ELISA FINAL report

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1.1 Executive summary

The ELISA project brought together 17 European synchrotrons and free electron lasers as partner facilities and 4 permanent observers from facilities under construction or in advanced design phase.

Participants were committed to structure the European Research Area by strengthening the links between laboratories, promoting transnational experiments based on scientific merit and supporting cutting-edge instrumentation.

ELISA had a great impact on European users via its Transnational Access program, supporting more than 4300 users to perform more than 2000 experiments, and producing more than 700 scientific publications in peer-reviewed journals. In addition, one of the main spin-off has been the establishment of the European Synchrotron User Organization (ESUO), to answer to users' needs and help them exploit the facilities at best.

Users took advantage also of the scientific and technical developments produced by the Joint Research Activities: new powerful detectors have been realized as well as record-performing X-Rays optics. Feasibility studies for free electron laser operation will benefit the FELs season to come.

Networking Activities promoted standardization and best practice sharing in the field of communicating science to the general public, paved the ground for software collaborations and supported high level schools for present and future facility users.

More generally, facilites grew together along the lines of future collaborations, standardization and best practice sharing. The involvement of facilities already in their early development stage is one of the ELISA flagships initiatives.

1.2 Summary description of project context and objectives

The ELISA (European Light Sources Activities – Synchrotron and Free Electron Sources) integrating activity opens up the world's largest network of synchrotrons and FEL facilities to the entire European user community. It was based on a bottom-up approach targeting a variety of different disciplines.

The project is organized in three main categories:
Networking Activities, to improve documentation and communication, bringing in particular the opportunities offered by the consortium to the attention of new potential users and to the general public;
Transnational Access Activities, to allow users from EU member states and associated states to have their beamtime and travel fully supported by the project, based on the scientific merit of their proposals. This leads to a better integration of national facilities and avoid duplication of efforts.
Joint Research Activities, to bring together scientists from different facilities and countries with common objectives in instrumentation and method development; the results will benefit all network members and again contribute to their integration.

Besides the goals of the single activities, the overall objective of the I3 Consortium was to contribute to the structuring of the ERA (European Research Area) by strengthening the links between the facilities and develop a long-term integration vision on integration on a pan-European scale. Facilities under commissioning or advanced design phase are therefore welcome to join the Consortium as observers in order to facilitate the full exploitation of their innovative potential.

1.3 Description of the main S&T results/foregrounds

1.3.1 Management

The ELISA Consortium brings together all European synchrotrons and free electron lasers providing open access to the best researchers solely based on scientific merit. The ELISA one is the world's largest research infrastructure network and its management can be defined "challenging".
The Coordinator role is twofold: it must ensure a smooth project workflow providing day-to-day administrative and scientific support, but in the same time it must foster innovative initiatives to fully exploit the network's capabilities.
ELISA partners benefited from good practices learning during previous experiences: I3 IA-SFS was chosen among the 40 most successful FP6 projects; more generally, lightsources are by construction open to external inputs and networking.

One of the first innovative initiatives has been to increase from 3 to 5 the user delegates with full voting rights, including vote on budget and strategic issues, in the ELISA Council.
This user delegates team achieved a critical mass and generated, already in the 1st project year, a grass-root initiative: the "European Synchrotron User Organization" (ESUO: www.esuo.org). described in more detail below. The main lines of actions have been to help the creation of national synchrotron users organization and to monitor needs and critical points of transnational open access at European level. In the years to come ESUO is expected to have an even larger structuring effect on the completion of the European Research Area. Its budget was derived from the Management one thanks to cost-saving organization of project meetings and hosting of ESUO meetings by different project partners.

The synchrotrons and free electron lasers community always welcomed new facilities with a pure networking spirit, and during ELISA 4 additional facilities were accepted as permanent observers to project meetings: the free electron laser FLARE (The Netherlands), the SOLARIS synchrotron (Poland), the European XFEL (Germany) and the Accelerator Centre TAC (Turkey). These are facilities in advanced design or commissioning phase: their early involvement in Pan-European strategies and initiatives will certainly help finding their role in the ERA framework.

The most recent user-friendliness initiative has been the creation of the wayforlight (www.wayforlight.eu) website (Fig.1), which can be considered a spin-off of ELISA and was published shortly after the end of the project. This website will act as a single entry point for all present and potential users of European lightsources through interactive search and training, standardized description of all experimental possibilities and – at a later stage – unified portal for proposal submission.

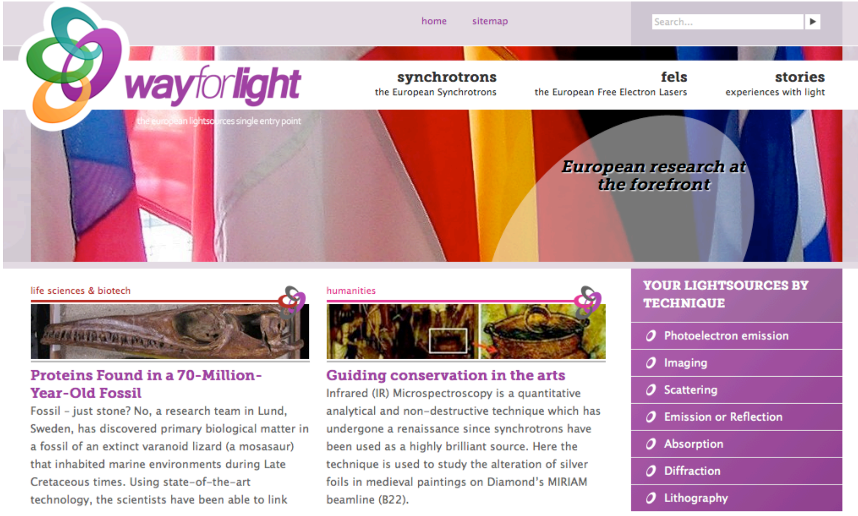


Fig.1: The wayforlight website homepage.

1.3.2 ESUO

The European Synchrotron User Organization (ESUO) has been established in spring 2010 as a body representing the users' interests in the European process of development of a Pan-European Research infrastructure of Synchrotron and FEL radiation. ESUO is composed by delegates from 23 European countries and the chairs of facility user organizations with an Executive committee of 7 members. At present the organization is headed Ullrich Pietsch from Germany (chair) and Malcolm Cooper from UK (vice-chair). ESUO represents at least 10,000 users of light sources throughout Europe who, in their mixture of long-, medium-, and short-term research projects, have enormous impact on all society's grand challenges, such as energy sources, healthcare, and the environment. ESUO has to consider the different degrees to which users are organized in the European countries; only six out of twenty five countries have active National User Organizations and only about ten provide national funding for experiments with synchrotron and FEL radiation. It is important to know that users of different countries have different experience with the system of beam time application. In contrast to users from countries with national sources which use the system frequently users of other countries may have difficulties to write proposals and find the appropriate station for their experiment. Therefore the action plan of ESUO envisages support of national synchrotron user organizations in order to strengthen their capability to influence national support programs for SR experiments and the collection and publication of unified technical beamline information to make writing proposals better informed and more effective.


Fig. 2: Snapshot of the 1st ESUO meeting in Lisbon

Austria		160	YES
Belgium		80	coord board
Czech Rep.		65	network
Denmark		335	YES
Estonia		30	no
Finland		100	YES 2010
France		1500	no
Germany		3000	YES
Greece		50	no
Hungary		60	no Syn Comm
Israel	nb		
Italy		1000	no Soc SR
Lithuania		25	no
Netherlands		175	no Res Counc
Norway		100	no
Poland		160	YES
Portugal		120	no
Serbia		30	no
Slovakia	nb		no
Spain		500	YES
Sweden		500	no
Switzerland		500	no
UK		1500	no
Ireland		70	no
total		10.000	

Fig. 3: User estimate 2010

In this sense, ESUO activities were always linked with the mission of ELISA. ESUO members are members of ELISA council. Main ESUO´s actiions were focussed on member activities (two meetings: Lisbon Jan 2010 and Warsaw Nov 2010) and coordination with directors of Light Source facilities (three meetings – Soleil June 2010, ESRF Nov 2010, DESY May 2011). At ESUO annual meeting the national delegates reported the number of active users, the level of national user organization and the amount of funding of light source experiments by national programs. Table 1 shows the approximate number of synchrotron users per country in 2010. Additionally the delegates discussed the structure of the ESUO website and made proposals for better feedback with light source facilities. The web-site www.ESUO.org has been launched meanwhile on voluntary basis.

Fig. 4: Delegates discussing at 2nd ESUO meeting in Warsaw

The meetings between ESUO Executive committee and the directors of Light source facilities revealed a platform for exchange of information about realization of Transnational Access in ELISA and its reflection to user community. There was extensive discussion of consequences of the limited budget for Trans National Access (TNA) allocated in successive phases of EU frame works. The point was emphasised that it hampers the best science being performed, especially when the proposals come from the considerable number of countries lacking research funding and/or a national facility. The participants unanimously agreed that "absolute excellence" was always the desired basis for allocating beamtime, independent of funding. EU funders would insist on scientific excellence and there was some discussion as to how this would be demonstrated (peer review of proposals beforehand, impact afterwards). The participants came in agreement to coordinate the activities between facilities and user organisation and discussed different scenarios of defining a common approach of infrastructure of synchrotron radiation and free-electron lasers in Europe in the framework of FP8. The vision of development of a European Research infrastructure for Light source experiments has been shared with members of EC commission during a visit of a delegation of ESUO and Facility directors at the European headquarter. Together with D. Pasini and C. Kurrer alternative approaches for future funding mechanism have been discussed.

1.3.3 NA1 – Communicators

Each light source facility in Europe carries out some form of communication with its key audiences – shareholders, staff, users, general public etc. The size and function of the communications departments at each facility vary widely; from teams of 10+, including both those with a science background and those with a communications background, to single-person operations working only part-time as a communications officer. It is generally agreed between these communicators that although each facility has its own unique attributes and operation-style etc. there are many aspects where best-practice can be shared. This is particularly true with communications efforts, where many of the key messages of the facilities are the same or similar. There is a belief that by working together where appropriate on communications activities, efforts and impact can be strengthened.

The ELISA NA1 work package set out to address this belief and create a network of communicators based at light source facilities across Europe. This network would work together to ensure that European light sources are making a proactive contribution to communicating to the public scientific results, at a national, European and international level. Communicators from 13 European light sources were invited to play a part in NA1; all have remained involved in some way – either proactively or by being kept informed of the network's progress, with an opportunity to contribute at any point. It was agreed that the members of the network would meet three times over the 30 month period, with specific topics for discussion, desired outcomes, and speakers for each meeting.

The network had set out three sub-objectives, which it aimed to address at each meeting and through the duration of the project:

Review and assess activities at synchrotrons in Europe, share best practices, identify projects and collaborations to disseminate the importance of the research taking place at each facility through visits by the media, stakeholders, students from universities and the general public at large.

In order to share best practices, it was felt that there needed to be a review of the current status of each facility's communications activities. This was carried out independently and the results shared amongst the network members. The report provides a useful overview of the resources available to each facility, and how they prioritise their communications activities. It created the opportunity for smaller teams in Europe to strengthen their communication activities; it helped to make the case for better resource allocation. The meetings also provided an opportunity to share experiences; discuss what works well and lessons learned.

A significant outcome of the network is the opportunity to exchange team members. During the NA1 work package, Diamond Light Source hosted staff from two other light source facilities. This idea is being taken forward as something to continue between facilities in the future.

Develop a strategy for the synchrotron light sources' community to optimise their communications' activities so that their national profile will incorporate a clear European identity, thus setting a precedent for long-term collaboration.

With a sounder knowledge base of each facility's communications priorities, it was possible to identify areas and projects where the network members could work together to achieve their objectives. During and following the third network meeting, a plan of joint activities for 2011/2012 was drawn up and is now underway. These activities take a variety of forms, targeting a number of key audiences, all with the ultimate aim of working together to disseminate the importance of the research taking place at each facility.

The creation of the network led to a joint presence at the EuroScience Open Forum (ESOF) 2010 in Turin, Italy, where a number of the facilities worked together to present seminars about light source science to a general audience. It also enabled a joint proposal to the American Association for the Advancement of Science (AAAS) 2012 meeting in Vancouver, Canada, about the Bragg centenary, but which was unfortunately unsuccessful due to a large number of applications.

The network also commissioned an audit of social media across Europe to help identify where best to target efforts in terms of achieving online science coverage and comment.

Develop concepts for novel tools that light sources throughout Europe can use for setting up efficient visits: interactive scale models, hands-on experiments, table-top demonstrations etc. Following the meetings, the network has shared resource and educational worksheets with content applicable to each facility. As part of the 2011/2012 activities, the network is also working on the creation of a travelling exhibition that could be used as a shared communication tool to highlight the importance of synchrotron science in general, as well as being suitable for adaptation for individual facility use.
It has been stated during and following each meeting that the chance to get together with fellow light source communicators is invaluable; a great opportunity to exchange ideas, contacts, positive and negative experiences, and increase the impact of light source communications activities. ELISA NA1 has served as a launch pad for forming an active and effective network of communicators at European light source facilities, the members of which will continue to work together to communicate the importance of light source facilities and transnational access.

1.3.4 NA2 – VEDAC

Introduction

Experiments performed at synchrotron light facilities produce huge quantities of data which allows determining the structure of matter ranging from proteins to fossils. These data need to be analysed online and offline, requiring considerable computing power and network bandwidth. Prominent examples are tomography, crystallography, and other imaging experiments. In the future, the amount of data will increase drastically due to the increased efficiency of the light sources (synchrotron and free electron lasers) and the new generation of detectors (pixel detectors, fast time resolved measurements) currently coming into operation. Sometimes complex computational operations are required to convert the raw experimental information to the final scientific results. Increasingly, it will exceed the capabilities of typical university computational facilities to go the classical route of transferring the data to the home institution to perform the final analysis. This is why the Research Facilities have decided to come together and to work towards the creation of a Virtual European Data Analysis Centre (VEDAC) for Photon Science. The VEDAC networking activity has been the first step towards this long-term goal and has allowed determining common points of interest and identifying the most pressing problems, created by data intensive X-ray detectors, in the participating facilities.

Outcome

The first information and coordination meeting of the VEDAC consortium allowed to have a broad overview of the IT activities in the laboratories and to come to the conclusion that two fundamental building blocks are essential to pave the way for future collaborations: a common AAI (Authentication and Authorisation Infrastructure) and a common data format.

