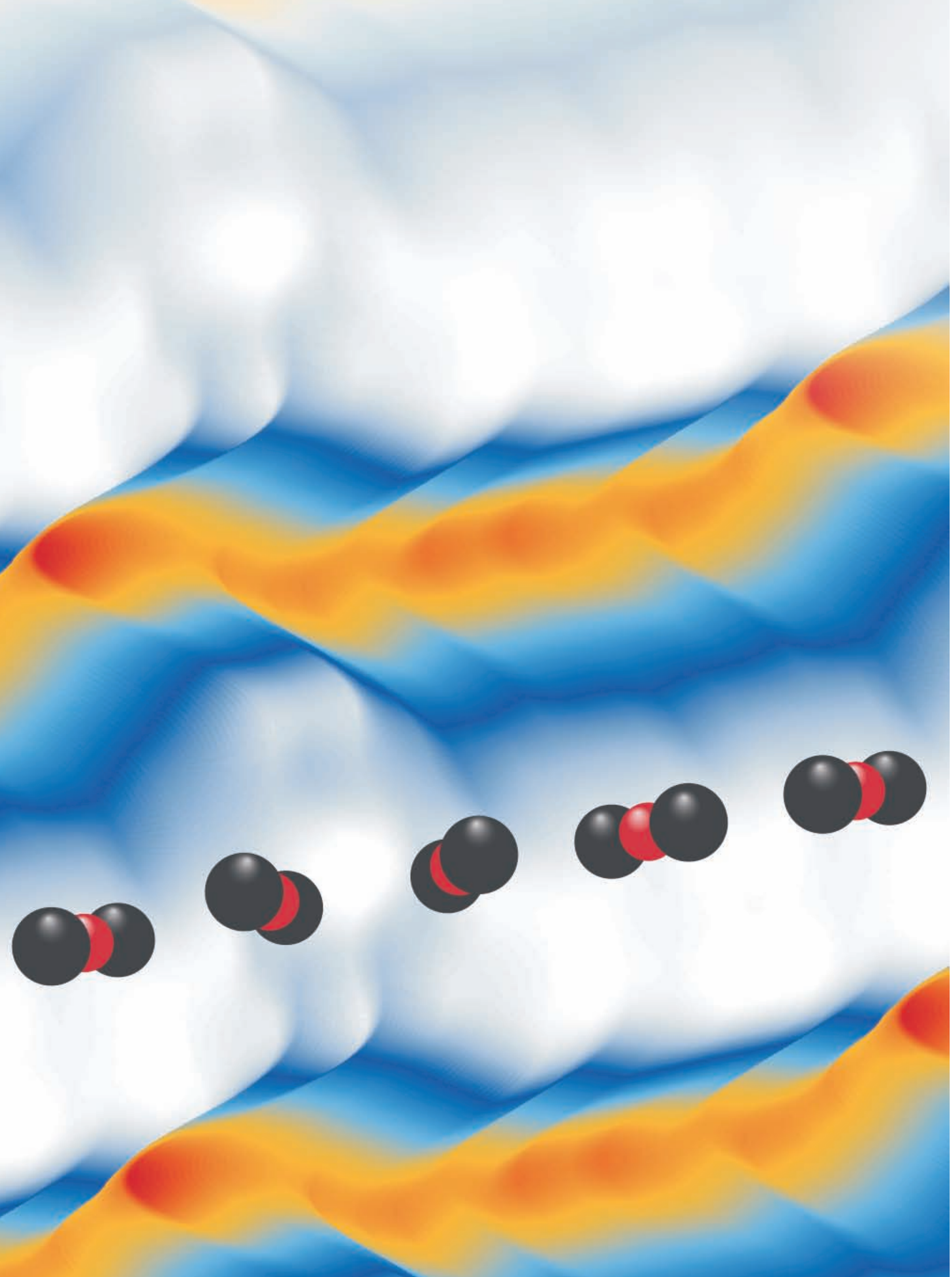
Issue 6 December 2008

Laserlab Europe

Laserlab Forum

Newsletter of LASERLAB-EUROPE, the integrated initiative of European laser infrastructures funded by the Seventh Framework Programme of the European Community



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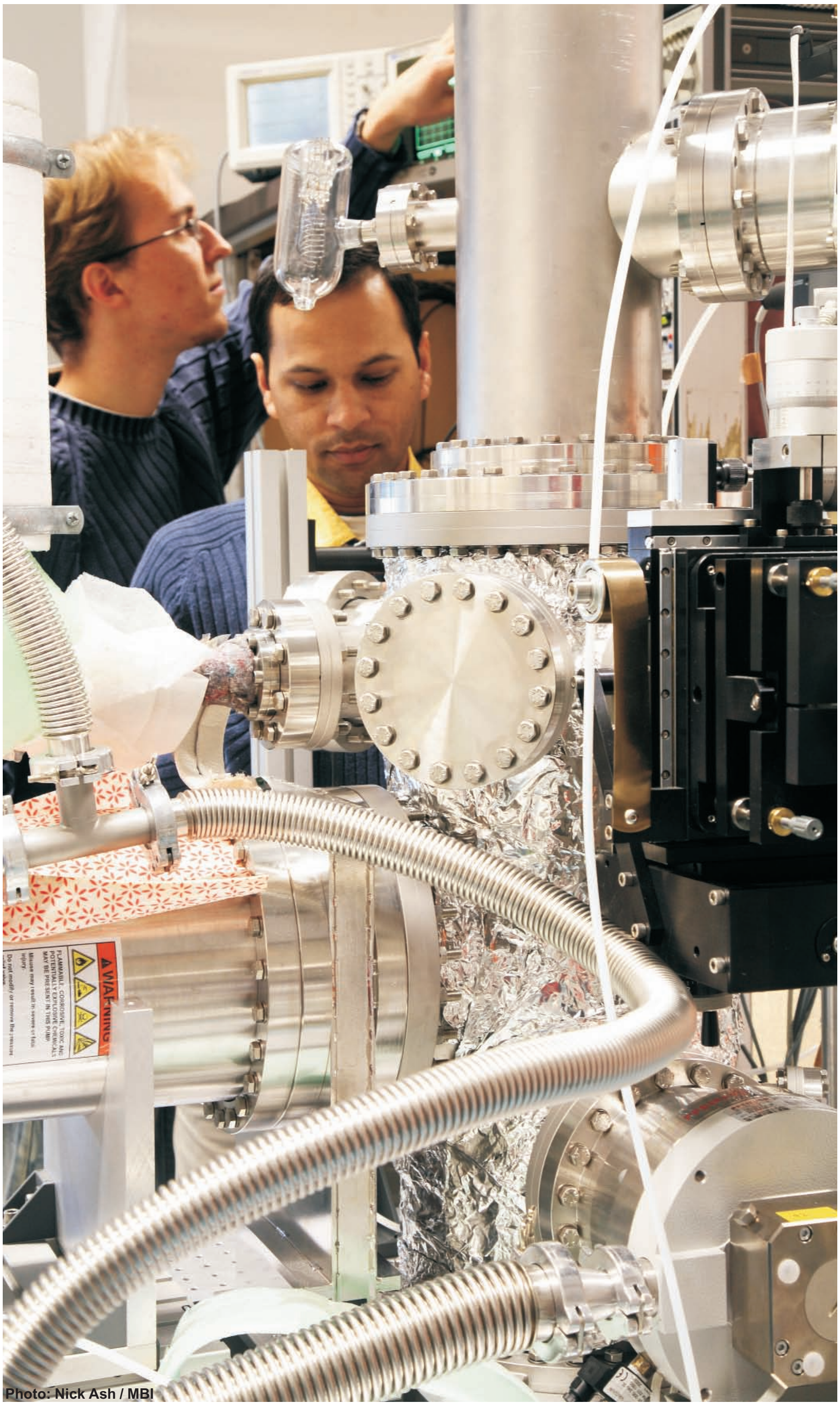


