

	EUROPEAN COMMISSION RESEARCH AND INNOVATION DG	Final Report
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**Project No:** 312284

**Project Acronym:** CALIPSO

**Project Full Name:** Coordinated Access to Lightsources to Promote  
Standards and Optimization

## Final Report

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ELETTRA - SINCROTRONE TRIESTE SCPA

# Final Report

## PROJECT FINAL REPORT

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# Final Report

Please note that the contents of the Final Report can be found in the attachment.

## 4.1 Final publishable summary report

### Executive Summary

CALIPSO is a successful pan-European initiative. It groups 20 partners, 13 synchrotrons and 8 free electron lasers from 11 European countries into one of the largest research networks in the world. Part of the consortium were also three facilities respectively in the advanced design and the commissioning phase: the SOLARIS synchrotron in Poland, the European X-FEL in Germany and the TARLA free electron laser in Turkey. The SESAME synchrotron in Jordan participated as an observer. The user base of European synchrotron and FEL facilities is estimated (<http://pan-data.eu/Users2014>) at 30,000 users. CALIPSO's efforts were focused on fostering integration of synchrotron and FEL facilities in Europe in order to offer high quality research services to users and in this way to enable them to conduct world-class research. In addition CALIPSO aimed at raising the awareness of industry of the opportunities provided by synchrotrons and FELs and at boosting jointly developed technology.

CALIPSO's commitment to standardisation was centered on the [www.wayforlight.eu](http://www.wayforlight.eu) portal, designed to offer a single entry point to all users of European synchrotrons and FELs and to provide a comprehensive and detailed overview of all facilities in the field in a standardised way. In addition, a single-sign-on login with the Umbrella tool and a pilot Standardized Proposal Format were offered to users, so that the same format can be used to apply for experiments at different facilities. Both tools requested unprecedented effort by hundreds of scientists and are now ready to be disseminated beyond the end of the project.

To foster the structuring of the European Research Area, CALIPSO supported the European Synchrotron User Organization (ESUO, [www.esuo.org](http://www.esuo.org)) composed of national delegates from 26 countries also including Turkey and Israel. ESUO has become a key player in the field, interacting with the research facilities as well as with national and European funding agencies, and has catalysed the formation of 7 new National User Organisations.

High-quality scientific training was offered by the HERCULES annual school (<http://hercules-school.eu/>) and its specialised courses on scientific hot topics. In addition, financial support was provided to the FELs of Europe (<http://fels-of-europe.eu/>) initiative for introducing young scientists and technicians in Free electron laser science through specific sessions at international conferences and by disseminating a dedicated newsletter.

Industry was involved through a dedicated networking activity, which aimed at raising awareness of the potential of light sources for industry. An Industrial Advisory Board was created jointly with the NMI3 neutron and muon Integrating Activity to identify common bottlenecks and propose practical solutions; a network of industrial liaison offices was created and 20 local workshops were organized at various facilities.

Transnational Access activities allowed more than 3.100 users to receive support for their experiments at state-of-the-art facilities, corresponding to more than 1.400 experiments that already now yielded more than 420 publications in peer-reviewed journals. These activities had a significant impact on countries without a national light source, helping to leverage geographical differences while fostering excellent science. Moreover, 53% of all supported users were younger than 35 years old, and 27% were women.

The joint research activity of CALIPSO's consortium was focused on the increase of rate capability, stability and size of detectors. Several prototypes have been designed, produced and tested, exhibiting promising characteristics that will induce future developments in the framework of the ESRF-upgrade II.

CALIPSO's impacts will extend well beyond the end of the project. Participants are already committed to continuing successful initiatives such as HERCULES, the Industrial User Offices and the Industrial Liaison Offices network as well as the networking in the framework of FELs of Europe.

One of the main project's spill-over is a specific collaboration to keep supporting ESUO and wayforlight in the next years, being finalised at the time of this writing. Finally, CALIPSO is already considered a benchmark for future initiatives and its results will enter a roadmapping exercise

(Photon Science Strategy Panel) for the long-term perspective of European lightsources.

## Summary description of project context and objectives

CALIPSO groups all European synchrotrons and free electron lasers into a fully integrated network. Building on successful integrated initiatives of FP6 and FP7, it pushes forward integration and innovation with enhanced focus on user-friendliness and industry involvement.

The 20 consortium members are one of the largest research networks in the world and also integrate the three ESFRI roadmap projects European XFEL, EuroFEL and ESRF upgrade.

CALIPSO is based on a new, common approach of lightsources and European users, targeted by specific networking activities to facilitate the use of the network by current and potential users, and to expand its impact on industrial innovation. It also includes specific support to the European Synchrotron User Organisation (ESUO [www.esuo.org](http://www.esuo.org)) which independently represents the user's voice throughout the project.

CALIPSO's core initiative is the realisation of the wayforlight ([www.wayforlight.eu](http://www.wayforlight.eu)) webservice as a single entry point, to guide users from a general knowledge of the field to specific information about techniques and instrumentation, taking advantage of online interactive tools and communication channels. First, standardised datasheets have been published for more than 300 beamlines; subsequently, a standardised proposal format was implemented to allow proposal submission via the wayforlight portal.

A specific networking activity is dedicated to industry as a lightsource user, with creation of an Industrial Advisory Board for the project, a network of industry/business offices and organisation of several workshops.

CALIPSO offers transnational open access solely based on scientific merit to a total user population recently estimated as 30,000 (<http://pan-data.eu/Users2014-Results>). The structuring effects of Transnational Access on the realisation of the European Research Area are promoting excellence, reducing emigration and enhancing transnational cooperation. In addition to all that, CALIPSO powers the services offered to the users with its innovative user-friendly approach.

The CALIPSO Joint Research Activity tackles one of the main challenges to realise state-of-the-art scientific experiments at lightsources: X-rays detectors performance. Numerous innovative detectors have been developed and tested at different facilities; numerical simulations and direct links with the industry dedicated action complete the activity.

## Description of main S & T results/foregrounds

### 1. Management

CALIPSO Consortium groups all European synchrotrons and Free Electron Lasers into a fully integrated network which also involves lightsources users through the European Synchrotron Users Organisation (ESUO). Its strength is a long-lasting but dynamic cooperation, open to new ideas, members and challenges and ensuring a smooth workflow to the project as a whole. Within the project, facilities in advanced design or commissioning phase (SOLARIS, TARLA, EU-XFEL) were welcomed as full partners or permanent observers (SESAME) and, as such, could benefit from knowledge exchange. ESUO nominated 5 voting delegates in the projects' general assembly as representatives of the European user community, and could raise its strategic impact among national communities, facilities as well as national and European political bodies. Close ties were established with two FP7-EU funded projects, Biostruct-X and NMI3-II, the equivalent of CALIPSO for the neutron and muon community: this resulted in cross-fertilisation and the joint Industrial Advisory Board. CALIPSO' dissemination was promoted in all its fields of action (Transnational Access, Detectors development, Training and Networking, Industry involvement) through scientific publications, participation in international conferences and workshops, preparation of flyers and posters and through the [www.wayforlight.eu](http://www.wayforlight.eu) portal. Wayforlight offers, for the first time, standardised tools for scientists willing to perform their experiments. For additional information, see attachments. CALIPSO's impact will still grow after the end of the project, since participants are already involved in industrial liaison office networking, FELs of Europe and Umbrella collaborations, HERCULES school and Detectors development. On top of that, it is worth noting that ESUO and wayforlight will be supported by a dedicated collaboration involving all facilities.

### 2. 2. WP2/NA1-User Friendliness across national borders

#### 2.1 Transnational Access Integration

User Friendliness is one of the main goals of CALIPSO, and was implemented through transnational access integration, users coaching and training. The steps towards standardisation and optimisation of

access procedures resulted from unprecedented efforts involving hundreds of scientists from all over Europe, demonstrating the commitment of the facilities and the scientific community for the realisation of the European Research Area.

The [www.wayforlight.eu](http://www.wayforlight.eu) portal was designed to present all European synchrotrons and free electron lasers at a glance, in a standardised way.

- 1) A first step has been the creation of facilities pages with relevant information on call deadlines, main facility parameters, beam status and contacts, etc.
- 2) A second major development included discussion, design and realisation of standardised technical datasheets for synchrotron, IR-FEL and X-ray FEL beamlines. Following a joint and parallel involvement of all facilities' scientists, more than 300 standardised beamline datasheets were published in summer 2014. The sheets are also equipped with interactive filters to ease the user's search for the most suitable instruments for each scientific experiment.
- 3) The third development consisted in the implementation of the Standardised Proposal Format, to be filled on wayforlight and then finalised at the chosen facility's website. This innovative tool for experiment time requests also allowed users to submit pairs of complementary proposals at different facilities. Around fifty Standardised Proposals were received overall at CALIPSO facilities, with very positive feedback from the users and review panel members. This proved to be a strong pilot initiative which now needs to be spread within and outside Europe.
- 4) As part of the user-friendliness package, the Umbrella software for user identification was installed at some CALIPSO facilities as well as on wayforlight, to allow single-sign-on for proposal creation up to submission completion. Moreover, 12 European facilities signed an Umbrella Memorandum of Understanding in spring 2015.

