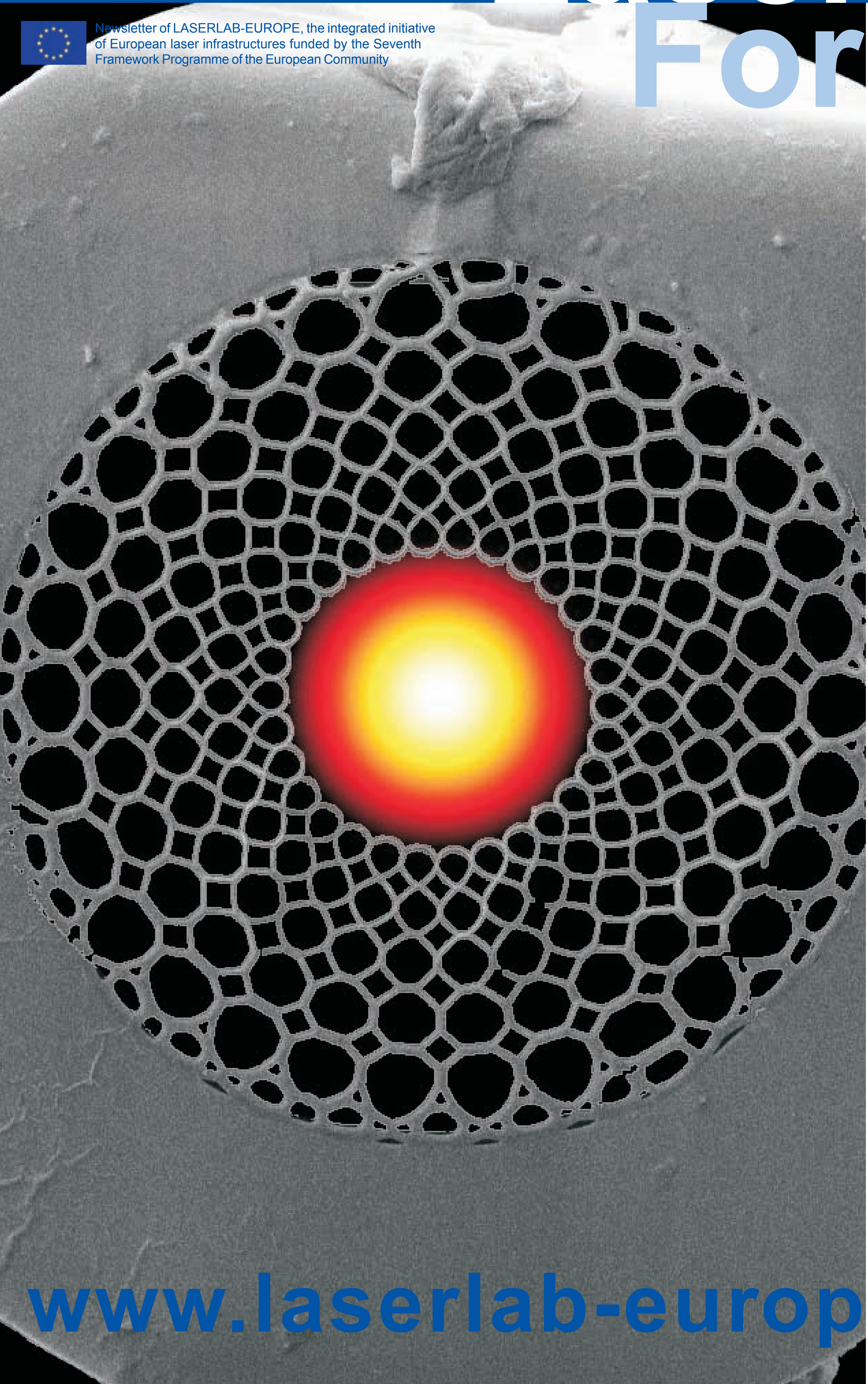
Issue 8 **December 2009**

Laserlab Forum

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



IN THIS ISSUE

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50 years old and younger than ever

Lasers have changed the world – this opening line from LASERLAB-EUROPE's very first EU proposal seems more true in recent decades than it was during the laser's first years, beginning in the 1960's. Today science, technology, medicine, communication and many other fields are more changing than ever under the influence of this invention. The coming year 2010 will host many celebrations of the laser's 50th anniversary, and LASERLAB-EUROPE and its partner institutions will be glad to participate in various ways, including co-sponsorship of a major Paris event in June 2010.

The European Union has changed the laser world – this seems equally true, at least for our part of the world. During a recent Lund Workshop on "Future Access to European Research Infrastructures", organized by the European Association of Research Facilities ERF, we were reminded that institutionalized and organized Transnational Access is a relatively new concept to the scientific laser community, with only very few exceptions of older traditions existing at large facilities. Today, LASERLAB-EUROPES innovative concept of a unified and common Access policy is well established within European laser science and is being observed with considerable interest, including occasional scepticism, from neighboring fields. Our users appreciate, however, the open Access opportunities to 20 world-class laser infrastructures, and are actively participating in the constant improvement of our Access procedures. The newly established Committee of User Representatives, presented in this issue, will be a valuable and crucial interface to the benefit to both the User community and the Infrastructures.

What will be the next changes? The Management Board, in a recent video conference, started the strategy process towards the next I3 proposal, already due in fall of 2010. This process will certainly require considerable attention from all our partners during the coming months. Scientifically, there seems to be hardly any limit. The present issue, again, presents a number of outstanding research results from our partner laboratories and Joint Research Activities. The European ESFRI projects ELI and HiPER continue to move with unprecedented strength and support from both science and politics towards new horizons. And, finally, lasers keep penetrating into other scientific fields.

A newly established official liaison between ICFA, the International Committee on Future Accelerators, and ICUIL, the International Committee on Ultra-High Intensity Lasers (both being IUPAP committees) will, for the first time ever, explore the synergies between both fields on a global platform. For us, with several of our JRAs being directly or indirectly involved in this science, this will provide additional scientific support and motivation.

On behalf of LASERLAB-EUROPE I wish all our partners, collaborators, users and friends a very successful 2010!

Wolfgang Sandner

ICUIL – ICFA liaison on future laser particle acceleration

ICUIL, the International Committee on Ultra-High Intensity Lasers (www.icuil.org) and ICFA, the International Committee on Future Accelerators (www.fnal.gov/directorate/icfa/) have decided to set up a joint "Task Force" to promote and encourage international collaboration between the accelerator and laser communities on future applications of laser acceleration. The decision was taken at the 61st ICFA meeting in Hamburg, Germany, where Wolfgang Sandner (ICUIL Co-Chair) was invited to attend and present the proposal.

On part of ICFA the Panels on Beam Dynamics (Chair: Weiren Chou, Fermilab) and Advanced Accelerators (Chair: Mitsuru Uesaka, Tokyo) will be involved. ICUIL will be represented by its newly established sub-group on laser acceleration (Chair: Wim Leemans, Berkeley).

