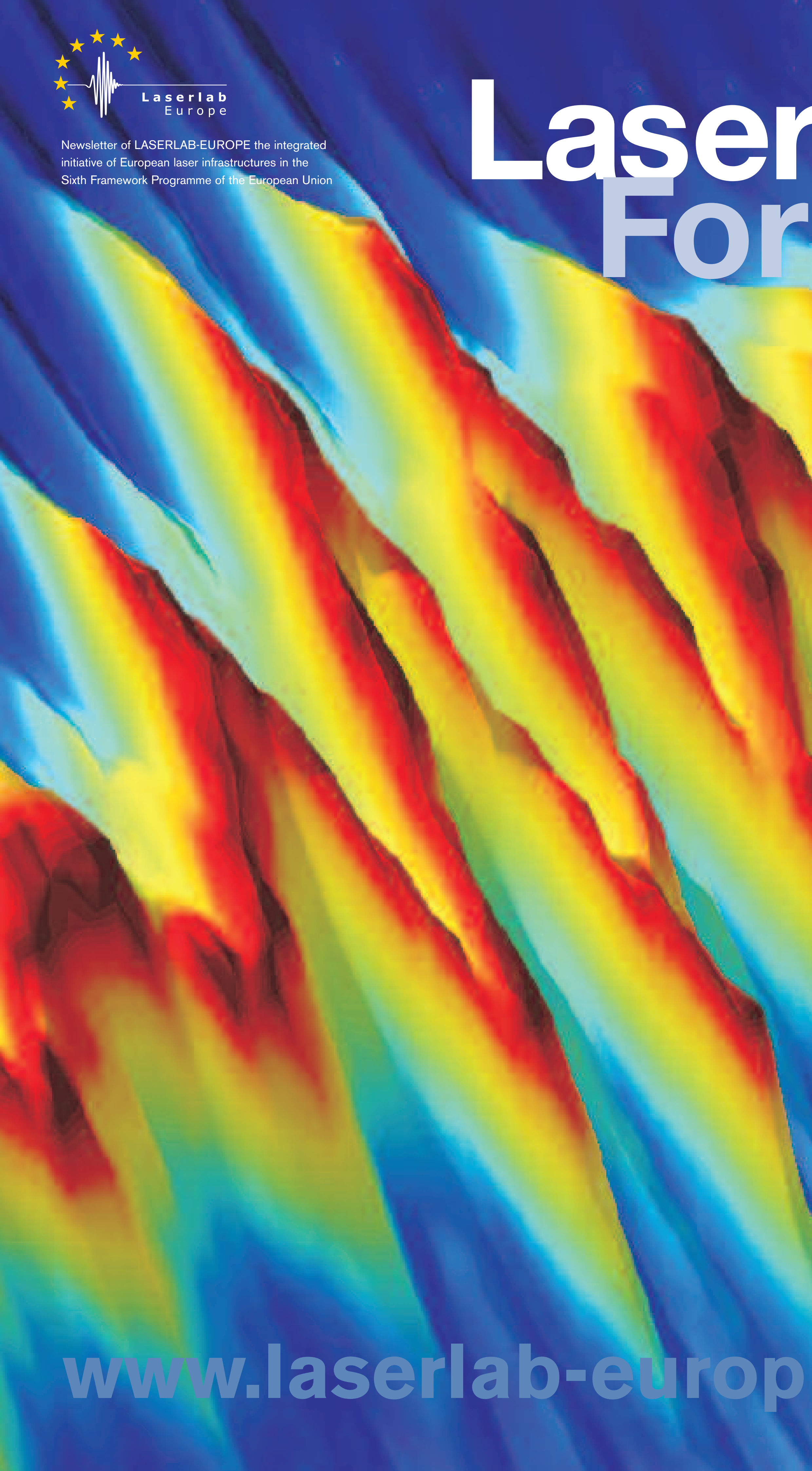
Issue 5 **September 2008**

Laserlab Europe

Newsletter of LASERLAB-EUROPE the integrated initiative of European laser infrastructures in the Sixth Framework Programme of the European Union

Laserlab Forum



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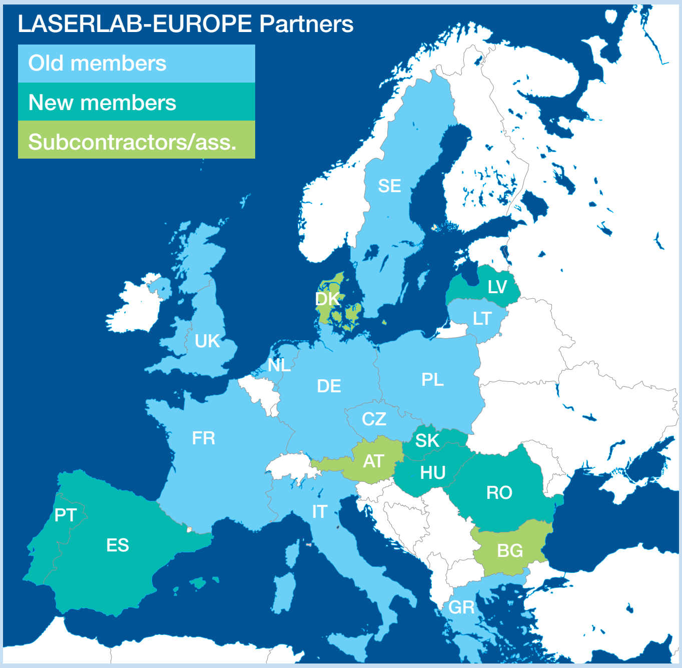
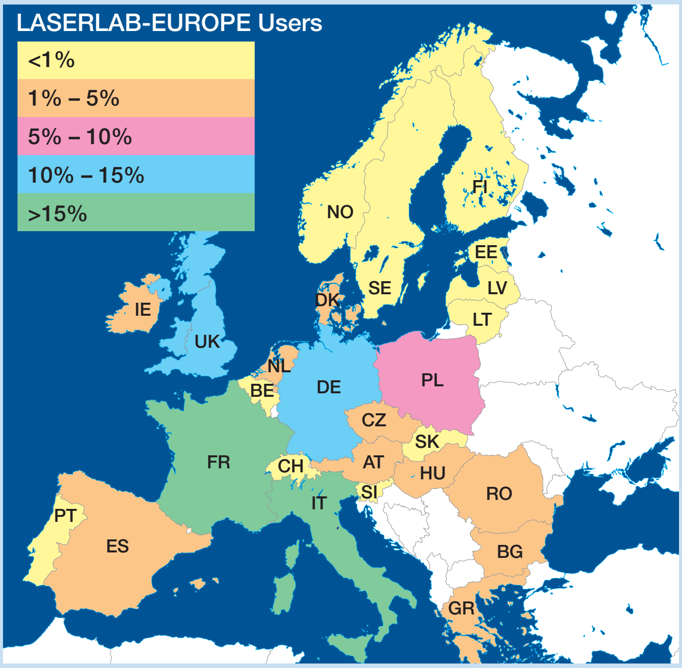
www.laserlab-europe.net





Editorial

Wolfgang Sandner

Expected or not, the aftermaths of the first Call in FP7 have given rise to a sharper view on the role of Research Infrastructures within future European Framework Programmes. The fact is that the 'I3' instrument, comprising the activities of networking, joint research activities and trans-national access, has become increasingly popular across all disciplines, much more than the EC budget growth in this area would allow. This is why only a fraction (~25%) of eligible proposals were selected for funding within the first Call in FP7. Even among those are some who will have to suffer substantial budget cuts.

