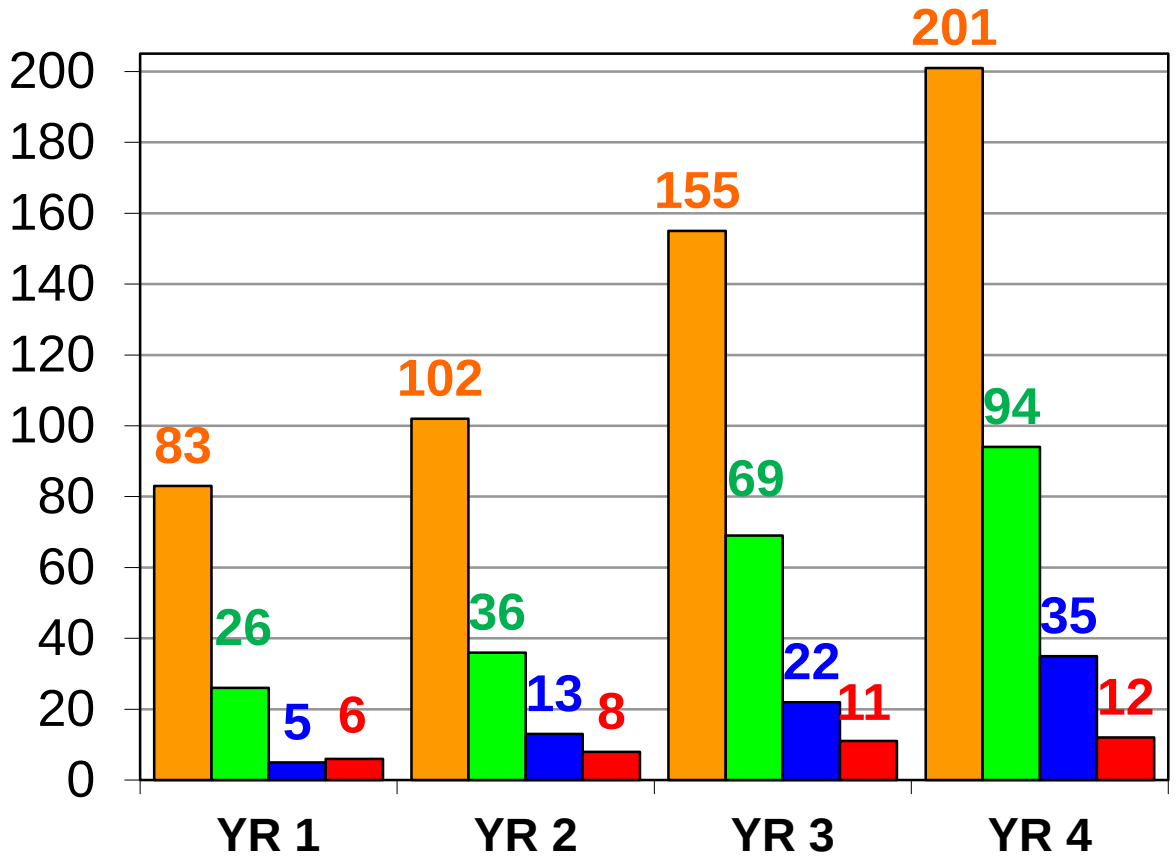
~~GH Institution~~

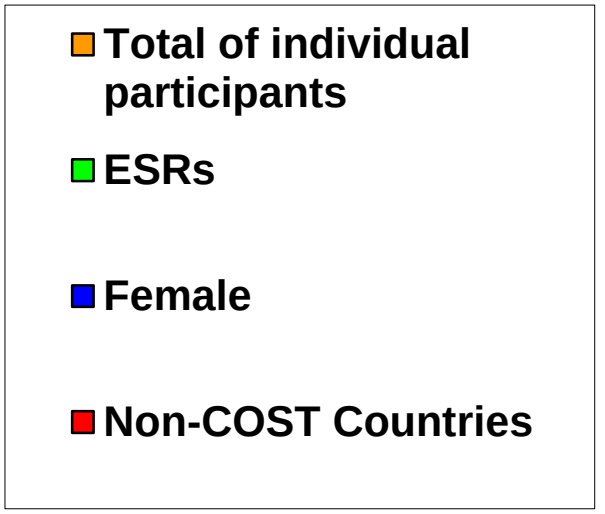
~~GH Representative~~

~~GH Country~~

NB: Does not include Russia & Turkey; both have made major contributions; Presentations were also made at WG meetings by colleagues from the USA. Japan and China.

Action participants





Note that the (>)17% of female participants is larger than current overall contributions to research in Physics based subjects. Many of the female participants are also ESRs.