Photo: Nick Ash / MBI

Editorial

In front of you lies the sixth issue of Laserlab Forum, the first of two issues under the colours of LASERLAB-EUROPE Cont.; the project that bridges the gap between LASERLAB-EUROPE (part of the Sixth Framework Programme of the European Union, FP6), and its successor LASERLAB-EUROPE II (part of FP7), which will officially start in March 2009. In LASERLAB-EUROPE II, the number of countries participating in the consortium is extended to nineteen, and a total number of twenty facilities will offer Transnational Access to their labs for European research teams. This extension of LASERLAB will certainly lead to many rewarding collaborations in the coming years.

This issue contains reports on two workshops held in the context of LASERLAB-EUROPE Cont.: the combined LASERLAB Foresight Workshop and Users Meeting in Heraklion, Crete (page 4), and the LASERLAB-funded 2nd Target Fabrication Workshop in Abingdon, UK (page 5), both of which were highly successful. As becomes clear from the report on the Foresight Workshop, the application of lasers in biology and medicine comprises a rapidly growing field of research. LASERLAB-EUROPE acknowledges this development by starting the OPTBIO Joint Research Activity (JRA) within the framework of LASERLAB-EUROPE II. One of the partners in the OPTBIO JRA is the LCVU in Amsterdam, which received a grant of 3.4 million euro to set up a national facility for laser-based microscopy (see page 3), reflecting the growing relevance of lasers in current biomedicine.

More news on grants on pages 8-10: several top researchers within LASERLAB-EUROPE received an Advanced Investigators Grant of over two million euro from the European Research Council in 2008. Three of them are highlighted in this issue. The topics covered by these researchers are coherent attosecond pulse trains (Anne L'Huillier, LLC), laser accelerators (Victor Malka, LOA) and advanced x-ray spectroscopy (Villy Sundström, also LLC).

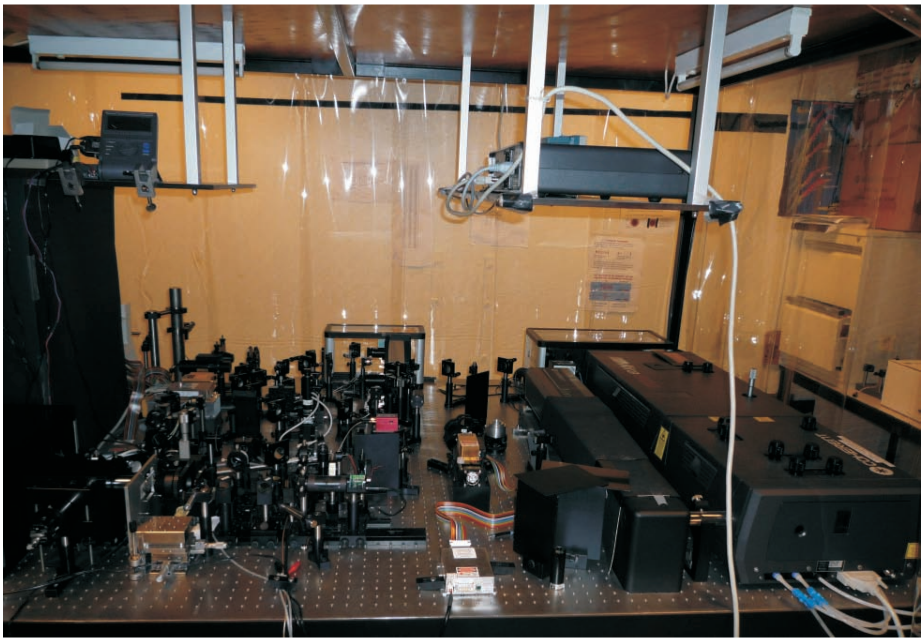
Our regular feature *Access Highlight* contains a description of experiments conducted within the Transnational Access Programme at the Saclay Laser Interaction Center (SLIC), where quantum interferences were measured between electronic states of aligned carbon dioxide molecules, leading to a publication in *Nature Physics* (pages 6-7).

Finally, this sixth issue also marks my start as the new editor of Laserlab Forum. Some of my background can be learned from the introduction on page 3. I am taking the place of Vicky Stowell, who was responsible for the previous two issues. I would like to thank Vicky for her work and I want to extend my gratitude to everyone who contributed to this issue. I hope you will enjoy reading this newsletter and please know that your input for this newsletter will be appreciated at all times.

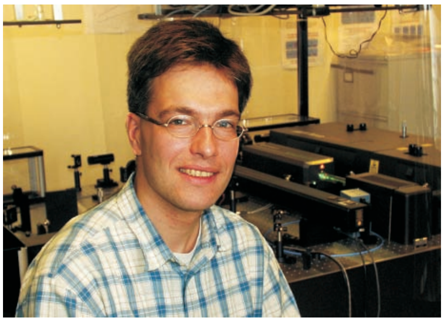
Tom Jeltes
Editor Laserlab Forum

New facility for bio-microscopy at LCVU

The Laser Centre Vrije Universiteit (LCVU) in Amsterdam has received a Dutch 'NWO Large'-grant of 3.4 million euros to set up a 'facility for advanced laser-based microscopy to study living, biological systems'. This project is an initiative of bio and laser physicists within the LCVU, and should result in a national facility with a wide range of microscopic tools, all located at the VU University campus.