Fortunately, LASERLAB-EUROPE is among the successful applicants. Given the conclusion of ongoing contract negotiations it will enter the next three years of funding with a number of new partners who introduce themselves inside this newsletter. We warmly welcome these partners and look forward to interesting and fruitful collaborations. With them LASERLAB-EUROPE now covers 19 out of the 27 EU countries. Considering the evolution from previous Framework Programs, the network seems to have come a long way.

This may be a moment for reflection on the European laser community and its research infrastructures. The first question is how big is this community, after all? Lacking a reliable quantitative answer we could resort to an indirect scale, e.g. measuring the annual number of publications with the key word 'laser' – being well aware of all the caveats associated with such crude method. This could give us a comparison with neighbouring disciplines (e.g. synchrotrons, neutrons, or others), or with other global regions like North America or Asia/Pacific. European laser publications yield the largest numbers in all cases. Further analysis yields a substantial interdisciplinarity, including physics, life sciences, chemistry, materials science, engineering and others.

Within this community the role of laser research infrastructures turns out to be rather specific. In general, lasers need not be concentrated in central large scale facilities but are mostly located in the laboratories. This leaves national laboratories and research infrastructures with the mission of hosting either exceptionally large lasers, or a concentration of smaller, highly innovative and unique prototype systems, or both. The role of such infrastructures is typically that of a top-level, interdisciplinary research facility, with the service (access) aspect being an integral part and absolutely indispensable for the community, but not their only purpose. In fact, access in its present institutionalised form is relatively new to large parts of the laser community, apparently initiated by previous EU Framework Programmes. Today it is taken for granted by the users throughout Europe and may contribute to a strong European position in laser science. More recently, the access concept seems to spread to other global regions where the number of national laser infrastructures is steadily increasing.

What are the conclusions? Laser research infrastructures of the size of national laboratories have a very special, but important role within an exceptionally large scientific community. This is why nations not only within Europe, but around the world keep investing in them, knowing that lasers will be indispensable for the science and technology of the 21st century. Europe and the EC have set the pace in several respects, most notably by the introduction of institutionalised access, networking and joint research activities. Other global regions are beginning to set up similar structures, with LASERLAB-EUROPE maintaining close contacts with them. By maintaining and increasing our activities and integration, we will not fall behind. Let's do it!

LASERLAB-EUROPE in **FP7**

Good news: LASERLAB-EUROPE successfully applied for a new project in FP7 and was invited to start negotiations for a 10 million Euro grant. Following the one-year extension of LASERLAB-EUROPE into 2008, this new "Integrating Activity" will involve several new partners and new collaborative research activities. Access will be offered to a broad range of unique laser facilities during the next years. These activities will be complemented by a set of networking activities, further improving the links between the participants.

New Laserlab Facility opens

On 28 November 2007, Ian Pearson MP (UK Minister of State for Science and Innovation) officially opened the Astra Gemini laser at the STFC Rutherford Appleton Laboratory.

Gemini is an upgrade to the current Astra facilities to produce the most intense laser in the world, delivering a total power of 1PW.

This has increased the current single beam power from 20 terawatts to 0.5 petawatts. This new, increased power beam has been duplicated to provide two independently configurable and synchronised beams that will give far greater versatility and scientific application than a single beam. This feature makes it totally unique.

The new facility opened to the international user community in January 2008.

Launch of NLS and PSRI

Last year's UK Light Source Review called on the national user community to come together and identify an optimum facility to serve their needs. It also suggested the formation of an institute to encourage research at existing Free Electron Lasers (FELs). In response, a town meeting on 11 April 2008 at The Royal Society in London saw the launch of the New Light Source project (NLS) and the Photon Science Research Institute (PSRI).

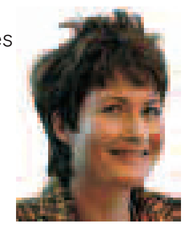
Phase 1 of the NLS involves a broad consultation to define the source's scientific case. Prof John Marangos (Imperial College, London) is co-ordinating input from subject area 'champions' and will deliver a case report in October 2008. As well as accommodating the NLS champions, the PSRI, under its Chief Scientist Prof Justin Wark (Oxford), is establishing itself as a focal point for the exploitation of next generation photon sources. This includes the provision of practical support for facility users.