Use of COST instruments

	YR 1	YR 2	YR 3	YR 4
No. of MC / WG meetings	3/2	2/2	2/2	2/3
No. of STSMs	1	3	7	8
No. of workshops / conferences	0	0	0	3
No. of joint publications	7	30	54	~200
No. of training schools	1	0	1	2

The Book

- We have a contract with the Royal Society of Chemistry to publish *Handbook of Short Wavelength Laboratory Sources: Principles and Practices*
- Fully-edited camera-ready manuscript is due by 30 June 2012.
- WG leaders are section editors.
- So far we have 28 contributions, but can still take more – some people offered but have not yet delivered. In order to give time for editing, we need all manuscripts by 31 January 2012 AT THE VERY LATEST!!!
- If you nead yuor contirbution too be porof raed or editted, see www.edisci.co.uk

Edi Sci
Scientific Proofreading

Scientific context and objectives (1/2)

- **Background / Problem statement:** Short wavelength radiation has been used in medicine and materials studies since immediately after the 1895 discovery of x-rays. The development of synchrotron sources over the last ~25 years has led to a boom in applications in other areas, including environmental science. Despite the widely acknowledged advantages of synchrotron radiation, there is not enough to go round. Due to the cost of such sources this is likely to remain the case. Hence the need to develop alternative, cheaper, more accessible sources which can offer at least some of the properties of synchrotrons.
- **Brief reminder of MoU objectives:** To advance European research and development in laboratory scale short wavelength sources in order to widen access to research and analysis that currently can only be undertaken at large scale facilities such as synchrotrons (and free electron lasers).

Scientific context and objectives (2/2)

- **Research directions:**
- The Working Groups were designed to carry out inter-connected tasks:

WG1 Modeling & Simulation, giving direction to the wide range of experimental parameters that must be varied to optimize source output;

WG2 Source Development, Improvement & Characterization, in order to verify the results of WG1 and to provide optimum emission properties;

WG3 Integrated Systems: Sources, Optics and Detectors, to ensure optimum use of the source output;

WG4 Applications: the raison d'être for the developments of WG1-3.

- **Nowhere else in the World is there such a concerted effort in developing laboratory based alternatives to synchrotrons.**

Working groups

1) **Modelling and Simulation:** To provide guidance on optimising the performances of EUV and x-ray sources, including those based on electron-impact (microfocus), plasmas, laser-like processes such as high-harmonic generation, and inverse Compton (Thomson) scattering. This will enable the best parameters to be established for generating specific wavelengths, e.g., 13.5nm, or ranges, e.g., the water window, as well as conditions leading to coherent output at short wavelengths.
2) **Source Development, Improvement and Characterization:** To develop and improve new and existing sources to enhance brilliance and coherence, with energy ranges for specific applications (including multi-energy sources) by reducing source size and improving flux, and to improve spectral features and time structure – shorter pulses, higher repetition rates.
3) **Integrated Systems: Sources, Optics and Detectors:** It does not make sense to optimise the output of radiation sources if later system components either cannot make use of or seriously degrade the improved source performance. The aim of this working group is thus to study, design, engineer and characterize integrated systems, involving short wavelength optics (focusing and beam manipulation) and detectors (spatially, temporally and energy resolving), that can utilize the sources modelled and developed in WGs 1 and 2.
4) **Applications:** Arguably the most important WG, as opportunities for new or improved applications must arise from the Action if is to be judged a success. Potential applications include x-ray imaging — for the life, medical, environmental and materials sciences and for cultural heritage —, extreme ultraviolet lithography for future generation microcircuits, surface modification and the microprobing of cells and tissues for studies related to radiation induce cancers and their therapies.

Results vs. Objectives

- Through modeling emission characteristics, we now have a much enhanced understanding of the most important source parameters (WG1).
- We have identified further potential mechanisms for laboratory-scale short wavelength sources, such as laser wakefield acceleration (WG2).
- Improved optics and detectors, developed within the Action*, have lead to more efficient use of the source output (WG3).
- The very wide range of cross-disciplinary applications which will be enabled by the work of the Action could not be envisaged by a single institution (WG4). The synergy with IE0601 has further enhanced the possibilities here.

*both as a direct result of COST funding and through national / cross-national funds raised (in part) through the support of COST.

The Future

As a result of new partnerships formed during the Action, we have been successful in obtaining Erasmus Mundus doctoral training. Extreme-ultraviolet and X-ray Training in Advanced Technologies for Interdisciplinary Cooperation (EXTATIC), ref 520293-1-2011-1-IE-ERA MUNDUS-EMJD, is a direct outcome of COST MP0601; the development of a Joint Doctoral Programme was a stated objective of MP0601.

Academic Institutions	Associate Institutions	Associate Industries
Dublin City University*, IE (lead Institute, Professor John Costello)	EUVRC, USA	Bruker, DE
King's College London*, UK	Purdue University, USA	EPPRA*, FR
Military University of Warsaw*, PL	Tongji University*, China	FhG-ILT, DE
RWTH Aachen*, DE		Rigaku*, CZ/JP
University College Dublin*, IE		Silson*, UK
University of Padova*, IT		PREVAC, PL
Southampton University*, UK		
Czech Technical University*, CZ		

*Active participants in MP0601

Challenges

- All working groups progressed largely according to plan, although there was more emphasis on WGs1, 3 & 4, and less on WG2, than originally envisaged.
- The progress made so far will be made use of in the new Erasmus Mundus programme EXTATIC, which will have 4 administrative work packages (WPs) — Governance, Administration, Mobility & Curriculum — and 6 subject WPS based on research undertaken in MP0601 — Sources, Optical Systems, Metrology/Analysis, Radiobiology, Photoionisation & Nanostructuring/Ablation. The challenge will lie in integrating the teaching programme over several institutions; the 8 academic partners are meeting in Dublin on 1 December to discuss this and other aspects. The graduate text being prepared by members of MP0601 will be used in EXTATIC.
- A new Action proposal involving several members of MP0601, *Advanced X-ray Spatial and Temporal Metrology*, passed the preliminary evaluation stage, but just missed out at the final evaluation. It has been resubmitted and again, I understand has passed the preliminary stage.
- We also need to devise methods of continuing collaborative work with members of IE0601