AAI being a complex issue, it has been decided to leave this subject for another EU project, and AAI was indeed included in the PaN-data project (Photon and Neutron Data Initiative). The data format discussion has been taken further within VEDAC and led to the workshop entitled "HDF5 as hyperspectral data exchange and analysis format" in Grenoble from January 11th to January 13th, 2010. The workshop concluded that there is consensus on the HDF5 data format and wherever possible also NeXus, but that many technical issues remain to be settled. Metadata definitions describing the most common experimental setups in the facilities need to be defined and agreed upon.
A second workshop took place on the 3rd and 4th February 2011 at RAL entitled "Sharing code and Eclipse plug-ins for Science". The workshop allowed establishing an agreement for a collaboration based around the Eclipse architecture with the goal to share well documented data analysis code. This initiative is producing first results with developments shared between DIAMOND, ESRF and EMBL/Grenoble. As a result of this workshop these three institutes have decided to collaborate on the development of a tool for data visualisation, workflows and scripting. The tool is based on the Eclipse/RCP workbench and is an open source project. The ultimate aim is to have high quality software for visualising large data sets and running data analysis codes and scripts to rival with and complement commercial tools like Matlab. The three institutes will contribute their separately developed source code to one project from January 2012 onwards under the code name of DAWN (Data Analysis WorkbeNch). The code will be publicly available on GitHub. The collaboration is open to all institutes doing synchrotron science in Europe and could potentially have a large impact.
The VEDAC coordination meetings allowed defining the priorities for future software developments which strongly influenced the contents of the PaN-data ODI[1] work programme and also the IT part of the CRISP[2] project.

Perspective

The VEDAC networking activity has highlighted the need and potential for software collaborations with the aim to develop or enhance data analysis programs. The report on the perspectives for common software developments lists a number of on-going initiatives but shows also that there is potential for much more. The PaN-Data ODI and CRISP FP7 projects have started and will continue to bring the computer scientists of the large research infrastructures together to work on the AAI, common data formats, data management and data continuum, and a common software repository. Many of the collaborations targeted on specific developments for data analysis code will continue, others are likely to fade away. Software collaborations are notoriously difficult for a number of reasons, and one of the obvious and easily achievable improvements would be higher visibility and stronger support from the top level managements of our laboratories. Networking activities like VEDAC are essential to foster and encourage software collaborations.

[1] PaN-Data ODI – Photon and Neutron Open Data Initiative, FP7 Project, Grant Agreement 283556, http://www.pan-data.eu/
[2] CRISP – Cluster of Research Infrastructures for Synergies in Physics, FP7 Project, http://www.crisp-fp7.eu/

1.3.5 NA3 – PUSH

Introduction
PUSH is a network uniting researchers using pulsed hard- and soft x-rays for their experiments.
Originally it had started out with the aim to construct common scientific equipment, but due to budget cuts was changed to a mere network project. The goal was to exchange information, and know-how, to organize conferences and workshops and to educate students for current and future x-ray experiments.

Outcome
The PUSH networking activity allowed financing a variety of events. These included a dedicated kick-off meeting of all PUSH partners which took place at PSI, co-sponsoring of workshops at DESY and ETH-Zurich, travel of PhD students to take part in FEL experiments.

Through the network the leading scientists in this field in Europe had the opportunity to discuss their present work. This initiated various discussions on the future challenges for the European XFEL, FERMI@ELETTRA, FLASH, SwissFEL, Soleil, SPF at MAX-IV, and BERLinPro.
The PUSH network approached the EU project IRUVX-PP– the "Preparatory Phase of the EuroFEL Consortium" of the ESFRI roadmap 2006 coordinated by DESY. A letter of intent was submitted for the directors meeting (25 to 26 November, Paul Scherrer Institute, Switzerland). PUSH wants to become part of this initiative with the goal of realizing common hardware for time resolved x-ray experiments.
IRUVX-PP is currently transforming into a collaboration based on a common memorandum of understanding which is currently being negotiated among the directors of the participating institutes.
The PUSH scientists are looking forward to this new phase of IRUVX-PP and to being part of a common initiative

Perspective
Ongoing and future projects for pulsed x-ray science will profit from the interaction and the personal contacts which were established or reinforced by the PUSH network. This will have a direct influence on diagnostics, endstation design, and common scientific projects.
If IRUVX-PP enters a new phase PUSH members will be an active part of this pushing the development of novel instrumentation and uniting European forces for science based on <u>pu</u>lsed <u>s</u>oft- and <u>h</u>ard x-rays (PUSH).

1.3.6 NA4 – HERCULES

The main aim of the HERCULES Course (Higher European Research Course for Users of Large Experimental Systems) is to train young European researchers (PhD students, postdoctoral scientists) to optimally use the state-of-the-art instruments at the present and future Large Installations (LI) that deliver synchrotron radiation (SR) or neutrons (n). During the 2,5 years of the project, HERCULES Annual Sessions trained 211 full time participants and 20 part time participants to use the exceptional infrastructures at LI, as well as their associated high-level human potential
The HERCULES (HAS) lecture programme involved every year from 58 to 67 lecturers with recognized expertise and chosen among the best European specialists with a range of 11 nationalities: 64% European or associated countries, 32 French, and 4% third countries; for

special topics where European expertise is not leading, we have selected some lecturers from the USA.
Concerning the technological point of view, the integrated practical training on high performance instruments represented 40 % of the training time of this annual session. More than one hundred teachers of practicals and tutorials were involved. This exceptional experimental training in groups of 4 participants given by teaching staff belonging to the L.I. is a very original and significant feature of the HERCULES training course. The participants have benefited during the 3 sessions of an exceptional experimental and technological training on the state of the art instruments/beamlines equipped with up-to-date optics, detectors and data acquisition devices in the five partners L.I. of neutrons and synchrotron radiation: ESRF, ILL, ELETTRA, SOLEIL and LLB. They have been formed by top level European beamline scientists.
The poster sessions with 228 posters (out of a total of 231 participants) covering various scientific fields represented in itself a rather exceptional scientific event were organised during the 3 HERCULES Annual Sessions.
More generally speaking, the foreground of the 3 HERCULES annual sessions concerned the pertinent association of lectures, tutorials and practicals in the two main fields (S.R. and n.) but more especially on soft X-rays, ultraviolet and infrared synchrotron radiation, for one week in the site of Saint Aubin. The HERCULES sessions have covered until now largely hard X-rays and at present it is crucial to prepare the n. and S.R. young researchers community to the applications of low and medium energy machines (DIAMOND, Spanish source CELLS, SOLEIL, ELETTRA, SLS, BESSY II, MAX II). The association of SOLEIL during the 3 years of the project for this specific experimental training and the ICTP centre (where schools on S.R. have been organized for participants of developing countries) for lectures and tutorials, was a key ingredient for the success of this operation. In parallel, the complementary number of participants interested by a reinforced neutron experimental programme (mainly practicals and tutorials), had the opportunity to benefit from special training during the same week at LLB. This practical and technological training at LLB composed of projects associating instrumentation, practicals and tutorials of one day duration was greatly appreciated by the participants. The detailed information about HERCULES school can be found at the HERCULES school website: http://hercules-school.eu/
3 HERCULES specialized one week courses were organized during the 2,5 years of the project: the HSC11 “Application of neutron and synchrotron radiation to magnetism” from 16 to 20 November 2009, the HSC12 “Synchrotron Radiation and Neutron for Extreme Conditions Studies” from 27 September to 2nd October 2010, the HSC13 “Neutrons and Synchrotron X-rays for Industrial Applications” from 2nd to 4th May 2011. The Hercules specialized courses retained the importance of the practical using the state-of-art instrumentation, enabling the most recent developments on selected topics to be explored in greater depth. The 3 HERCULES specialized courses brought together 72 young researchers and involved some 52 lecturers and practical teachers.
All the 3 HSCs corresponded to a request from the students and colleagues of being able to go deeper on selected topics. The HSCs also respond to a demand of scientists and engineers working in industrial R&D units, aiming to acquire, within a short delay, all the knowledge necessary to solve a given applied problem.
These one week courses retained the successful scheme of the general course, by combining theoretical and tutorial courses with practical lessons performed using neutrons and/or synchrotron radiation on state of the art instruments/beamlines. The practicals took place at the European neutron (ILL) and synchrotron radiation (ESRF) facilities located in Grenoble. The poster sessions were organized also during 2 specialized courses with 30 posters.

The detailed information about HERCULES specialized courses can be found at the HSC website: http://www.esrf.eu/events/conferences/HSC/AboutHSC.

1.3.7 JRA1 – FELINS

1. Motivations

The Free Electron Laser (FEL) and the seeded-FEL require novel instrumentation and diagnostics. The spatial and temporal distributions of the electron beam necessary for lasing ask for very high resolution measurements and the FEL produced photon beam need a new class of detectors.
The main objective of the JRA-FELINS is to study and to propose the development of suitable diagnostics for free electron lasers working in the VUV to soft X-ray range. Emphasis has been placed on special diagnostics required for the characterization and operation of seeded FELs which are currently under development at SPARC, FERMI@Elettra and FLASH. An important goal of this JRA was to initiate a long-term collaboration of the FEL facilities in Europe in this area.
The work has been divided in three main activities: the electron and photon beam profiling, the synchronization and FEL photon diagnostics.

2. Main steps and results

Transverse electron and photon beam profiling

Controlling the spatial profile of the electron beam and the photon beam at the entrance and exit of the first undulator section in a seeded FEL configuration is crucial for stable and reliable user operation.
Initially, to commission the FEL and to optimize its operation, intra-undulator beam profile diagnostics using multiple screens is proposed. Special targets with different response function to electron and photon pulses will be compared.
It is important to develop also non-destructive beam position monitors which can be used online during operation. At FLASH, a non-disruptive, intra-undulator profiling of the electron beam is carried out using wire scanners, where e.g. a thin tungsten wire (10um) is moved transversely across the electron beam, while the secondary radiation is monitored with a photomultiplier arrangement. Similar to the detection of the electron beam profile, the metal wire could also be used to measure the transverse profile of the HHG beam with high resolution if scattered VUV-photons were detected by backward mounted micro-channel plates (MCP). Using the same wire for both measurements would provide precision information about the spatial overlap between electrons and photons without interrupting the machine operation.
Within this project, a compact wire scanner chamber has been studied, which accommodates wire scanners in both x and y-direction including the MCP detector units optimized for weak photon beams as expected from high laser harmonics down to 12 nm.

Synchronization

This activity aims at obtaining general synchronization among laser pulses, RF fields and LINAC electron bunches with the external laser seeding pulses on the femtosecond scale. The study of temporal profile monitors for electron and laser pulses will be carried out. Methods and instrumentation to measure shot by shot the phase deviation between laser and electron bunch with a resolution in the 10 femtosecond range has been studied. The set up consists of a resonant bunch monitor and a fast light pulse detector. The bunch monitor is based on a RF cavity placed along the beam trajectory to capture the bunch passage and convert it into an electro-magnetic oscillation whose phase is measurable and contains the information on the bunch phase. The laser pulses are converted in RF electric signals by means of a fast photodiode coupled with a tuned RF cavity in order to create the sinusoidal signal. The phase difference between laser and bunch signals is measured using microwave mixing techniques.

The triggering of time resolved techniques with the FEL pulse with femtosecond precision is another crucial point for diagnostics and experimental support. For this reason the study of an ultra-fast photo-detector is proposed to measure the arrival time of the individual FEL photon pulses in the VUV and soft X-ray. To overcome the accuracy limitations of the commercially available detectors a new design in which the ultra-fast photo-detector (>100 GHz) incorporated into coplanar waveguide (CPW) structure, etched onto an electro-optically active substrate has been proposed. The electro-optical substrate allows the detection of the photo-current induced electric fields in the vicinity of the photosensitive area using the polarization change induced in a probing laser pulse. Ultra-fast RF pulses of below 5 ps (FWHM) duration and RF frequencies beyond 300 GHz frequencies have been measured using this technique. The probing laser beam can be the laser pulses used to synchronize the FEL facility (1550 nm). Due to the step transients of the signal a timing resolution below 100 fs toward the 10 fs range is feasible.

Characterization of FEL pulses

This activity deals with the study of a special photon diagnostics system for a comprehensive characterisation of the seeded FEL pulses at SPARC. Close interaction with FLASH make sure that their experience with similar systems is exploited to propose an advanced diagnostics system. It includes a cross-correlation system for measuring the energy and temporal structure of the FEL pulses, an improved wave front sensor to determine the intensity distribution in the gas target and a spectrometer to measure the spectral distribution of seed and output radiation pulses.

An instrument for photon diagnostics based on the ionisation of rare gas atoms has been studied. The instrument consists of: (I) a UHV interaction chamber equipped with a multi-diagnostic tool for achieving spatial and temporal overlap of the beams, (II) a photo-ionisation detector based on an appropriate time of flight (TOF) analyzer and fast detector; a proper choice of the entrance lens of the instrument may allow the detection of both electrons, whose spectrum can provide information on the duration of the FEL pulse, and ions which can provide information on the intensity of the pulse, (III) a fast photon detector to exploit optical cross correlation techniques with the FEL radiation below the first ionisation potential of the target, (IV) an adjustable gas inlet, (V) optical and mechanical alignment tools for UHV chamber positioning with respect to the FEL beam and the external optical laser. The instrument is complemented by spectrometer to measure simultaneously the spectral distribution of the FEL radiation pulses.

A prototype wave front sensor for the soft X-ray spectral range, approx. 7-40 nm, has been extensively tested at FLASH in a collaboration of DESY, LOA, SOLEIL, and Imagine Optic. This wave front sensor could be demonstrated to be a very valuable tool for characterizing and aligning the different FEL beam-lines and to determine e.g. the intensity distribution in a tight focus which cannot be measured directly due to the high power density. The technique has thus proven very useful for soft X-ray optics as well as beam characterization; however the current design has several drawbacks limiting its applicability for FEL's, such as long readout times of several seconds and large physical dimensions.

A new prototype sensor specific for FEL applications has been studied incorporating a gated system allowing the study of individual pulses in long FEL bunch trains time resolved. Thus, the behaviour of the wave front within a bunch train or its deformation due to heat loads on optical elements has been studied. Secondly, the spectral sensitivity has been extended down to 2 nm allowing the wave front sensor to be used as an alignment tool at the new facilities. Finally, a much more compact design is envisaged to increase the wave front sensor's flexibility as an optical characterization tool for user experiments and a multitude of FEL and synchrotron sources.

1.3.8 JRA2 – HIZPAD

1. Motivations

X-ray pixel detectors are promised to a great success on synchrotron beamlines owing to their unique detection capabilities, in particular a readout noise free data collection and a high data acquisition rate. Their recent introduction on beamlines is indeed revolutionizing both scientific perspectives and experimental methods in many fields of synchrotron and FEL science. However these devices being based on silicon sensors lack detection efficiency for energies up to 20 keV. More absorbing, high-Z semiconductor sensor materials like CdTe, CZT, or GaAs, must be used in order to access higher energy ranges up to 100 keV and more as required in particular for material science experiments.
The HIZPAD (HIgh-Z Pixel Array Detectors) JRA was therefore initiated with the aim of evaluating the capabilities of current state-of-the-art high-Z pixel sensors technology, for application to high-energy X-ray detection at SR and FEL sources. HIZPAD gathered the major European SR sources as well as leading European institutes and companies in the field of pixelated semiconductor detectors.