www.newlightsource.org

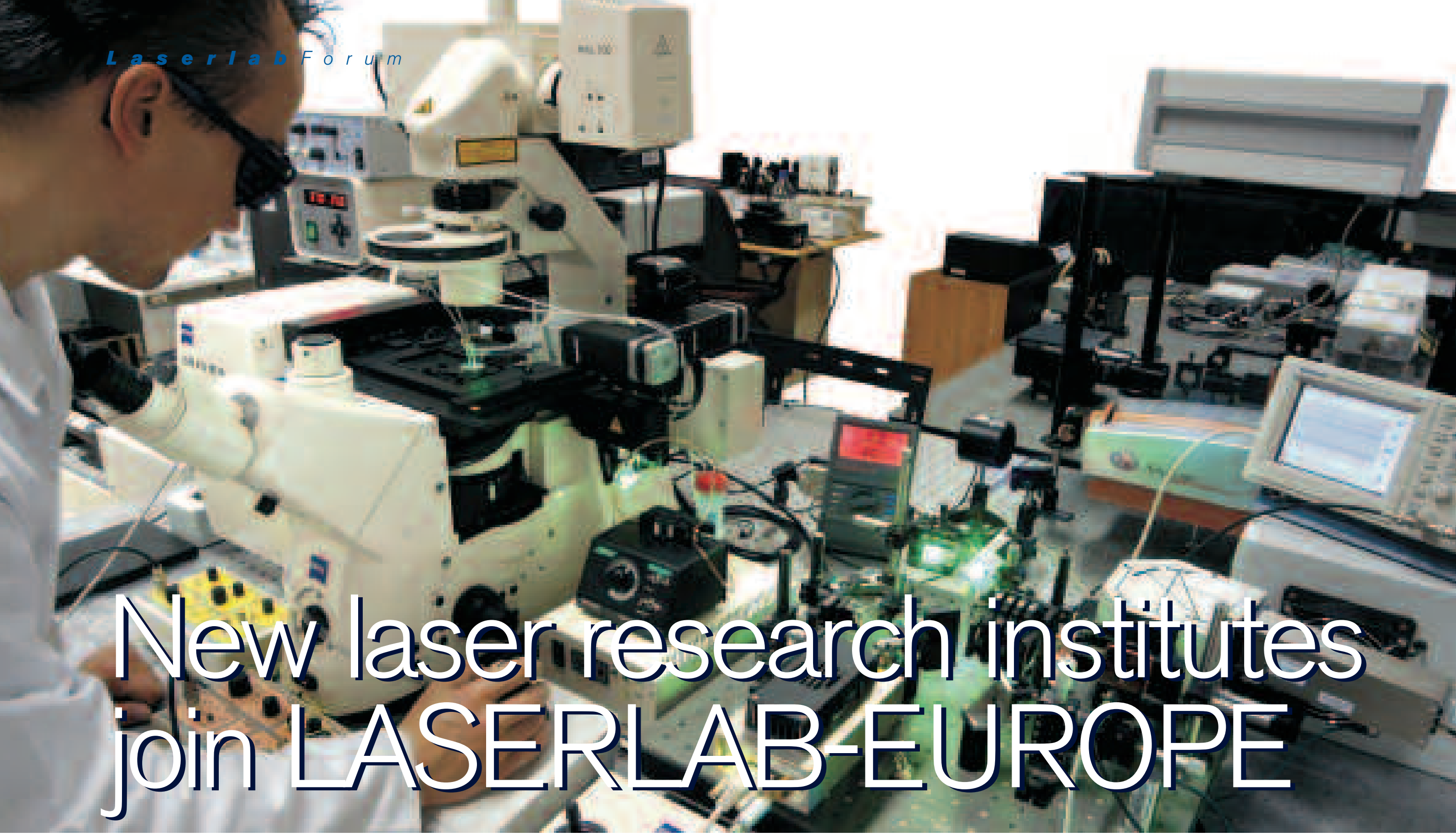
www.photonscienceresearch.org

LCVU starts new research lines in biomedical photonics

In order to strengthen its research in the field of laser-based optical imaging techniques, the department of Physics (FEW) of the Vrije Universiteit (VU) Amsterdam has appointed Prof. dr Johannes de Boer (previously at Harvard Medical School). He is recognized as a world leader in the development and clinical application of Optical Coherence Tomography (OCT). He pioneered Polarization Sensitive OCT, and was the first to realize video rate OCT using Spectral Domain OCT technology. He is also Scientific Research Director at the Rotterdam Ophthalmic Institute.



In addition Prof. Dr Marloes Groot and Dr Erwin Peterman have received 1 M€ from the Institute for Neuroscience at the VU and the Department of Physics to develop advanced deep tissue microscopic methods for brain research, in a close collaboration with researchers from both departments.



New laser research institutes join LASERLAB-EUROPE

The confocal microscope workstation with nonlinear excitation, combined with multispectral and fluorescence lifetime detection at Department of Biophotonics, ILC Bratislava.

The International Laser Centre, Slovakia

The International Laser Centre (ILC) in Bratislava was founded in 1997 as a national platform for advanced education, research and development in photonics in Slovakia.

Being a member of the European platform Photonics 21, ILC is currently involved in more than 35 national and international research projects.

Its scientific program aims to develop:

- New optically active materials (organic semiconductors, nano-assemblies)
- Novel components (photonic integrated circuits)
- Techniques (super-continuum generation in photonic-crystal fibers)
- Applications at the frontier of laser and photonics technologies in the emerging areas of life sciences, nanotechnology, material research or information technology.

Recent advances in laser microscopy based on nonlinear excitation by pulsed tunable laser sources followed by spectral and time-resolved detection of light have opened up new possibilities of high-content, multi-dimensional visualisation of living cells and tissues under controllable physiological conditions.

Some of the research activities currently addressed by the advanced technologies at ILC are:

- Study of metabolic activity by the means of endogenous fluorescence in living cells
- The anti-cancer effect of natural photosensitizers
- Ultrafast molecular dynamics of photoactive molecules
- Development of new biosensors and biomaterials

www.ilc.sk

Laser Centre of the University of Latvia

The Laser Centre of the University of Latvia (ULLC) is the largest centre of laser-based research in the country, working in the areas of astrophysics, atomic, molecular and chemical physics as well as various kinds of applications of laser techniques.

The specific topics are:

- Linear and nonlinear magneto-optics, electro-optics and quantum interference phenomena in atomic and molecular gases, with possible applications for optoelectronic as well as weak magnetic and electric field measurements with nanosize spatial resolution. (Prof. M. Auzinsh, mauzins@latnet.lv);
- High resolution Fourier transform spectroscopy and construction of potentials of alkali diatomics relevant for producing ultracold molecules, and development of all optical techniques for accurate electric field mapping (Prof. R. Ferber, ferber@latnet.lv);
- Development of techniques for laser manipulation of atomic and molecular quantum states with a long-term goal to develop novel approaches to accurate control of bimolecular fragmentation (chemical) processes (Dr. A. Ekers, ekers@latnet.lv);
- Studies of chemical composition of stellar atmospheres, nucleosynthesis, evolution of galactic chemical composition, and atoms and molecules in the interstellar and circumstellar environment (Dr. L. Zaãs, zacs@latnet.lv).

www.lasercentre.lv

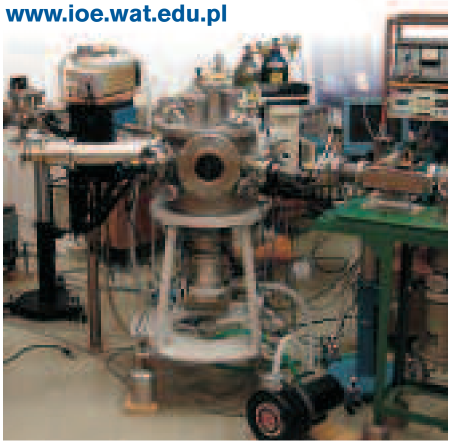
Institute of Optoelectronics, Warsaw

Institute of Optoelectronics (IOE) is an interdisciplinary institute at the Military University of Technology in Warsaw with a mission to support research and education in the optoelectronics and photonic technologies.

IOE is engaged in research and development in the fields of optical, electrical and mechanical processes, components and systems. The research efforts are integrated with academic education. The specific areas of research activities include: design and analysis of optical systems, optical materials, optical technologies, optical metrology, thin film technologies, X-ray and EUV optics, laser optics and electronics, new solid state lasers, laser systems, laser-matter interactions, laser cleaning, medical lasers, nanotechnology, biochemistry, biomaterials, optical spectroscopy, laser ranging and sensing, detection of optical signals, dynamic material studies, security systems, image processing, infrared physics and technology, computer modeling.

With a staff of about 150 employees including 90 scientists and 60 engineers and technicians IOE is a leading research institution on laser development and application in Poland.

www.ioe.wat.edu.pl



Institute of Photonic Sciences, Barcelona

The Institute of Photonic Sciences (ICFO) was created in 2002 as a flag-ship research center in Barcelona. Its mission is to push the limits of scientific and technological knowledge in laser science and technology.

The centre is engaged in research, education and training of post-doctoral researchers, MSc and PhD students. Research at ICFO is organized in four areas: nonlinear optics, quantum optics, nanophotonics and biophotonics.