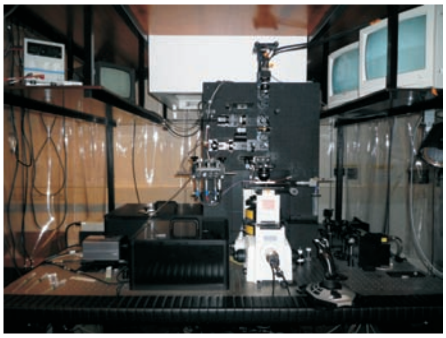


According to project coordinator Dr. Erwin Peterman, the new facility will allow biologists and medical scientists from the Netherlands and around the world to study living biological samples at various levels of detail, from the constituent molecules to the level of living tissue. "The idea is that one could literally carry a single sample from one diagnostic setup to another, to examine it at all relevant length scales."



Dr. Erwin Peterman

Peterman gives an overview of the main objectives of the project: "For visualisation at the molecular level, we want to construct two different ultra-sensitive fluorescence microscopes to study motor proteins, neurons and DNA-binding proteins. At the cellular level we will develop non-linear optical and x-ray microscopes which will allow us to study processes without the need for labelling, so that we can use living cells." Prof. Dr. Johannes de Boer, recently appointed full professor at LCVU and previously employed at Harvard Medical School, developed a technique called 'spectral-domain optical coherence tomography', a tool that will be used to study live brain tissue, and that can also be used for early detection of cancer in the oral cavity. Peterman: "This technique allows us to look deeper into the brain, opening up a new possibility to study neuronal processes, hopefully leading to a better understanding of diseases like Alzheimer and Parkinson."



The LCVU initiative fits well in one of the new focal points of Laserlab Europe: LCVU is heavily involved in the new OPTBIO Joint Research Activity, which focuses on using lasers to study and manipulate biological systems.

TJ

New editor Laserlab Forum

From this issue onwards, Laserlab Forum will be edited by **Tom Jeltes**, an Amsterdam based science writer with firm roots in Laserlab Europe: in March 2008 he obtained his PhD degree in the Atomic, Molecular and Laser Physics group at the Laser Centre Vrije Universiteit (LCVU) in Amsterdam.

During his PhD period, Tom has been involved in laser cooling of metastable ($^3S_1$) helium atoms, which led to the production of a Bose-Einstein Condensate of helium-4 and a quantum degenerate mixture of (fermionic) helium-3 and helium-4.

The new editor's research directly benefited from Laserlab Europe, as the LCVU cold atoms group worked together with a team of researchers from the Institut d'Optique in Palaiseau, to demonstrate the Hanbury Brown-Twiss effect for massive fermions and bosons. This collaboration, which led to a *Nature* publication in 2007 (highlighted in Laserlab Forum issue 4, pp. 8-9) was sponsored by the Laserlab Europe Transnational Access facility.

Please do not hesitate to contact Tom if you have any news or contributions related to Laserlab Europe: be it scientific results, grants, conferences or symposiums; anything that might be interesting for publication in Laserlab Forum will be appreciated.

Email: tomjeltes@gmail.com

LASERLAB Foresight Workshop and Users Meeting "Trends of Laser Applications in Biology and Biomedicine"

Heraklion, Crete, Greece, October 23-24, 2008

A Foresight Workshop on Laser Applications in Biology and Biomedicine was organized by Costas Fotakis and Maria Farsari of ULF-FORTH on October 23-24 in Crete, Greece. The purpose of the Workshop was the exploration of emerging laser based techniques in the fields of biophotonics and medicine. For the wider exposition to the interested scientists, the event was combined with a Laserlab Europe Users Meeting.

The programme included presentations by a number of highly-acknowledged scientists who provided an overview of the different emerging subfields within the areas of biophotonics and biomedicine. Optical techniques have always been important in life sciences. However, as was demonstrated in the workshop, the advances in femtosecond laser technology provide unique monitoring and imaging capabilities, and also capabilities for the manipulation of biomolecules, cellular organelles and tissue structures at unprecedented spatial and temporal resolution, specificity and penetration depths. These techniques are already revolutionalizing the approaches of life scientists.

The breadth of the capabilities of femtosecond laser technology for imaging and probing including multiphoton detection of endogenous and/or delivered fluorophores enabling probing of processes at cellular and at clinical levels, as described in detail by Prof. Paul French (Imperial College), optical tomographic schemes (Prof. Vasilis Ntziachristos, T.U. Munich), holographic techniques of increasing resolution for the functional imaging in life sciences, and nonlinear optical microscopy of intracellular structures. Finally, Prof. Graham Fleming (Berkeley) discussed novel 2-D spectroscopic imaging for the detailed monitoring of energy transfer processes in photosynthetic centers, reaching the intriguing conclusion that they may constitute the prototype of quantum computers.

Besides the capabilities in imaging and probing, irradiation with femtosecond laser pulses enables highly spatially-resolved and well-defined "perturbations" of cellular components. Cellular phenomena such as mitosis, mobility, metabolism, differentiation, apoptosis, etc. are due to a combination of processes occurring in distinct subcellular domains, so that the selective removal of these functional domains within single living cells affords the most direct way for assessing their role or functionality. As illustrated by Prof. Kazuyoshi Itoh (Osaka University), femtosecond laser based manipulation in combination with femtosecond monitoring approaches far surpass, in selectivity and in spatial resolution (sub- μm versus tens of μms), the conventional chemical and genetic methods that have been used thus far in molecular biology. Prof. Kishan Dholakia (St. Andrews University) discussed how these capabilities can be further enhanced by the use of beam shaping techniques such as Bessel optical systems.

In a different field, non-linear polymerization enables the direct fabrication of complex 3D structures with sub- μm resolution, even below the diffraction limit, for developing scaffolds and in the long term tissue implants (Prof. Boris Chichkov). In fact, tiny blood valves that may find use in replacing failed valves in arteries and veins have been constructed in a collaboration between scientists from the laser group at FORTH, Crete, Greece and LZH at Hannover, Germany.

The Foresight Workshop was combined with a LASERLAB Users meeting focusing on this field. This combination was found to be very useful and stimulating for all participants. The workshop demonstrated the high potential and profound impact that the femtosecond laser technologies available within Laserlab Europe can have for scientists in emerging fields of biophotonics and biomedicine.

Savas Georgiou

Target Fabrication Workshop in Abingdon

Abingdon, UK, October 27-28, 2008

The highly successful Laserlab-funded 2nd European Target Fabrication Workshop was held at Cosener's House, Abingdon, UK on 27th and 28th October 2008. It comprised over thirty delegates from fifteen institutions spread across France, Germany, Japan, Russia, Spain, UK and USA. The number of delegates was almost exactly double those attending the previous European Target Fabrication Workshop held in 2006, showing a strong growth in the European Target Fabrication community.