To spread knowledge of the wayforlight tools, a video tutorial (<https://www.youtube.com/watch?v=QkYibLbNbM0>), web-tutorials and a wayforlight brochure were prepared. The average number of visits is 300/week, including scientists from US, India and Russia. To further rise awareness of these new and powerful tools, ideally reaching the 30,000 European users, aggressive advertising is required, directly involving facilities and experienced users. To continuously improve and disseminate wayforlight tools, as well as to keep supporting the European Synchrotron User Organisation activities, the CALIPSO consortium established a collaboration after the end of the project. The goals include closer interaction with the user offices of the facilities, the creation of an ESUO section on wayforlight, realisation of the first European User Survey and pan-european dissemination. Last but not least, in the European roadmap for the future of synchrotron and FEL science in the next 25 years, wayforlight is presented as a prototype of standardisation and integration and as such as a significant achievement towards the implementation of the European Research Area.

Our vision of the future is the natural use of wayforlight as the one and only electronic access portal for the application of beamtime at any photon science facility in Europe, in particular by users requesting funding from a European transnational access program.

## 2.2 Training of SR and FEL staff and users

The advent of short-wavelength free electron lasers has recently opened completely new research opportunities, as they combine the wide spectral range and tunability of synchrotron radiation sources with the coherence and intense femtosecond pulses of optical lasers. There are still many technical and methodological challenges, and the exploitation of the full scientific potential of these new sources is still at the beginning. Therefore, all FEL facilities and projects, including European XFEL, the partners of the ESFRI project EuroFEL, as well as the infrared facilities CLIO, FELBE, FELIX and TARLA, have recently established a long-term collaboration under a memorandum of understanding, signed on 31 May 2012. The FEL collaboration then adopted the name "FELs OF EUROPE". The Steering Committee of FELs OF EUROPE meets regularly and decides and coordinates all activities. In March 2015 it revisited the collaboration strategy and introduced a new management structure in order to ensure that key areas such as training are constantly taken in hand. The FELNET Networking Activity of the CALIPSO project has supported some of the core activities of FELs OF EUROPE, in particular training and dissemination activities, and has thus contributed to consolidate and foster the network. The Steering Committee of FELs OF EUROPE agreed and supervised the specific activities under FELNET.

Two international conference series have been established which provide fora for knowledge exchange between users and staff and, in addition, include regular training activities for young researchers and staff: the Science at FELs conference series in even years and the PhotonDiag workshop series in odd years. The first science conference, the "Science at FELs 2014", took place

on 15 - 17 September 2014 at the Paul Scherrer Institute (PSI) in Villigen, Switzerland, with a participation of 150 scientists from all over the world. The first part of the conference specifically addressed students and young researchers and included lectures from well-respected European and international scientists, as well as interactive activities to encourage networking between the students. The highly educative lectures were very well received by the audience. The participation of 22 students was partly supported with financial contribution from members of FELs OF EUROPE, the Swiss National Science Foundation, the Ecole Polytechnique Fédérale de Lausanne and the Roche pharmaceutical company.

The PhotonDiag Workshop on FEL Photon Diagnostics, Instrumentation, and Beamlines Design is a workshop series specifically targeted at technical staff with introductory lectures and much time for detailed discussions and exchange of experience. The second workshop of this series, PhotonDiag 2015, was prepared during the reporting period and held in Trieste from June 8th to the 10th, 2015 at the International Centre for Theoretical Physics (ICTP) with an attendance of ~90 participants.

Two technical expert groups have been supported to promote the exchange of ideas, knowledge and technology within the network and beyond, partly including experts from the USA and Japan as well as academia involved in specific developments. FELs OF EUROPE has also been promoting the exchange of staff between member facilities to share experiences during special activities such as machine and photon beamline commissioning at operational facilities.

HERCULES stands for Higher European Research Course for Users of Large Experimental Systems, and these schools were conceived 25 years ago to train future users of Europe's large neutrons and X-rays sources so that they would take full advantage of their scientific opportunities.

Today, HERCULES exhibits several features that distinguish it from other schools on the same topic: it provides simultaneous training in neutron and synchrotron radiation science during one month for groups of about 75 young scientists (the Hercules Annual Session - HAS); the school recruits an international and multidisciplinary group of participants; lectures and tutorials are given by outstanding specialists, including Nobel prize winner Ada Yonath; and critically some 40% of the programme consists of practical sessions on cutting-edge instruments at leading neutron and X-ray sources across Europe. These features are specific to HERCULES and, along with the informal network of the past participants (particularly important scientifically, as pointed out by many former participants), form the basis of current and future success.

HERCULES has considerably evolved over its 25 years of existence. The school has gradually been shortened from an eight-week course in 1991 to one month today, which is a good compromise between training and student availability to achieve the school's goals. Each year, some lectures are updated to integrate new developments both of the scientific themes and the techniques discussed. In the last few years during the CALIPSO project, lectures have notably been added to include new applications taking advantage of X-ray Free Electron Lasers (XFEL), and the future European Spallation Source (ESS).

Three Hercules annual sessions were organised during the CALIPSO project: each included lectures (given by 60 lecturers, selected because of their internationally recognised expertise in each field, and pedagogical skills), tutorials and practicals (about 40% of the time of the session), visits to laboratories and a poster session. It was structured into two parts:

- A general, common, part of a week and a half bringing together the multidisciplinary audience. The common lectures covered the various properties of neutrons and synchrotron radiation beams, and presented the most appropriate methods and instruments for the young scientists' needs in the future, i.e. basic notions on sources, detectors, optics, interaction of neutrons and X-rays with matter, powder and single crystal diffraction, small angle and diffuse scattering, inelastic scattering, absorption spectroscopy and imaging techniques.
- The application part (3 weeks) is split into 2 parallel specialised sessions:
  - o Session A: Applications to physics and chemistry of condensed matter (two thirds of participants).
  - o Session B: Biomolecular and soft condensed matter structure and dynamics (one third of participants).

This application part contains most of the experimental training with beam on instruments at the cutting edge of the technique during special days. This includes two days of practicals at the ESRF and two days at the ILL in Grenoble.

During the HAS, one week (including two days of hands-on practicals) is spent in a partner institution:

- At the Swiss Light Source (Paul Scherrer Institute, Switzerland) for 20 participants
- At the Laboratoire Léon Brillouin, and the SOLEIL Synchrotron (Paris-Saclais campus, France) for

~52 participants

In addition to the HAS schools, one-week Hercules Specialised Courses (HSC) have been organised each year since 2006, attracting around 20 participants for three days of lectures and two days of practicals at the ESRF and ILL in Grenoble. The topics are different for all schools, which are focused on recent developments. Since 2013, the following HSC have been organised:

- September 2013: HSC15 “Synchrotron X-ray Imaging for Biology”, with 22 participants
- September 2014: HSC16 “Non-atomic resolution scattering for biology & soft condensed matter”, with 17 participants
- September 2014: HSC17 “Dynamical properties investigated by neutrons and synchrotron X-rays”, with 18 participants

The demand from European and international scientific communities for state-of-the-art training in the use of large X-ray and neutron facilities remains very high. After 25 years, HERCULES continues to be a highly successful school, now training students of former participants. This has been achieved by constant adaptation to new science, techniques, and instruments, and to a political environment undergoing many changes, with an increasing role played by funding agencies in Europe. Combining this adaptability to the established traditions of HERCULES should pave the way for a bright future for training schools for motivated young scientists wishing to embrace a career in X-ray and neutron science.

### 2.3 Dissemination

FELNET has supported several dissemination activities of FELs OF EUROPE. These included, in particular, the two international conference series mentioned under 2.2 above, i.e. the Science at FELs conference and the Photon Diagnostics workshop. Both series have been established with the goal to become THE regular international events to attract the user community and FEL facility staff from all over the world to exchange the latest developments in FEL science and technology and to offer regular training for young researchers and staff. Both events have attracted very significant interest of American and Asian colleagues active in this field, and on request of LCLS management (SLAC, USA) the next PhotonDiag 2017 workshop will be organised jointly by SLAC and FELs OF EUROPE and take place in California.

The main media for the dissemination of information to the wider FEL community and the public are the FELs OF EUROPE newsletter and the new website. The newsletter appears regularly twice a year. Both, the website and the newsletter, evolved from the preparatory phase project IRUVX-PP, but after the MoU in 2012 and the adoption of the new name FELs OF EUROPE a new design was made and a completely new website developed in 2014. These media are important FELs OF EUROPE activities and will persist in the future independent of EU funding.

During the funding period of CALIPSO, European Synchrotron User Organisation (ESUO) became an active user representation body. ESUO is considered by all light source facilities and national authorities as partner in the process of development of European research infrastructure. Meanwhile ESUO represents 26 European countries with about 30,000 synchrotron and FEL users, and members of three new countries joined ESUO during CALIPSO (Croatia, Slovenia, Israel). ESUO has been established in 2010 with support of ELISA and is composed by national delegates headed by an elected executive board of 7 members. Since 2010 ESUO arranged 8 annual meetings (5 within CALIPSO) and 7 meetings (4 within CALIPSO) with light sources facility directors (or their respective deputies). ESUO has sent 5 elected user representatives to CALIPSO Council with right to vote. Another main activity is the support of National User Organisations (NUOs). Within CALIPSO 7 new NUOs have been established. These meanwhile 15 NUOs have a strong impact for the promotion of national support for the use of synchrotron radiation.