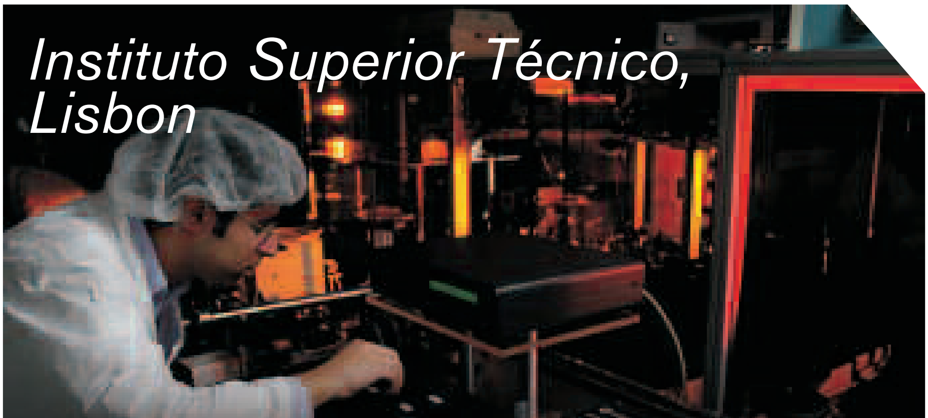
ICFO hosts 15 research groups that use more than 45 laboratories and one nanophotonics fabrication facility. These are housed in a 9,000m^2 dedicated building based at the Mediterranean Technology Park in the Metropolitan Barcelona area.

ICFO participates in a variety of projects funded by the EU and has a leading role in several national efforts in photonics and its applications.

On the industrial side, ICFO actively participates in the European Platform Photonics 21 and hosts a Corporate Liaison Program that aims at setting collaborations and links with European industry.

www.icfo.es

Instituto Superior Técnico, Lisbon



The Instituto Superior Técnico in Lisbon is the leading science and technology university in Portugal, attracting the top physics and engineering students.

IST's Laser and Plasma Group (GoLP) is integrated in the Institute for Plasmas and Nuclear Fusion, an Associated Laboratory for Plasma Physics, Nuclear Fusion and Intense Lasers - a status given to the top research units of high strategic relevance to the country.

IST is home to the Laboratory for Intense Lasers, the largest laser laboratory in Portugal, managed and operated by GoLP researchers.

This facility is equipped with a multi-terawatt CPA laser, a dedicated interaction area for laser-plasma experiments, and a suite of optical and plasma diagnostics.

Experimental expertise includes electron acceleration, high-harmonic generation and tunable sources, and CPA laser science and technology; GoLP is also renowned for its theoretical and advanced computing capabilities.

www.ist.utl.pt

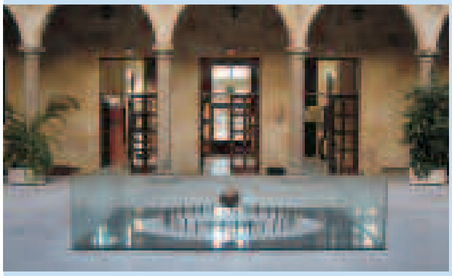
New laser research institutes join Laserlab Europe *(continued)*

Ultra-short, Ultra-intense Pulsed Laser Centre, Spain

The Ultra-short, Ultra-intense Pulsed Laser Centre (CLPU) is a new research facility that has been created as a Consortium of the Spanish Ministry of Education and Science, the Regional Government of Castille and Leon and the University of Salamanca, as part of the implementation of the Spanish Scientific Infrastructures Roadmap. The Consortium was created on 19 December 2007 and its headquarters are in Salamanca, Spain.

The objectives of the Consortium are:

- To build and operate a Petawatt laser (20 to 30 fs) in Salamanca
- To develop ultra-short-pulse technology in Spain
- To make significant advances in intense, compact laser technology
- To promote the use of such technology in several fields: physics, engineering, chemistry, biology, medicine, energy, etc
- To open the facility to the domestic and international scientific community.



Physics Building, just down the pendulum is the most powerful laser in Spain.

The Consortium constructing a new building in the recently-created Technological Park of Salamanca at Villamayor.

In the meantime it is operating a Ti:Sapphire multi-TW laser system (25 fs) at the Physics Building at the University of Salamanca. This system, along with a second Ti:Sapphire TW-class laser (120 fs), already operates as a national users facility.

www.usal.es/~laser/

National Institute for Laser, Plasma and Radiation Physics, Romania

With a history of more than 50 years the National Institute for Laser, Plasma and Radiation Physics (INFLPR), accredited as national institute since 1996, develops scientific and academic activities in the fields of radiation, plasma, CO_2 high power lasers, solid state lasers, metrology, nonlinear and information optics.

The institute has a large laser department developing research in modern topics such as:

- photonic processing of advanced materials
- laser synthesis of nanostructures
- laser-surface-plasma interactions
- nanocomposites and nanoplastics for solar cells
- photoaccoustic spectroscopy (LPAS)
- atomic and ion spectroscopy

As well as fundamental research, interest is focused on developing applications and useful devices. The laboratory has been accredited for its international standard laser metrology and standardisation services.

About 60 scientists are involved in 10 European projects and 25 have been part of the EURATOM programme since 2001.

There are two national projects, coordinated by INFLPR, dedicated to research infrastructure development and one Centre of Education:

1. 'CAPACITIES' Solid State TW laser and material processing
2. 'CAPACITIES 2008' Integral Centre for Advanced Laser Technology PP/PC7
3. 'The Centre for Education and Training' is involved in the dissemination of scientific information for civil society and activities to increase interest in science amongst women and young people.

www.inflpr.ro

Department of Physics, University of Szeged, Hungary

The University of Szeged (USZ) is the largest university in Hungary outside Budapest.

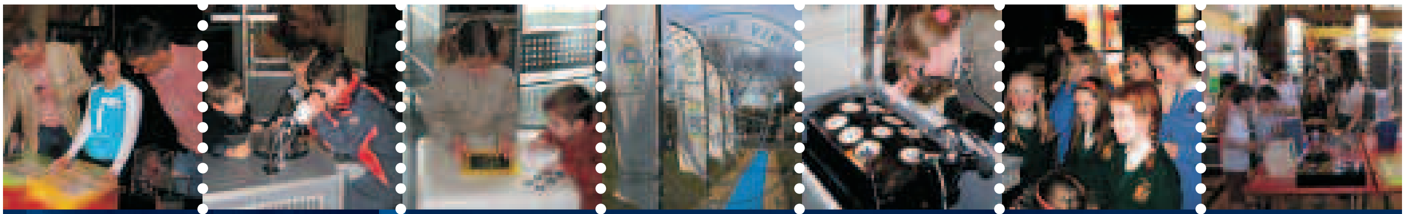
The Department of Physics (USZ DP), part of the Faculty of Science and Informatics, is the leading photonics-related higher education site in Hungary. Research into optics and lasers and their applications started in the mid-seventies. The total number of staff at USZ DP is approaching 100, of which around 40% are senior scientists and 20% PhD students.

Besides the deep theoretical and experimental knowledge of laser physics and optics accumulated during the last four decades in Szeged, the majority of publications are in the fields of laser-matter interactions (linear and nonlinear propagation, surface processing, bio-medical applications, and ionisation physics). The most important research groups relevant to optics and lasers are the High Intensity Laser Laboratory (HILL), the TeWaTi Group, the Laser-Matter Interaction Group, and the Ablation Group.

USZ DP hosts two high power laser systems (HILL at 248 nm and TeWaTi at 800 nm), which are the only laser systems of this kind in Hungary. A large number and high variety of diagnostic equipment (time of flight spectrometer, mass spectrometer, NMRI, atomic force microscope, scanning microscope, electronmicroscope, profilometer) are also available with their in-house experts.