Participants of the 2nd European Target Fabrication Workshop in Abingdon.

The workshop consisted of six sessions: capability overviews, characterisation, microtechnology 1 & 2, cryogenics and foams. There was a final summary session which produced a range of action points, not least of all the intention to hold a third workshop in about two years time. It was clear from the presentations that Target Fabrication as a generic activity is broadening its influence particularly due to the urgent microtargetry challenges arising from recent and ongoing advances in high power lasers. Much novel and exciting work was presented throughout the workshop; here is not space in this article to mention all of the highlights, but the characterisation talks given by NPL, and the University of Huddersfield both presented highly novel solutions to micro-target characterisation challenges. These are particularly good examples of research groups which have not been involved with Target Fabrication in the past engaging at a very high level.

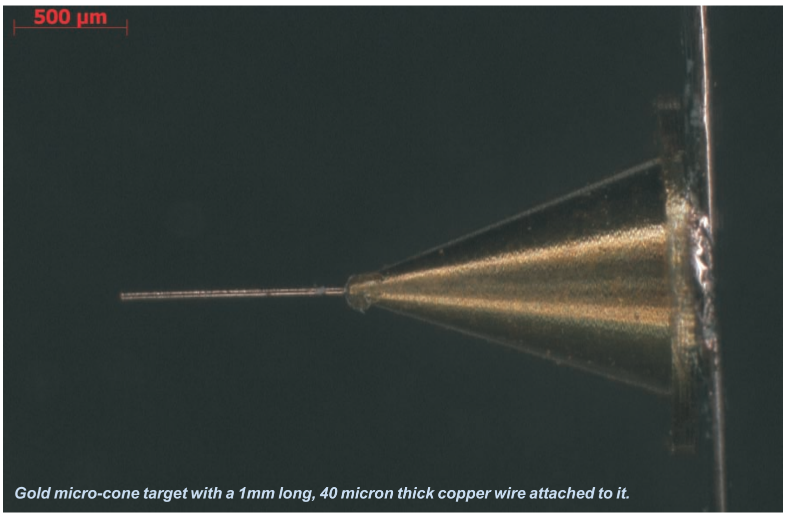
In addition to the challenges of producing microtargets for high power lasers currently available in Europe, a new challenge which repeatedly appeared throughout the workshop, is that posed by the high repetition rate of high power lasers which are coming on line or are planned for the future. Discussion in the context of HiPER and beyond that IFE (Inertial Fusion Energy, which will require over 500,000 fuel capsules per day per reactor) added the dimension of industrial scalability, something which has not traditionally often been considered within Target Fabrication and offers significant scope for involvement to the microelectro-mechanical systems community.

The workshop gave numerous opportunities for discussion between delegates, and it was particularly encouraging to see attendees from different areas of science and technology, who would perhaps not usually meet, initiate collaborations to solve the unique challenges posed by advances in high power, high repetition rate lasers.

The overall feel of the workshop was one of great positivity which grew over the two days as opportunities and collaborations arose. Microtarget requirements for high power lasers now and in the future acted as a catalyst to bring together many specialist branches of science and technology. It will be fascinating to see how much Target Fabrication, particularly in Europe, develops over the next few years.

Martin Tolley and Hazel Lowe

Presentations from the workshop can now be accessed via **www.laserlab-europe.net/events/2008/workshop_target_fabrication.html**



Gold micro-cone target with a 1mm long, 40 micron thick copper wire attached to it.

Shaping attosecond pulses by intramolecular quantum interferences

Progress in the emerging field of attosecond science continues apace. Attosecond pulses of extreme-ultraviolet light can be generated in atoms interacting with a high-intensity laser. For greater versatility and control, molecules offer new degrees of freedom. An international team* at the Saclay Laser Interaction Center (SLIC, CEA-Saclay) measured quantum interferences between intramolecular electronic states of aligned carbon dioxide molecules. The control of these interferences allows shaping the attosecond emission, and opens the perspective of ultrafast imaging of molecular orbitals.

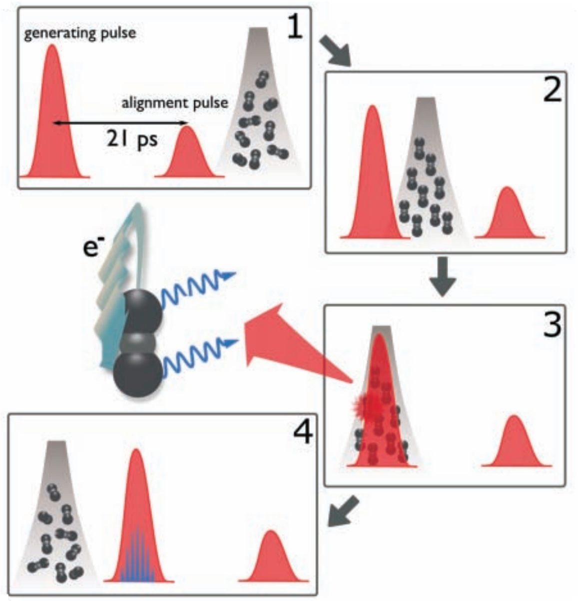
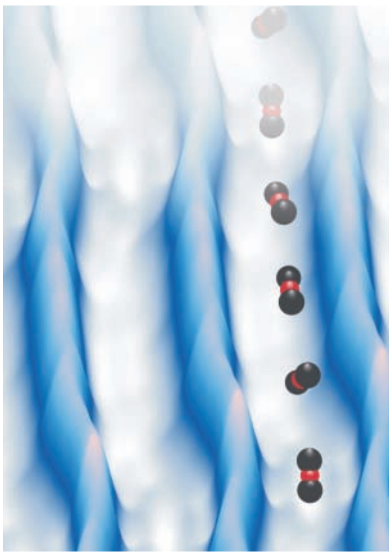


Fig. 1: The first two stages of the experimental scheme: 1-2: aligning the CO_2 molecules and 3-4: generating an attosecond pulse train in the sample of aligned molecules.