Following ESUO's aims and constitution (see U. Pietsch & M. J. Cooper *J. Synch. Rad.* (2010). 17, 428–429) ESUO has promoted the success of Transnational Access (TNA) to international and national communities. ESUO published the paper “The benefit of the European User Community from transnational access to national radiation facilities” (*J. Synchr. Rad.* (2014) 21, 638–639) authored by all ESUO members. This activity is particularly highlighted by ESUO brochure entitled “Towards even brighter photon science: A manifesto for a truly European photon science community” acting as an instructive information material in particular for National authorities responsible for national science policy. Using this material almost all national delegates were able to establish direct contacts to national authorities in order to negotiate the level of national support for synchrotron experiments, to promote importance of TNA for respective national research areas and to increase awareness of the need for an extension of European funding.

Together with facility directors ESUO continuously discussed the progress of TNA process. Initiated by ESUO, the topic of promotion of TNA on European and national level became a major point of common activities. ESUO appreciates facility support for the ESUO brochure (see above). ESUO raised the issue of maintaining a critical mass of activities also beyond the end of CALIPSO, thus favouring the implementation of a dedicated collaboration between facilities.

ESUO supported wayforlight by insertion of user specific titles: “How to write a good proposal” and by discussion and proposing the issue of complementary experiments as special offer for European users. ESUO website is linked to wayforlight and vice versa to generate maximum integration of both activities.

ESUO created links to other user communities. With the European User Organisation for Neutron research (ENSA) we started intensive discussions about exchange of experience in embodiment of TNA and on common activities to promote TNA. Furthermore ESUO invited a user representative of SESAME (Near East Synchrotron facility) to the recent ESUO annual meeting in order to discuss possible routes of support by ESUO support for development of an active SESAME user community.

### 3. WP3/NA2-European Light Sources for Industry and Innovation

The European Light Sources for Industrial Innovation (ELSII) Networking Activity was put in place to catalyse and enhance the industrial use of and interaction with European light source research infrastructures. ELSII aimed therefore to improve the mutual confidence and, importantly, the awareness between these facilities, largely devoted to pure academic research, and industry. As identified by ERIDWatch, strong constraints to increased industrial interaction with third-generation light sources exist in a “culture-clash” between the oft academic ivory tower nature of light sources and commerce driven by market forces. This creates real and perceived bottlenecks for industrial access with the result that industry largely, and regretfully, under-exploits these facilities for its R&I needs; this concerns both direct access and deeper partnerships with light source facilities for both research and synchrotron instrumentation development programmes.

Currently, European companies are very often not or poorly aware of the potential for industrial research at modern third-generation light sources. One exception is the pharmaceutical industry which uses synchrotron protein crystallography as a day-to-day tool, but most industrial sectors are underdeveloped with regards to the application of synchrotron X-ray techniques for industrial R&D, and development of instrumentation for the growing European and worldwide synchrotron market. Three task areas were deployed to address the barriers between the business and synchrotron worlds

- ADVICE: harvesting advice from industry
- AWARENESS: raising awareness of light source sciences and techniques to industry
- NETWORK: sharing experience and challenges of working with and for industry.

From the outset of the project, a transversal link was made between ELSII and the equivalent tasks in the neutron and muon community European Framework Project “NMI3”. This project represents the neutron and muon sources in Europe which face the same challenges of working with industry as the light sources. The link between ELSII and NMI3 provided the opportunity for a larger set of research infrastructures working together towards common goals, as well as a stronger critical mass for exchange and potentially longer term sustainability of the activities.

#### a) ADVICE

To provide pragmatic feedback, a joint CALIPSO-NMI3 Industrial Advisory Board (IAB) of some 12 representatives from industry, both large and small, was created. The goal of this joint advisory group was to provide feedback, advice and input, which is otherwise usually extremely limited. The ELSII and NMI3 budgets allowed two meetings of the IAB to be held with the industry and business representatives of the European light, neutron and muon facilities. These meetings also enabled networking amongst the facility industry and business liaison officers, in many cases for the first time. The first meeting focussed on how far can and should the RIs go in providing a full service, especially in view of the growing panorama of capable facilitating companies with entrepreneurs providing bridges between RI and industry clients. In a second meeting, the IAB and RIs focussed on the Innovation Campuses that analytical RIs, such as light and neutron sources, are increasingly often hosted at or the Campuses are being constructed organically around existing RI. These Campuses are often levers that the RIs can use to better work with industry and have support with links to Regional and National knowledge/industry networks.

The participants of the joint CALIPSO-NMI3 IAB have been all highly motivated to provide advice and insight. It is hoped that the team can continue to meet using NMI3 support in the short term, and institute support in the medium term. All of the members are enthusiastic to continue in their role. The CALIPSO and ELSII Coordinators gratefully acknowledge and sincerely thank the IAB

participants for their enthusiastic work and valuable feedback during the project.

The IAB raised a number of major points and which could be/should be addressed by RIs to provide a high quality access, service and collaboration for and with industry and which are listed in short form below. The IAB members have proposed to publish their overall view and feedback in a refereed scientific journal. This paper is under drafting as CALIPSO reaches its end, but is expected to be published before the NMI3 project is completed.

Access to research infrastructures

- Specific beam time slots could be kept for industry to allow a rapid access meeting industry needs.
- Understaffed beam lines are not acceptable in an industrial context. It is essential that the customer can reach the beam line scientist whenever there are any questions, and that results are delivered on time and on budget.

Cost/benefit - Communication of techniques

- The cost of beam time is often highlighted as a hurdle for Industry, but what really matters is the cost-benefit ratio. Consequently, benefits need to be clearly communicated in a form that is appealing (and comprehensible!) to industry. The RIs therefore need to market and communicate on their services (and openness to industry) if they want to attract industry. For instance, this means that web pages need to be tailored to cater to industry's need for information.
- "Scientific translation" is a two-way process. It is necessary for scientific RI staff to successfully translate new scientific opportunities to a language that make the opportunities understandable and appeal to industry. However, it is also highly beneficial if industry demonstrates that many of its challenges contain a core of interesting and challenging science.

Service / Collaboration / Training of industry staff

- Whenever possible for practical reasons and necessary for scientific reasons, industry should have the option to purchase beam time along with a skilled beam line scientist.
- The increased industrial focus on precompetitive collaboration opens new possibilities to build industrial-academic consortia around scientific areas of interest to several partners. This distributes costs to address unfavourable cost-benefit ratios.
- Poor or non-existent harmonisation of software is a concern. Data processing software (in particular on-the-fly processing of raw data) should be user-friendly, standardised and transparent in order to benefit (often standard) industrial use, whereas this aspect is far less critical for software used for further, more complex and specialised, data analysis.

Accurateness and timeliness vs publishable science

- Validation of experimental methods and techniques is not always strictly necessary for industrial use. This is particularly true for methods designed to provide scientific understanding (rather than actual testing and analytical work). Increasing industrial focus on quality by design (rather than quality by inspection) increases interest of non-validated and more explorative methods.
- Accreditation of RIs is an absolute prerequisite in order to allow regulated industries to use RIs for regular and actual testing. Today, few synchrotron facilities in the world have initiated certification processes (however, examples include the Australian Light Source and Elettra); none has accreditation for stress/strain measurements and for where there is an identified need and where neutron facilities do have a validated process in place. Accreditation may serve as a shared objective of future RI-IAB collaboration.

Incentive for instrument scientists/ group – Management issues

- Part of the income from industrial projects should go back to the instrument or beamline for their scientific use, rather than all being put into a general overhead account. This would create incentives for the beamline team to spend time and effort on industrial projects.

## b) AWARENESS

RIs have both an international reach but also, importantly, strong Regional impact in local innovation ecosystems. The ELSII industry-as-a-user workshops were originally foreseen at a European level, but the task was modified to allow a much greater range of events to be held at the local geographical level of the light and neutron source facilities to take advantage of this local effect. As ELSII developed, several workshops were also held at industry sites to allow a greater number of industrial scientists to be implicated on specific topics of interest to the company concerned. This approach allowed a much finer-grained discussion and 1:1 discussions between the RI specialists and industry scientists and engineers. The workshops aimed to build awareness of the potential of light sources for application to industrial R&D. Each workshop was typically one or two days, to make it attractive to the targeted industrial participants. In total 20 events were held, spread throughout the ELSII participants, with some combining either different light source facilities and/or X-rays and neutrons:

1. 3-4 June 2013: Expert Panel on Neutron and Synchrotron X-rays for Pharmaceutical R&D jointly with ESRF, ILL & EMBL Grenoble Outstation (Grenoble, France)
2. 3 December 2013: Industrial Research using Synchrotron and Neutron Methods at HZB centre as satellite to the BERII/BESSYII user meeting (Berlin, Germany)
3. 12 February 2014: Synchrotron symposium at AZ Sweden held jointly with ESRF and MAXIV. Colloidal invited but at last minute could not attend (Mölnadal, Sweden)
4. 15 April 2014: Synchrotron Applications for Chemical and Material Industries, ALBA (Barcelona, Spain)
5. 25 April 2014: Focus meeting on ligand screening, The Partnership for Structural Biology – ESRF, EMBL, IBS and ILL (Grenoble, France)
6. 4-5 December 2014: Industry Expert Panel on Catalysis and Materials Chemistry, Opportunities with the Upgrade Phase 2 at ESRF (Grenoble, France)
7. 21-22 January 2015: Workshop on Membrane Protein Structure Determination for Industry at DIAMOND (Rutherford, UK)
8. 19 February 2015: Industrial Research using Synchrotron and Neutron Methods HZB (Berlin, Germany)
9. 10 March 2015: Austrian Synchrotron and Neutron School; Neutron and Synchrotron Radiation for Industrial Applications (Altaussee, Austria)
10. 23 March 2015: Grenoble European Photon and Neutron Campus Meets SanofiAventis (Paris, France)
11. 7 May 2015: Synchrotron Applications for the Pharmaceutical Industry at ALBA (Barcelona, Spain)
12. 13 May 2015: Mediator Company event at MAXIV (Lund, Sweden)
- 13-20. Series of eight company workshops at ELETTRA from March 2014-April 2015 (Trieste, Italy).