The USZ DP is involved in a large number and variety of cooperative research projects with other universities, research institutions and industrial partners.

www.physx.u-szeged.hu



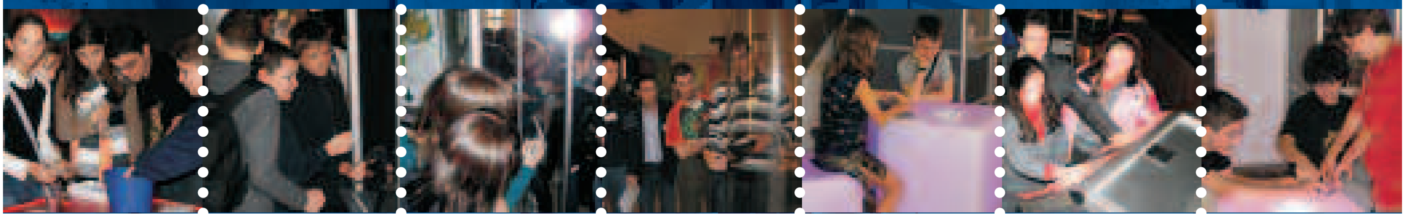
FASCINATION OF LIGHT

More than 30,000 visitors saw the exhibition at nine locations

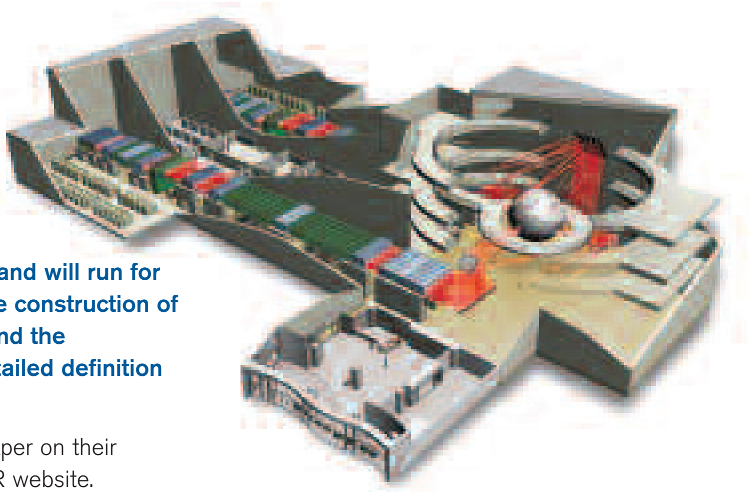
On 2 April 2008 the Irish Minister for Education and Science, Mary Hanafin opened the 'Fascination of Light' exhibition at the Dublin Institute of Technology. The show has proved to be so popular in Dublin that all tours for schools were fully booked up for the two week period, with class groups from 79 schools attending.

Over the last two years the exhibition has been hosted in nine European cities, with stops at the LASERLAB-EUROPE partners in Amsterdam and Prague and in cooperation with the Warsaw University of Technology during the second half of 2007. The exhibition met with lively interest from schools and the public. More than 30,000 visitors have enjoyed guided tours. Registration requests from school classes for these tours often exceeded the number available. In Prague where the exhibition was shown in the context of the 'Week with Science and Technology' people even queued outside the building for an opportunity to visit at the weekends. In the autumn the exhibition will be in Barcelona, Spain on the last stop of this European tour. We hope for further opportunities in the future!

The exhibition explains light and how it affects our lives through the means of interactive installations, experiments, multimedia presentations and visual diagrams and is supported by the European Commission and the German Ministry for Education and Research. It helps contribute to educate young students with an interesting topic with attractive professional opportunities. Experts predict enormous growth rates in technologies that involve light and 'Fascination of Light' aims to encourage more students to study science.



HiPER



The Preparatory Phase of HiPER formally started on 28 April 2008 and will run for three years. This phase is designed to assess the options for future construction of the facility in terms of the technology choices (eg repetition rate) and the associated impact, feasibility and cost, leading to a subsequent detailed definition and design phase.

Many of the technical work packages have already started with several working group meetings taking place during the 35th EPS Plasma Physics Conference and the 10th International Fast Ignition Workshop in Crete in June.

The Executive Board, the formal oversight body of the project, also held their first meeting in early June and will publish a summary paper on their discussions on the HiPER website.

Dr Chris Edwards has been appointed as the HiPER Project Manager. Chris will be known to many in the LASERLAB-EUROPE community from his many years at the STFC Central Laser Facility. Most recently he has been the Project Manager, and subsequently the Project Sponsor for the UK ORION laser.

The formal project was launched on 6 October 2008 at the Science Museum in London attended by all partner institutes and invited guests.

www.hiper-laser.org

New joint research topics of Laserlab Europe

ALADIN

Attosecond Laser sources and Applications; Design and Innovation

The name Aladin is forever connected to the concept of the magic lamp. Within LASERLAB-EUROPE a highly successful JRA: FOSCIL has been executed aiming at the realization of such a magic light source.

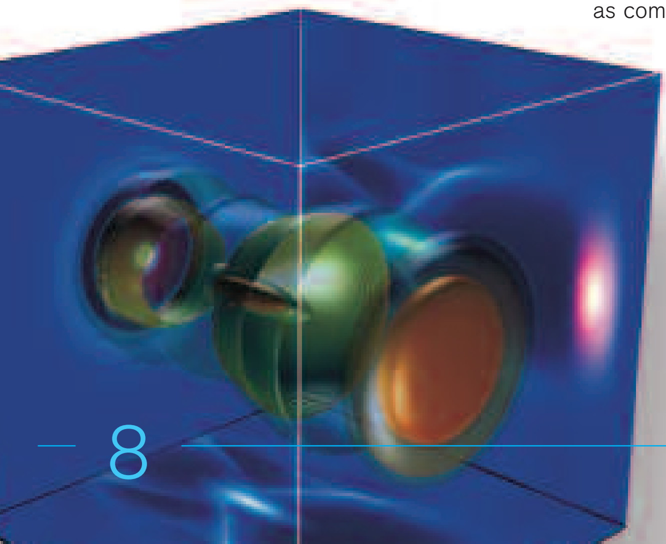
Groundbreaking scientific and technological developments of ultra-short pulse duration, carrier-envelope phase stabilization, XUV and soft X-ray sources, as well as of novel diagnostic approaches have contributed to a number of breakthroughs in ultrafast science. Europe leads this rapidly expanding field of science. In particular, the extension of the femtosecond sources into the extreme ultraviolet and soft X-ray spectral range opens up a new field of attosecond science.

The groups participating in LASERLAB-EUROPE are making an effort to proliferate attosecond technology to a broad user community and to explore the full potential of these 'magic' light sources in innovative science experiments. Phase-stabilized laser sources for ultrafast science shall be improved and made available, spanning a wide range of different wavelengths from IR via VUV to XUV.

In the XUV, attosecond beamlines for pulse trains and isolated pulses shall be further developed and made accessible for users in several fields of physics, chemistry and biology, exploiting their ultra-high resolution in both the frequency and the time domain.

Laptech

To maintain their leadership in laser plasma accelerators, groups of physicists, participants and associate partners of the existing LASERLAB-EUROPE have proposed a joint research activity (JRA) focused on the production of high quality, ultra-short bunches of electrons with femtosecond duration and energies up to 1 GeV.