Controlling attosecond electron wavepackets and light pulses represents a formidable challenge of general implication to many areas of science. A strong infrared (IR) laser field interacting with atoms or molecules drives ultrafast intra-atomic/molecular electron wavepackets on a sub-femtosecond timescale, resulting in the emission of attosecond bursts of extreme ultraviolet (XUV) light. More precisely, the strong laser field 'tunnel ionizes' the atom/molecule, creating a free electron wavepacket that is subsequently accelerated and driven back to the core. It may then recombine to the ground state, releasing its accumulated kinetic energy in the form of an attosecond burst of XUV light. In a multi-cycle laser field, this process is repeated every half-cycle, leading to a train of attosecond pulses whose spectrum contains only the odd harmonics of the laser frequency. The precise characterization of this light emission gives insight into the ultrafast electron dynamics [1]. In turn, controlling the latter allows steering the attosecond emission.

In molecules, the interaction of the laser-driven electron wavepacket with the core leads to quantum interferences. This is due to the fact that the returning electron de Broglie wavelength is of the order of the size of the molecular orbital. The XUV emission from different 'parts' of the orbital may thus be dephased and interfere.



A linear molecule such as CO_2 is an ideal candidate for observing this quantum interference. Indeed, its highest occupied molecular orbital (HOMO) is essentially composed of two atomic orbitals centred on the oxygen atoms. The molecule then behaves like a two-point emitter whose emissions are dephased due to the path length the electron wavepacket has to travel between the two centers. This path length is determined by the oxygen internuclear distance and by the angle of the molecule with the electron travelling direction, given by the driving laser polarization.

For a given angle, a destructive interference will be obtained for a given de Broglie wavelength and thus a given frequency of the emitted light. It should thus correspond to both an amplitude minimum and a π phase jump in the light spectrum.

This is precisely what the international team of physicists has measured at the Saclay Laser Interaction Center, a LASERLAB facility in France. To this aim, they combined the techniques of laser alignment of molecules with the generation and measurement of attosecond pulses. The experiment consists of three stages (illustrated in Fig. 1):

1. First, the CO_2 molecules need to be aligned. A moderately intense first laser pulse creates a rotational wave packet in a gas of cold molecules through Raman excitation. Since the rotational frequencies of the excited rotational states are harmonics of a fundamental frequency, the wavepacket periodically rephases, resulting in an angular distribution of the molecular axis peaked along the polarization direction of the alignment laser pulse. The period of the rephasing is half the rotational period of the molecule, i.e. 21.1 ps for CO_2.

** The international team gathered scientists from CEA-Saclay (France), LCPMR (Paris, France), Blackett Laboratory (London, UK) and Institute of Physics (Krakow, Poland).*

2. Second, at this delay, an intense laser pulse is focused into the sample of aligned molecules, and launches the process of attosecond pulse generation. The polarization of this second laser pulse can be controlled independently from that of the first one, allowing control of the recollision angle of the electron with the molecule.

3. Third, the emitted light is characterized in amplitude and phase by photoionization of a detection gas. The photoelectron spectrum contains direct information on the spectrum of the ionizing light. Getting the spectral phase requires more demanding interferometric schemes such as the RABITT technique that was used in this experiment. A weak third laser beam opens two-photon XUV-IR ionization channels. Some channels involving two neighbouring harmonics interfere according to their relative phase. Scanning the delay of the XUV and IR probe beam with a sub-laser cycle precision (i.e. ~100 attoseconds) allows retrieving the relative phases of the odd harmonic orders.

The measured spectral amplitudes and phases contain the signature of destructive quantum interference – namely an amplitude minimum and a phase jump at the same spectral position. These interferences can be finely controlled by turning the molecular axis relative to the laser polarization, i.e. changing the electron recollision angle. They could be modelled as involving a plane-wave continuum state and the HOMO of CO_2. This means that the properties of the emitted light encode information on the spatial structure of this orbital. In fact, the light contains the image of the orbital, mapped out in the direction of the electron re-collision. So by repeating the measurement with different alignment angles of the molecules relative to the laser field direction, one could retrieve a full image of the orbital through a tomographic reconstruction [2]. Since the light is emitted in the form of extremely short bursts (a few hundred attoseconds), this orbital image is a snapshot of extremely short duration. These results thus open the perspective of ultrafast imaging of molecular orbitals with both attosecond and Angström resolutions.

Another important consequence of this work is that by finely controlling the molecular interference, the emitted attosecond pulses can be shaped on demand [3]. For instance, by using appropriate spectral amplitude filters, the timing of the light emission can be controlled finely in a 150-attosecond window (Fig. 2). Using different filters could result in a double-pulse emission. Being able to control the shape of these extremely short light pulses is a big challenge and this work adds a new handle for such a control. Attosecond laser pulse sources can then be more versatile and adaptable to specific requirements of experiments, and allow future applications in, e.g., ultrafast coherent control of atomic and molecular processes.

Pascal Salières
Graphics by Stefan Haessler

[1] Y. Mairesse *et al.*, Science **302**, 1540 (2003)

[2] J. Itatani *et al.*, Nature **432**, 867 (2004)

[3] W. Boutu *et al.*, Nature Physics **4**, 545 (2008)

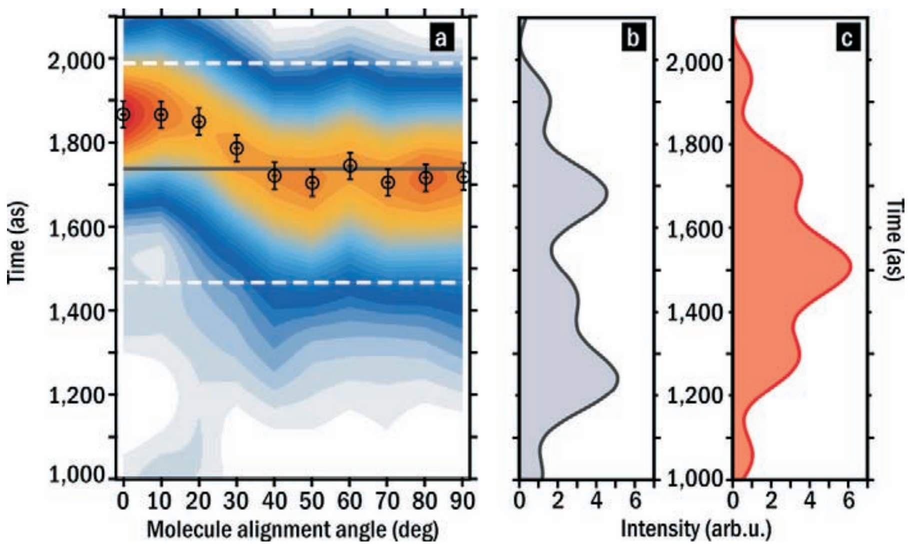


Fig. 2: Attosecond pulses generated in aligned CO_2 molecules. (a) With a spectral filter, transmitting only the harmonic orders around the interference position (harmonic 23 to 29). Circles give the peak position of the pulse for ten θ values in a series of RABITT scans. Black and dashed white lines indicate the positions of peak and half-maximum, respectively, of the attosecond pulse generated in krypton (atom with the same ionization potential as CO_2) under the same experimental conditions. For the parallel alignment, the pulse is shifted by 150 as owing to the phase jump and gradually moves to the same timing as krypton as the molecules are rotated towards the perpendicular alignment. (b) Time profile for harmonics 17-29 assuming constant spectral amplitudes for parallel alignment and (c) perpendicular alignment. For this spectral amplitude filter, the pulse profile would change from a double peak to a single peak structure when rotating the molecules from parallel to perpendicular alignment. In all figures, the time (vertical axis) is relative to the maximum of the generating laser field.