#### c) NETWORKING

Both networking and awareness are also critical points in developing industry relationships for the conception and creation of state-of-the-art synchrotron instrumentation – which can have spillovers into more day-to-day technological applications such as health and mobile communications. Within this, light sources are important instigators, developers and users of high level instrumentation. This is especially the case for high performance detector systems. Linking to the HIZPAD2 joint research activity of CALISPO, ELSII also allowed for a networking activity in the form of a workshop to bring together industrial detector suppliers with light source detector scientists. 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. The participants 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 are available on the ESRF web site. The key outcome of the meeting was to set up working groups to put in place technology roadmaps for High-Rate Spectroscopy Systems, High Energy Spectroscopy Systems, and Imaging Spectroscopy Systems. These teams are aiming to provide short and clear feedback which could act as a basis for potential detector projects.

A major theme of ELSII networking was simply between the light, neutron and muon facility business and industry offices. The staff running these offices had often never met each other – and certainly very rarely cross-light-neutron facilities, and the ELSII IAB meetings provided the opportunity for exchange, meeting and sharing the challenges of how best to work with and for industrial clients and partners. Throughout the ELSII project lifetime there was a clear willingness to share ideas and methods, with cultural/regional variation, industry variation and facility motivation to work with industrial R&I needs. This networking has led to a number of new initiatives and projects inspired by sharing approaches and ideas. Some of these are incorporated as concrete sub-tasks or work packages in European project proposals – some, with regret, failed to secure funding whilst others are awaiting evaluation. Others are seen in a more closely-knit business community at the

facilities, with a fertile ground to work together in serving industry.

#### Future

The future ambition of the ELSII participants is to continue – all participants in the IAB and from the facilities strongly desire to continue meeting, exchanging and growing the network (for example to user-based research infrastructures beyond light, neutrons and muons). The X-ray and neutron industry liaison network will be funded using institutional support initially.

These central facilities can permit industry to perform truly unique materials characterisation using the special properties of light sources in terms of throughput, spatial resolution, following dynamic processes/in operando, element sensitivity and in-bulk microscopy. New facilities, upgraded facilities and new techniques allow unparalleled advances in materials characterisation, and communication to and delivering photons for industry requires a constant effort to allow actual and potential clients and partners to keep abreast of the latest developments. Working together is one way to help make and cross the bridge to our European industrial colleagues.

#### 4. Transnational Access Activities

CALIPSO supported 1,408 experiments, corresponding to a 34.7% proposals success rate, in disciplines varying from Physics to Engineering, Life Sciences and Humanities. The number of beamtime (=light) hours provided by 14 partners running 17 facilities sums up to more than 155.000, i.e. 248% of the facilities' minimum commitment.

Out of 2,159 supported users, 27% were women researchers and 73% men. It is worth noting that 53% of all supported users were younger than 35 years old, and women share among young users was even higher (31%).

Analyzing the 3,136 user visits divided by researchers' home institution country is interesting, as well as looking at the number of users, on a headcount basis; however, to catch the impact of Transnational Access Activities on the European Research Area, the relative weight of supported users with respect to the users population in each country shall be considered. Thanks to the FP7 EU project PanData it was possible to obtain data which clearly shows how important CALIPSO has been for countries without a national lightsource and in particular for smaller ones, helping to bridge geographical and economic gap by supporting scientific excellence. These experiments already produced 413 peer-reviewed papers, and more are expected to be published in the years to come. In the following, we present some highlights from transnational access experiments at CALIPSO facilities, which demonstrate how useful is insight from synchrotron radiation for many different scientific disciplines.

- Cystic fibrosis (CF) is a lethal genetic disease caused by mutations in the protein CFTR. Small angle X-ray scattering (SAXS) method and synchrotron radiation have been applied to analyse the effects of two representative drugs, approved for human use, in a model phospholipid membrane.  
Discipline: Molecular and cellular biology Facility: ALBA synchrotron, Spain
- Graphene, a single layer of carbon atoms, is an extremely promising material for many applications due to its mechanical strength, optical transparency and high conductivity. In this study, a completely revolutionary method to grow graphene on a metal and oxidize it was developed and tested.  
Discipline: Chemistry Facility: ASTRID2 synchrotron, Denmark
- Curcumin, which gives the Indian spice tumeric its yellow colour, could be a useful treatment from many health issues, from allergies to neurodegenerative diseases, as it is anti-oxidant, anti-inflammatory and can prevent the build-up of mis-folded proteins. However, it is broken down rapidly within the body. Several by-product of curcumin were evaluated to determine their suitability for use in future drug therapy designs.  
Discipline: Medicine Facility: Diamond synchrotron, UK
- Carbon nanotubes were proven to be active at their tip. After exposure to nitrogen plasma, by means of a powerful spectromicroscope it was possible to determine where and in which geometrical arrangement was nitrogen located. Moreover, resistance to heating of the various nitrogen species was also investigated.

Discipline: Condensed Matter Physics Facility: Elettra synchrotron, Italy

- Free electron lasers generate pulses as short as femtoseconds (one-millionth of a milliardth of a second), capable of taking ultra-fast snapshots of physical systems. In this experiment, two 100-femtoseconds pulses were used, one to excite the magnetic system by local heating (pump) and another one (probe) to measure the magnetisation changes induced by the first one. It was demonstrated that a single optical laser pulse can reverse the Fe magnetisations locally, and this is potentially attractive for applications in sensors and devices.

Discipline: Condensed Matter Physics Facility: FERMI free electron laser, Italy

- Planets are thought to form through large-scale melting, leading to a liquid metal core and rocky mantle. Planets that did not melt are not expected to have generated a geomagnetic field, however recent observations suggest this is not the case. Thanks to imaging of nanomagnetism in unmelted rocky and metallic meteorites, planetary formation is elucidated and the variations in the geomagnetic field over tens of millions of years are described. Basic insight into process of planetary formation and creation of magnetism was provided.

Discipline: Earth Sciences Facility: BESSY II synchrotron, Germany

- Individual transitions between Landau levels in graphene can be addressed by circularly polarised radiation. Pump-probe spectroscopy reveals the scattering dynamics in this system. The particular non-equidistant Landau level ladder of graphene suggests the development of a tunable THz laser. For its realisation precise knowledge of the carrier relaxation processes is of utmost importance.

Discipline: Condensed Matter Physics Facility: FELBE free electron laser, Germany

- Thanks to synchrotron radiation fourier transform infrared imaging, sub-cellular contents as the extracellular matrix, the membrane and related organelles can be studied. A first series of measurements with animal lung cells exposed to low but gradual amounts of mineral fibres (crocidolite asbestos) demonstrated that cells show changes already at very low fibre amounts. If confirmed by future experiments one should therefore consider that official exposition levels to mineral fibers might be revised.

Discipline: Molecular and cellular biology Facility: DAFNE-Light synchrotron, Italy

- Tissues from healthy or Alzheimer disease brain hippocampus/cortex mice were studied by infrared micro-spectroscopies in order to identify markers for each of the stages of the Alzheimer Disease. These markers could then be used in the diagnosis at the early stage of the disease.

Discipline: Chemistry Facility: ANKA synchrotron, Germany

- Three-dimensional collagen matrices (3D-CMs) may be visualized by cumbersome reconstructions of serial sections. Synchrotron-based X-ray tomographic microscopy (SRXTM) was proven to be extremely powerful to image 3D-CMs in native tissue probes, allowing non-destructive visualization and analysis of structures within the 3D-CMs without the need of serial sectioning and reconstruction. Clinical relevance SRXTM may help to understand the clinical characteristics of 3D-CMs in more detail.

Discipline: Clinical medicine Facility: PSI-SLS synchrotron, Switzerland

- Far-infrared and terahertz spectroscopy provides essential insights into the structure and dynamics of biomolecules, as it contains information on collective delocalised vibrations as well as specific vibrations e.g. hydrogen bonds. By combining far-IR/THz action spectroscopy and gas phase molecular beam techniques, it is feasible to isolate the vibrations of biomolecules, to work under controlled solvation conditions and to retrieve conformer selective information. The combination of far-IR action spectroscopy and DFT-based molecular dynamics simulations provides a new tool to probe and characterise the spectroscopic far-IR signatures of e.g. model biomolecules in the gas phase and thereby reveals important information that is complementary to the conventional mid-infrared fingerprint domain.

Discipline: Atomic and Molecular Physics Facility: FELIX free electron laser, The Netherlands

## 5. Joint Research Activity: High-Z Pixel Array Detectors

### 5.1 Motivations and goals

The HIZPAD2 (High-Z Pixel Array Detectors) JRA of CALIPSO was dedicated to the improvement of high-Z pixel sensor technologies and to the implementation of such sensors into large-area X-ray

detectors systems for synchrotron experiments at energies up to 100 keV or more. The JRA work programme essentially consisted of the following topics:

- increase of pixel sensors effective detection areas, development of innovative pixelisation and hybridisation techniques, development of linear sensors, modelling of the sensor response, investigation of alternative pixel sensor technologies based on quantum well structures.
- development of unit detector modules with larger size, assembly of multimodule large area systems.
- beamline evaluations of the produced pixel sensors and detector systems.