2. Main steps and results

In order to start the JRA activity on reliable grounds the workprogramme started with an extensive survey of the high-Z pixel sensors field : high-Z pixel detector needs for SR and FEL sources (carried out by SOLEIL synchrotron), high-Z materials characteristics and sensors suppliers (FMF - Freiburger Materialforschungsinstitut, University of Surrey), and high-Z pixel sensor hybridization technologies and suppliers (STFC). This survey clearly showed that in the time frame of the JRA, CdTe and possibly CZT were the only viable options as the pixel sensor material. It also allowed us to identify the most advanced industrial providers for high-Z sensor materials and processing.

After assessment of the sensor materials electrical performance (University of Surrey, FMF), a collection of CdTe pixel sensors with pixel pitches from 55 to 172 µm and detection areas from 2 to 14 cm^2 were produced by X-ray Imaging Europe (XIE) and coupled to TIMEPIX, XPAD, and PILATUS pixel readout chips. CdTe linear microstrips connected to a MYTHEN readout system were also produced by the Paul-Scherrer Institute (PSI, Switzerland). A few CZT sensors were also made for further evaluations.

The CdTe assemblies were then integrated into detector demonstrators and an extensive characterization work was carried out at ESRF, DESY, SOLEIL, DLS, PSI. Among the large amount of data produced, the following results can be outline:
Although made of the highest available material grade, all of the produced CdTe devices exhibit defects of various types and quantities, the origin of which is still to be identified. The

sensor coupling to the readout chips remains a delicate operation and some failures were experienced.
We obtained a spatial resolution of 65 µm (PSF FWHM) on a CdTe pixel device in the 22-90 keV energy domain. At 22 keV the spatial resolution is even found slightly better than with silicon pixel devices of same pixel size.
In a powder diffraction experiment carried out at ID11 ESRF materials science beamline, we compared a CdTe pixel demonstrator with a CCD-based X-ray detector of similar pixel size. At 50 keV the CdTe pixel device showed 10-times higher detected signal, as well as better spatial resolution and nearly complete background cancellation (Fig.1). The main limitation of this device is at present the small detection area, preventing the acquisition of complete diffraction spectra within a single frame.

3. Conclusion

The HIZPAD collaboration demonstrated the feasibility as well as the advantages of high-Z pixel devices for SR/FEL applications and more particularly for materials science. A key result is the dramatic increase in detection efficiency without loss in spatial resolution. Developments initiated in HIZPAD will be continued in the next years with a focus on the reduction of sensor defects as well as on the increase of detection areas.

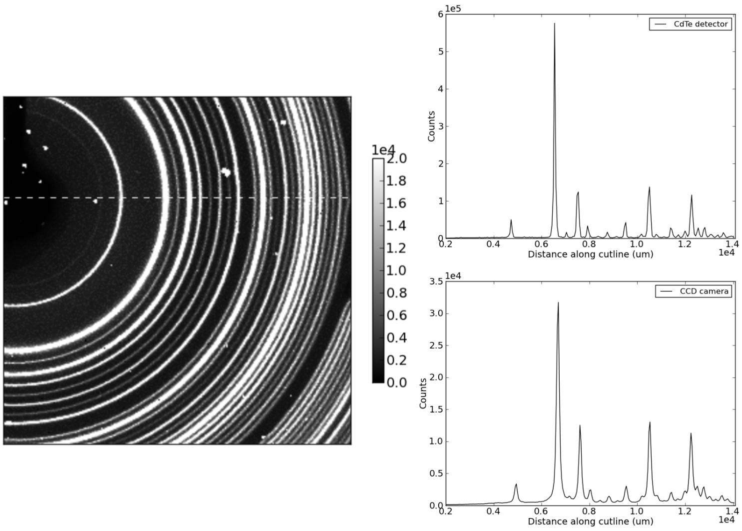


Fig.1: Diffraction pattern of a YB2O3 nanopowder acquired with a CdTe/TIMEPIX pixel detector demonstrator. Top-right : Cross-section along dashed cutline of diffraction pattern. Bottom-right : cross section in same portion of an image acquired with a CCD detector of same pixel size.

1.3.9 JRA3 – NanoFOX

The use of X-ray wavelengths offers, in principle, the prospect of achieving spatial imaging resolutions which could be 2-3 orders of magnitude better than the highest performance conventional visible light microscopies. Unlike their visible light counterparts however, the performance of X-ray optics for microscopy applications is still largely dictated by manufacturing limitations. Improvements in the optics processing and new manufacturing techniques can therefore yield immediate benefits in the capabilities of the X-ray microscopes both through improved imaging resolution and/or increases in the useful photon flux which is transmitted by the focusing element. The NanoFOX JRA was intended to enhance these fabrication aspects and shorten the development cycles for new and improved optics. In recent years, higher performance X-ray focusing optics have been one of the key enabling technologies behind the widespread application of micrometre and nanometre scale X-ray studies of heterogeneous and small samples. The availability of improved X-ray focusing optics is consequently of interest for applications including the engineering, life, chemical, physical and environmental sciences. Often improved quality optics can be implemented relatively rapidly into existing light source end stations without the need for extensive redesign and consequently advances in this field can have an impact upon scientific productivity within months of their development.

NanoFOX aimed to develop the technologies needed for the fabrication of nanofocusing X-ray optics capable of spatial resolutions down to 10nm. The workpackage tasks included developments of three approaches towards X-ray nanofocusing based upon alternatively, diffractive (Fresnel), refractive and reflective optics. The JRA gave the opportunity to explore several promising processing technologies to assess their potential for production of improved optics. Apart from advanced process development, the tasks also produced high performance X-ray optics which were deployed for routine operation at both 'soft' and 'hard' X-ray beamlines. A goal for attaining 10 nm or lower spatial resolution was set and was accompanied by other targets aimed at producing improved focusing optics for intermediate resolutions. In order to shorten development cycles, a rapid-access optics test infrastructure was established which allowed regular testing of the prototype optics. In particular this permitted the optimisation of key processing variables to ensure improved optical performance of the final devices.

Summarised below are some of the principle S&T results of the JRA organised according to the principal themes of the workpackage tasks.

Diffractive Optics
High quality line-doubled Fresnel zone plate fabrication (Figure 1) (PSI-SLS). Demonstrated sub-15 nm resolution at X-ray energies of 6 keV (see Figure 2) using iridium zone structures. Sub-10 nm resolution was also demonstrated at lower (1.2 keV) X-ray energies.
High-order gold zone plate fabrication for resolution improvement (HZB). 10 nm image resolution has been demonstrated at photon energies of 700 eV using the 3rd diffraction order of a single layer gold zone plate objective with 20 nm outermost zone width at the HZB transmission X-ray microscope (TXM) (see Figure 3).
Fabrication of diffractive optic elements using gold, platinum or tungsten as phase-shifting materials (MaxLab-KTH). Development of software allowing the simulation of the X-ray interactions with such complex diffractive structures. Figure 4 shows a high-quality, 90 nm thick tungsten grating structure with 12 nm half-pitch period.

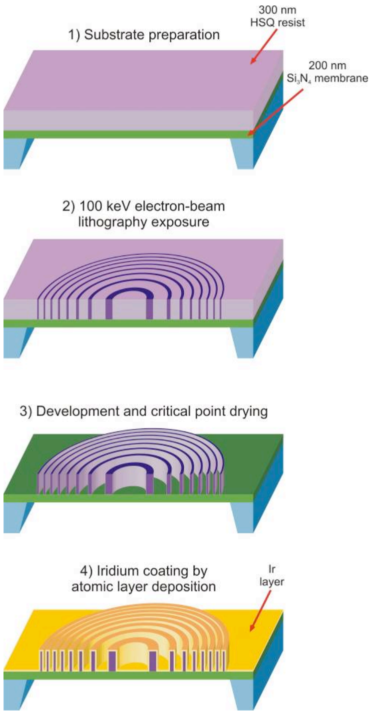


Fig. 1: Fabrication scheme of the line-doubled Fresnel zone plates.

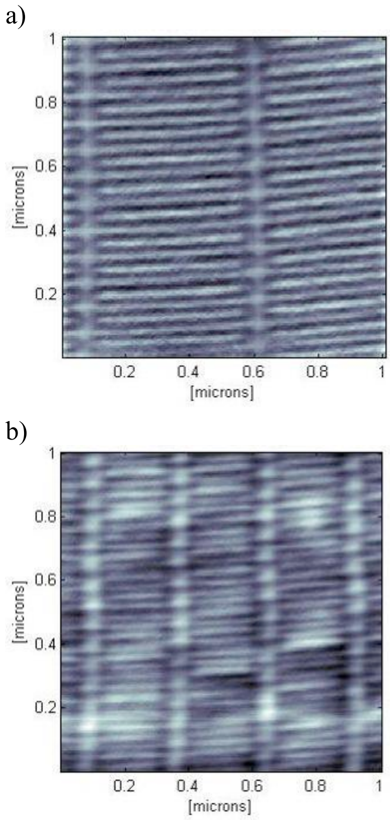


Fig. 2: STXM micrographs of test structures with (a) 20 and (b) 15 nm lines and spaces acquired using a line-doubled FZP with a diameter of 100 µm and an outermost zone width of 15 nm.

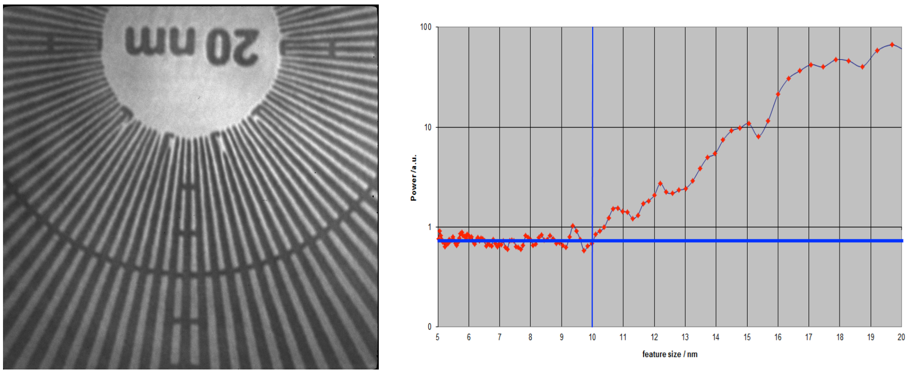


Fig. 3: **left:** X-ray microscope (TXM) image of a gold Siemens star with a smallest feature size of 20 nm. Parameters: Photon energy E = 700 eV, E/DE = 13800, exposure time 30 s, pixel-size 2.0 nm. **right:** Power spectrum calculated from the TXM image. The cut off frequency corresponds to a smallest feature size of 10 nm.

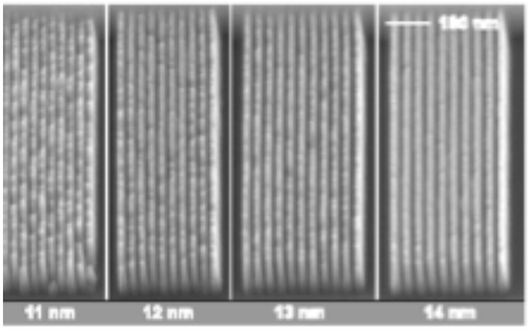


Fig. 4: Very high resolution tungsten gratings with half-period ranging from 11 to 14 nm with height of 90 nm. For the good-quality 12-nm half-pitch grating this corresponds to an aspect ratio of 7.5 - a unique result for patterning at these dimensions.

Planar Refractive Optics

Production, based upon deep X-ray lithography, of polymer-based large-aperture 'clessidra' lens systems aimed at prefocusing or collimating the X-ray beam (ELETTRA). The process has the particular attraction that, once optimised, the mask can be reused to replicate cheaply many lens structures rapidly and repeatedly. Figure 5 shows the central portion of one of these lenses manufactured from SU8 photoresist.

Improved process parameters for Silicon nanofocusing lens structures giving better lens shape precision and reduced aberrations (TU-Dresden). Technique developed to protect the lens structures from dust particles and facilitate automatic lens alignment by implementing a glass cover connected with the front-side surface by anodic wafer bonding. First high-quality prototype adiabatic focusing lens (AFL) structure fabricated (Figure 6) providing an important step towards improved numerical apertures, and hence smaller spatial resolutions, for this class of optic.

Fabrication of complex kinoform refractive lens structures in order to improve lens transmission and increase the optical aperture (Diamond Light Source). Figure 7 shows the current lens designs which have demonstrated line-focusing of 8 keV X-rays to a FWHM beam size of 225 nm with good flux transmission over a large aperture. By decreasing the radius of the nano-focusing lens to R = 0.5 µm, rather than using refractive arrays, two element optics with focal length of only f = 75 mm have been obtained.

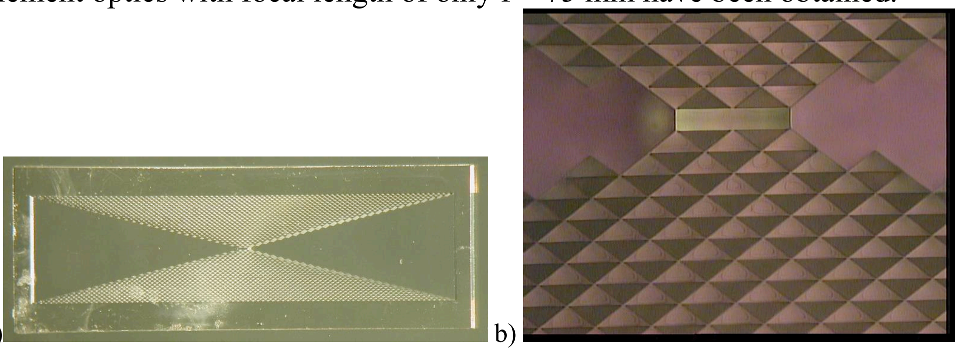
a)  b)

Fig. 5: Optical micrographs of a 8 mm long 'clessidra' lens with 2 mm aperture a) the entire lens in its supporting frame b) the central zone of. the lens. The base of the individual triangular refractive elements is approximately 100 µm long.