Advanced Investigators Grants for researchers Laserlab Europe

Three researchers taking part in Laserlab Europe – Prof. Victor Malka from LOA, and Prof. Anne L'Huillier and Prof. Villy Sundström, both from Lund – received an Advanced Investigators Grant from the European Research Council (ERC) this year. These large grants – over two million euros each – are intended for exceptional established research leaders in their field of expertise, and they are meant to encourage risk-taking and interdisciplinarity.

Anne L'Huillier: coherent pulse trains

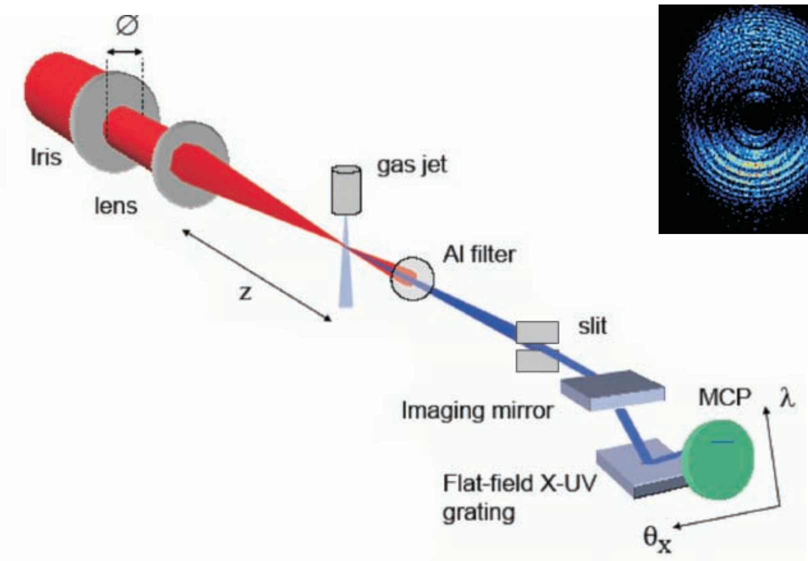
Professor Anne L'Huillier's work at the Lund High-Power Laser Facility of the Lund Laser Centre (Sweden) has chiefly been on the generation of high harmonics and attosecond pulses, but with the proposal that got her the Advanced Investigators Grant, she wants to push attosecond physics into a new direction. "The idea is to create controlled sequences of pulses, and to use them to coherently control electronic processes."

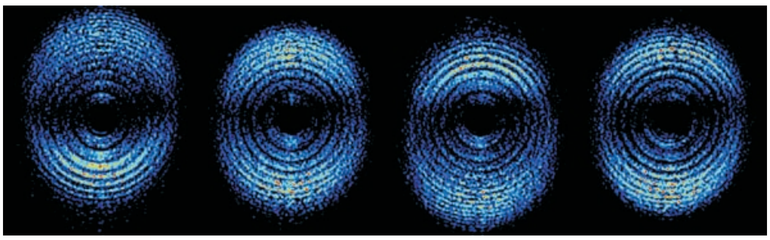
The concept of coherent control stems from the chemistry community, says L'Huillier. "The idea of coherent control in chemistry is that you force chemical reactions to go in a certain direction." In chemistry, this concept has been demonstrated to a certain extent. Instead of chemical reactions, though, L'Huillier would like to control electronic processes. "You have to go to the time and energy scales relevant for these electronic processes, which means higher photon energy and shorter timescales: we need XUV light and attosecond pulses."

Later steps in her project would involve more intense pulses, in order to get into the nonlinear regime. The last step would be to achieve both spatial and temporal resolution of the pulses, such that the pulse trains can be used to study and control electronic processes in more complex systems.

The research group of L'Huillier in Lund was part of the FOSCIL Joint Research Activity (JRA), which ends at the end of this year. Part of the research conducted within FOSCIL will be continued within the ALADIN JRA. L'Huillier says she is very happy to be in Laserlab Europe and the JRA's. "Apart from the funding that comes with it, the importance of the network lies in collaborations that are stimulated by Laserlab Europe. I think this type of research is strong in Europe because of the networking that exists due to Laserlab Europe and the Marie Curie network. We are performing difficult experiments, and often we do this in collaboration with other groups. That is very useful and efficient." Over the years her group has cooperated with groups from different Laserlab Europe partners; such as the Polytechnic in Milan, MPQ Garching, and LOA in Palaiseau, as well as with several groups outside Laserlab.

One of those collaborations was actually described in the February 2007 issue of Laserlab Forum (p.10/11). About this research L'Huillier says that it can be seen as a first step into the direction that she wants to go using the Advanced Investigators Grant of 2.25 million euros. The grant money will be mainly used to hire people, she says. "It is hard to get funding for postdocs and PhD students here in Sweden." She is actively seeking candidates at the moment.



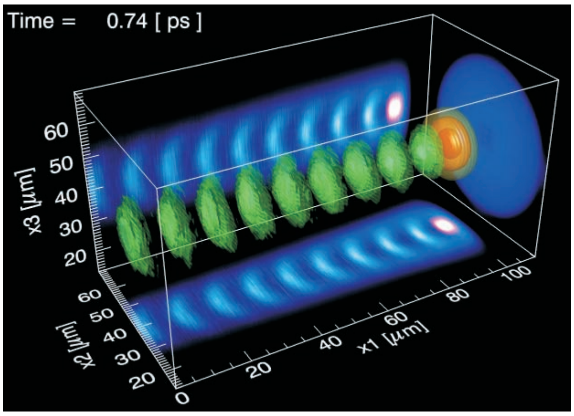


Electron momentum distributions in argon shifted up or down depending on the delay between the attosecond pulses and the infrared laser field.