The Task Force, originally consisting of a small number of representatives from both communities, will pursue the following proposed activities:

- Convene an international panel of experts on laser technology,
- Create a comprehensive survey of the requirements for laser-based light and particle sources with emphasis on sources that can advance light and particle science AND require lasers beyond the state of the art or state of current use,
- Identify future laser system requirements and key technological bottlenecks,
- From projected system requirements, provide visions for technology paths forward to reach survey goals and outline required laser technology R&D steps that must be undertaken,
- Write a technical report.

A broad involvement of international experts from both communities will be sought. A precursor strategy workshop will be held in April 2010, in preparation of more comprehensive events involving larger numbers of attendees later in the year. Interested LASERLAB-EUROPE partners may contact Wim Leemans (Berkeley), Wolfgang Sandner (Berlin), Chris Barty (Livermore), Dino Jaroszynski (Strathclyde), or the ICUIL Chair Toshiki Tajima (Paris/Munich). The activity will be covered in upcoming issues of LASERLAB Forum.

Wolfgang Sandner

Photo Cover: Scanning electron micrograph of chirped photonic crystal fiber and computed mode profiles, with colors red through white indicating increasing levels of intensity.

News

Dutch minister visits LCVU Amsterdam

On October 7th, 2009, Ronald Plasterk, Dutch minister of Education, Culture and Science, chose LCVU Amsterdam as the location to announce the allocation of an extra twenty million euro a year for strengthening research in physics and chemistry. The government money will also be used to make university studies in these areas more attractive to students, aiming to reduce the shortage of science students in the Netherlands. During his visit to LCVU, the minister installed a committee which will decide how the funds can be spent most effectively. Subsequently, Mr. Plasterk was given an extensive tour through the laser centre.

Dutch Science minister Plasterk in the LCVU, accompanied by LCVU-director Wim Ubachs (middle) and LCVU OPTBIO coordinator Johannes de Boer (right).

Thin-Film Nickel Anodes

Nickel is a good alternative anode to ITO for OLED (organic light-emitting diodes), as is shown by research from ICFO, Barcelona. The implementation of organic devices is strongly limited by the use of indium tin oxide (ITO) as a bottom electrode. ITO is expensive, scarce, involves high temperature processing, polymer degradation and introduces optical modes that lower the out-coupling efficiency of the device. In a paper published in *Nanotechnology*, researchers at ICFO have investigated the possibility of using a thin nickel layer instead of ITO as anode for bottom-emitting organic light-emitting diodes. The team, led by Prof. Valerio Pruneri, has demonstrated that similar efficiencies were reached for devices with either ITO or nickel films of less than 10 nm.

Advanced Investigators Grant for research on nano-antennas at ICFO

Prof. Dr. Niek van Hulst (ICFO)

Prof. Niek van Hulst (ICFO, Barcelona) has been awarded one of the 2009 European Research Council Advanced Investigators Grants to pursue his project "Nano-Optical Antennas for Tunable Single Photon Super-Emitters". The ERC Advanced Grants aim to allow top-level established scientists to carry on with pioneering frontier research projects. According to Van Hulst, recent advances by PhD- and Post-doctoral researchers, together with the excellent reputation of LASERLAB-EUROPE partner ICFO, were crucial in obtaining this prestigious grant of 2.5 million euro. More about Van Hulst's research on the particular topic of nano-antennae can be found on page 5 of this issue of Laserlab Forum.

Record Participation at LPHYS'09, Barcelona

The International Laser Physics Workshop, which was held in Barcelona, Spain, this summer, had record participation in its 18th Annual edition. The workshop was chaired by Prof. Jens Biegert from the Institute of Photonic Sciences (ICFO), Barcelona and Prof. Pavel P. Pashinin of the A. M. Prokhorov General Physics Institute (RAS), Moscow (Russia). With more than 560 researchers present, 540 oral contributions and 130 posters, LPHYS'09, which took place at the World Trade Center in Barcelona from July 13th to 17th, achieved its all time record in participation and scientific dissemination. In addition to highlighting research in six parallel sessions, the meeting included an exhibition of several companies from Europe and the United States. The contributions accepted by this workshop (plenary, invited, and contributed) will be published in issues 2 and 3 of the international journal Laser Physics, 2010 (vol. 20).

Special professorship for LCVU professor

More good news from Amsterdam: on September 23rd Rienk van Grondelle, professor of Biophysics at LCVU, has received the prestigious KNAW professorship from the Dutch Academy of Sciences. He will be provided a 5-year salary to devote himself to academic studies and to give LCVU the opportunity to appoint a young professor in the same field. Van Grondelle has been awarded this position 'for his outstanding contributions to the understanding of the first stage in photosynthesis'.

MBI shows laser acceleration of neutral atoms

A team from the Max Born Institute (MBI), led by Dr. Ulli Eichmann, used femtosecond laser pulses to accelerate neutral helium atoms to a rate of ~ 10^{14} times the Earth's gravitational acceleration; by far the highest observed acceleration on neutral atoms in external fields. This breakthrough research was published as a cover story in *Nature*. Eichmann et al. identify the well-known ponderomotive force on the atom's electrons as the driving mechanism. It turns out that the helium atoms can be accelerated to about a hundred kilometers an hour in a few femtoseconds, without the atoms being torn apart. This previously unconsidered mechanism may lead to exciting new applications in experiments with neutral atoms. Nature **461**, 1261-1264, 2009

The cover image is a record of the deflection of neutral helium atoms after interaction with a focused laser beam. Photo: Nature

Laser flashes without bounds

Researchers of the Max Born Institute for Non-linear Optics and Short-Pulse Spectroscopy (MBI) have developed a novel optical fiber that enables transmission of ultrashort light pulses with an unprecedented low degree of distortions. The researchers transmitted light pulses of 13 femtosecond duration (1 fs = 1 millionth billionth of a second) over one meter distance, with the pulses only stretching to about double of the initial duration.

"Currently, no other fiber-based technique is capable of such little distortion." says Dr. Günter Steinmeyer. In comparison, using similar fibers of a more conventional make, pulse stretching to more than fifty times the original duration was observed. The novel fibers may be useful in medical applications, e.g., for guiding femtosecond pulses to the patient in a flexible manner.