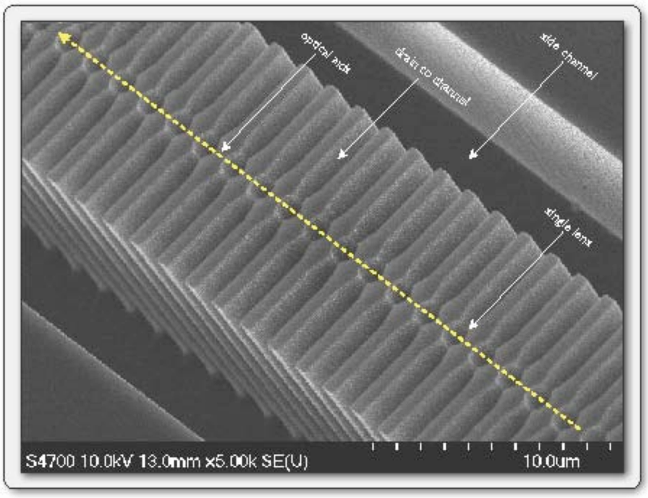
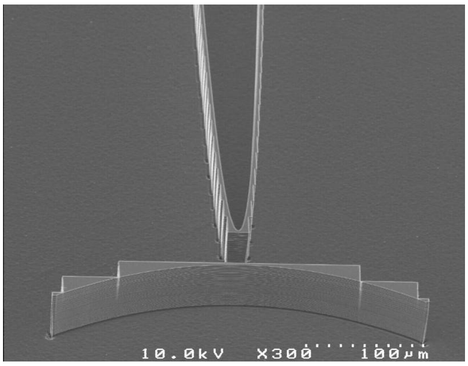


Fig. 6: SEM image of a part of an adiabatic focusing lens (AFL) prototype. The region shows the smallest single lenses near the exit aperture of the AFL.



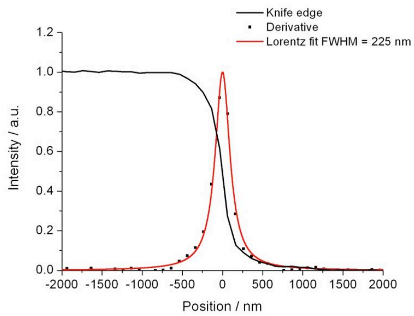
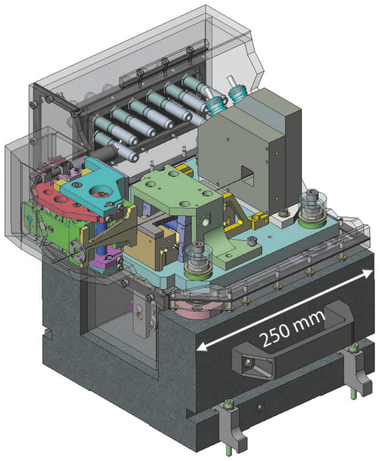


Fig. 7: left: Scanning electron microscope images showing details of a two elliptical element nano-focusing kinoform silicon lens. The kinoform steps are parallel to the (vertically aligned) optical axis of the lenses. right: Raw data (black) showing variation of transmitted flux from knife edge scan in the focal plane of lens with f = 75 mm, E = 8 keV. The derivative (red) indicates the corresponding focused spot profile.

Reflective Optics

Design and fabrication of high throughput Kirkpatrick-Baez (KB) configuration dynamically-bent mirror system (ESRF). An iterative design process using mechanical and wave-optical modelling combined with the use of complex multilayer-coated optical substrates yielded a KB system for routine use at the ESRF ID22NI nano-imaging end station focusing monochromatic X-rays (in the energy range 17-29 keV) into a highly focused (60 x 45 nm^2) spot. The X-ray flux densities (in excess of 10^8ph/s/nm^2) are, to our knowledge, the highest time-averaged values delivered by any nanoprobe. (Fig. 8).



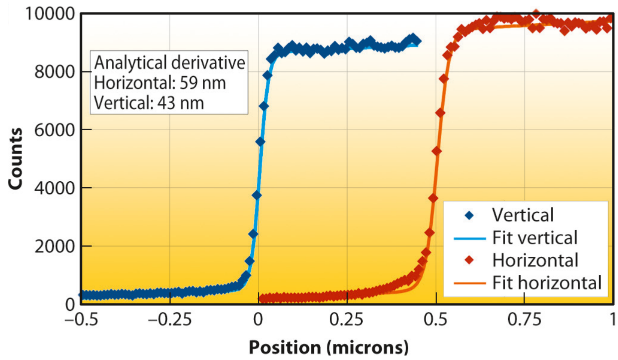


Fig. 8: left Schematic diagram of the ID22NI KB system. right Knife-edge scans (Au L fluorescence detection) across the beam focused by the system at 17keV

Test facilities

Network of X-ray test facilities with optimized instrumentation for testing of focusing optics. Currently the network includes the following beamlines: ESRF ID06, SOLEIL 'Metrology', Diamond B16 'Test', DESY PETRA III Undulator Beamlines.

Implementation and development of at-wavelength metrology techniques and protocols: X-ray Hartmann sensor (SOLEIL), Grating interferometry techniques (PSI, Diamond, ESRF), Ptychography methods (TU Dresden), Zone plate efficiency measurement (PSI, ESRF).

1.3.10 Transnational Access Activities

Transnational Access has been the core ELISA activity, involving 14 partners (Fig. 1) which provided 97.933 access hours, corresponding to 4.080 days; this is more than twice the minimum access provision commitment foreseen in the project proposal.

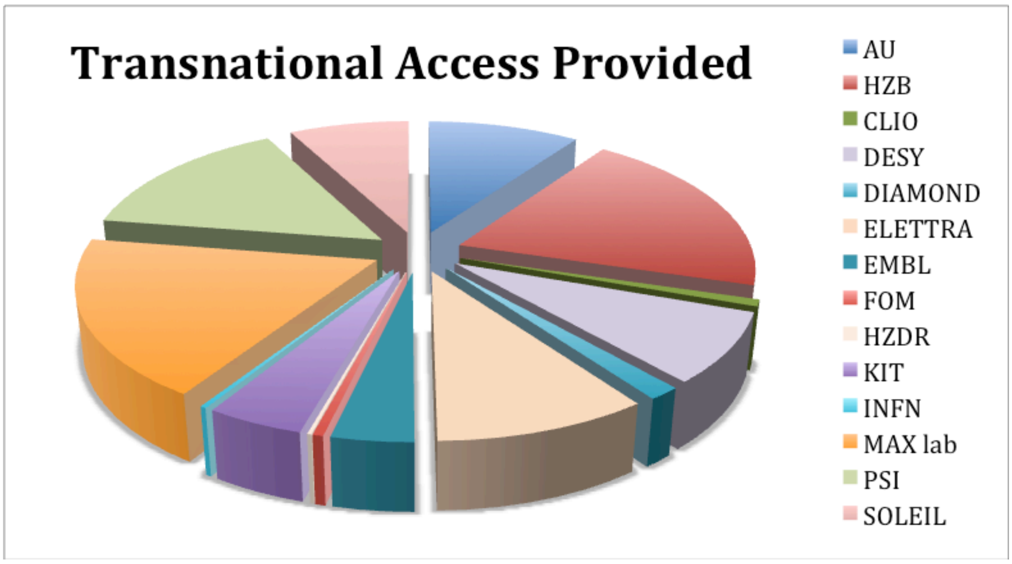


Fig. 1: Transnational Access provided during ELISA project by partner facilities.

The average success rate of experiment proposals eligible for EU support is 42% (Fig. 2), which means selection is high and this ensures scientific quality; on the other hand, the rate is not too low to discourage proposal submission.

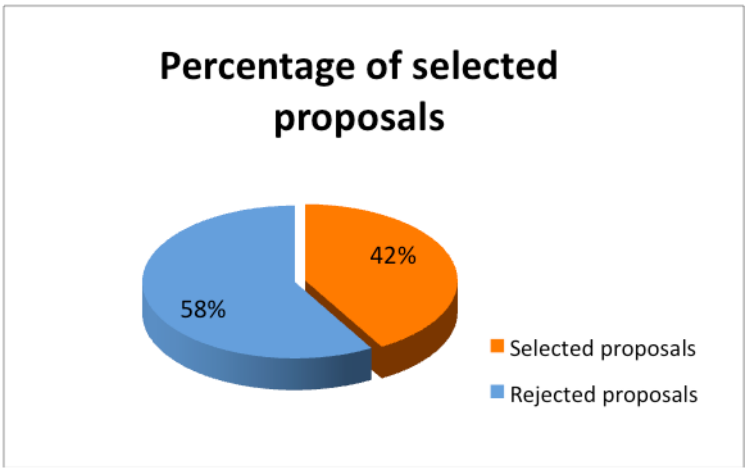


Fig. 2: Percentage of proposals selected for ELISA EU support. The number of eligible proposals was 4901 of which 2041 have been supported.

Figure 3 shows the main scientific field of supported experiments: Life Sciences has a greater share than Physics or Chemistry alone, with emerging fields like Material Sciences and Environment. This demonstrates that synchrotrons are strongly multidisciplinary facilities; moreover, it must be remarked that synchrotron measurements are often the crucial part of a set of measurements with complementary techniques and therefore cross-technique fertilization is also important at lightsources.

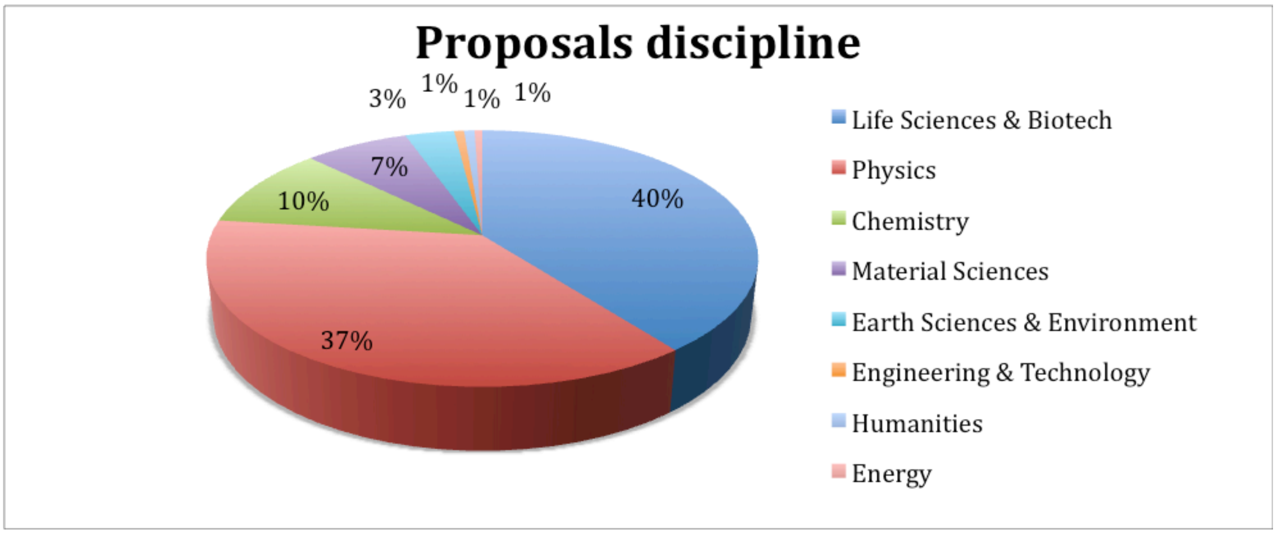
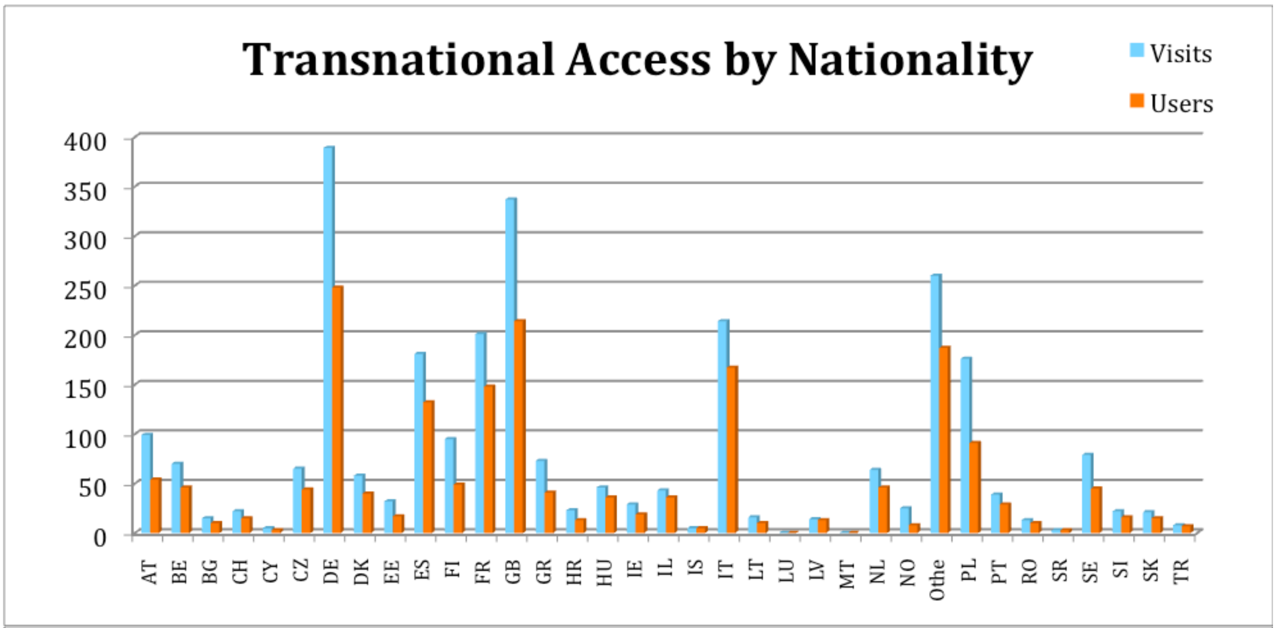


Fig. 3: Distribution of supported proposal by main scientific discipline.

In figure 4 the distribution of transnational access visits and users during the last ELISA 18 months is presented: 4a shows distribution by Nationality and 4b by Home Institution Country; when considering visits, users are counted once for each experiment. According to EC support rules, only users from Home Institution Countries set in Member States or Associated Countries are eligible. Germany and United Kingdom are the countries creating and hosting the higher number of researchers; comparing their shares in 4a and 4b we can see that GB has a greater portion of foreign researchers than DE, since it has greater quantities of visits and users by Home Institution Country than by Nationality.
More generally, these graphs demonstrate the large spectrum of countries that benefit from Transnational Access.