Victor Malka: laser accelerators

Professor Victor Malka from the Laboratoire d'Optique Appliquée (LOA) in Palaiseau near Paris received his Advanced Investigators Grant for a proposal appropriately called PARIS (PARticle accelerators with Intense lasers for Science). In the coming five years he will use the money to develop compact particle accelerators based on the wakefield of laser pulses. Shining a laser into a plasma creates an electric field that can be used to accelerate an electron beam. Using this method, one can produce electric fields that are up to 10,000 times larger than those used in conventional particle accelerators. This means one can create accelerators that are much more compact than accelerators based on other techniques.

Malka explains the mechanism: "The electric field of a laser pulse pushes the electrons away from the path of the beam, separating the electrons from the much heavier ions. This

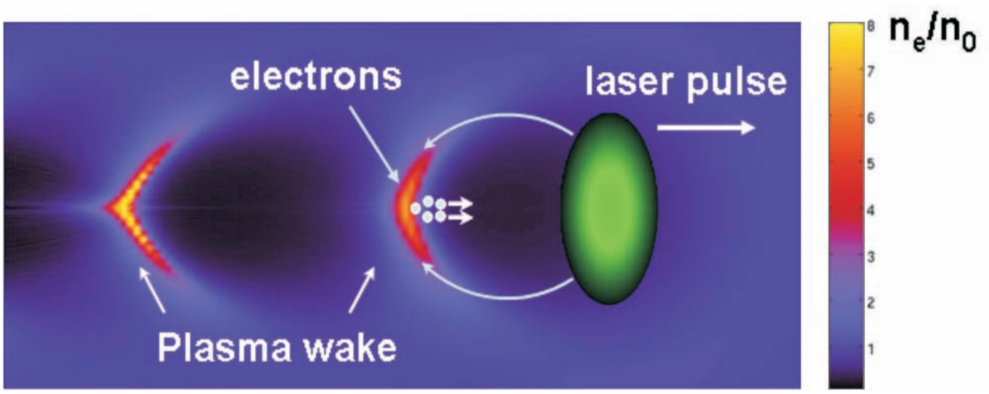


A 100 microns plasma accelerating structure.

creates a travelling electric field in the wake of the laser pulse with which electrons can be accelerated to relativistic energies." It is a very promising technique, according to Malka: "The last few years we have been able to improve this approach a lot and therefore the quality of the electron beam we can produce. We are now able to control both the energy and total charge in the electron beam."

According to Malka the money will be used to build a better facility for the project. "For the coming years, we have two main objectives. First we want to improve on the parameters of our beams, that is very fundamental. And second, which I think was quite convincing for the reviewers, we want to work on several important applications." The electron beam could be coupled into an undulator, a device in which the electrons are forced into a curved trajectory in such a way that high-energy photons are produced. Another application is for cancer treatment: "One can use high-intensity electron pulses to destroy the cancer cells, which can be used to improve the tumours treatment", says Malka. Finally, there are applications in material science. "Our beams could be used for non-destructive inspection of materials."

Malka is the coordinator of the new LAPTECH Joint Research Activity, in which about ten labs take part. "In the next few years we want to explore the 'bubble regime' in plasma accelerators, which has been done, but not yet with lasers with optimal parameters. Several labs in Europe operate lasers with various different parameters, and together we want to explore this regime. There is not much money involved in this JRA, but that is of lesser importance: it is enough to do the experiments and especially to coordinate the collaboration between the labs involved. It is a well-focused activity on a hot topic. I think this JRA will be a useful instrument to focus on the use of the powerful lasers that are being built in the European laser labs."



Schematic of the plasma acceleration mechanism in the bubble regime. It shows the plasma electron density behind the laser pulse (green ellipse). The electrons (white dots) that are trapped in the wake field of the laser pulse are accelerated.

Villy Sundström: x-ray spectroscopy

The Chemical Physics group in the Lund Laser Centre, led by Professor Villy Sundström, focuses on research related to sunlight: they look for new materials for solar cells, and are trying to mimic natural photosynthetic systems in order to produce fuel – such as molecular hydrogen – with sunlight. They also investigate the harmful effect that sunlight has on human skin. Sundström says this research involves studying both the structural and the electronic dynamics of the reactions. The Advanced Investigators Grant will be used to develop a table-top setup in which sub-picosecond x-ray pulses are employed to probe the dynamics of reactions. "The x-rays will be produced by shooting intense femtosecond laser pulses onto a liquid water target. This has as an advantage over solid targets that the shot-to-shot variations are much smaller. In this way we can generate x-rays with energies from approximately two keV to about fifteen keV, the range in which many elements have their core absorptions. We have recently installed a kHz, several mJ laser system that produces a much higher flux of x-rays than the 10 Hz system that we used up to now."

In order to do spectroscopy, one has of course to be able to determine the energy of the x-ray photons. Since these are generated in all directions, there are too little x-rays to record a spectrum using a conventional crystal monochromator. One would therefore like to measure the energy of single photons coming from the reaction volume. Sundström: "Direct detection of x-rays can be done with CCD cameras but these have a limited energy resolution. We will use the grant to develop a detection system based on 'transition edge' detectors using superconducting material. We will cool this detector to just below the critical temperature where the material is superconducting. Now if an x-ray photon is absorbed, the temperature is increased and the material will go into a non-superconducting state, and from the change in resistive properties of the material we can deduce the energy of the x-ray photon with a resolution of a few eV. This kind of detector has been utilized in the development of imaging spectrometers for astrophysical observations and in spectrometers for materials analysis applications, but not at all for this kind of spectroscopy. We are very excited to try it."

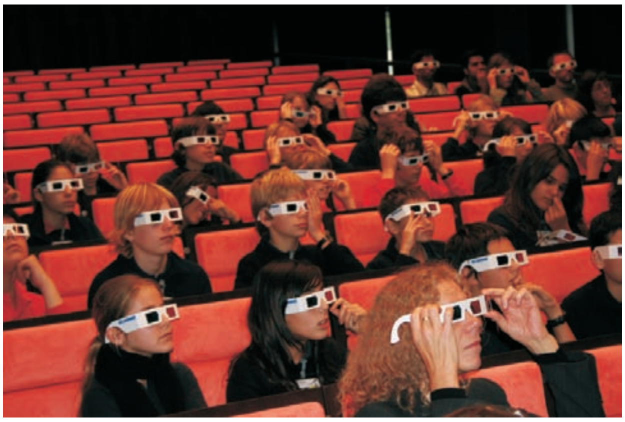
Femtosecond pulses focussed into a water jet for x-ray fs-pulse generation.