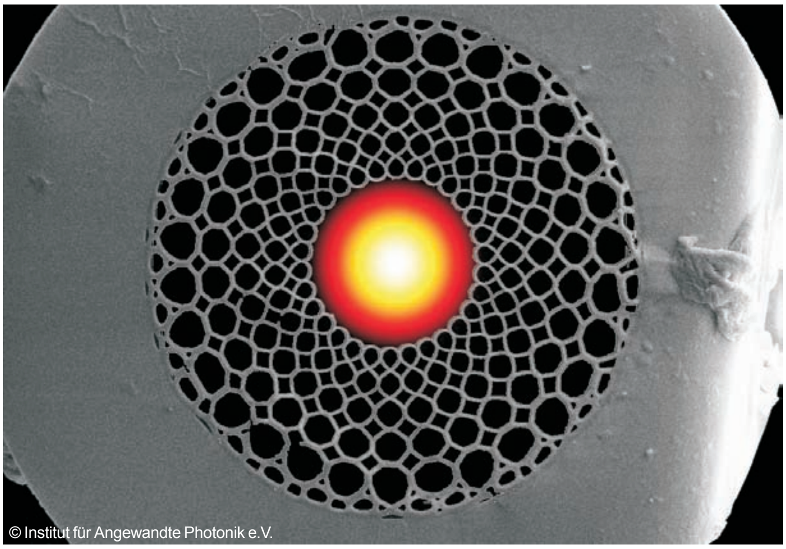


Fig. 1: Scanning electron micrograph of chirped photonic crystal fiber and computed mode profiles, with colors red through white indicating increasing levels of intensity.

Gluing straws

The MBI fiber consists of many glass capillaries and guides the light on a diameter equal to about half the diameter of a human hair. In contrast to conventional hollow fibers, which consist of capillaries of equal diameter, the diameter changes in MBI's novel fiber (see Fig. 1). This can be understood as gluing straws side by side, yielding a tube of straws when the first and the final straw are also glued together. Repeating this procedure with straws of different diameter and fitting the resulting tubes into one another ultimately yields a structure similar to MBI's fiber. For manufacturing the fiber, the researchers have used five such tubes of straws. Referring to the systematic change in capillary diameter, the researchers call such a structure chirped. Launching ultrashort laser pulses into such a fiber, the chirped structure acts to distribute detrimental resonances over a wide wavelength range, which would otherwise add up at one wavelength if the capillaries had all the same diameter. The fiber was manufactured at Saratov State University in Russia.

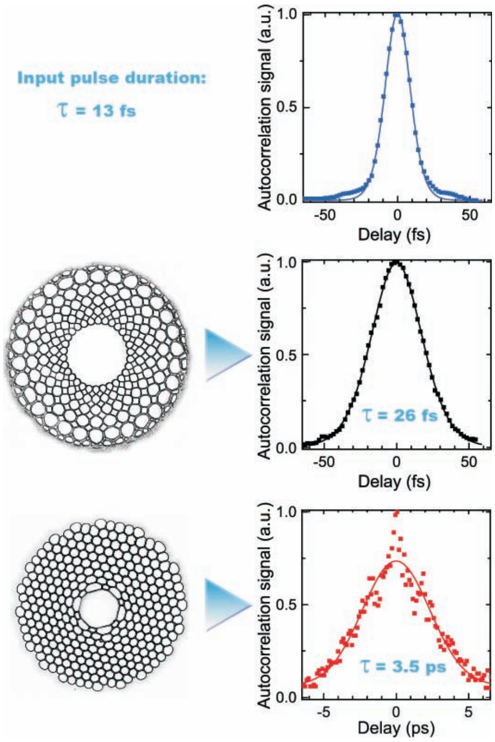


Fig. 2: Chirped Photonic Crystal Fibre (CPCF) for sub-20fs pulse delivery
a) Autocorrelation of a 13-fs pulse from a Ti:sapphire laser.
b) The same after propagation through 1.05 m of CPCF with 53-µm core size.
c) Autocorrelation for a 1.05-m-long piece of commercial HC800 fibre.

Medical application

The researchers see one particularly interesting medical application of their fiber in photodynamic therapy. For this method, a photosensitizer is accumulated in cancerous cells. Exposing the photosensitizer to light, a substance is formed which causes fatal damage of the tumor cells. Using ultrashort laser pulses rather than continuous light, the selectivity of this therapeutic method could be significantly improved as the photoexcitation could be limited to the immediate vicinity of the focal area, whereas tissue layers immediately above or below the interaction zone would stay unharmed. So far, however, no fiber was available to guide the required short light pulses to the patient in a flexible way without severe distortions through an endoscope. The chirped fiber structure could also be beneficial for diagnostic applications in biology and medicine, such as in two-photon microscopy, a method that allows for three-dimensional resolution of smallest biological structures at an effective suppression of stray light.

MBI / Christine Vollgraf

Tiny antennae reveal molecules

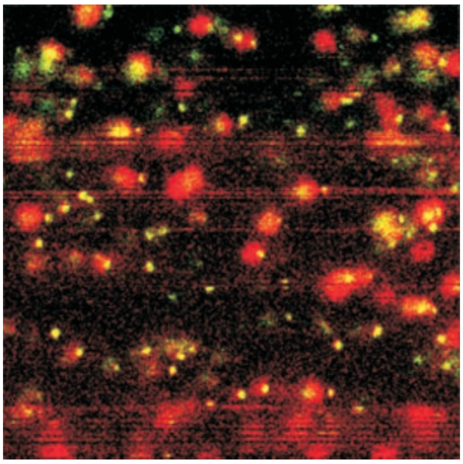
As scientists are trying to study chemical and biological processes in increasing detail, a demand is created for laserlike light sources and optical components that defy the classical limit of wavelength resolution. Prof. Dr. Niek van Hulst, working at new Laserlab Europe partner ICFO (The Institute of Photonic Sciences) in Barcelona, uses nanostructures which act in analogy with classical radio antennae.

The traditional approach to circumvent the diffraction limit posed by traditional lenses has been the use of sub-wavelength apertures, forcing the light through holes or fibers smaller than the wavelength of the light. Another viable approach does exist, says Van Hulst. "In radio engineering, sub-wavelength manipulation of radio waves by antennae is standard technology. A similar approach can be taken for optical frequencies. In the past years, nanofabrication technology has reached the point where arrays of nanostructures with a precision of about ten nanometers can be produced." Such nano-antennae work in a similar fashion as their much larger radio frequency counterparts. They can be used to collect, redirect and focus light, enabling optical sensing at a subwavelength scale.

In order to probe the characteristics of the light field produced by the antennae, Van Hulst and his co-workers put single molecules close to the antennae and observe the effect the antennae's light field has on the optical properties of the molecule. Reversely, the small-scale optical interaction between antennae and photon emitters is also employed to visualize biomolecules.

"Now one can visualize biomolecules on the cell membrane with twenty nanometer resolution, using the light field emitted by nano-antennae, made of gold or aluminum in the cleanroom here at ICFO", Van Hulst says. "The antenna is scanned along the cell membrane. Since the light emitted by the antenna is confined to a twenty nanometer region, only molecules in that region will be excited by the antenna's light field. We subsequently detect the induced fluorescence to visualize the molecules on the membrane."