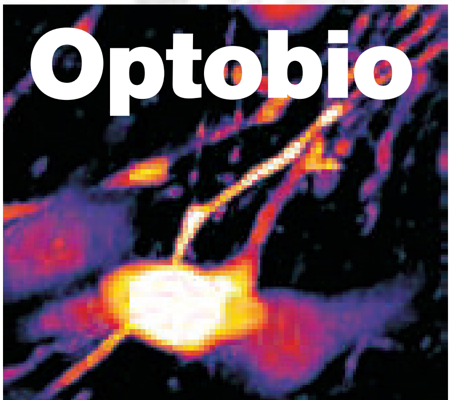


This challenging JRA will take advantage of the growth in expertise and facilities related to LASERLAB-EUROPE to significantly advance the field of laser-plasma accelerators over the next four years to the point where accelerators can be provided to the wider community for exploitation.

The unique properties of beams from laser-plasma accelerators include their short duration (as short as a few femtoseconds), and their high peak brightness. This could lead to applications as compact light and particle sources in many fields, including medicine, chemistry, physics, material science and high energy particle physics.

It is the intention that this JRA (called Laptech) will enhance the synergy between EU laboratories with a proven excellence in the field while promoting integration of theoretical and experimental effort.

Optobio



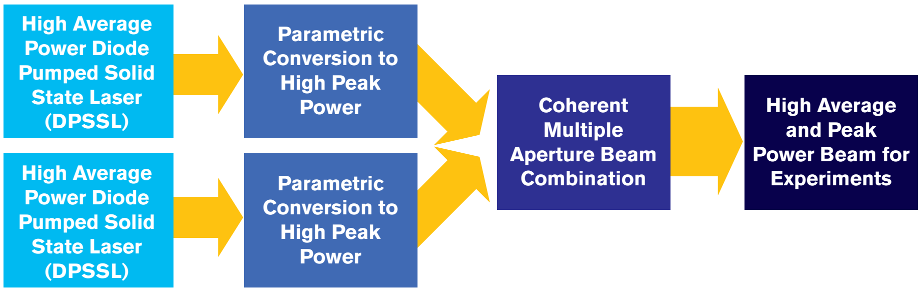
A multi-photon in-vivo imaging of pyramidal cells in mouse hippocampus in intact neural network

Over the last years laser-based techniques such as optical trapping, harmonic generation and multiphoton excitation developed in fundamental laser sciences have found their applications in biophysical research. These non-invasive tools can be used to manipulate molecules and to image cells and tissues with unprecedented resolution and penetration depth.

By using optical tweezers it is now possible to manipulate single DNA molecules for the study of the regulatory mechanisms of gene expression, as well as for investigating the molecular mechanisms of complex enzymes such as molecular motors. Cell biologists are increasingly wanting laser-based technology for the visualization and manipulation of single cells, and the development of tools to image biological processes in living animals.

An example of the exciting developments is the visualization of neural activity from single synapses to complex neural networks in living animals. The application of laser techniques in medicine is creating unique tools for the characterization of living tissues and promises to become essential for the development of innovative and powerful techniques to diagnose and treat human diseases.

HAPPIE



Almost all high energy or high power solid state lasers are severely limited in shot repetition rate by the technology used as a power source – flash lamps. Opportunities now exist to use an alternative method – direct pumping by solid-state laser diodes (DPSSL). This method has efficiencies of orders of magnitude greater. Consequently, it will be possible to build lasers with energy or power performances similar to systems that exist today, but at repetition rates measured in Hertz rather than hours.

A number of projects to do just this are underway around the world, principally centred on High Energy Missions, with several in Europe. This JRA proposal builds on these investments by targeting new technology development that would be centred on a high power mission. It is broadly aligned to a vision of future high average, high peak power development. Technology development areas are:

- Thin disc technology
- Photonic rods
- Broadband parametric conversion techniques
- Linear and non-linear coherent aperture combination

SFINX

Since the early 90s soft X-ray lasers have demonstrated their potential for multi-disciplinary applications through numerous experiments. Currently a number of soft X-ray lasers worldwide are delivering beamtime for users like any other laser facility. Despite such important evolution, soft X-ray lasers have not yet reached the level of maturity and uniqueness, in particular compared to VUV free-electron lasers, to be highly attractive sources for European users achieving cutting-edge research in Biology, Chemistry, Material Science ....

- The SFINX JRA is structured around three main goals. First, we will improve the existing soft X-ray lasers to deliver to LASERLAB2 users soft X-ray beams with sub-ps duration and near mJ energy and high focusability (sub-µm). Such soft X-ray lasers would be able to produce intensities above 10^{18} Wcm^{-2} that are currently seen only on free-electron lasers.
- Consequently the second goal will consist in progressing towards ultra-high intensity experiments by focusing the soft X-ray laser on a µm-scale focal spot. Efforts will be devoted to measuring the absolute intensity produced in the focal volume.
- In parallel, we will progress on the third goal: achievement of near keV X-ray lasers for which a wide range of pluridisplinary application is foreseen. Experiments will be strongly supported by up-to-date modelling in order to progress quickly and efficiently.