The new detection technique will first be applied to simple chemical reactions such as photodissociation, and later to the more complex systems that are studied in Sunström's group, such as metal-organic complexes for solar cells and multichromophoric complexes for artificial photosynthesis. "Some of the metal-organic molecules we study do not have a good response in the visible part of the spectrum, but we can still study, for example, the transfer of electrons in these complexes with x-ray spectroscopy." An inner shell electron that is kicked out of an atom scatters on surrounding atoms and causes interference between electron waves, which gives rise to modulated x-ray absorption. The modulation pattern carries information about the nature of surrounding atoms and their distances, and careful analysis of the temporal evolution of the energy spectrum provides information on the conformational dynamics of the molecule. "This type of spectroscopy is sensitive to the local structure of molecules. This is really different from the information you get from x-ray diffraction experiments, where one resolves global structures and you need crystalline samples. For reactions it is often the local structure in the vicinity of a 'reaction centre' that is of interest."

TJ

Barcelona lights up photonics for children

‘Fascination of Light’ at ICFO, Castelldefels, Barcelona, Spain from 12 November to 3 December 2008



"Why do we have two eyes? And why are they where they are?" These questions were answered during the exhibition 'Fascination of Light' by means of simple experiments and through 3D images, giving the opportunity to talk about some of the properties and applications of light.

More than 1,300 students took part in the presentations preceding their visit of "Fascination of Light" at the Institute of Photonic Sciences in Barcelona. For ICFO PhD students and postdocs it was a pleasurable opportunity to explain their field of research to kids aged ten to twelve and to guide the groups of visitors through the different thematic sections of the exhibition.

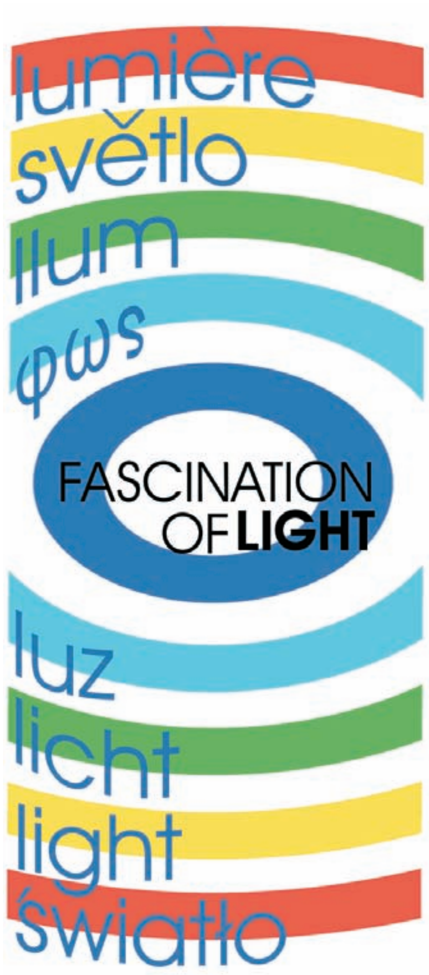
Alejandra Valencia, one of the organisers of the event at ICFO was very happy that people of all ages came to see the exhibition and that all of them enjoyed it. "The kids, for example, commented that they had not known that light could be used for so many different things." And quite a few asked what they should study in order to work with light. The positive feedback is encouraging and shows that the exhibition is a good way to create interest in science and especially in research involving light.

Barcelona was the closing event of this travelling exhibition. 'Fascination of Light' had two years of very popular exhibitions in many European cities with more than 32,000 visitors. The project was funded under the EU's Sixth Framework Programme, and the partners in LASERLAB-EUROPE hope for new opportunities for such an inspiring outreach activity under the Seventh Framework Programme.

Daniela Stozno

www.fascination-of-light.net

Exhibition brochures are available in Spanish, Catalan, English, Polish, Greek, Czech, French and Dutch at www.fascination-of-light.net.



ELI part of European City of Science in Paris

The Extreme Light Infrastructure (ELI) has presented itself in 'Le Grand Palais' in Paris during a three-day exhibition called 'European City of Science', held 14-16 November 2008. ELI was invited to fill an apartment of three rooms, representing past, present and future, where visitors learned about the influence of lasers on their everyday lives. Lasers were shown to have a profound impact because of their application in telecommunication (through optical fibres), data storage (on CD/DVD), high precision cutting and welding (e.g. in the auto-industry), high precision measurement systems, eye surgery etc.

The aim of ELI, one of the proposed large-scale facilities within the so-called roadmap of the European Strategy Forum for Research Infrastructures (ESFRI), is to develop the world's most powerful laser system, which would be able to produce 200 PW of energy, equivalent to 100,000 times the power produced by all current laser facilities combined. These high power, ultrashort laser pulses will be used for both fundamental high-energy physics and the production of particle and x-ray beams for diagnostic and medical applications. ELI is now in the Preparatory Phase, leading to the planned start of its realization in 2011. Thirteen European countries participate in the project.

www.eli-laser.eu

HiPER Launch Event in London

Scientists, politicians and press gathered at the Science Museum in London on October 6th 2008 for the formal project launch of HiPER, which marked the beginning of the three-year Preparatory Phase of the project. HiPER (the High Power Laser Energy Research facility) is being designed to demonstrate the feasibility of laser driven fusion as a future energy source. The facility, which will probably be built in the UK, should be in operation by the early 2020's.

www.hiper-laser.org

Workshop on Radioprotection Issues in Chamonix

Chamonix in the French Alps, near the Mont-Blanc, is the location for the Laserlab Europe Workshop on Radioprotection Issues; the third workshop in a series originally sponsored by the LASERNET network and now organized by Laserlab Europe. The workshop takes place 14-17 December 2008 in the Mercure Chamonix centre. About thirty participants, from Laserlab partners and related institutions, will take part. Previous workshops on this topic were held in Paris (2003) and Prague (2005).

www.luli.polytechnique.fr/pages/ LASERLAB_N4-workshop.html

Workshop on Lasers and Accelerators in South-Africa

The Stellenbosch Institute for Advanced Study in South-Africa will organize a workshop on particle acceleration with high-intensity lasers on 12-16 January 2009. Topics include; theory of laser plasma interaction, isotope selective laser ionization, laser particle acceleration experiments, and physics of radioactive particle beams. Among the lecturers are two representatives from Laserlab Europe: François Amiranoff from LULI Palaiseau, and Claes Göran Wahlström from Lund Laser Centre.

http://academic.sun.ac.za/ lasers%26accelerators/

Announcements

Forthcoming events 2008-09

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

LASERLAB General Assembly Meeting
Munich, Germany
15 January 2009

LASERLAB II Kick-off Meeting
ICFO, Barcelona, Spain
March 2009

How to apply for access

Interested researchers are invited to contact the LASERLAB-EUROPE website at www.laserlabeurope.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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