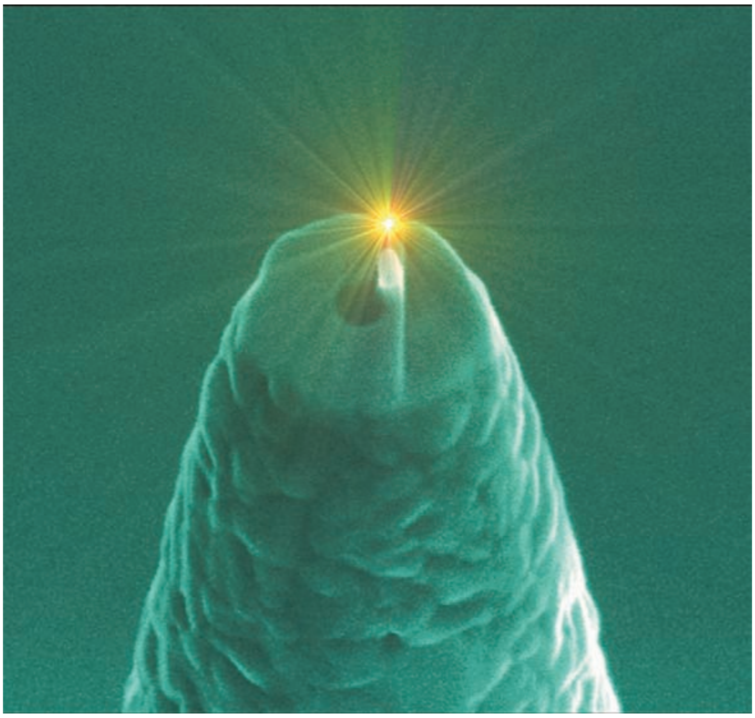
The close presence of the antenna has a rather large influence on the system to be studied, says Van Hulst. As is well known from radiofrequency engineering, the characteristics of the entire optical nanosystem depend also on the size, shape and orientation of the antenna. Single molecules and quantum dots are used to drive the antennae. In the presence of an antenna such quantum emitters have been shown to emit only in the antenna mode, which can be useful, according to Van Hulst. "The presence of antennae can be used to enhance the amount of light emitted by quantum dots, and we can also make the quantum dot emit all of its light in a specific direction. We recently used antennae to rotate the light emission direction of single molecules over a full ninety degrees. I think nano-antennae will be useful both for applications in optical sensing and quantum optics in the future."



Single molecules excited by antenna show up as 20nm nonpolarized spots

The nano-antenna research comprises one of many contributions of ICFO to the LASERLAB community. Outside this specific area of research, Van Hulst and his colleagues at ICFO are starting collaborations on various research topics, e.g., within the OPTBIO Joint Research Activity with LENS (Florence), FORTH (Crete) and CUSBO (Milan).

Tom Jeltes



Single Emitter close to optical antenna

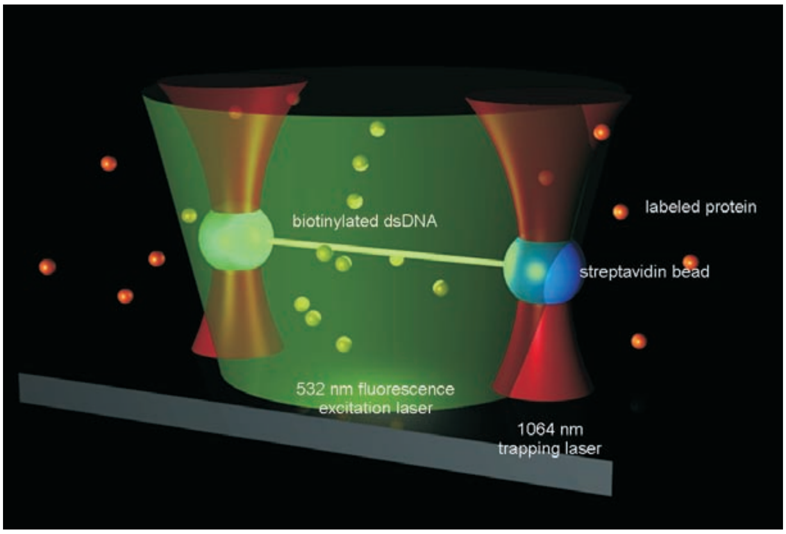
OPTBIO: using lasers to study life

Slowly pulling strands of DNA apart using optical tweezers, visualizing neural activity in living organisms, following the migration of receptor proteins on the cell membrane; all of it has become possible by using state-of-the-art laser techniques. As many research groups within LASERLAB-EUROPE are either developing or using laser-based techniques for studying biophysical and biomedical systems, it has been decided to start a new Joint Research Activity (JRA), aimed at stimulating the cooperation between these related groups: OPTBIO.

The kick-off meeting of LASERLAB-EUROPE II, in March 2009, also marked the start of OPTBIO (Advanced Optical Techniques in Bio-imaging and Bio-processing). The next OPTBIO meeting took place a few months later in Munich. Here, representatives from the twelve participating partners were given the opportunity to present their current research, looking for overlaps and possibilities for collaborations.

Prof. Dr. Francesco Pavone (LENS), coordinator of OPTBIO, says that in Munich it became especially clear that the JRA covers many related research themes: "It was really nice to see that OPTBIO spans a 360 degree range of competences in the world of biomedical imaging. Furthermore, many groups are already working with *in vivo* imaging techniques."

In order to facilitate sharing of information between the participating research groups, OPTBIO is planning to set up a special web platform where all participants can upload databases and descriptions concerning their field of expertise. This website should take the form of an intelligent platform, Pavone explains, provided with semantic tools which assist in organizing the information content of the site. "It should be an intelligent multidimensional matrix, which will foster integration and collaboration, and which I hope we can develop into a tool which could be adopted by the European community for that purpose one day." This is an ambitious and complex task, which will require the assistance of third parties, according to Pavone. "But I like to view this as one of the experiments within OPTBIO."

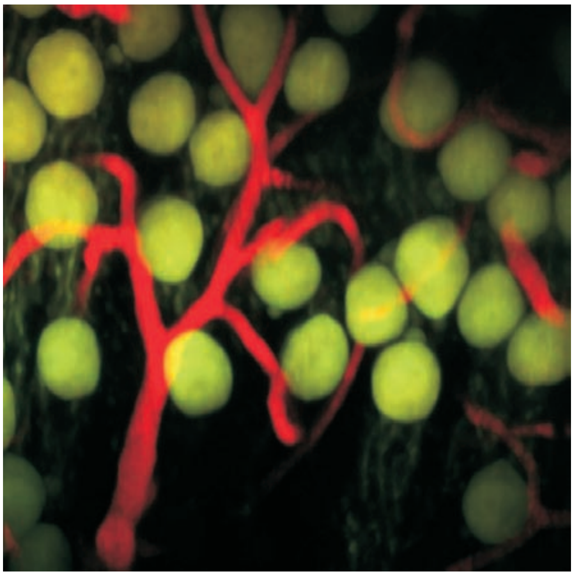


DNA-molecule stretched between two optical pincets, surrounded by fluorescent proteins (LCVU)