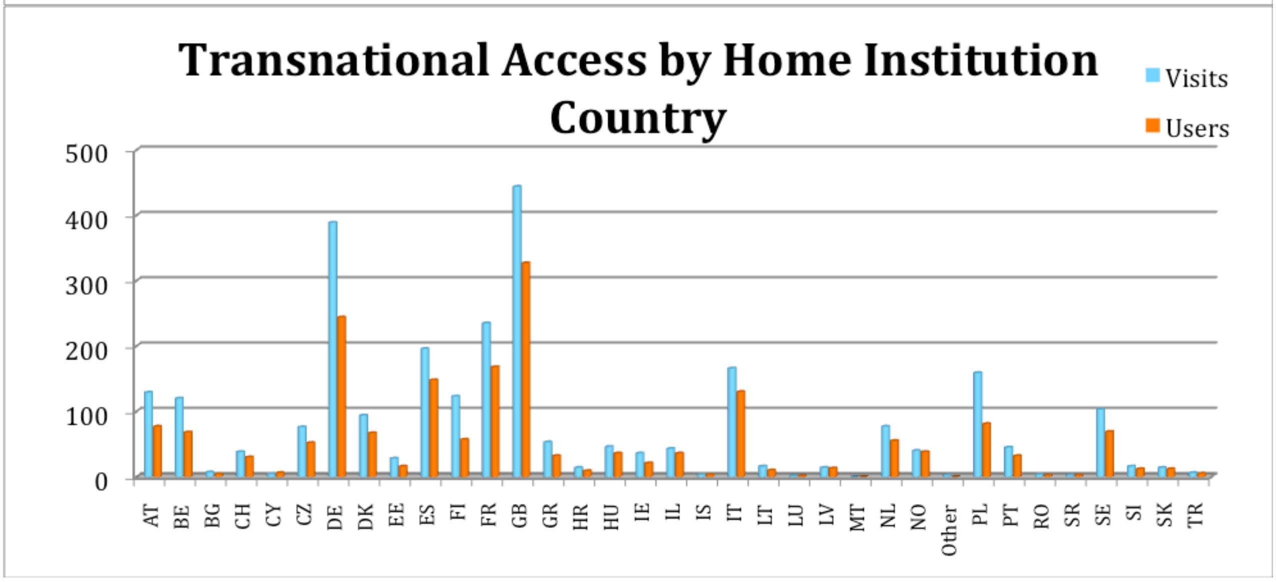


Fig.4a: Transnational Access distribution by Nationality 4b: Transnational Access distribution by Home Institution Country. Data refer to the last 18 months of the ELISA project.

Additional analysis of users and users visits will be presented in section 1.4-Impact.

In the following, we present one highlight per each facility providing access in the ELISA project, with emphasis on multidisciplinarity and innovation.

Facility: Elettra
Main Field: Physics **Specific Discipline:** Condensed matter physics
Project title: Growth of epitaxial graphene on Pt(111)
Project summary: Depending on the procedure used to grow graphene different phases, including defective structures, can be formed on metal substrates. Epitaxially grown graphene arranges in coincidence structures (Moirés) with different periodicities and crystallographic orientations for each transition metal substrate. STM measurements, combined with Synchrotron radiation XPD and theoretical calculations demonstrated that a graphene commensurate layer on platinum (Pt(111)) is originated by the formation of an ordered

vacancy network in the outermost Pt layer and by the covalent bonding between graphene and the Pt substrate.
Innovation dimension: Epitaxial graphene on transition metal surfaces is nowadays a very active research field for innovative electronics, energy storage and new materials. Therefore understanding the growth, morphology, and structure of these layers is of fundamental and practical interest.

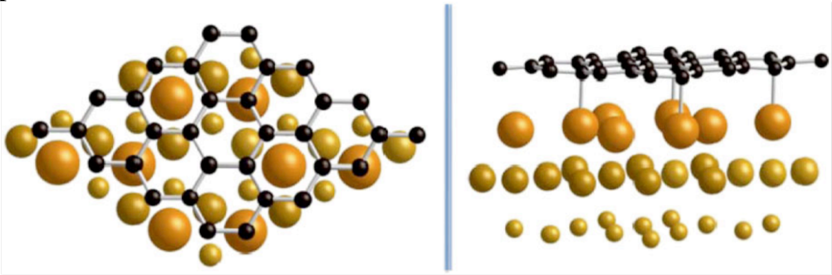


Fig. 6: Top view (left) and side view (right) of the structural model derived from XPS, STM images and DFT calculations for the (√3x√3)R30º reconstruction. Smaller sizes on the spheres represent deeper atoms. The side view is slightly tilted for a better visualization of the vacancy channels and interaction between C (black) and surface Pt (gray (yellow)) atoms.

Facility: ISA-AU
Main Field: Physics **Specific Discipline:** Condensed matter physics
Project title: Band gap opening in graphene induced by patterned hydrogen adsorption
Project summary: Graphene, a single extended layer of carbon atoms and the subject of a very recent Nobel prize, has exceptional properties creating a vision of graphene as the basis for a new generation of nanoelectronics. However graphene lacks a band gap, the hallmark of a semiconductor and an essential prerequisite for efficient switching between on and off states in a transistor. In our work we adsorb atomic hydrogen on graphene, inducing a large band gap near the Fermi level. Graphene which is modified in this way is thermally stable above room temperature and this work could lead nanoscale low power graphene-based semiconductor electronics.
Innovation dimension: The band gap reductions on graphene may revolutionize future electronics and computers.

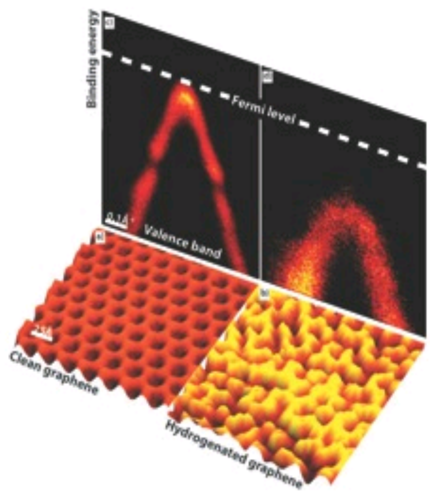


Fig. 7: Modified grapheme valence band: Vertical panels: photoemission intensity for clean graphene on Ir(111) and graphene exposed to a 50s dose of atomic hydrogen. Horizontal panels: Moiré pattern of clean graphene on Ir(111) and graphene exposed to atomic hydrogen

Facility: BESSY II - HZB
Main Field: Life Sciences & Biotech **Specific Discipline:** Molecular and cellular biology
Project title: X-ray cryo-tomography (XCT) of vaccinia virus infected cells
Project summary: The HZB cryo full-field X-ray microscope was used by researchers from Madrid and Barcelona to produce tomographic reconstructions of vaccinia virus (VACV) infected cells. The cells were fixed by plunge freezing after several hours post-infection, without any chemical fixation or staining. Different cellular organelles could be identified in the reconstructed tomograms together with other structures derived from the virus infection.

These results demonstrate biologically relevant information: the whole-cell maps obtained by XCT for infected eukaryotic cells have shown for the first time a complete cartographic description of the maturation process of VACV within whole unperturbed cells (F.J. Chichon et al., submitted to PNAS, Sept. 2011).
Innovation dimension: Soft X-ray microscopy for 3-D imaging of cells yielding tomographic reconstructions at resolutions in the order of 36 nm is now one alternative to overcome the resolution limits imposed either by light microscopy based analyses, or by the penetration power of transmission electron microscopy (TEM) to deal with thick, whole cell samples.

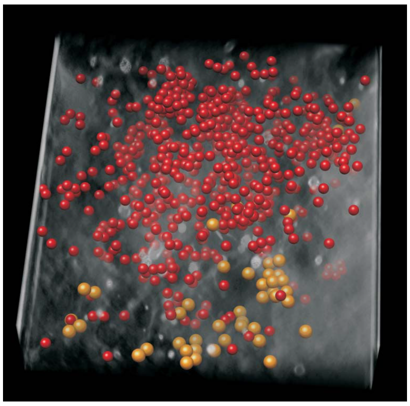


Fig. 8: Volumetric representation of a cryo-X-ray tomogram taken with the HZB X-ray microscope. The viral particle positions are shown as spheres. Orange spheres mark the location of the immature virions, while red spheres represent the mature virus particles. Field of view about 10 µm x 10 µm.

Facility: CLIO – CNRS
Main Field: Chemistry **Specific Discipline:** Physical Chemistry
Project title: IR Spectroscopy of CID Fragments of Protonated Peptides
Project summary: Protein identification in proteomics is primarily based on sequencing of peptides by means of tandem mass spectrometry. Ionized peptides are introduced into the mass spectrometer and then fragmented in the mass spectrometer via collision-induced-dissociation (CID). The corresponding product ion spectra are used to deduce peptide and protein primary structure. Nevertheless, the chemistry associated with the fragmentation of peptides is particularly complex. Infrared spectroscopy has recently been critical for the characterization of the chemistry of peptide fragmentation. IR spectra of large peptide fragments give evidence for the formation of macro-cyclic structures, and their subsequent reopening leading to permuted peptide sequence.
Innovation dimension: Our work should not only contribute to a better understanding of peptide fragmentation chemistry, but also of the control of the experimental conditions (transfer to the gas phase, fragmentation, thermalization) leading to the peptide fragmentation spectra.

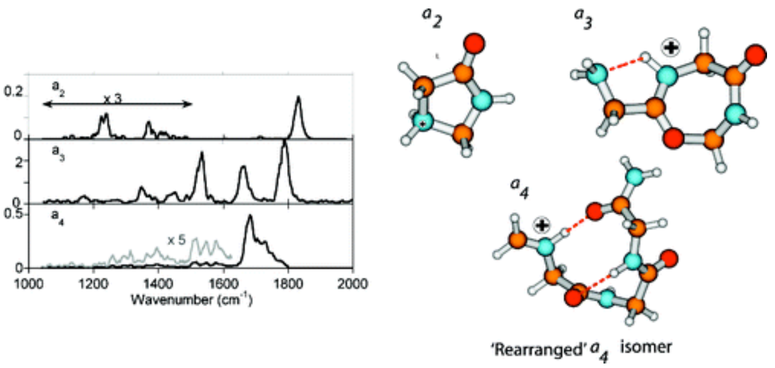
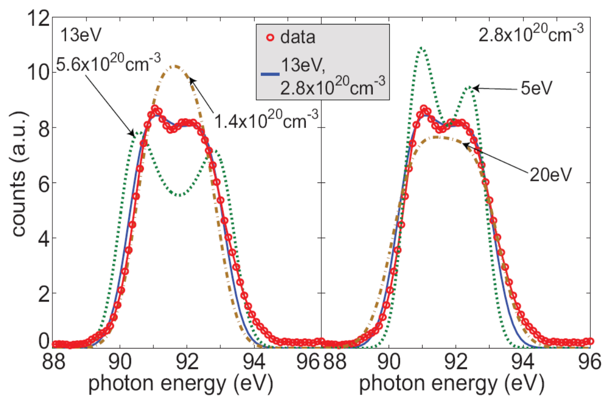


Fig. 9: IR spectroscopic evidence for the formation of cyclic and "rearranged" isomers of peptide fragments.

Facility: FLASH-DESY
Main field: Physics **Specific discipline:** Plasma Physics
Project summary: Thomson scattering in the XUV or x-ray regime using free electron laser (FEL) radiation provides a diagnostic method for the determination of important plasma parameters such as temperature and density. Such a diagnostic is of crucial interest for the investigation of so-called Warm Dense Matter (WDM), a state at solid density and with for plasma physics moderate temperatures of several 10,000 K. At these conditions the close competition between thermal and Coulomb energy makes it difficult to model theoretically thermodynamic and transport properties. Using XUV radiation provided by the FLASH facility, we successfully demonstrated "self-Thomson Scattering" on liquid hydrogen. Here the liquid hydrogen sample at an initial temperature of ~20 K is hit by the intense XUV pulse with pulse duration of ~40 fs. The liquid hydrogen droplet is then heated by the FEL pulse via photoionization while a small fraction of the FEL photons due to the lower Thomson scattering cross section is in addition simultaneously scattered, hereby probing the heated sample. Fig.10 shows the measured Thomson scattering spectrum and the obtained plasma parameters at probing time. By fitting the measured spectral distribution we obtain a free electron density of 2.8x1020 cm^{-3}, which corresponds to ~1% ionization in the sample and a free electron temperature of 13 eV (~150,000 K) which is determined through the intensity ratio of the two plasmons peaks via detailed balance. The result shows that FEL sources are indeed an ideal probes to determine plasma parameters via Thomson scattering. In the future, by employing pump-probe schemes it will be possible to determine the complete time evolution of the WDM state with fs time resolution.



Facility: DORIS III-DESY
Main field: Life Sciences & Biotech **Specific discipline:** Medicine
Project title: Local analysis of levels, speciation and chemical environments of zinc and copper in brain gliomas
Project Summary: Brain gliomas are the most common major histological type of brain cancer and account for more than 40% of all neoplasms of central nervous system. In spite of such frequency of occurrence the knowledge of this type of cancer is still very poor. The biomodulators causing unrestrained growth of brain tumor cells are not well known and current therapies are relatively ineffective. The complex chemical analysis of Fe, Cu and Zn

in tumor tissue is particularly essential considering biochemical processes that may participate in pathogenesis of the brain gliomas. The main goal of our study is complex local chemical elemental imaging of the levels of total Cu and Zn, $Cu2^{+}$, $Cu3^{+}$, Zn(0) and $Zn2^{+}$ in brain gliomas coupled with bulk analysis of Cu and Zn levels, speciation and chemical environments. The successful XANES measurements of both Zn and Cu were performed at the beamline L at HASYLAB. No presence of metallic Zn was found in the tissue areas analysed, see Figure 11B. A distribution of oxidized form of Zn in tissue structures revealed that the areas of calcification reveal high level of $Zn2^{+}$. XANES spectra at the Cu K-edge were collected in the "homogeneous" area of oligodendroglioma (II grade according to WHO classification), glioblastoma multiforme (IV grade WHO), control sample from the wall of brain abscess and blood vessel in neoplastic tissue. The measured positions of the white lines in the XANES spectra suggest that Cu in all samples is present on 2^{+} oxidation state.