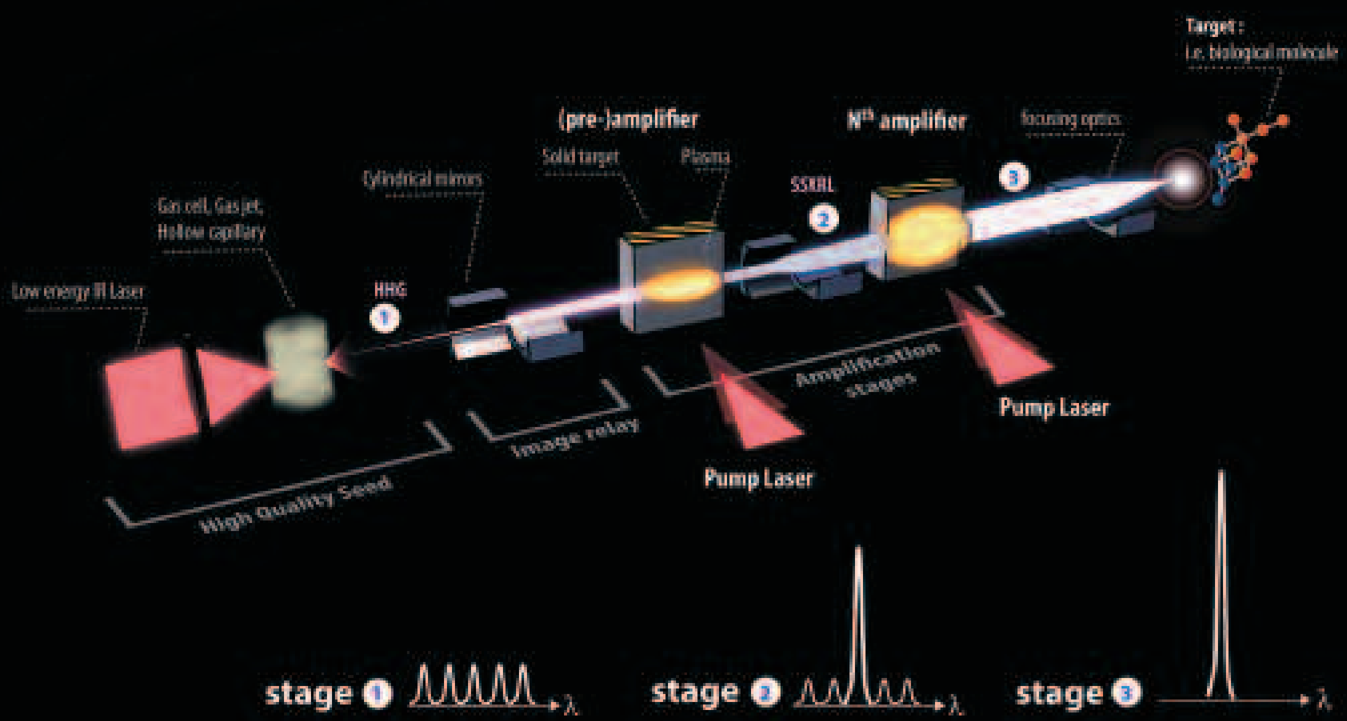
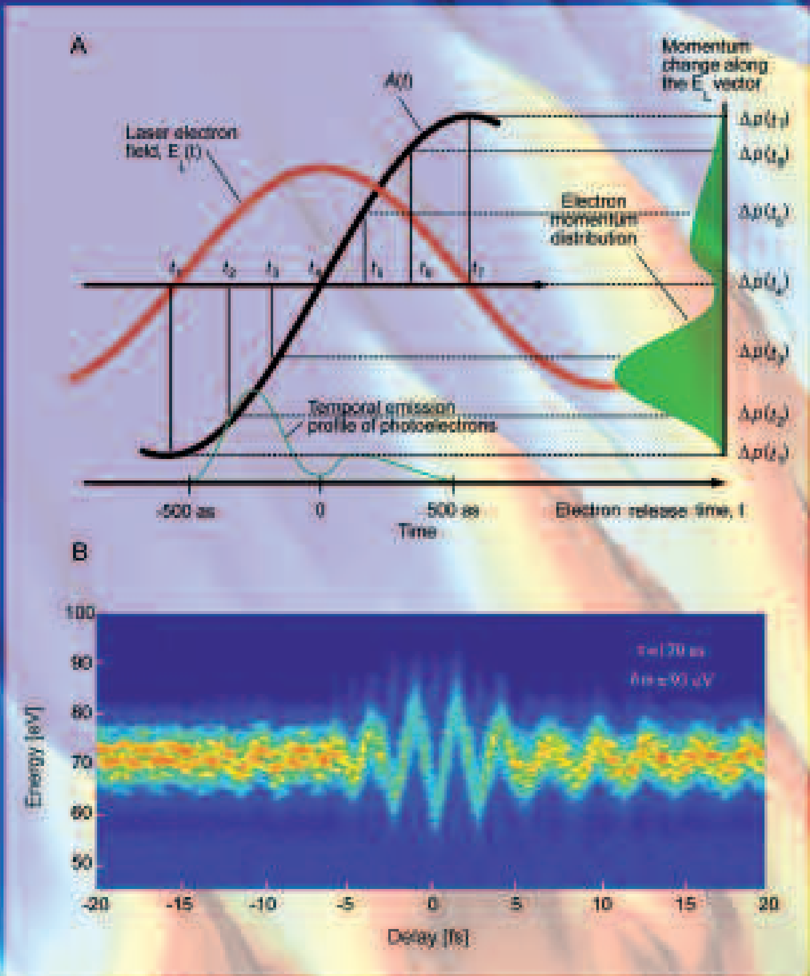


Figure 1 (A) Concept of optical-field-driven streak imaging of electron emission from atoms. A soft X-ray pulse is used to ionize atoms and to generate electrons in the presence of a laser field. Electrons released parallel to the direction of electric field (red line) suffer a change of their initial momenta depending on the instant of release, mapping the intensity profile of the emitted electron and hence of the ionizing sub-fs soft X-ray pulse into a corresponding final momentum and energy distribution of electrons. (B) Application of the optical-field-driven streak camera for the characterization of sub-200 attosecond soft X-rays pulses. Streaked spectra of photoelectrons released from neon atoms by a single sub-femtosecond soft X-ray pulse (~95 eV) recorded for a series of delays between the soft X-ray pulse and laser field. The laser field causes only a moderate broadening (streaking) of the electron spectra, with its main effect being the shift of the centre of mass of the electron spectrum. Each of these pulses contained more that 100000 of soft X-ray photons and enable one to study electronic processes with unprecedented resolution.



Sub-cycle-precision control of light pulses that comprise a mere of two field oscillations has played a central role in attosecond physics (1 as = 10^{-18} s). Demonstration of powerful 170-attosecond soft X-ray pulses, as well as generation of ultrabroad soft X-ray spectra that hold promise for advancing attosecond science into the sub-100 attosecond realm, comprise recent developments that benefit from this precision.

Steering electrons
Attosecond

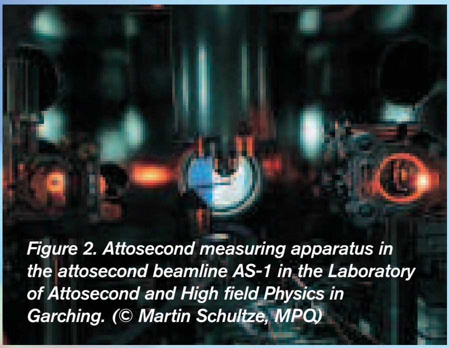


Figure 2. Attosecond measuring apparatus in the attosecond beamline AS-1 in the Laboratory of Attosecond and High field Physics in Garching. (© Martin Schultze, MPQ)

The rapidity of microscopic phenomena in matter is predicted by quantum mechanics to be inversely proportional to the size of a microscopic system or to put it more accurately in the language of quantum mechanics, inversely proportional to spacing between the relevant energy levels of the microscopic system. For example, the millielectronvolt energy spacing of vibrational levels imply that structural dynamics of molecules and solids as well as related chemical reactions and phase transitions evolve on a femtosecond time scale. Access and control of these phenomena on a femtosecond time scale relied on laser pulses the intensity envelope of which undergoes a variation within femtoseconds. However a light pulse cannot be shorter than a field oscillation (~2 femtoseconds for visible light) and this imposes severe limitations to studying even faster processes with such tools. Such phenomena are pertinent to the motion of electrons in atoms and in molecules which, as dictated by the few-electronvolt energy spacing between the electronic levels in such systems, extend into the attosecond regime. In contrast to the pulse envelope, the electric field of visible light changes its strength and direction within a few hundreds of attoseconds and therefore affords the possibility of accurate steering of electrons at unprecedented speeds if precisely controlled. Generation of isolated attosecond pulses in the soft X-ray regime as well as their precise measurement comprises some of the most spectacular results of sub-cycle level light control.