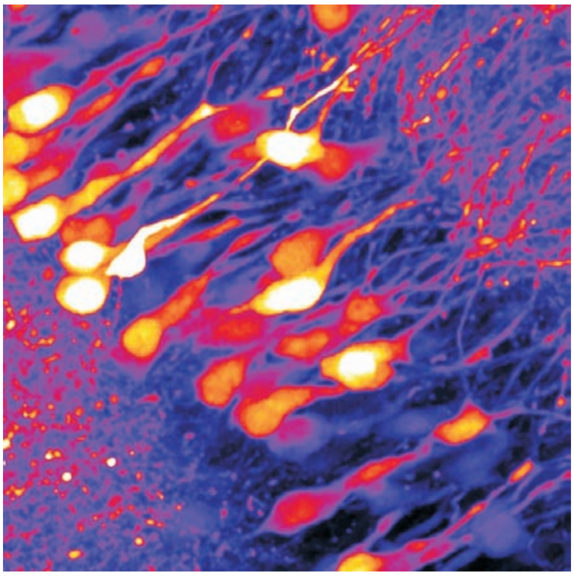
Prof. Dr. Francesco Pavone (LENS), coordinator of OPTBIO

The ten partners involved in OPTBIO contribute the following expertise:

CUSBO (Milan, Italy):
pump-probe system and spectral imaging in highly scattering media
LLC (Lund, Sweden):
spectral imaging in highly scattering media
LENS (Florence, Italy):
combined trapping and fluorescence, TP and SHG microscopy, *in vivo* imaging
VULRC (Vilnius, Lithuania):
optical parametric amplifiers, laser-based optical biopsy methodologies
FORTH (Heraklion, Greece):
laser-assisted workstation for subcellular surgery and processing and micro/nano structuring, nano-thermolysis methods, TP, SHG, and THG microscopy, *in vivo* optical tomography
LCVU (Amsterdam, The Netherlands):
combined trapping and fluorescence, MP microscopy, structured light illumination microscopy
CLF (Oxfordshire, UK):
fluorescence lifetime imaging for massive streamlining signal readout in photon counting
ILC (Bratislava, Slovakia):
multi-spectral fluorescence lifetime imaging microscopy
ULLC (Riga, Latvia):
imaging of laser-excited tissue autofluorescence fading rates
ICFO (Barcelona, Spain):
plasmonic micro- and nanostructures, optical parametric amplifiers, nanoantennae, photonic force microscopy, TP microscopy



In vivo imaging in cerebellar cortex of the brain. In green several purkinje neurons, and in red the vascular structure (LENS)



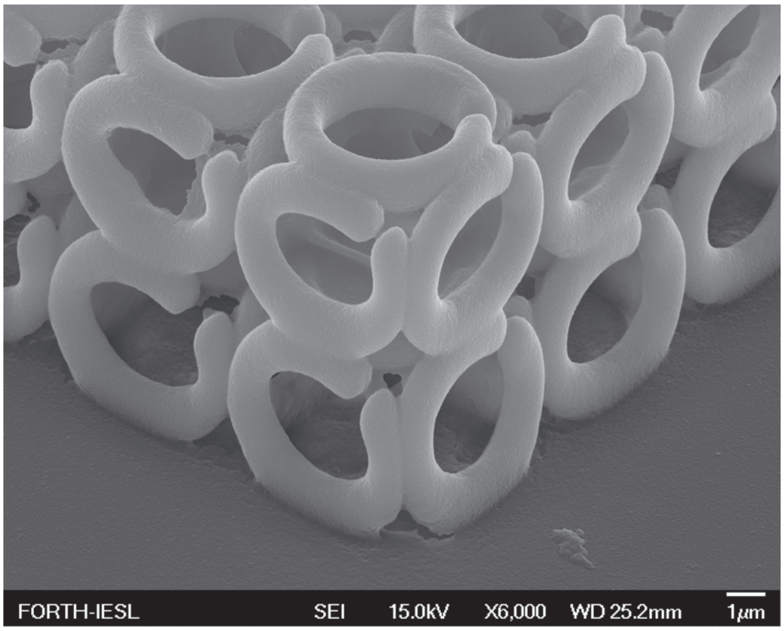
Two-photon imaging of hippocampal pyramidal neurons (LENS)

Another important development is the planned collaboration with 'Photonics4Life', the European Network of Exellence for Biophotonics led by Prof. Dr. Jürgen Popp (IPHT, Jena), who was also present in Munich. Pavone already presented OPTBIO at the kick-off meeting of the Network of Excellence, and OPTBIO and Photonics4Life will organize a joint meeting in April 2010 in Brussels. "For that meeting, we will also invite people from the medical world, such as medical doctors and representatives from the medical industry, to assess what are the needs of the end-users; an important objective for both OPTBIO and Photonics4Life."

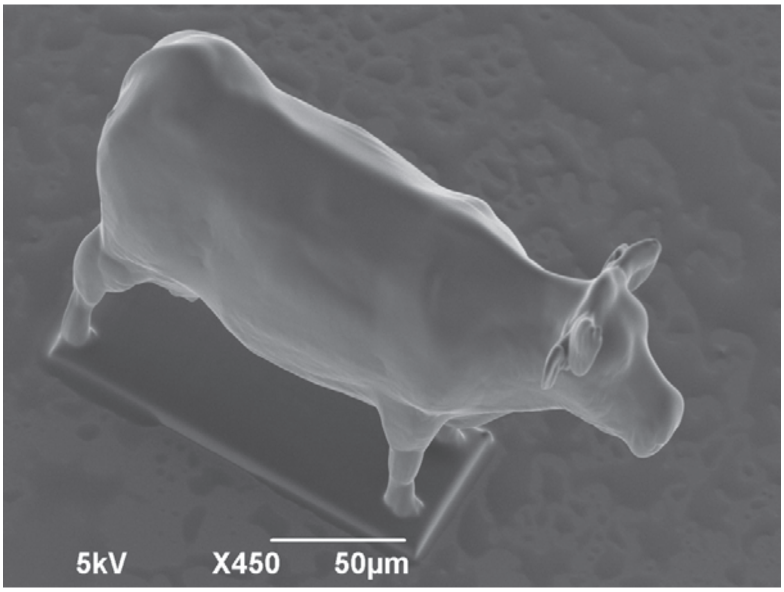
Tom Jeltes

The goals of OPTBIO are divided into three tasks:

- Laser analysis and manipulation of biological samples (aiming at the development of platforms for combined manipulation and imaging, from single molecules to single cells).
- Advanced microscopy (multiphoton microscopy, using second and third harmonic generation microscopy to investigate living cells and organisms, real-time pump probe spectroscopy).
- Biomedical imaging (*in vivo* imaging, optical biopsy methodologies and photodynamic therapy for eye, skin and tumor treatment).



Scanning Electron Microscope picture of a 3D micro scaffold (FORTH)



Scanning Electron Microscope picture of a cow fabricated using two-photon polymerization (FORTH)

Extreme Ultraviolet imaging of nanosized objects

In order to visualise non-periodic nanometer-sized structures, such as proteins, parts of cells and viruses, one requires novel imaging techniques to complement 'conventional' Bragg X-ray diffraction imaging. Bertrand Carré from CEA-SLIC (Saclay, France) recounts experiments that were performed in Saclay as part of the LASERLAB-EUROPE Transnational Access Program.