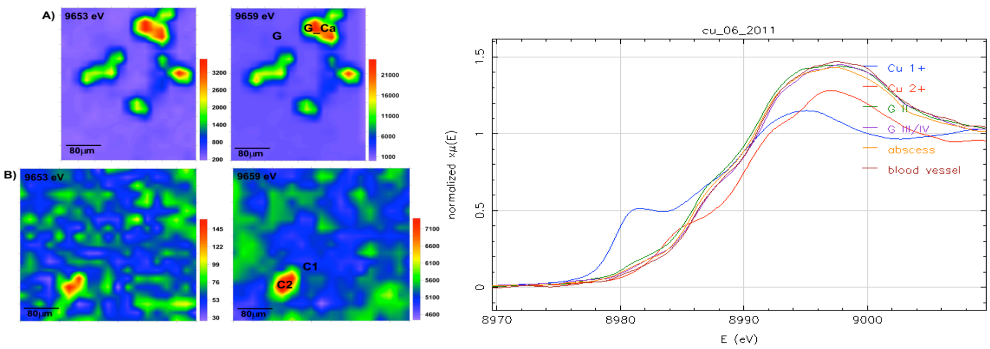


Fig. 11: Left side: Scanning X-ray microprobe determination of zinc oxidation states in oligodendroglioma anaplasticum (A) and control sample (B). The energy of excitation was shown in upper, left corner of each map. G – homogeneous neoplastic tissue, G_Ca calcification, C1 – homogeneous control tissue, C2 – Zn-rich area. Data presented in arbitrary units. Right Side: Absorption spectra near Cu K-edge of brain gliomas, control sample from the wall of brain abscess, blood vessel in neoplastic tissue and the reference materials CuO (Cu 2+) and Cu_2O(Cu 1+).

Facility: PETRA III-DESY
Main field: Physics **Specific discipline:** Condensed matter physics
Project title: Periodic dislocations in thin PbSe films
Project summary: Self organization provides a possibility to create dislocation free regions in heteroepitaxial structures in order to improve the quality of the production of semiconductor devices. In this work the statistical properties of a periodic array of dislocations in thin PbSe films deposited on a PbTe buffer were investigated by means of x-ray diffraction. A novel method for the calculation of the displacement field due to the dislocations was used. A short range order model was applied successfully for the description of the dislocation distribution and verified by computer simulations.
In this work we investigate the statistical properties of a periodic dislocation network in a thin PbSe (6.1 nm thick) film on a 100 nm PbTe buffer. The buffer layer was deposited on a CdTe substrate. Both layers were grown by means of molecular beam epitaxy at a growth temperature of 360°C. Diffraction experiments were carried out at beamline P08 at PETRA III. In a coplanar diffraction geometry, reciprocal space maps (RSMs) were recorded around the (002) and (115) CdTe Bragg positions at an x-ray energy of 8994 eV. The color maps in Figure 3 show the (002) and the (115) RSMs recorded during the experiment. From the position of the PbSe peak in the (002) RSM it follows that the PbSe film is completely relaxed and therefore, plastic relaxation has occurred. From the evaluation of the RSMs a mean dislocation distance of 10.5 nm was found along with a FWHM of 0.81 nm of the underlying Gaussian distribution which fit best to simulations for a FWHM value of 0.8 nm.

From the simulations the following conclusions can be made: 1.) the dislocation distribution can be described with a SRO model, 2.) since we were able to reproduce the diffraction pattern with a single dislocation type, this type is most likely the dominating type within the sample.

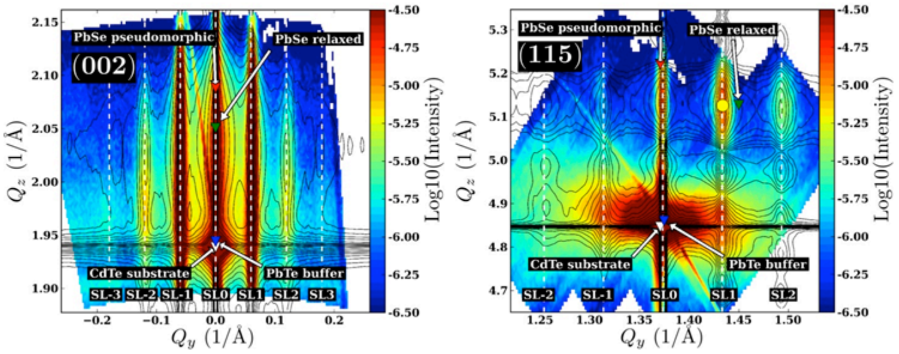


Fig. 12: The left and right panel show the (002) and (115) RSMs around the CdTe Bragg position. Experimental data is denoted by the color map while the black contour lines show the simulation data for a FWHM of 0.8 nm of the Gaussian inter-dislocation distance distribution.

Facility: Diamond
Main field: Humanities **Specific Discipline:** Arts
Project Title: SR microFTIR study of the alteration of silver foils in medieval paintings
Project Summary: The alteration shown by silver leaf applied to polychrome carved wood and altarpieces to imitate metal objects (arms, garments, tools, decorative mouldings) is a very generalised phenomenon. The processes involved are not fully understood, limiting the development of adequate conservation strategies. For this several silver foil areas covered with different varnish from polychrome carved wood, mouldings as well as flat surfaces of altarpieces from the medieval period were analysed. The results obtained suggest that atmospheric corrosion thorough the damaged varnish or cracks in the painting are the dominant mechanisms, and therefore the degree of preservation is mainly related to the conservation state of the protecting coating layer.
Innovation dimension: The submillimetric layered structure, the high variability and low amount of content for most of the molecular compounds present in the different layers, as well as their differing nature (organic and inorganic) make the use of IR microspectroscopy analysis essential for such study. Moreover, the high spatial resolution needed is possible thanks to the high synchrotron radiation brilliance and the SR IR microbeam allow a spectral quality, in terms of both high sensitivity and signal to noise ratio, adequate for these study at the molecular scale.

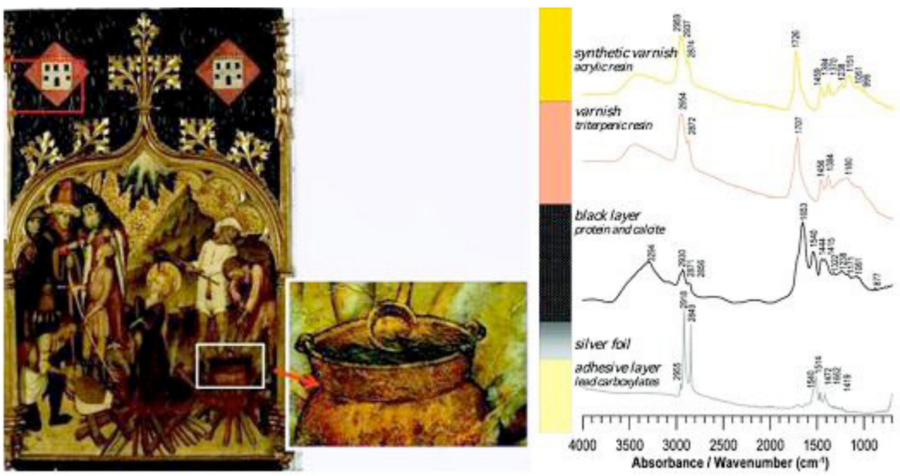


Fig. 13: a) Santa Llúcia altarpiece, Museu Nacional d'Art de Catalunya, Barcelona. © MNAC-Museu Nacional d'Art de Catalunya (Barcelona) Photo: Calveras b) µSR-FTIR spectra of sample from the pot area.

Facility: EMBL
Main Field: Life Sciences & Biotech **Specific Discipline:** Molecular and cellular biology
Project title: Allostery and intrinsic disorder mediate transcription regulation by conditional cooperativity.
Project summary: Regulation of the phd/doc toxin-antitoxin operon involves the toxin Doc as co- or derepressor depending on the ratio between Phd and Doc, a phenomenon known as conditional cooperativity. The mechanism underlying this observed behavior is not understood. Here we show that monomeric Doc engages two Phd dimers on two unrelated binding sites. The binding of Doc to the intrinsically disordered C-terminal domain of Phd structures its N-terminal DNA-binding domain, illustrating allosteric coupling between highly disordered and highly unstable domains.
Innovation dimension: Our experiments provide the basis for understanding the mechanism of conditional cooperative regulation of transcription typical of toxin-antitoxin modules.

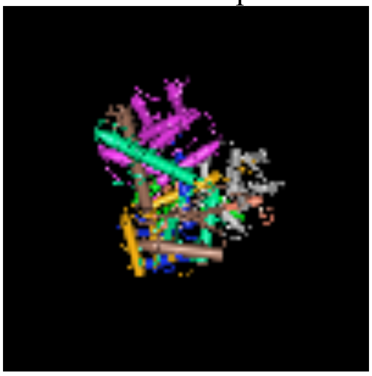


Fig. 14: Crystal Structure Of The Phd-Doc Complex; PDB: 3K33; Source: Enterobacteria phage P1, unidentified; Method: X-Ray Diffraction, Resolution: 2.4.

Facility: FELIX - FOM
Main Field: Physics **Specific Discipline:** Atomic and molecular physics
Project Title: Gas Phase IRMPD Spectroscopy of Microhydrated Dianions
Project Summary: Isolated dicarboxylate dianions are stable in the gas phase and serve as model systems for multiply charged anions. The presence of two charge centers separated by a hydrophobic, aliphatic chain also makes them ideal for studying charge screening and solvent-mediated effects. In this study gas-phase infrared (IR) spectroscopy using the Free Electron Laser "FELIX" of the microhydrated suberate dianion (SA_2-, $-OOC(CH_2)6COO-$) is used together with quantum chemical calculations to establish relationships between conformational changes and spectroscopic features. The combination of techniques leads to considerably more detailed understanding of the hydration mediated folding process at the molecular level.
Innovation dimension: Dicarboxylate salts play an important role in many areas of science, including atmospheric chemistry, biochemistry, and synthetic chemistry and are, for example, used as antitumor drugs and as building blocks for metal–organic framework materials, and they are found in aerosol particles comprising photochemical smog. This study explores at a fundamental level how hydration can drive a conformational transition in a dianion and what role the hydrogen-bonded network plays and should have important implications for probing the structure in condensed phase as well as for remote sensing applications used, for example, in atmospheric measurements.

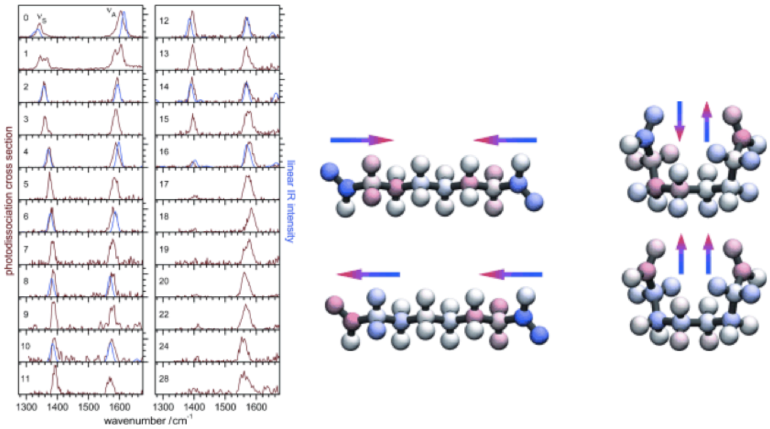


Fig. 15: The relationship between conformational changes of suberate dianions in water clusters and the corresponding spectroscopic characteristics were studied. The picture shows on the left the experimental (red) infrared spectra for the suberate dianion with n=0-28 water molecules and the calculated (blue) infrared spectra for selected systems. On the right, the charge displacement associated with the excitation of the carboxylate symmetric stretching modes is shown for the linear and the folded dianion with 12 water molecules. Folded structures are stabilized by the formation of additional hydrogen bonds between the solvated dianion and H2O molecules and should thus be retained in larger, microhydrated clusters.

Facility: FELBE - HZDR
Main Field: Physics **Specific Discipline:** Condensed matter physics
Project title: Pump-probe investigations of carrier relaxation in graphene
Project summary: The relaxation dynamics in graphene is studied for photon energies in the range from 10 – 300 meV. The experiments complemented by microscopic theory clarify the role of different relaxation processes, especially the role of optical phonons. For photon energies below the optical phonon energy the relaxation is significantly slower, however, relaxation via optical phonons is still the predominant relaxation channel. For photon energies about twice the Fermi energy a surprising change from pump- induced transmission to pump-induced absorption occurs due to the interplay of interband and intraband processes.
S. Winnerl et al., Phys. Rev. Lett. 107, 237401 (2011).
Innovation dimension: The project resulted in the first study of graphene excited at low photon energies. This provides valuable insights into the carrier dynamics and is important for graphene-based optoelectronic device applications.

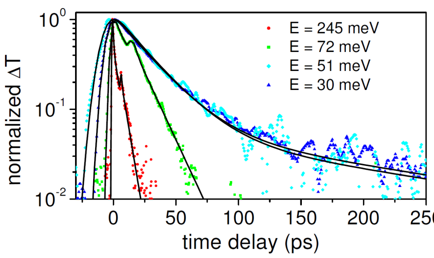


Fig. 16: Normalized pump-induced transmission for different photon energies E.

Facility: ANKA - KIT
Main Field: Life Sciences & Biotech **Specific Discipline:** Medicine
Project title: The distribution of important bio-metals and the determination of Fe, Cu and Zn oxidation state in breast tumour tissue using μSRXRF and XANES Techniques
Project summary: Excessive accumulation of copper, zinc and iron in breast cancer compared to normal breast tissues has been reported in a number of studies. The observation

of such differences in bulk samples has in the last few years been followed up by small beam imaging that allows metal levels to be mapped across a specimen revealing preferential sites of accumulation.

Cellular concentrations of zinc, one of the metals of physiological importance in many processes, are strictly regulated by a number of zinc transporter proteins. A subset of these proteins has been shown to be regulated by oestrogen, a hormone that is heavily involved in the progression of the disease.

X-ray fluorescence micro mapping reveal the accumulation of the metal in the invasive tumour areas. For the statistical analysis, regions of tumour and normal tissue were selected in each sample and the normalised zinc signal from each was then calculated.

For each specimen the levels of zinc in the cancerous parts were statistically compared with that of the surrounding normal tissue and that parameter was then correlated to the ER status of patients. While the metal is always found to be elevated in the tumour areas in relation to the normal tissue surrounding it, this contrast is much more marked for the ER +ve cases. The results suggest that increased intracellular Zn levels can be used as a predictor of failure in patients treated with tamoxifen. Because of the large number of variables involved in the trial data, more cases from the trial samples have been scanned in order to obtain significant data to complete this study. The determination of any alteration in the oxidation state of the metals and the distribution of the metals in different oxidation states within the tumour and normal cells could be used as oxidative markers.