By providing 2D X-ray detection devices with enhanced characteristics in a wide energy range and by investigating on novel detection schemes, HIZPAD2 intended to bring a significant benefit to a large spectrum of SR applications, in particular in materials science.

HIZPAD2 started in November 2012 and terminated in May 2015. It gathered major European SR facilities (ESRF, ELETTRA, DLS, DESY), as well as world-leading European research institutes in the field of X-ray detection (STFC, PSI, CNRS), with ESRF as coordinator.

## 5. 2 Main results

The established work programme was successfully fulfilled, generating significant advances in all addressed topics: improved CdTe pixel sensors and assemblies, demonstration of their superior performance for high-energy applications on synchrotron beamlines, simulation models enabling a better understanding of high-Z pixel sensor operation and limitations, implementation of CdTe sensors into large area detector systems, novel pixel devices based on quantum well multilayered structures on GaAs substrate, improved interconnect technologies for CdTe microstrips. This also generated a significant amount of scientific publications and public presentations.

It could also be confirmed that despite its known limitations the CdTe material remains at this time the most relevant choice for pixel sensors dedicated to X-ray imaging applications at energies up to 100 keV.

## Potential impact and main dissemination activities and exploitation results

The two dominant impacts of CALIPSO are the networking activities which contributed to the structuring of the European Research Area and the scientific results emerging from transnational access which contributed to the advancement of science. Both aspects in turn contribute to the so-called “Fifth Freedom of the European Union” i.e. free circulation of knowledge.

CALIPSO groups together 20 beneficiaries representing 13 synchrotrons and 8 free electron lasers in Europe, which form one of the world’s largest research networks. Moreover, to a larger extent than previous initiatives, it included facilities in advanced design and commissioning phase as full partners, thus strengthening their links with the other facilities and among users communities (SOLARIS synchrotron in Poland, European X-FEL in Germany, TARLA free electron laser in Turkey), enabling them in this way to profit from best practice of established infrastructures and to communicate with user communities from the beginning.; the SESAME synchrotron in Jordan was welcomed as a permanent observer.

CALIPSO’s Transnational Access program supported more than 3.100 user visits to perform more than 1.400 users experiments. The Transnational Access program was of particular importance for countries without a national lightsource/a national users organisation. Access was provided on the basis of scientific merit, but the request for support by users from such countries largely imported over the request by users disposing of a national lightsource. Moreover, 53% of all supported users were younger than 35 years old, and 27% were women.

To maximise the impact of the project, great importance was attributed to dissemination activities throughout the duration of the project. They included the design of a project poster, the production of flyers and presentations at user meetings and symposia.

Scientific dissemination was mainly implemented via peer-reviewed publications (more than 420) and presentations at international conferences. Considering the average time-delay between experiment and publication a high number of publications is expected within the next 2-3 years, .

Training of young researchers was ensured by high-level schools and workshops (HERCULES, FELNET see below).

Owing to the strong commitment of the project partners and the users represented by the European Synchrotron Users Organisation (ESUO, see below), CALIPSO’s impact will persist well beyond the end of the project. To maintain the activities of ESUO and the [www.wayforlight.eu](http://www.wayforlight.eu) portal, the

consortium partners have concluded a collaboration agreement for 18 months. The portfolio of activities to be continued during this 1 ½ years includes meetings of ESUO national delegates, meetings of ESUO members with facilities directors, technical meeting of user offices and IT staff responsible for the implementation of the wayforlight portal at the facilities, update and amelioration of the portal tools and intensified dissemination of the benefits of this portal.

CALIPSO representatives were invited by the EC delegation in Tokio, Japan, to joint the “Science Agora” conference in November 2015 (<http://www.jst.go.jp/csc/scienceagora/about/index.html>). The project will be presented in a special session dedicated to Light, a tribute to the International Year of Light 2015.

The CALIPSO consortium is committed to the preparation of a proposal for a new integrating activity, which will exploit the most prominent results of the preceding project but the goals of which will go far beyond the present achievements by focusing in addition on the long-term sustainability of synchrotrons and FELs and on data management and storage enabling the open access to and re-use of data generated at the infrastructures.

In this sense CALIPSO has been invited to participate in the Photon Science Strategy Panel lead by Prof. H. Dosch from DESY, aiming at the development of a strategy for the long-term sustainability of synchrotrons, FELs and High-power lasers in Europe. Of particular interest are CALIPSO’s experiences with ESUO and wayforlight which will enter in a dedicated section on standardisation of access procedures.

#### Transnational Access Integration

With respect to previous initiatives, CALIPSO moved a step further in facilities’ integration regarding access procedures and information provision. The agreement on standardised beamline datasheets, filled in parallel by more than 300 scientists, and the pilot offer of a Standardised Proposal Format represented a significant improvement that now needs to be consolidated.

A comprehensive impact of [www.wayforlight.eu](http://www.wayforlight.eu) on the users of European synchrotrons and free electron lasers will only be assessed in the years to come. To exploit its user-friendly tools, together with the Umbrella authentication system ones, ideally all 30,000 users should be informed about them. Dissemination was boosted in the last year of the project, but needs to be further enhanced by a capillary commitment of facilities’ scientists and user offices, as well as by the European Synchrotron User Organisation (ESUO). To facilitate this process and ensure that users’ needs are properly addressed, a dedicated Users Survey is planned for Autumn 2015. wayforlight statistics have shown that website visitors are also located outside Europe (US, India, Russia, China) and therefore wayforlight may contribute to a geographical widening of the active users community.

#### Training of SR and FEL staff and users

For the past 25 years, HERCULES has successfully built a worldwide community of about 2,300 scientists – including about 300 during the lifetime of the CALIPSO project. A number of those have become scientists in synchrotron and neutron facilities (e.g. between 25 and 30% of scientists at the ESRF and ILL), and others continue as users of all European Neutron, Synchrotron and XFEL facilities.

A short history of HERCULES was described by José Baruchel (former school director) in the following article: “The HERCULES Schools: A Bright Future Ahead” *Synchrotron Radiation News*, 26 (2013), 5-8, DOI: 10.1080/08940886.2013.753771 – particularly giving an overview of the recipes used to make the school a success.

One symbol of the success of Hercules is its international impact: a “Latin-American” edition of HERCULES was organized in 2010 in Brazil (co-organised by the Brazilian synchrotron and the Grenoble school team), and to celebrate the 25th anniversary, an Asia-Pacific Edition of HERCULES is organised in Taiwan for July 2015.

Two international conferences were organised, as mentioned above: The Science at FELs 2014 at PSI in Switzerland and the PhotonDiag 2015 at ICTP in Italy, establishing a series of meetings where European and international users of FEL facilities and the technical and scientific staff operating and developing these facilities come together and share their results and experiences. These conference series belong to the main fora for knowledge sharing in FEL science and technology worldwide.

Two technical expert groups have been supported to promote the exchange of ideas, knowledge and technology within the network and beyond, partly including experts from the USA and Japan as well as academia involved in specific developments. FELs OF EUROPE has also been promoting the exchange of staff between member facilities to share experiences during special activities such as machine and photon beamline commissioning at operational facilities.

#### Dissemination

Dissemination of information within the FEL and neighbouring communities and the public is mainly achieved by the semi-yearly publication of the FELs OF EUROPE newsletter and the website [www.fels-of-europe.eu](http://www.fels-of-europe.eu). The newsletters are downloadable from the website. The new website was developed in 2014 and includes also an online calendar with relevant conferences and other events which is regularly updated.

Established in 2010 (J. Synchrotron Rad. (2010) 17, 428-429) during the ELISA project (March 2009-August 2011, grant agreement No. 226716), the European Synchrotron User Organization (ESUO) could further develop its activities for the European synchrotron and FEL users, thanks to the European funding support of the 3 year CALIPSO project. ESUO is an active political body representing about 30.000 synchrotron and free electron laser (FEL) users from 26 European countries (including the newly joining countries of Croatia, Slovenia and Israel). This large user community is represented within ESUO by national user delegates from 26 European countries headed by an elected executive committee of 7 members.

ESUO is considered as a real partner in the process of development of European research infrastructure by all European light source facilities and national authorities. ESUO has been deeply involved within the CALIPSO project, a part of its activities extending also beyond this project.

#### CALIPSO activities: ESUO dissemination and coordination

ESUO which is represented by 5 user representatives within the CALIPSO Council has been involved in the achievements of several tasks such as:

- # the organizations of 5 ESUO annual meetings and of 4 meetings with light source facility directors (or their respective deputies);
- # the coordination of the Transnational Access Activities (TNA);
- # the dissemination of ESUO activities via different communication materials (e.g. PSI facility news)
- # the support -via informative materials accessible on the wayforlight portal (<http://www.wayforlight.eu/eng/home.aspx>)- to the synchrotron and FEL users thanks to dedicated guidelines on "How to write a successful proposal using the standard proposal form (SPF)" including the possibility to submit a pair of complementary experiments to two different European large scale facilities. The optimization of the integration of the ESUO and wayforlight activities is insured by the link of their two websites.