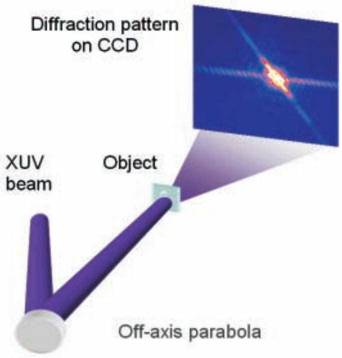


Fig. 1: XUV beamline for CDI

X-ray diffraction is a powerful technique for characterizing matter at the atomic scale. To determine the structure of regular, generally periodic arrangements of elementary 'objects', *Bragg diffraction* is the primary tool. However, the information contained in the Bragg diffraction is rich, but mainly concentrated in the discrete Bragg peaks, whereas it is not as easily accessible in the much lower diffraction signal in between the Bragg peaks. In particular, if the elementary object has an amplitude and phase (e.g., nanoparticles which simultaneously absorb X-rays and change their phase), Bragg diffraction will not, in general, determine the phase.

In contrast with Bragg diffraction, *Coherent Diffraction* makes it possible to get an image – in amplitude and phase – of non-periodic, spatially extended and isolated objects. Indeed, the continuous diffraction pattern (see Fig. 1) allows for an 'over-sampling' in the reciprocal space: this optimizes information retrieval and the complete reconstruction of the object in the real space, with a nanometric scale resolution.

However, the high flux of (transverse) coherent light required by Coherent Diffraction Imaging (CDI) in the X-ray and extreme-UV ranges could not be produced until recently. The first CDI studies have used third generation synchrotron radiation (Miao, Nature 1999). Applications have then expanded to biological objects and nanoparticles.

Recently, CDI of isolated nanometric objects has been achieved using one single ultra-short pulse (λ = 30 nm, duration ~ 20 fs) from the FLASH free electron laser located at DESY in Hamburg, Germany (Chapman et al., Nature Phys. 2006).

In the collaboration at Saclay Laser-matter Interaction Centre (CEA-SLIC), involving expertise from Laserlab groups and beyond, the challenge of single shot CDI has been taken up with the laser-based XUV harmonic source [1], a priori less bright than FLASH (approximately 10^{11} photons at a wavelength of 32 nanometer, in one pulse of 20 femtosecond duration), but much more compact.

In the Coherent Diffraction Imaging line installed on the LUCA laser at Saclay (Fig. 1), harmonic light generated in gas is spectrally filtered and focused on the object with an off-axis parabola under a 4 micrometer diameter spot.

The *pure amplitude* object (i.e., it does not change the phase of the light) in Fig. 2(a), which has a size of 3 micrometer with a smallest dimension of 70 nanometer, has been etched by ion beam in a 150 nanometer membrane (made of gold and silicon carbide).

Fig. 2(b) shows the diffraction pattern obtained in 40 shots, and the object reconstructed with a 60 nanometer resolution (close to theoretical resolution). Fig. 2(c) shows the diffraction pattern obtained in *only one shot*, equalizing performance of the FLASH free electron laser on a table-top system. This result substantially improves the reported CDI studies using a harmonic source (Sandberg, Phys. Rev. Lett. **99**, 098103 (2007)) which needed about one million shots! Single shot studies on both free electron and other laser-based sources open very promising perspectives in the characterization of non-periodic isolated systems, such as unique proteins (e.g., membrane proteins which cannot crystallize), cells, viruses, and nanoparticles.

Of major interest are the dynamical studies on *transiently excited* samples; combining laser excitation and CDI probe with femtosecond time resolution. As a next step, CEA-SLIC envisions using CDI to catch the motion of polymers films adsorbed on substrate.

Bertrand Carré

[1] Single-shot diffractive imaging with a table-top femtosecond soft X-ray laser-harmonics source, A. Ravasio, D. Gauthier, F. Maia, M. Billon, J.-P. Caumes, D. Garzella, M. Géléoc, O. Gobert, J.-F. Hergott, A.-M. Pena, H. Perez, B. Carré, E. Bourhis, J. Gierak, A. Madouri, D. Mailly, B. Schiedt, M. Fajardo, J. Gautier, P. Zeitoun, P. H. Bucksbaum, J. Hajdu and H. Merdji, Phys. Rev. Lett. **103**, 028104 (2009)

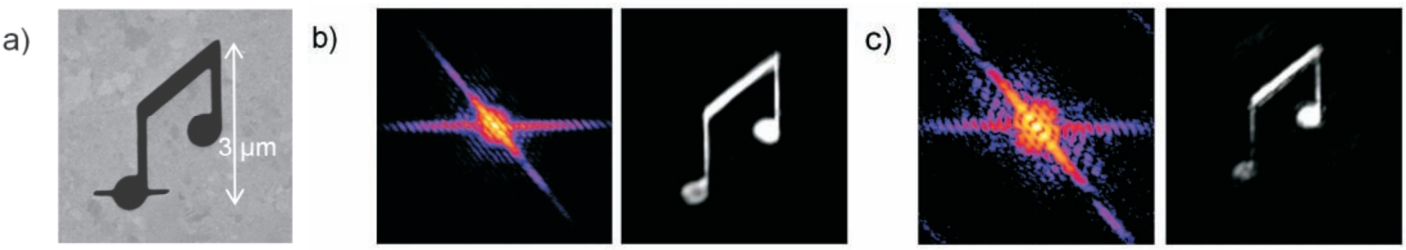


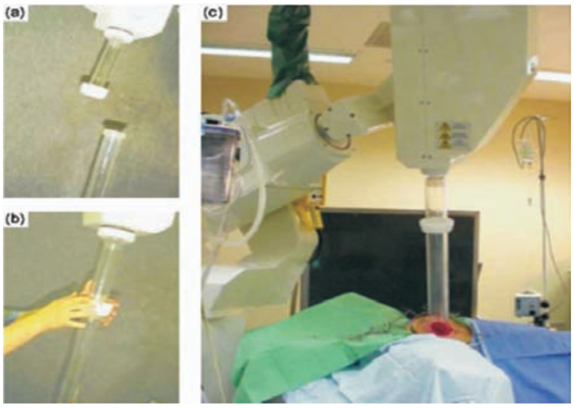
Fig. 2: a) object in transmission (ion beam etching on substrate, collab. Laboratoire de Photonique et Nanostructures, Orsay, France); b) diffraction pattern obtained after 40 shots at 32 nm, reconstruction with an 60 nm effective resolution (collab. Uppsala Univ., Sweden); c) diffraction pattern obtained in single shot, reconstruction with an 110 nm effective resolution.

Laser Science drives novel Cancer Radiotherapy from Labs to Operating Theatres

A French-Italian team of researchers from the LASERLAB-EUROPE consortium has shown that a tabletop laser can be used to accelerate a beam of electrons suitable to be used in cancer radiotherapy.