Al-Ebraheem, M. Farquharson, J. Göttlicher, T. Geraki, & R. Steininger, "The determination of zinc, copper and iron oxidation state in invasive ductal carcinoma of breast tissue and normal surrounding tissue using XANES", X-Ray Spectrometry 39 (2010) pp. 332-337

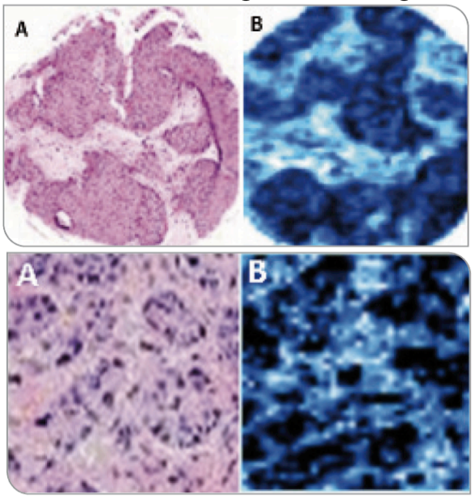


Fig. 17: upper left) H&E stained reference sample, upper right) Zinc distribution map. The dark areas are the tumour cells whereas the lighter areas are normal tissue. 900 x 900 μm, beam size of 25 x 15 μm. Lower left) H&E stained reference sample, lower right) Zinc distribution map. The dark areas are the tumour cells whereas the lighter areas are normal tissue. 200 x 200 μm, beam size of 5 x 5 μm.

Facility: DAFNE - INFN
Main Field: Life Sciences & Biotech Specific Field: Medicine
Project Title: FTIR and X-Ray microscopy characterization of Cu-carrier agents in vascular endothelial cells
Project Summary: The project goal was to unravel the correlations existing between vascular endothelial cells development during glioma tumor angiogenesis and copper translocation between these cells forming capillaries tubes. We proposed to use FTIR-SR imaging and X-Ray fluorescence microscopy for determining copper contents. The most important objectives have been to determine which cellular contents are transporting copper

to filopodia while endothelial cells undergo tubular formation and the collagen contents present in the extracellular matrix of endothelial cells very close to blood capillaries of glioma tumors.
'Functional histology of glioma vasculature by FTIR imaging' Razia Noreen, Raphael Pineau, Chia-Chi Chien, Mariangela Cestelli-Guidi, Yeukuang Hwu, Augusto Marcelli, Michel Moenner & Cyril Petibois; Anal Bioanal Chem 40, 795 (2011)

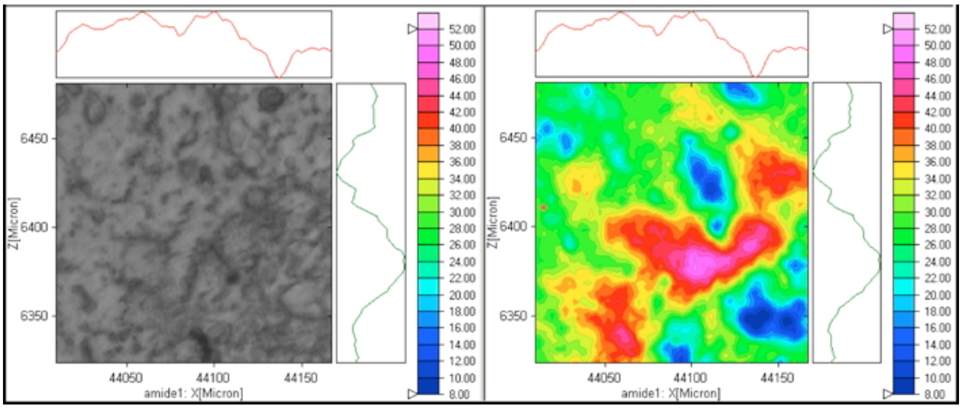


Fig. 18: Left: visible image of a tissue sample of glioma tumour; Right: chemical distribution of the Amide I band within an area of 170x170 mm^2 and a pixel resolution of 1mm. Images are obtained integrating the absorption between 1720 cm^{-1} and 1600 cm^{-1} (AmideI band).

Facility: MAXlab
Main field: Physics
Specific discipline: Atomic and molecular physics
Project title: Photochemical molecular devices for the production of hydrogen from water.
Project Summary: Some molecules known as dye complexes have potential use in solar cells and also in activating chemical reactions using energy from sunlight. One of these reactions is the water splitting reaction which produces hydrogen and oxygen molecules from water molecules, i.e. producing hydrogen fuel using low cost materials and the free source of solar energy. Of crucial importance is to understand the charge transfer between the dye complex and the supporting substrate, which appears on the femtosecond time scale, since that process governs the reaction. In a recent project several Ru(II) dye complexes have been studied using various spectroscopic techniques (M. Weston et al., J. Chem. Phys., 134, 054705, 2011).
Innovation dimension: Dye complexes have important applications in harvesting sun light for energy conversion and/or promoting chemical reactions.

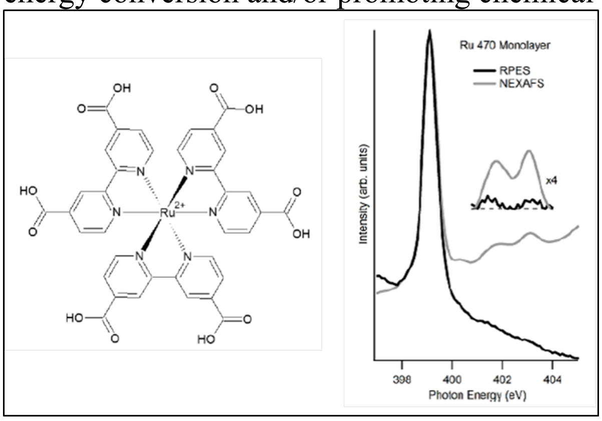


Fig. 19: spectroscopic data (N1s RPES & NEXAFS) from a monolayer Ru 470 complex deposited on a TiO2(110) substrate. From this type of data detailed information on the charge transfer dynamics can be obtained.

Facility: SLS - PSI
Main Field: Life Sciences & Biotech **Specific Discipline:** Medicine
Project Title: High-resolution method for computed nano-tomography developed
Project Summary: A novel nano-tomography method developed by a team of researchers from the Technische Universität München (TUM), the Paul Scherrer Institute (PSI) and the ETH Zurich opens the door to computed tomography examinations of minute structures at nanometer resolutions. The new method makes possible, for example, three-dimensional internal imaging of fragile bone structures. The first nano-CT images generated with this procedure were published in the renowned journal Nature on September 23, 2010. Innovation dimension: this high-resolution tomography technique will provide invaluable information for both the life and materials sciences.

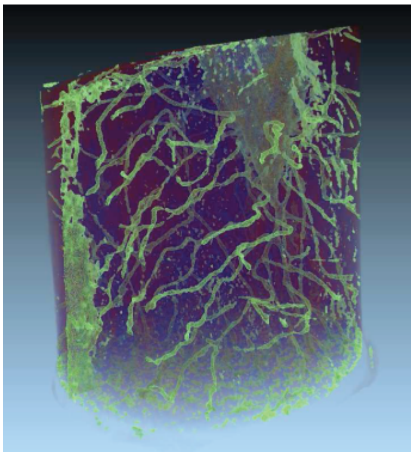


Fig. 20: A high-resolution tomogram of piece of mouse femur, approximately 30µm (millionths of a meter) in size.

Facility: SOLEIL
Main Field: Physics **Specific Discipline:** Atomic and Molecular Physics
Title: Fourier-Transform spectroscopy on HD in the VUV range
Project Summary: Absorption spectroscopy in the vacuum ultraviolet domain was performed on the hydrogen-deuteride molecule with a novel Fourier-transform spectrometer based upon wavefront division interferometry. The HD spectral lines in the Lyman and Werner bands were recorded for comparison with astronomical observations of H_2 and HD spectra from highly redshifted objects. The goal is to extract a possible variation of the proton/mass ratio (m) on a cosmological time scale. The Ki coefficients, associated with the line shift of each spectral line resulting from varying value for m, were derived from calculations as a function of m solving the Schrödinger equation using ab initio potentials.

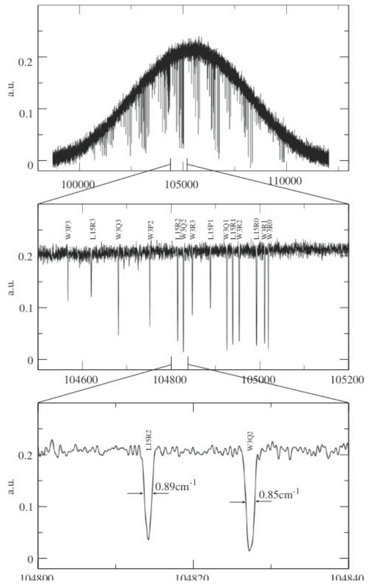


Fig. 21: Absorption spectrum representing detailed and entire investigated spectral range, 90,000–115,000 $cm^{-1}$with an unprecedented resolution of 0.04 cm^{-1} ($Dl/l \sim 4x10^{-7}$) . Published in Molecular Physics 108, 771-786 (March 2010)

1.4 Impact, dissemination activities and exploitation of results

1.4.1 Management and ESUO:

ELISA represents the world's largest network of research facilities, impacting on ~30.000 users all over Europe. All its activities promoted leveraging of geographic and financial differences, prevented brain-drain and were devoted to provide a better service to scientist but also to the ultimate end-users, European citizens.

The main channels of scientific foreground dissemination have been peer-reviewed publications, PhD thesis, participation in international conferences, press releases, web news etc. Overall, ELISA generated more than 760 peer-reviewed publications in high-level scientific journals, and more publications are expected in the months to come.

The ELISA project was also presented with a poster at the ECRI2010 conference (Spain, see Fig. 1), was described on the Italian Synchrotron Radiation and Neutron Journal (http://issuu.com/nnls/docs/vol15-n2_10) and actively took part in the I3 network (http://i3.neutron-eu.net) and was described in a divulgative brochure published in July 2010 (http://www.elettra.eu/ELISA/index.php?n=Main.News20100603).

Fig. 1: ELISA poster at ECRI conference

To present the projects' activities to the general public, partner facilities organized open days, school visits and published specific booklets. In spring 2009, an italian delegation of the European Youth Parliament (www.eypej.org) visited Elettra and took part in a seminar about European Activities.

In March 2011 the Coordinator, in collaboration with project partners, sent ELISA's contribution to the public EC consultation on the Green Paper on a Common Strategic Framework for EU research and innovation funding (http://ec.europa.eu/research/horizon2020/index_en.cfm?pg=documents).

Finally, the wayforlight (www.wayforlight.eu) initiative was launched shortly after project end, and is meant to serve present and potential users of European lightsources with a user-friendly, interactive portal containing standardized information on all experimental possibilities, training material and, at a later stage, a unified way for proposal submission.

Fig. 2: *wayforlight* initiative logo.

One of the most notable ELISA spin-offs is the creation of ESUO: European Synchrotron User Organization.

Establishment of ESUO has enormous impact on the development of a pan-European Research Infrastructure for the use of Synchrotron and FEL Radiation. For the first time all users of light source in Europe find an own body representing their common interests with respect to all European Facilities and for European funding organizations. For the first time ESUO made a measure of the size of Light source community in Europe and visualized the differences between European countries with respect to the degree of organization of national users and the amount of national funding provided for experiments with synchrotron and FEL radiation. Based on these data ESUO could motivate needs for continuation of Transnational Open Access founded by EC. Users needs expressed by ESUO found consideration by the board of directors of European Light Source facilities. Visibility of ESUO in Europe and the start of a common discussion between representatives of ESUO and Light source facilities are the main result of ESUO activity the previous discussed the future of process of development of a pan-European Research Infrastructure for experiments with synchrotron and FEL radiation.

1.4.2 Communicators:

The first meeting of the network brought together 13 communicators from nine European light source facilities and was largely an opportunity for the network members to either meet for the first time or get to know each other better; to get an idea of how each facility carries out public and educational visits; and to discuss the way forward for the network and topics for the next meeting. The network was strengthened as a result of meeting up with each other and discussing experiences and ideas; knowing each other better helps to share ideas and resources and to work together on collaborative projects. This would not have been possible if good relationships had not been established; something that the first meeting enabled. The funding from ELISA helped to prioritise the meetings and resulting collaborative activities.

The second meeting brought together 14 communicators from eight European light source facilities plus two light source communicators from further afield – Australia and Japan. It focused on how the network can use new media, along with implementing the review of light sources' communications practices. The meeting was an opportunity to build on the outcomes of the first, in particular, the review of light sources' communications practices, which was the main area identified by the group as something that would be extremely beneficial to all.

The third meeting brought together 12 communicators from seven European light source facilities. Since the NA1 work package would be drawing to a close, the meeting focused mainly on working on ideas and activities that can be taken forward by the network following the cessation of the ELISA funding. The main outcome was a document that lists activities, with owners and timescales, which have been agreed by the network to be carried out over the next 12 months. The activities in this document form the basis of a strategy for working together in the future and aim to address all three sub-objectives.

Activities from the list completed by the end of month 30 include: the creation of a list server for the network, which has provided an easy method of communication that enables sharing; an audit of social media to help inform how best to target online media and where to target to reach key stakeholders; and a design study for a travelling exhibition showcasing synchrotrons and industrial innovation.

The seminar at the 2010 EuroScience Open Forum (ESOF) aimed to highlight the importance of synchrotron science to a science-interested audience, using four research examples from a number of European synchrotron facilities, presented by the researchers themselves. The session was scored 3.15 out of 4 overall by the audience, with 4 being 'excellent'.

1.4.3 VEDAC:

The VEDAC activity has highlighted that software is nowadays at the heart of the scientific endeavour. The classic approach that every lab develops its own software becomes economically unsustainable and leads to very different environments which are difficult to apprehend by scientists using several analytical facilities for their research. A common software approach would also greatly enhance the quality of the software produced in the facilities. VEDAC has brought together the computer specialists of the photon science community who have started learning to work together in an environment of increasing complexity. It is expected that this collaborative spirit will continue and result in common development projects of high impact for the facilities.

1.4.4 PUSH:

PUSH NA grouped together the leading European Scientist in the pulsed soft and hard X-rays, fostering coaching and sharing of experimental results. Future challenges of the upcoming new generation sources have been discussed and brought to the development of a common initiative for PUSH to become a part of the next phase of IRUVX-PP collaboration. Therefore this networking activity had a solid impact on its scientific community, creating the basis for long-term collaboration between partner facilities.