#### Other ESUO activities:

- # the support to the establishment of National User Organizations (NUOs): seven new NUOs formed during the CALIPSO project duration, bringing the total number of NUOs to 15;
- # the promotion of the success of TNA activities to national and international synchrotron and FEL user communities via (i) an article authored by all ESUO national members and published in the Journal of Synchrotron Radiation ("The benefit of the European User Community from transnational access to national radiation facilities", J. Synchr. Rad. (2014) 21, 638-639), (ii) a brochure entitled "Towards even brighter photon science: A manifesto for a truly European photon science community" written by the science writer, Dirk Rathje and funded by European facilities;
- # the establishment of direct contacts by various ESUO national delegates to their Research Infrastructure national representatives for the promotion of TNA for synchrotron and FEL users in Horizon 2020;
- # The initiation of contacts with other user communities such as (i) the European Neutron Scattering Association (ENSA, <http://www.neutronsources.org/neutron-centres/europe/ensa.html>) in order to exchange experience about TNA and to possibly identify new synergies for the promotion of TNA, (ii) the SESAME (Synchrotron-light for Experimental Science and Applications in the Middle East, <http://www.sesame.org.jo/sesame/>) via its user representative who was invited in the frame of the 8th ESUO annual meeting in order to discuss possible support actions by ESUO for the SESAME user community.

Major activities could be achieved by ESUO for the synchrotron and FEL users in Europe thanks to the funding support of the European Commission via the ELISA and CALIPSO FP7 projects. ESUO is thankful to the European Commission for the financial support of a part of its activities. With the expiration of CALIPSO, constructive discussions between ESUO and the management of the European large scale facilities have taken place, and a post-CALIPSO bridging agreement could recently be launched between ESUO and light source facilities to assure the continuation of the ESUO activities. ESUO greatly appreciate this constructive interplay between the synchrotron and FEL large scale facilities and their user community.

The European Light Sources for Industrial Innovation networking activity was directly targeting real impact of light sources for commercial R&I. The tasks set out, within the means provided, to raise awareness with industry of the increasing potential and interest of the light sources to work with and for industry. These applications are wide and diverse, but only a few select industries are making strong use of such facilities for their proprietary and publishable science. This limitation is often due to poor awareness and/or being averse to using “large public research infrastructure” – particularly for SMEs.

Changing the image of research infrastructures for industry and evolving industry attitudes to these facilities takes time. Industry is usually slow to pick up on new technologies, often waiting for others to take the first plunge and risk before industry as a whole then takes up the innovation. ELSII therefore set out to better understand industry, asking for feedback from the Industrial Advisory Board and to proactively seek how the infrastructures could better deliver services and photons for European industry needs.

The full impact of ELSII will only be seen with time. However, in the CALIPSO project period, ELSII enabled over one hundred industry scientists to learn more about the light facilities through the series of light source-industry workshops held at the facilities or industry sites. An important further and more immediate impact is through a bottom-up structuring of the interactions between the industry offices of the light source facilities with much enhanced contact and awareness of what each facility is doing and the staff working there for industry. This is helping to highlight common problems, sharing of ideas and maturing thinking towards joint efforts in (for example) European wide and Regional projects.

A key feature of the ELSII activities was to team up with the equivalent tasks in the neutron and muon project “NMI3”. This gave a greater transversality to the work, with a wider set of research infrastructures implicated and a larger set of IAB representatives. The joint approach highlighted the fact that the light and neutron/muon sources have the same issues in working with industry – and vice versa for industry to access and use the facilities.

The CALIPSO-NMI3 industrial networking results and output has already informed new Horizon2020 projects, with smaller tasks within the overall projects taking on board the ELSII findings. Projects include “PANDAAS” and “RIM” (unfortunately neither funded) and the “NFFA” project (funded), as well as several projects responding to specific Regional innovation needs within the Regional innovation ecosystems of the research infrastructures that are currently under first stage evaluation.

Linked to the CALIPSO JRA “HIZPAD2”, the ELSII tasks also included the organisation of a workshop with industry as a technology supplier and instrumentation partner for detector systems. The workshop focussed on high performance spectroscopy detector systems, with the aim to draw together industry and academic detector scientists. The immediate impact of this work is to draw together the two sides with a perspective towards European support for detector projects. A natural framework for this could be ATTRACT (which was presented at the meeting). Matching with the timescale of ATTRACT, three working groups instigated at the ELSII meeting are expected to report back with concise roadmaps on the required detector technologies and which could form the basis of real development projects with industry on-board at an early concept stage.

The ELSII network is expected to continue either fully or partially, with further meetings requested by the network participants. The next opportunity is scheduled for October 2015 in Copenhagen within the context of an NMI3 meeting (NMI3 project finishing after CALIPSO). By continuing to work together, the European light sources, plus perhaps other families of facilities, can better serve industry in the longer term with better outreach, better delivery of industrially-tenable access, and more involvement in partnership with industrial R&I.

#### Detectors Development

Results of HIZPAD2 JRA were reported in several peer-reviewed scientific articles and presented in numerous conferences in particular at IWoRID 2013 (Paris, France), EuroMBE 2013 (Levi, Finland), IWoRID 2014 (Trieste, Italy), IEEE RTSC 2014 (Seattle, USA), PSD 2014 (Guildford, UK), SRI 2015 (New-York, USA).

Improvements of CdTe sensor technologies achieved in the frame of subcontracting agreements will have direct benefit for the involved industrials in terms of increased business opportunities. As these industrials are mainly young startup companies, this is of particular importance since it can contribute to secure their development in the coming years.

Technologies developed within HIZPAD2 for integration of large-area detector systems will serve the synchrotron user community in need of efficient detectors for experiments at high energies. To this end, technology transfers to industrial providers would be considered whenever appropriate.

### **Address of project public website and relevant contact details**

CALIPSO's website: [www.calipso.wayforlight.eu](http://www.calipso.wayforlight.eu)  
contact: Dr. M. Bertolo (Project Manager), [calipso@wayforlight.eu](mailto:calipso@wayforlight.eu)  
wayforlight portal: [www.wayforlight.eu](http://www.wayforlight.eu)  
contact: Dr. C. Blasetti (wayforlight coordinator), [calipso@wayforlight.eu](mailto:calipso@wayforlight.eu)  
ESUO website: [www.esuo.org](http://www.esuo.org)  
contact: Prof. U. Pietsch, ESUO chair, [pietsch@physik.uni-siegen.de](mailto:pietsch@physik.uni-siegen.de)

## 4.2 Use and dissemination of foreground

### Section A (public)

#### Publications

LIST OF SCIENTIFIC PUBLICATIONS, STARTING WITH THE MOST IMPORTANT ONES										
No.	Title / DOI	Main author	Title of the periodical or the series	Number, date or frequency	Publisher	Place of publication	Date of publication	Relevant pages	Is open access provided to this publication ?	Type
1	Contributions de SOLEIL et de l'ESRF à l'activité et à la compétitivité des entreprises <a href="http://dx.doi.org/10.1051/refdp/201334106">http://dx.doi.org/10.1051/refdp/201334106</a>	Philippe Deblay, Edward P. Mitchell	Reflets de la Physique	Issue 34-35	EDP Sciences	France	01/06/2013	106-107		Peer reviewed
2	The HERCULES Schools: A Bright Future Ahead <a href="https://doi.org/10.1080/08940886.2013.753771">10.1080/08940886.2013.753771</a>	José Baruchel	Synchrotron Radiation News	26:1	Gordon Publications		08/02/2013	5-8	No	Peer reviewed
3	European Synchrotron Users Unified <a href="https://doi.org/10.1080/08940886.2010.485522">10.1080/08940886.2010.485522</a>	Ullrich Pietsch, Malcolm Cooper	Synchrotron Radiation News	Vol. 23/Issue 3	Gordon Publications	United States	02/06/2010	39-39	No	Peer reviewed
4	European Synchrotron User Organization established <a href="https://doi.org/10.1107/S0909049510010484">10.1107/S0909049510010484</a>	Ullrich Pietsch, Malcolm J. Cooper	Journal of Synchrotron Radiation	Vol. 17/Issue 3	International Union of Crystallography	United Kingdom	01/05/2010	428-429	No	Peer reviewed
5	The benefit of the European User Community from transnational access to national radiation facilities <a href="https://doi.org/10.1107/S1600577514007619">10.1107/S1600577514007619</a>	EBarrier, Braz Fernandes, Bujan, Feiters, Froideval, Ghijsen, Hase, Hough, Jergel, Jimenez, Kajand	Journal of Synchrotron Radiation	Vol. 21/Issue 3	International Union of Crystallography	United Kingdom	01/05/2014	638-639	No	Peer reviewed

		er,Kikas, Kokkinidis , Kover,Larsen ,Lawson, Lawniczak-Jablonska, Maria ni, Mikulik, Monnier, Morera,McGinness ,Müller-Buschbaum, Nielson,Pietsch,Tromp,Simon,Stangl ,Zanotti								
	CALIPSO Project at Elettra	G. Paolucci, M. Bertolo, C. Blasetti and O. De Giacomo	Notiziario Neutroni e Luce di Sincrotrone	18 n.2			01/07/2013	30-32	Yes	Article