Radiotherapy uses beams of particles to destroy tumors. Presently, millions of patients worldwide are treated each year with high-energy electron beams, directly or after their conversion into gamma-rays. The high-energy electrons are produced by specially designed accelerators driven by powerful radiofrequency generators. Usually the tumor is located deeply inside the body and, before reaching it, the electrons (or gamma-rays) release a considerable amount of energy into healthy tissues which are consequently damaged.

In order to reduce this undesired collateral effect, a novel technique known as Intra-Operatory Radiotherapy (IORT) is increasingly employed. IORT involves irradiating the patient with electrons in the operating theatre right after the tumor has been surgically removed. The idea is to destroy tumor cells that the surgery has missed. Damage to healthy tissues is then drastically reduced. Because electrons do not have to penetrate deeply, they can be fewer in number and have a lower energy, which means smaller accelerators than for ordinary radiotherapy.



Conventional IORT equipment

However, the IORT technics presently uses linear conventional accelerators (the so-called LINAC) measuring typically more than two meters and over half a ton in weight. In addition, the machine must be shielded from the operating theatre and any maintenance requires the shutdown of the theatre.

A recent LASERLAB-EUROPE experiment opens new opportunities in this field. In fact, the joint CNR-CEA team has shown that most of the problems presently affecting the IORT technique can be overcome by using laser light rather than radiofrequency to produce electrons for radiotherapy.

At the SLIC laboratory in CEA Saclay, France, the researchers fired ultra-short laser pulses onto a suitable target, creating a plasma oscillating at a frequency much higher than radiofrequency. In this way electrons suitable for IORT therapy of tumors are generated in a few millimeters instead of one meter or more. (A. Giulietti *et al.,* Phys. Rev. Lett. **101** 105002). This laser-based accelerator produces bunches of 12 MeV electrons carrying a charge of 2nC at a repetition rate of 10 Hz : these performances are compatible with numbers required for IORT.

Experimental set-up for laser-proton acceleration

Besides saving on size and cost of installations, the laser-acceleration technique offers several additional advantages. Because the laser beam transport is quite easy, the laser can be located in a nearby chamber allowing insuring service and control of the system without harming the sterility of operating room. The laser beam can also be distributed at the same time in different operating theatres in order to provide more flexibility and reduce the costs. The novel equipment does not require the use of the high power radiofrequency generator and the ultra-high vacuum, as the current accelerator technique does. Finally, the radioprotection issue is expected to be considerably relaxed, because of the small size of the laser driven accelerator head, and because the radiological emission is essentially emitted in the forward direction. The only equipment that needs to be installed in the operation theatre is the mini-accelerator box of moderate weight and size, which is easy to be handled and to apply to the surgical wound.

A European consortium including CEA, CNR, laser and medical industries is presently considering the possibility of exploiting such a scientific breakthrough. This exciting adventure has been promoted by the LASERLAB-EUROPE Transnational Access Program.

Didier Normand

LASERLAB Committee of User Representatives

The User Representatives Committee consists of scientists who are frequent Users of the LASERLAB-EUROPE Access facilities and, hence, are familiar with both the scientific needs of the Users and the opportunities provided by the host infrastructures. In their capacity they shall act as interface between the User community and LASERLAB-EUROPE, providing advice to both sides and helping to maintain and improve the relations between them. User Representatives have permanent seats in most Boards of LASERLAB-EUROPE, in particular the Access Board, the Management Board and the General Assembly.

Among the tasks of the User Representatives Committee are the organisation of the regular User meetings and User training schools, and the definition of instruments for their implementation and supervision. The Committee will support the LASERLAB-EUROPE Infrastructures in informing the European User community in all matters of Transnational Access, e.g. through the Newsletter or other dissemination activities.

The following scientists, acting as user representatives within LASERLAB, introduce themselves:

Marta Castillejo (Chair)
Instituto de Química Física Rocasolano, CSIC, Madrid, Spain

My research activity involves: a) laser micro- and nanoprocessing of materials, using pulsed ablation and deposition, with accent in the physical chemistry side and applications in biomedicine and conservation of Cultural Heritage; and b) the study of molecules in ultraintense laser fields.

Istvan Földes
KFKI Research Institute for Particle and Nuclear Physics (RMKI), Budapest, Hungary

My main research activities cover laser-plasma interactions, plasma spectroscopy, inertial confinement fusion, and ultrashort pulses. The basis facility to which I have access is HILL Laboratory, USZ (Hungary). Within the LASERLAB consortium I have performed experiments at PALS and LWS20 (MPQ).

Annie Klisnick
LIXAM, Paris, France

My main research activity relevant to LASERLAB deals with the generation of XUV lasers emitted from laser-produced plasmas and with the development of their applications. To conduct the experimental work I have had access to several European high-power laser infrastructures (LULI, LOA, CLF, PALS, GSI, LLC), which are now in the LASERLAB Consortium.

Oldrich Renner
Institute of Physics, Prague, Czech Republic

My research interest is high-resolution X-ray spectroscopy of the laser-produced plasma, investigation of phenomena accompanying creation and evolution of strongly coupled and correlated plasmas. Within the LASERLAB Consortium I have experience with diagnostic experiments at CLF, FSU-IOQ, LULI, MBI, MPQ, and PALS.

Antonio Giulietti
Users Selection Panel Co-chair
ILIL, CNR Campus, Pisa, Italy

My activities relevant to LASERLAB are experimental research on laser-induced plasma instabilities relevant to ICF, laser-driven particle acceleration and gamma sources in view of medical applications. Together with my colleagues from ILIL-Pisa we have been longtime users of several European high-power laser facilities including CLF, LULI, LOA, SLIC, PALS and JENA.

Leszek Frasinski
Imperial College, London

My research interests are in probing the dynamics of simple molecules exposed to intense pulses of electromagnetic radiation. The research has been carried out using femtosecond lasers (CLF, LLC), attosecond pulses (SLIC, LCVU) and the free-electron laser (FLASH) in Hamburg.

Jouko Korppi-Tommola
Nanoscience Center, University of Jyväskylä, Finland

My main research activities relevant to LASERLAB are related to the study of electron transfer processes in molecule- semiconductor interfaces, chemical dissociation reactions and energy transfer processes in photosynthetic light harvesting. My LASERLAB research partners have been and continue to be LLC, CUSBO and MBI.