1.4.5 HERCULES:

Concerning the HAS as a support to the training objectives and programmes, we published HERCULES volumes where the pedagogical abilities of the lecturing were channelled and contained most of the scientific programme. Five volumes have already been published. Volume V entitled "X-Ray and neutron spectroscopies" has been published by Springer in January 2006. Two HERCULES volumes were given to the session A and B participants in 2009, 2010 and 2011. With regards to the first four volumes (Editions de Physique, Springer, Oxford) and for Volume V (Springer), the choice of an international editor ensures a good diffusion of these books, which has become very useful for newcomers to the field of S.R. and n. (either students, post docs or established scientists). One of their specialities, apart from other textbooks available, is to treat both neutron and X-ray radiations and thus to emphasize their complementarities.
Copies of computer-made presentations and transparencies were given to all HERCULES participants in order to facilitate their understanding of the course.
During the 3 years of the project, several articles were published in the local scientific press: ESRF Newsletter, UJF weekly leaflet.
All information concerning the Hercules Annual Sessions is displayed on the HERCULES website: http://hercules-school.eu/ and linked to the ELISA project website.
Each lecturer provided a contribution summarizing his/her lecture (about 15 pages for a lecture of 1.5 hour) with a special emphasis on adequate references in order to introduce further reading. These notes were a good starting point for students who wanted to deepen their knowledge on a given subject. Most of these supports are available on the HERCULES website.
A restricted access to the past and present HERCULES participants and to the lecturers' staff to all the electronic documents (abstracts, transparencies, written contributions) is provided.

As for the Hercules specialized courses (HSC), electronic documents (web and/or CD) produced by the lecturers, and covering the whole content of the lectures, were made available to the participants. The evaluation of these documents by the participants was very positive. Most of the lectures were accessible via the web before or immediately after the lectures, and could be downloaded by each of the participants.

The HSC were advertised /publicized in several ESRF and ILL publications, with interviews to lecturers and participants.

1.4.6 FELINS:

Free Electron Lasers are the ultimate generation synchrotron light sources and great impact results are expected from them in the years to come. FELINS initiated and strengthened a long-term collaboration of the European FEL facilities, thus having a structuring effect on the overall scientific community.

Within the project, a compact wire scanner chamber has been studied for transverse electron and photon beam profiling, a new design detector and a prototype wave front sensor have been realized and extensively tested at various facilities.

1.4.7 HIZPAD:

With a total of 17 detector demonstrators produced and a few others still being processed, the HIZPAD JRA generated an important knowledge base on CdTe/CZT pixel sensor technology and physics, which benefits to both industrial and SR/FEL communities in Europe. Moreover, by involving both communities in the same framework the JRA also strenghened the links between them.

The produced batch of demonstrators provided a statistically significant information on quality and reproducibility of current sensor processing technologies. This allowed partner companies in the JRA to focus on the critical processing steps and to start implementing various improvements.

The evaluation program carried out on beamlines with the produced demonstrators has confirmed the interest of CdTe pixel sensors for medium (up to 50 keV) or high (up to 100 keV or more) energy SR applications, despite the still improvable sensor quality. Scientific users can now consider new applications on SR/FEL beamlines, which would not have been possible without high-Z pixel sensors. As a consequence several CdTe pixel detector systems will be implemented on ESRF beamlines in the near future.

Finally, results obtained in this JRA can be expected to have a strong impact in the definition of future development programs in the field of high-Z pixel detector devices.

1.4.8 NanoFOX:

Through the fabrication of working prototype optics which have been deployed at operational beamlines, the NanoFOX JRA has had almost immediate impact for the operation of certain endstations both in the ELISA light sources and beyond. These optics are enabling technologies which permit the extension of existing scientific techniques with improved spatial resolution, detection sensitivities and/or reduced measurement times. The potential impact of the devices extends across a broad spectrum of the activities of current light sources encompassing the life & physical sciences, engineering and cultural heritage applications. Already scientific results obtained using optics developed within the JRA have been published in high impact journals.

Within the community of researchers and engineers at light sources working in the development of high performance X-ray focusing optics, the JRA helped consolidate an informal collaborative network. In particular, it permitted the development of a coordinated approach to addressing several technological problems common to the different groups. It is hoped that it will be possible to build upon and extend this network in the future.

On a longer term, the foreground developed during the project will provide sound foundations for the fabrication and characterisation of a new generation of nanofocusing optics with improved performance.
In addition to the physical dissemination of the fruits of the JRA (via optical device deployment), the workpackage S&T results have been widely presented through oral and

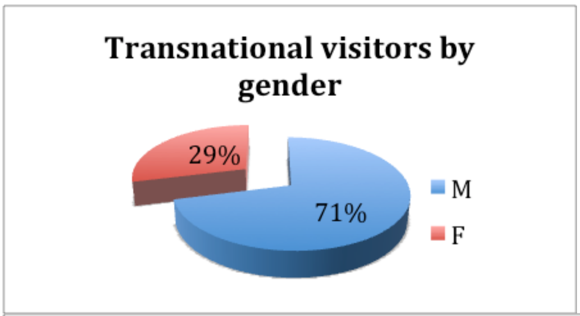
poster contributions at international conferences and workshops. Furthermore many of the activities have been described in academic articles published in refereed journals.

1.4.9 Transnational Access

Transnational Access has a multi-faceted positive impact on the European Research Area.

First of all, scientific impact can be assessed from the more than 700 peer-reviewed publications derived from EU supported experiments.

Transnational Access prevents brain drain, since each experiment takes up to 1 week abroad on average while preliminary measurements and data analysis are performed at home institution. In this respect, TA contributes both to societal challenges like gender issues and brain drain prevention and to the "Fifth Freedom" i.e. free movement of knowledge.
Figure 1a shows gender distribution of user visits during the whole ELISA project: female share is in line with current EU standards. More interesting, this percentage is significantly higher when taking into account young (<35 years) researchers (Fig.1b), which represent 48% of total visitors: in this case, female share grows up to 36%.
This high share of female participation in a traditionally male-prevalence field is a good starting point for a roadmap towards gender equality.



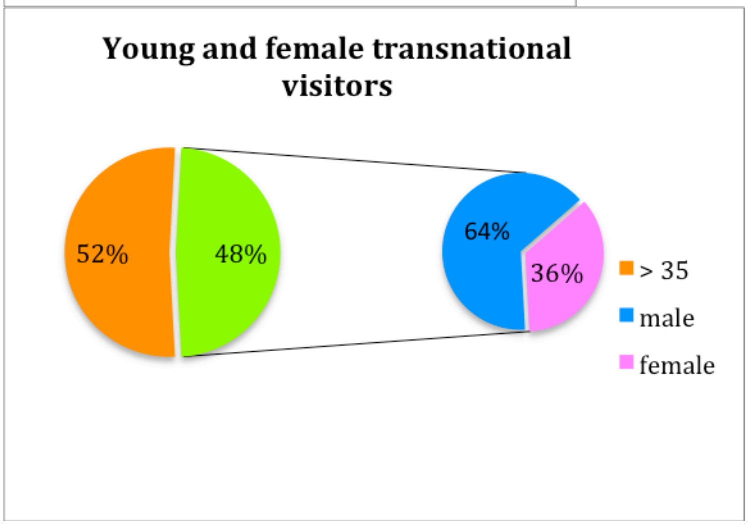
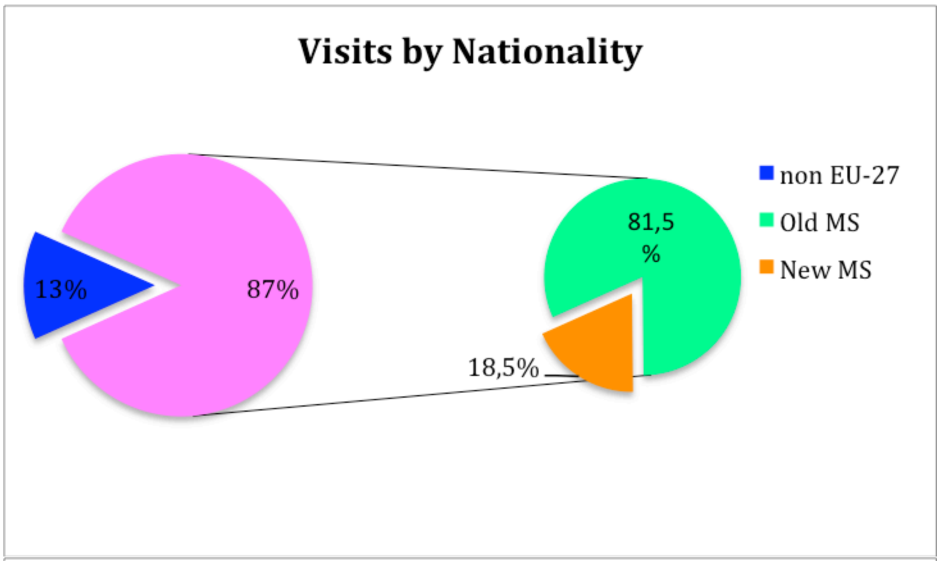


Fig.1a: Gender distribution of transnational user visits during the ELISA project. 1b: Percentage of young (<35) visitors and gender distribution.

Figure 2 presents an overview of user visits by Nationality and Home Institution Country. Comparing 2a and 2b it is clear that EU-27 countries (pink) host in their institutions 8%, on average, of non EU-27 researchers: infact, only 5% of all experiments are performed by researchers coming from institutions based in non EU-27 countries (Fig 1b) while 13% of all visitors are of non EU 27 nationality (Fig 1a). However, 15% of visitors coming from institutions based in EU-27 countries are from institutions based in New Member States, and this is an added value for Transnational Access.



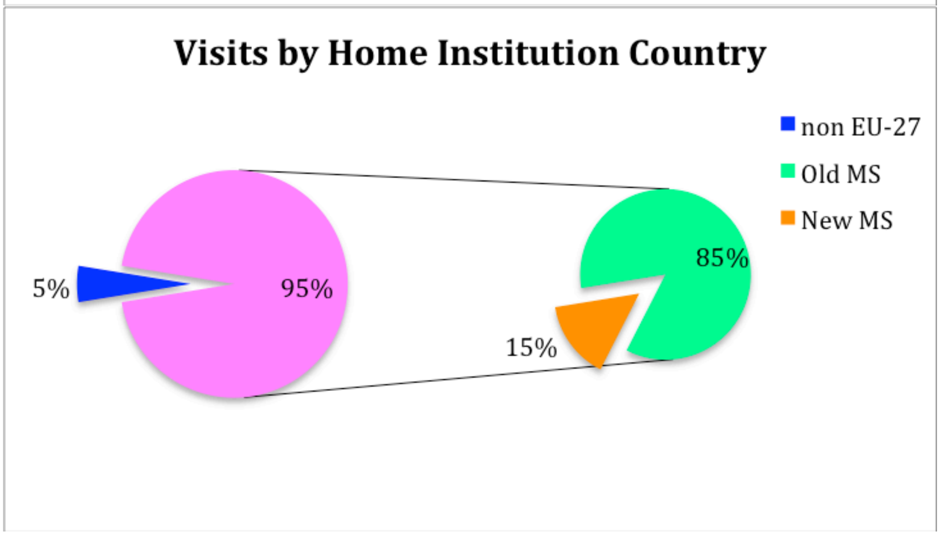


Fig.2a: Total Transnational Access visits by Nationality and portions of visits from EU-27, Old and New Member States. 2b: Total visits by Home Institution Country. New Member States: Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovenia, Slovakia.

If we split the total visits by Home Institution Country on the basis of countries having or not-having a national synchrotron or FEL source (Fig. 3) we find out that majority of users come from Institutions based in countries with a national lightsource. We must remark once more that access provided within the project is transnational, and so for example a user based in a German institution cannot get support to go to any of the several German laboratories. This result can be directly interpreted by the fact that since 9 European countries do have at least a national lightsource, the sum of user visits from these nations (both by nationality and by home institution countries) will automatically be the majority. However, we can also see this fact from the point of view of science dissemination and cross-fertilization: a user is favoured writing a (successful) proposal if he/she is based in a country with a national user community. In addition, the percentage of total visits from countries without a national lightsource is quite high, 38%: comparing this with Fig. 2b we can say that transnational access help a lot researchers from these countries to perform their experiments at the best facilities.

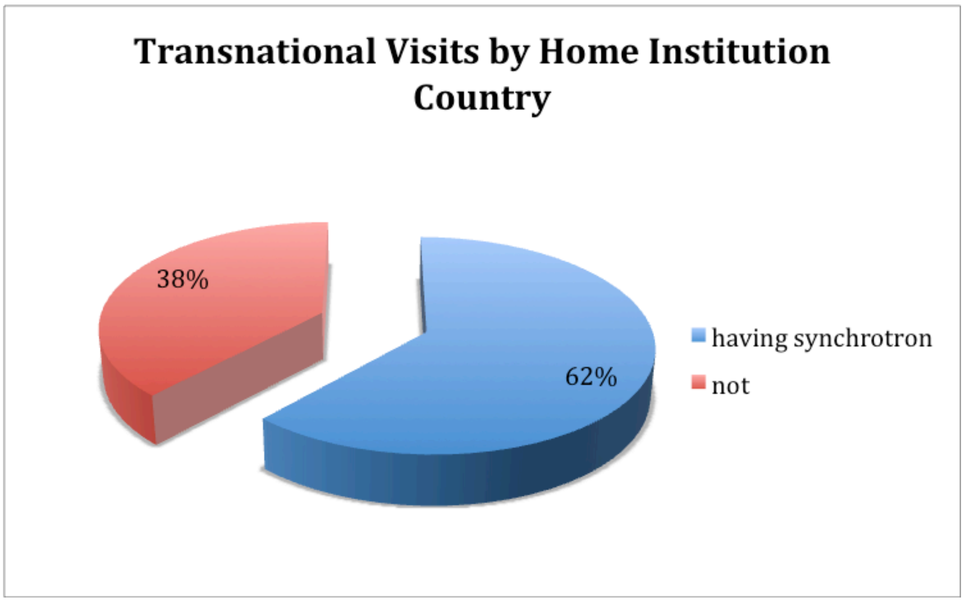


Fig.3: Total user visits by Home Institution Country, taking into account countries with or without a national lightsource. European Countries with at least a national synchrotron or FEL: Switzerland, Germany, Denmark, Spain, France, United Kingdom, Italy, Netherlands, Sweden.

1.5 Project public website and contact details

Project public website: http://www.elettra.eu/ELISA/
Project Coordinator: Sincrotrone Trieste S.C.p.A., Italy
Project Manager: Dr. Michele Bertolo, Head of Sponsored Research Office at Sincrotrone Trieste, Italy

Fig. 1: ELISA project logo.

ELISA project partners

#	Participant organization short name	Country	Delegate (email)
1	Elettra	Italy	G.Paolucci (Giorgio.paolucci@elettra.trieste.it)
2	ALBA	Spain	G.García (ggarcia@cells.es)
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4	HZB	Germany	A.Kaysser-Pyzalla (anke.pyzalla@helmholtz-berlin.de)
5	CNRS	France	JM Ortega (jean-michel.ortega@clio.u-psud.fr)

6	DESY	Germany	Gerhard Grübel (gerhard.gruebel@desy.de)
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10	FOM	The Netherlands	A.F.G. van der Meer (a.f.g.vandermeer@rijnhuizen.nl)
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