LIST OF DISSEMINATION ACTIVITIES								
No.	Type of activities	Main Leader	Title	Date	Place	Type of audience	Size of audience	Countries addressed
1	Oral presentation to a scientific event	ELETTRA - SINCR OTRONE TRIESTE SCPA	Coordinated Access to Lightsources to Promote Standards and Optimization	18/09/2013	E-MRS Fall meeting, Symposium M, Warsaw, Poland	Scientific community (higher education, Research) - Industry - Policy makers - Medias	50	All European Countries
2	Oral presentation to a scientific event	INSTALLATION EUROPEENNE DE RAYONNEMENT SYNCHROTRON	Structural defects in CdTe: a local scale study with collimated synchrotron beam	02/11/2012	Anaheim, California	Scientific community (higher education, Research) - Industry - Policy makers	100	European Countries and USA
3	Flyers	STIFTUNG DEUTSCHES ELEKTRONEN- SYNCHROTRON DESY	Enhancing the development and exploitation of the scientific potential of Free Electron Lasers (FELs) in Europe	01/03/2014	DESY	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias	30000	All European countries and all other interested in FEL science
4	Flyers	ELETTRA - SINCR OTRONE TRIESTE SCPA	wayforlight flyer	01/09/2014	Elettra, Trieste, Italy	Scientific community (higher education, Research) - Industry - Policy makers - Medias	30000	All European countries and all other interested in synchrotron and FEL science
5	Posters	ELETTRA - SINCR OTRONE TRIESTE SCPA	CALIPSO Poster @SNI2014	22/09/2014	Bonn, Germany	Scientific community (higher education, Research) - Policy makers	600	Germany and collaborating European countries
6	Posters	ELETTRA - SINCR OTRONE TRIESTE SCPA	CALIPSO Poster @NESY 2015 winterschool and symposium	10/03/2015	Altausee, Austria	Scientific community (higher education, Research)	40	Austria and collaborating European countries
7	Web sites/Applications	ELETTRA - SINCR OTRONE TRIESTE SCPA	wayforlight website new release	01/08/2014	All over the world	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias		All European countries and all other interested in synchrotron and FEL science
8	Videos	ELETTRA - SINCR	wayforlight video	01/07/2014	Elettra, Trieste, Italy	Scientific comm		All European countries

		OTRONE TRIESTE SCPA			ally	unity (higher education, Research) - Policy makers - Medias		untries and all other interested in synchrotron and FEL science
9	Web sites/Applications	ELETTRA - SINCR OTRONE TRIESTE SCPA	Standardized Proposal Format web tutorial	01/08/2014	All over the world	Scientific community (higher education, Research)	30000	All European countries and all other interested in synchrotron and FEL science
10	Organisation of Workshops	INSTALLATION EUROPEENNE DE RAYONNEMENT SYNCHROTRON	Expert Panel on Neutron and Synchrotron X-rays for Pharmaceutical R&D	03/06/2013	Grenoble	Industry	10	All European Countries
11	Organisation of Workshops	HELMHOLTZ- ZENTRUM BE RLIN FUR M ATERIALIEN UND ENERGIE GMBH	Industrial Research using Synchrotron and Neutron Methods	03/12/2013	Berlin	Industry	21	Germany
12	Organisation of Workshops	INSTALLATION EUROPEENNE DE RAYONNEMENT SYNCHROTRON	Synchrotron symposium	12/02/2014	Molndal	Industry	20	Sweden
13	Organisation of Workshops	CONSORCIO PARA LA CO NSTRUCCION, EQUIPAMIENTO Y EXPLOTACION DEL LABORAT ORIO DE LUZ DE SINCROTRON	Synchrotron Applications for Chemical and Material Industries	25/04/2014	Barcelona	Industry	50	Spain
14	Organisation of Workshops	INSTALLATION EUROPEENNE DE RAYONNEMENT SYNCHROTRON	Focus meeting on ligand screening	25/04/2014	Grenoble	Scientific community (higher education, Research) - Industry	100	All European Countries
15	Organisation of Workshops	INSTALLATION EUROPEENNE DE RAYONNEMENT SYNCHROTRON	Industry Expert Panel on Catalysis and Materials Chemistry, Opportunities with the Upgrade Phase 2	04/12/2014	Grenoble	Industry	10	All European Countries
16	Organisation of	DIAMOND LIGHT	Workshop on Mem	21/01/2015	Rutherford	Industry	20	UK

	Workshops	SOURCE LIMITED	brane Protein Structure Determination for Industry					
17	Organisation of Workshops	HELMHOLTZ-ZENTRUM BERLIN FÜR MATERIALIEN UND ENERGIE GMBH	Industrial Research using Synchrotron and Neutron Methods	19/02/2015	Berlin	Industry	50	Germany
18	Oral presentation to a scientific event	INSTALLATION EUROPEENNE DE RAYONNEMENT SYNCHROTRON	Neutron and Synchrotron Radiation for Industrial Applications	10/03/2015	Altaussee	Scientific community (higher education, Research)	100	Austria
19	Organisation of Workshops	INSTALLATION EUROPEENNE DE RAYONNEMENT SYNCHROTRON	Grenoble European Photon and Neutron Campus Meets SanofiAventis	23/03/2015	Paris	Industry	20	France
20	Organisation of Workshops	CONSORCIO PARA LA CO NSTRUCCION, EQUIPAMIENTO Y EXPLOTACION DEL LABORATORIO DE LUZ DE SINCROTRON	Synchrotron Applications for the Pharmaceutical Industry	07/05/2015	Barcelona	Industry	40	Spain
21	Organisation of Workshops	LUNDS UNIVERSITET	Mediator Company event	13/05/2015	Lund	Industry	10	All European Countries
22	Organisation of Workshops	ELETTRA - SINCROTRONE TRIESTE SCPA	Materials and Microsystems Workshop	13/03/2014	Trieste	Industry	5	Italy
23	Organisation of Workshops	ELETTRA - SINCROTRONE TRIESTE SCPA	Control System workshop	12/06/2014	Trieste	Industry	5	All European Countries
24	Organisation of Workshops	ELETTRA - SINCROTRONE TRIESTE SCPA	Innovation in semiconductor technologies	12/06/2014	Trieste	Industry	13	Italy
25	Organisation of Workshops	ELETTRA - SINCROTRONE TRIESTE SCPA	Welding Applications	15/10/2014	Trieste	Industry	10	Italy
26	Organisation of Workshops	ELETTRA - SINCROTRONE TRIESTE SCPA	Defence and aerospace	17/11/2014	Trieste	Industry	11	Italy

27	Organisation of Workshops	ELETTRA - SINCROTRONE TRIESTE SCPA	Automotive R&D	16/02/2015	Trieste	Industry	16	Italy
28	Organisation of Workshops	ELETTRA - SINCROTRONE TRIESTE SCPA	Cement, Aggregates and ready mixed concrete Workshop	17/02/2015	Trieste	Industry	13	Italy
29	Organisation of Workshops	ELETTRA - SINCROTRONE TRIESTE SCPA	Free Electron Laser (FEL) instrumentation	24/04/2015	Trieste	Industry	7	Slovenia
30	Oral presentation to a scientific event	INSTALLATION EUROPEENNE DE RAYONNEMENT SYNCHROTRON	Connecting Research Infrastructure to Industry: The case of the European Synchrotron Radiation Facility (with special emphasis on CALIPSO)	05/09/2013	Athens	Policy makers	30	All European Countries (RINET representatives)
38	Flyers	ELETTRA - SINCROTRONE TRIESTE SCPA	Towards even brighter European Photon Science	01/09/2014	All of Europe	Scientific community (higher education, Research) - Civil society - Policy makers - Medias	30000	All European Countries
39	Posters	ELETTRA - SINCROTRONE TRIESTE SCPA	ESUO poster presentation at IUCr conference	02/08/2014	Montreal, Canada	Scientific community (higher education, Research) - Industry - Policy makers - Medias	500	All European countries + US and Canada

## Section B (Confidential or public: confidential information marked clearly)

LIST OF APPLICATIONS FOR PATENTS, TRADEMARKS, REGISTERED DESIGNS, UTILITY MODELS, ETC.					
Type of IP Rights	Confidential	Foreseen embargo date dd/mm/yyyy	Application reference(s) (e.g. EP123456)	Subject or title of application	Applicant(s) (as on the application)

OVERVIEW TABLE WITH EXPLOITABLE FOREGROUND

Type of Exploitable Foreground	Description of Exploitable Foreground	Confidential	Foreseen embargo date dd/mm/yyyy	Exploitable product(s) or measure(s)	Sector(s) of application	Timetable for commercial use or any other use	Patents or other IPR exploitation (licences)	Owner and Other Beneficiary(s) involved
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ADDITIONAL TEMPLATE B2: OVERVIEW TABLE WITH EXPLOITABLE FOREGROUND

Description of Exploitable Foreground	Explain of the Exploitable Foreground
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## 4.3 Report on societal implications