Rosa Weigand
Department of Optics, Faculty of Physics, Complutense University, Madrid, Spain

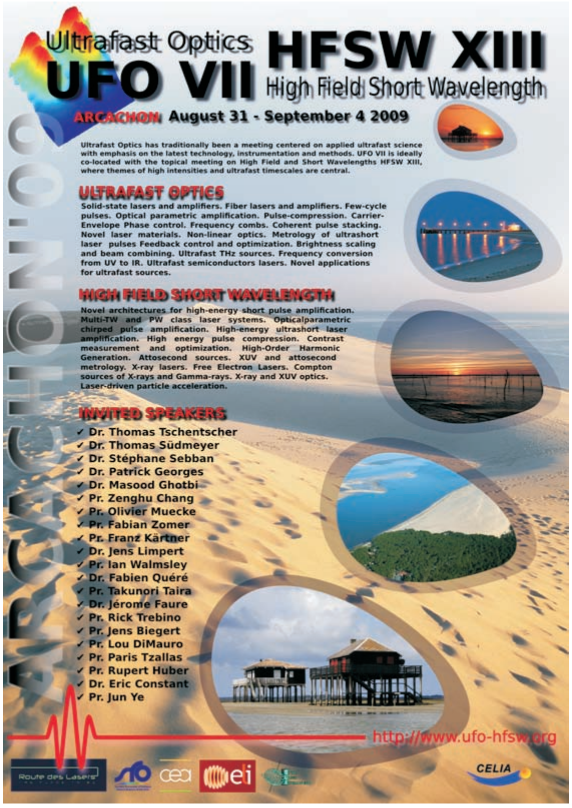
My research interests include the development of lasers in different temporal regimes, the study of pulse propagation in linear and nonlinear regimes and the study of non-linear optical effects in solids. I have performed part of my work thanks to the use of the LASERLAB-EUROPE infrastructures at MBI and LOA.

Questions, comments or suggestions from interested Users are always welcome and highly encouraged. Please, contact any of the User Representatives at the email addresses given at:
www.laserlab-europe.eu/transnational-access/user-representatives

UFO-HFSW: Where ultrafast technology meets high-field physics

The UFO-HFSW '09 conference was held in the seaside town of Arcachon near Bordeaux, France from August 31 to September 4. Chaired by Eric Cormier from CELIA-Bordeaux and Rodrigo Lopez-Martens from LOA-Palaiseau (both partners in LASERLAB-EUROPE), the conference was the third joint edition of the Ultrafast Optics (VII) and High Field Short Wavelength (XIII) meetings.

The UFO meeting traditionally deals with the latest developments in ultrafast laser technology and is ideally co-located with the HFSW meeting, where the central themes are high intensities, short wavelength applications and ultrafast timescales. Historically, the joining of the two meetings was aimed to be able to look at the latest advances in high-intensity physics from a source perspective. With this in mind, the UFO–HFSW '09 programme was put together to focus on the manifold ways of generating, amplifying and measuring ultra-short laser pulses: from picosecond to attosecond durations, from ultrafast THz sources to ultrafast X-ray and particle beams, from compact fiber lasers to PW-class systems. Sessions included carrier-envelope phase stabilization in laser oscillators and amplifiers, novel methods for pulse compression, ultrafast fiber oscillators and amplifiers, advances in solid state oscillator technology and parametric sources, high-harmonic generation and attosecond technology, ultra-high peak power laser development, table-top X-ray lasers, X-FEL facilities, laser-accelerator interactions and laser-based electron acceleration.



This edition of UFO-HFSW was quite successful, with close to 170 registered participants and as many as 20 exhibitors and sponsors. The programme included both keynote and tutorial talks by leading scientists who provided enlightening introductions to each session and several invited speakers provided participants with a glimpse at the recent breakthroughs in each subfield. Very positive feedback came from high-field scientists who learned more about the ultrafast laser tools they use today as well as about the ones they are likely to use tomorrow. In particular, the meeting highlighted the evolution of "table-top" systems into more than potential instruments for driving high-field applications, emphasizing again the benefits of bringing UFO and HFSW together.

The LASERLAB-EUROPE network was massively represented during this international conference, which we hope will grow bigger whilst keeping its original flavour of a conference dedicated to the source technologies surrounding the ultrafast, ultra intense, short wavelength and high field domains.

Eric Cormier and Rodrigo Lopez Martens

LEI2009 – Light at Extreme Intensities: Scientific opportunities and technological issues of the Extreme Light Infrastructure

The first international conference of the ELI - Extreme Light Infrastructure project took place from 16th to 21st of October in Brasov, Romania. "LEI2009 - Light at Extreme Intensities" attracted scientists from the European Union, Russia, Korea, China, India and the USA.

All of them were eager to participate in the first global meeting dedicated to the future laser facility ELI that should be operational in 2015.

Close to 200 participants discussed the design of the Extreme Light Infrastructure, and the exciting perspectives it opens up for future experiments. With plenary talks in the core themes of ELI, from exotic physics at high laser intensities to secondary sources of particles and radiation, the program contributed to define the state-of-the-art of high intensity lasers and its applications.

Three young scientists were awarded an ELI prize for their special research, that will give a significant contribution to the realization of ELI in the near future: S. Banerjee from STFC (UK) for a breakthrough in diode-pumped scheme enabling kJ-class pumping, S. Martins from IST (Portugal) for laser-plasma simulations scaling to ELI intensities and Zs. Major from MPQ (Germany) for the progress in the Petawatt Field Synthesizer.

The proceedings of the first International Conference on Light at Extreme Intensities will be published by the American Institute of Physics (AIP).

Marta Fajardo

HiPER holds Mid-Term review

A formal Mid-Term Review of the Preparatory Phase of the HiPER (High Power Laser Energy Research) project took place in September 2009 in Cadarache, France (the site of ITER and the Jules Horowitz Reactor). The purpose of the review was to assess the current status and future strategy of the project.

The review panel consisted of LASERLAB Coordinator Prof. Wolfgang Sandner, Prof. Mike Key from Lawrence Livermore National Laboratory and Dr. Francis Kovacs, Deputy Director CEA Cadarache, as chair.

The Review panel acknowledged the good progress that has been made by the full HiPER team, not least with regard to European alignment onto a single track for Inertial Fusion Energy (IFE). They also recognised that there is much work still to do to realise the objective! The panel endorsed the planned strategy for the next phase of HiPER. This is to progress with the current Preparatory Phase design work, but also initiate large-scale prototyping and demonstration activities (e.g. diode-pumped laser demonstrator beamline), and demonstrate the preferred physics scheme on large scale facilities in the US, Japan and Europe.

It was agreed that the recent down selection decision to high repetition rate operation was a very positive move. It allows HiPER to act as the final step to making IFE a reality. It opens up substantial new scientific options, and it provides the opportunity to develop new technology with wide market potential. Such development aligns with other projects and initiatives (such as the Extreme Light Infrastructure, ELI) and will help to grow the laser community and supplier industry.

Anne-Marie Clarke

Announcements

Forthcoming events

30 November - 11 December 2009
Related event: Training Course Laser Technologies at Bordeaux, France

6 - 7 April 2010
Related event: Symposium – Modern Trends in Basic and Applied Laser Spectroscopy at Lund, Sweden

22 - 25 April 2010
Baltic / Northern Europe Training School for potential Users, Riga, Latvia

How to apply for access

Interested researchers are invited to contact the LASERLAB-EUROPE website at www.laserlab-europe.eu/transnational-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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