Attosecond pulses can be generated when intense laser pulses are focused into an ensemble of atoms to generate soft X-rays in a process known as high harmonic generation. At the crests of the few light oscillations that comprise such a pulse, the electric field is strong enough to pull out electrons from the atoms and accelerate them at high energies that approach several hundreds of electronvolts. In the ensuing half cycle the light field will drive the electrons back to the atom that upon their recombination with it release their energy in the form of soft X-rays. With a conventional laser pulse consisting of many field cycles the process of recombination and therefore emission of soft X-rays takes place many times. To isolate only a single powerful emission of soft X-rays the team at Max-Planck-Institute for quantum optics and the Ludwig-Maximilians University in Munich, Germany employed pulses that comprise a mere of two field oscillations to drive the high harmonic generation process. Within such a pulse only a single wave crest corresponds to field that is strong enough to generate highly energetic photons. Therefore the emission of the soft X-rays was confined within a fraction of an optical cycle (Figure 1). In a next step the emitted soft X-rays were spectrally filtered from lower photon energies generated by less intense cycles around the peak of the pulse utilizing advanced multilayer optics. For the temporal characterization of these pulses which is as demanding as their generation, the concept of the optical-field streak camera was employed and it is illustrated schematically in Figure 1B.

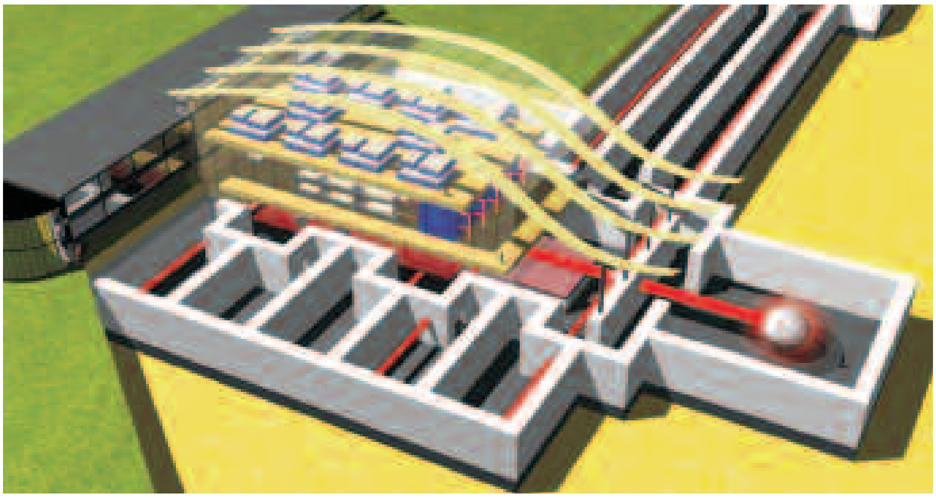
The approach has allowed generation of powerful attosecond pulses shorter than 200 attoseconds which are expected to dramatically expand the capabilities of modern attosecond metrology and technology. Further experiments with even shorter pulses comprise not more than ~1.5 field oscillations and containing almost 50% of their energy in a single oscillation cycle were employed in similar experiments. It was shown that the soft X-ray pulses emitted by atoms that interact with such a pulse are at least twice as broad as compared to the previous experiments and if properly filtered and compressed can result in pulses beyond the sub-100-attosecond frontier.

These developments will allow researchers to freeze frame the motion of electrons in atoms molecules and solids and to interrogate their role in structural changes that occur on such a short time scale opening the door to ultimate light based control of the microcosm.

[1] M. Schultze *et al., New J. Phys.* **9**, 243 (2007).
[2] A. L. Cavalieri *et al., New J. Phys.* **9**, 242 (2007).
[3] E. Goulielmakis *et al., Science* **317**, 769 (2007).

at light frequencies: metrology and control

ELI Preparatory phase on track



The European Community (EC) has decided to fund the Preparatory Phase of what may become the world´s highest power laser, the Extreme Light Infrastructure (ELI). ELI is one of the proposed large-scale facilities which were put on the European Roadmap of the European Strategy Forum for Research Infrastructures (ESFRI) in September 2006.

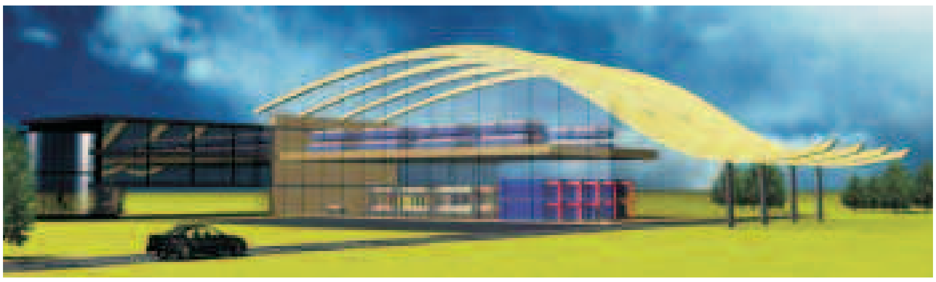
ELI is a joint effort of 13 European countries including Bulgaria, Czech Republic, France, Germany, Greece, Hungary, Italy, Lithuania, Poland, Portugal, Rumania, Spain, and UK. The EU grant of €6M is dedicated to making all necessary preparations for the planned start of ELI's realization in 2011.

The international ELI project team under the leadership of Prof. Gerard Mourou has started to work out scientific, technical and organizational aspects of ELI as well as proposals for the site choice and funding. Major decisions are being made by the ELI Participant Council (one mandate per country) and the ELI Steering Committee composed of representatives of funding agencies. Daily operations are run by the ELI Executive Board (EB).

All these bodies were established during the kick-off meeting in Paris earlier this year. The EB coordinates nine different work packages in the area of science, technology, support actions and coordination actions through their corresponding leaders. The scientific working group and the international scientific advisory board composed of high level internationally recognized researchers help to sharpen and to update the scientific and technical program.

The preparatory phase has been started through a series of meetings. The site choice committee is expecting to receive the first documents from the countries willing to host ELI by 20 September 2008. The first international ELI related conference will be held in late 2009 in Romania.

For further information about the project please visit www.eli-laser.eu.



Announcements

Forthcoming events 2008

Laserlab meetings

LASERLAB Foresight Workshop and Users Meeting 'Trends of Laser Applications in Biology and Biomedicine'
Heraklion, Crete, Greece
23-24 October 2008

LASERLAB N4 Workshop on EU Target Fabrication Capabilities
Cosener's House, Abingdon, UK
27-28 October 2008

'Fascination of Light' in Barcelona, Spain
12 November - 3 December 2008

LASERLAB N4 Workshop on Radioprotection Safety
Chamonix, France
15-17 December 2008

How to apply for access

Interested researchers are invited to contact the LASERLAB-EUROPE website at www.laserlab-europe. net/access/, where they find all relevant information about the participating facilities and local contact points as well as details about the submission procedure. Applicants are encouraged to contact any of the facilities directly to obtain additional information and assistance in preparing a proposal.

Proposal submission is done fully electronically, using the LASERLAB-EUROPE Electronic Proposal Management System. Your proposal should contain a brief description of the scientific background and rationale of your project, of its objectives and of the added value of the expected results as well as the experimental set-up, methods and diagnostics that will be used.

Incoming proposals will be examined by the infrastructure you have indicated as host institution for formal compliance with the EU regulations, and then forwarded to the Users Selection Panel (USP) of LASERLAB-EUROPE. The USP sends the proposal to external referees, who will judge the scientific content of the project and report their judgement to the Users Selection Panel. The Users Selection Panel will then make a final decision. In case the proposal is accepted the host institution will instruct the applicant about the further procedure.

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