### B. Ethics

<b>1. Did your project undergo an Ethics Review (and/or Screening)?</b>	No
<b>If Yes: have you described the progress of compliance with the relevant Ethics Review/Screening Requirements in the frame of the periodic/final reports?</b>	
<b>2. Please indicate whether your project involved any of the following issues :</b>	
<b>RESEARCH ON HUMANS</b>	
<b>Did the project involve children?</b>	No
<b>Did the project involve patients?</b>	No
<b>Did the project involve persons not able to consent?</b>	No
<b>Did the project involve adult healthy volunteers?</b>	No
<b>Did the project involve Human genetic material?</b>	No
<b>Did the project involve Human biological samples?</b>	No
<b>Did the project involve Human data collection?</b>	No
<b>RESEARCH ON HUMAN EMBRYO/FOETUS</b>	
<b>Did the project involve Human Embryos?</b>	No
<b>Did the project involve Human Foetal Tissue / Cells?</b>	No
<b>Did the project involve Human Embryonic Stem Cells (hESCs)?</b>	No
<b>Did the project on human Embryonic Stem Cells involve cells in culture?</b>	No
<b>Did the project on human Embryonic Stem Cells involve the derivation of cells from Embryos?</b>	No
<b>PRIVACY</b>	
<b>Did the project involve processing of genetic information or personal data (eg. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)?</b>	No
<b>Did the project involve tracking the location or observation of people?</b>	No
<b>RESEARCH ON ANIMALS</b>	

<b>Did the project involve research on animals?</b>	Yes
<b>Were those animals transgenic small laboratory animals?</b>	No
<b>Were those animals transgenic farm animals?</b>	No
<b>Were those animals cloned farm animals?</b>	No
<b>Were those animals non-human primates?</b>	No
<b>RESEARCH INVOLVING DEVELOPING COUNTRIES</b>	
<b>Did the project involve the use of local resources (genetic, animal, plant etc)?</b>	No
<b>Was the project of benefit to local community (capacity building, access to healthcare, education etc)?</b>	Yes
<b>DUAL USE</b>	
<b>Research having direct military use</b>	No
<b>Research having potential for terrorist abuse</b>	No

## C. Workforce Statistics

**3. Workforce statistics for the project: Please indicate in the table below the number of people who worked on the project (on a headcount basis).**

Type of Position	Number of Women	Number of Men
Scientific Coordinator	5	30
Work package leaders	39	50
Experienced researchers (i.e. PhD holders)	82	170
PhD student	47	46
Other	19	24

<b>4. How many additional researchers (in companies and universities) were recruited specifically for this project?</b>	4
<b>Of which, indicate the number of men:</b>	2

## D. Gender Aspects

<b>5. Did you carry out specific Gender Equality Actions under the project ?</b>	Yes
<b>6. Which of the following actions did you carry out and how effective were they?</b>	
<b>Design and implement an equal opportunity policy</b>	Almost effective
<b>Set targets to achieve a gender balance in the workforce</b>	Effective
<b>Organise conferences and workshops on gender</b>	Not Applicable
<b>Actions to improve work-life balance</b>	Very effective
<b>Other:</b>	gender balance criteria applied in the composition of the selection panel of job candidatures
<b>7. Was there a gender dimension associated with the research content - i.e. wherever people were the focus of the research as, for example, consumers, users, patients or in trials, was the issue of gender considered and addressed?</b>	Yes
<b>If yes, please specify:</b>	Girls days, open days

## E. Synergies with Science Education

<b>8. Did your project involve working with students and/or school pupils (e.g. open days, participation in science festivals and events, prizes/competitions or joint projects)?</b>	Yes
<b>If yes, please specify:</b>	Presentations to PhD students, school visits, open days/Researchers' night, summer schools
<b>9. Did the project generate any science education material (e.g. kits, websites, explanatory booklets, DVDs)?</b>	Yes
<b>If yes, please specify:</b>	wayforlight web tutorials, ppt presentations, lecture booklet for summer schools, educational games

## F. Interdisciplinarity

<b>10. Which disciplines (see list below) are involved in your project?</b>	
<b>Main discipline:</b>	
<b>Associated discipline:</b>	2.2 Electrical engineering, electronics [electrical engineering, electronics, communication engineering and systems, computer engineering (hardware only) and other allied subjects]

<b>Associated discipline:</b>	3.1 Basic medicine (anatomy, cytology, physiology, genetics, pharmacy, pharmacology, toxicology, immunology and immunohaematology, clinical chemistry, clinical microbiology, pathology)
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## G. Engaging with Civil society and policy makers

<b>11a. Did your project engage with societal actors beyond the research community? (if 'No', go to Question 14)</b>	Yes
<b>11b. If yes, did you engage with citizens (citizens' panels / juries) or organised civil society (NGOs, patients' groups etc.)?</b>	Yes - in implementing the research
<b>11c. In doing so, did your project involve actors whose role is mainly to organise the dialogue with citizens and organised civil society (e.g. professional mediator; communication company, science museums)?</b>	Yes
<b>12. Did you engage with government / public bodies or policy makers (including international organisations)</b>	Yes, in communicating /disseminating / using the results of the project
<b>13a. Will the project generate outputs (expertise or scientific advice) which could be used by policy makers?</b>	Yes - as a secondary objective (please indicate areas below - multiple answer possible)
<b>13b. If Yes, in which fields?</b>	
<b>Agriculture</b>	No
<b>Audiovisual and Media</b>	No
<b>Budget</b>	No
<b>Competition</b>	No
<b>Consumers</b>	No
<b>Culture</b>	Yes
<b>Customs</b>	No
<b>Development Economic and Monetary Affairs</b>	No
<b>Education, Training, Youth</b>	Yes
<b>Employment and Social Affairs</b>	No
<b>Energy</b>	Yes
<b>Enlargement</b>	No
<b>Enterprise</b>	No
<b>Environment</b>	Yes
<b>External Relations</b>	No
<b>External Trade</b>	No
<b>Fisheries and Maritime Affairs</b>	No

<b>Food Safety</b>	Yes
<b>Foreign and Security Policy</b>	No
<b>Fraud</b>	No
<b>Humanitarian aid</b>	No
<b>Human rightsd</b>	No
<b>Information Society</b>	Yes
<b>Institutional affairs</b>	No
<b>Internal Market</b>	No
<b>Justice, freedom and security</b>	No
<b>Public Health</b>	Yes
<b>Regional Policy</b>	No
<b>Research and Innovation</b>	Yes
<b>Space</b>	No
<b>Taxation</b>	No
<b>Transport</b>	No
<b>13c. If Yes, at which level?</b>	International level

## H. Use and dissemination

<b>14. How many Articles were published/accepted for publication in peer-reviewed journals?</b>	6
<b>To how many of these is open access provided?</b>	1
<b>How many of these are published in open access journals?</b>	0
<b>How many of these are published in open repositories?</b>	1
<b>To how many of these is open access not provided?</b>	4
<b>Please check all applicable reasons for not providing open access:</b>	
<b>publisher's licensing agreement would not permit publishing in a repository</b>	Yes
<b>no suitable repository available</b>	No
<b>no suitable open access journal available</b>	Yes
<b>no funds available to publish in an open access journal</b>	No
<b>lack of time and resources</b>	No
<b>lack of information on open access</b>	Yes
<b>If other - please specify</b>	
<b>15. How many new patent applications</b>	0

**('priority filings') have been made? ("Technologically unique": multiple applications for the same invention in different jurisdictions should be counted as just one application of grant).**

**16. Indicate how many of the following Intellectual Property Rights were applied for (give number in each box).**

<b>Trademark</b>	0
<b>Registered design</b>	0
<b>Other</b>	0

**17. How many spin-off companies were created / are planned as a direct result of the project?**

0

**Indicate the approximate number of additional jobs in these companies:**

0

**18. Please indicate whether your project has a potential impact on employment, in comparison with the situation before your project:**

Difficult to estimate / not possible to quantify,  
In small and medium-sized enterprises

**19. For your project partnership please estimate the employment effect resulting directly from your participation in Full Time Equivalent (FTE = one person working fulltime for a year) jobs:**

5Difficult to estimate / not possible to quantify

## **I. Media and Communication to the general public**

**20. As part of the project, were any of the beneficiaries professionals in communication or media relations?**

No

**21. As part of the project, have any beneficiaries received professional media / communication training / advice to improve communication with the general public?**

Yes

**22. Which of the following have been used to communicate information about your project to the general public, or have resulted from your project?**

<b>Press Release</b>	Yes
<b>Media briefing</b>	Yes
<b>TV coverage / report</b>	Yes
<b>Radio coverage / report</b>	Yes
<b>Brochures /posters / flyers</b>	Yes
<b>DVD /Film /Multimedia</b>	No
<b>Coverage in specialist press</b>	Yes
<b>Coverage in general (non-specialist) press</b>	Yes

<b>Coverage in national press</b>	Yes
<b>Coverage in international press</b>	Yes
<b>Website for the general public / internet</b>	Yes
<b>Event targeting general public (festival, conference, exhibition, science café)</b>	Yes

**23. In which languages are the information products for the general public produced?**

<b>Language of the coordinator</b>	No
<b>Other language(s)</b>	Yes
<b>English</b>	Yes

<b>Attachments</b>	CALIPSO_Final__attachments_20150722.pdf, CALIPSO_Final_merged_questionnaire.pdf
<b>Grant Agreement number:</b>	312284
<b>Project acronym:</b>	CALIPSO
<b>Project title:</b>	Coordinated Access to Lightsources to Promote Standards and Optimization
<b>Funding Scheme:</b>	FP7-CP-CSA-Infra
<b>Project starting date:</b>	01/06/2012
<b>Project end date:</b>	31/05/2015
<b>Name of the scientific representative of the project's coordinator and organisation:</b>	Dr. Michele Bertolo ELETTRA - SINCROTRONE TRIESTE SCPA
<b>Name</b>	
<b>Date</b>	09/11/2015

This declaration was visaed electronically by Cecilia BLASETTI (ECAS user name nblasece) on 09/11/2015