Issue 2 **October 2006**

Laserlab Forum

Newsletter of Laserlab-Europe the integrated initiative of European laser infrastructures in the Sixth Framework Programme of the European Union

IN THIS ISSUE

Editorial

Europe seems to be constantly changing, but there are times when the rate of change is particularly high. The preparation of a new Framework Programme is such a time, and we are right in the middle of it now. There seems to be a consensus on the basic structure of FP7, its time frame and finances. The good news is that the I3 instrument is likely to continue with only a few modifications, leaving us with an opportunity to apply for a project to succeed Laserlab-Europe. The time frame for a Call for Proposals is presently under discussion, as is the instrument's financial frame – the only safe assumption seems to be that the competition will be just as fierce as last time.

There are, however, interesting changes and new developments which may affect our future strategy. First, the ESFRI group will soon release the new issue of a European 'Roadmap' towards large Infrastructures of pan-European interest. We proudly note that the contributions from the laser community are highly innovative proposals in the area of laser fusion energy (HIPER and PETAL) and ultra-high intensity physics (ELI). Each project is based on consortia led by Laserlab-Europe members. The trend towards single research units of pan-European interest, complementing the present networks of national infrastructures, seems to gain importance within the vision of a European Research Area. We will be well advised to take this fact into account in our future strategies.

At the opposite end, the concept of networking is very much alive and seems to be developing new dimensions. Examples include thoughts about inter-disciplinary networks which will pursue topics of general interest between sciences, life sciences and humanities. This may reach from inter-disciplinary I3's (e.g. on Cultural Heritage) to the creation of completely new structures, such as 'Knowledge Communities' in the context of a future European Institute of Technology (EIT). Whatever networks exist – there is a good chance that lasers will be needed, and we should be prepared to offer our contribution.

Last, but not least, the laser community itself should start thinking about a specific network to succeed Laserlab-Europe. I will be glad to collect ideas and suggestions on visions, structures, JRA's, access and networking both from within our present network and from the community of users and friends outside. Let us try to be as innovative and, hence, successful in the future as we have been in the past!

Professor Wolfgang Sandner
Laserlab-Europe Coordinator

I3-NET: to create a European access market

The Integrated Infrastructure Initiative (I3) instrument was created under the 6th Framework Programme (FP6). As FP7 approaches, a lot can be learned from this first period of implementation. As early as 2004, a few I3 coordinators felt the need to exchange experience with the common goal of optimizing research infrastructure (RI) management. They decided to formalize their discussion inside a specific support action, called I3-NET. This forum started with about twenty I3, and is now preparing to welcome another twenty. Together these encompass hundreds of Research Infrastructures, from telescopes to botanical collections, open to thousands of European scientists.

Professor Robert McGreevy

Professor Robert McGreevy, coordinator of the Neutron-Muon I3, is also the coordinator of I3-NET. According to him all RIs, irrespective of their nature, have a lot in common in the way they need to operate. Creating a forum to allow these communities to talk together, when they usually operate separately, might be beneficial to all. Some interesting solutions for improved access management have already been suggested...

Organisational aspects of I3s must be an important part of the I3-NET discussion, but is it the only one?

I3 coordinators have undoubtedly benefited a lot from talking to each other about contract management; we were all new to this – as were our colleagues in Brussels.

But our discussions very quickly extended to how to operate research infrastructures with a long term view. It is important to recall that RIs are at least 20 year projects, so they need permanence and stability in funding. The investment in a RI is very heavy. To make it cost effective we need to be looking for the widest possible user community. As a matter of fact, the success of the EC access programme shows that there is a lot of demand from European researchers.

So, there is a large potential access market and we need to find new mechanisms, different from the EU programmes, which are limited, to make that market work.

What kind of mechanisms are you thinking of?

We looked at the new practice for research ships. In this field, you had the situation where some ships were sitting in port without anyone using them. This led the research managers to create an international agreement for some equitable time sharing. They formed a 'club' which is the official body controlling the exchange. On the basis of their experience, we would like to make a similar system work at the European scale and for all types of research infrastructure.

Any EU country might receive and exchange a number of 'tokens for access' on the basis of its capacity to host a number of research projects at its own facilities. That is how we view such a general mechanism – the exchange of tokens without the need to exchange real money, which always complicates matters. The access system would be all the more efficient!

Which body could operate it?

This isn't clear yet. The proposal will be looked at by EUROHORCS[1]. It is also directly connected with the ESFRI[2] work – which concentrates on the construction of new RI of pan-European interest. Indeed, our common goal is to develop an efficient market of access. In this context, we are particularly concerned with the situation in new member states where structural funds are available to build RI. In order to make their investment fruitful, we would recommend that they build something which is very unique. Under our access mechanism they could easily integrate this into the access market by supplying services for which there is a concrete demand...

Now, considering the variety of RIs participating in I3-NET, is it also the place to stimulate interdisciplinary research?

With regard to FP7, one of our tasks is to find out how RIs could work better on the basis of our experience in FP6. Interdisciplinary research is one of the issues we have discussed in the sense that we are trying to push the idea of 'horizontal I3' forward.

What are horizontal I3s?

They would combine different kinds of RI to study a specific problem, compared to 'vertical I3' which supply specific 'tools', such as lasers or aircraft, to study a range of problems. Most I3s in FP6 are vertical, and they are so successful that one would not consider getting rid of them. But one can also imagine the scientific advantages of putting different types of RI together!

A good example of a horizontal I3 might be in the field of cultural heritage, which is of high priority notably in Italy and Greece. Combining various types of research infrastructure would allow us to supply a

Erratum: A broad consensus in the scientific community

In the layout version of Issue 1, an unfortunate misprint occurred in Professor Krausz's interview about Professor Hänsch's Nobel Prize. His first answer should read *"I do not know anyone else in physics who would have deserved the Prize more [...]"*.

We wish to apologize to Professor Krausz for the inconvenience.

The editorial team.

variety of diagnostic and conservation tools for these studies. Last December, we organized a meeting on cultural heritage that representatives from 5 or 6 different kinds of RI attended. From the discussions, it became obvious that there is the potential for a large scale horizontal I3 in this field.

We would like to encourage the EC to develop such an instrument in future RI programmes; but this is very challenging! We have to find out how to manage access for horizontal I3. So far, a research project which required access to different types of RI would be evaluated several times, by separate review panels. There is no guarantee that the project could be carried out entirely. Establishing a horizontal I3 implies that this sort of access mechanism would be changed. A single proposal for different kinds of RI should be all that is needed, so this means forming new review panels dedicated to these specific topics. And that's only one of the aspects we have to consider inside I3-NET...'

The I3-NET initiative proves that, even if the different I3 compete to get funding from the European Commission, they all benefit from collaborating because globally they play an absolutely central role in the European Research Area.

To demonstrate this, I3-NET has decided to produce a booklet describing the broad range of research infrastructures in Europe, to be released during 2006!

[1] The European Heads of Research Councils group is currently carrying out a survey of Research Infrastructures in Europe, in collaboration with the European Sceince Foundation and the European Commission.

[2] The European Strategy Forum on Research Infrastructures supports a coherent approach to policy-making regarding research infrastructures in Europe.

Changes of appointment at *LaserLab*

FSU-IOQ

Laserlab-Europe welcomes Dr Heinrich Schwoerer as its new partner at FSU-IOQ (Jena, Germany). Dr Schwoerer has become the acting leader of the Quantum electronics group after Professor Roland Sauerbrey has acquired a new position as director at Forschungszentrum Rossendorf in Dresden.

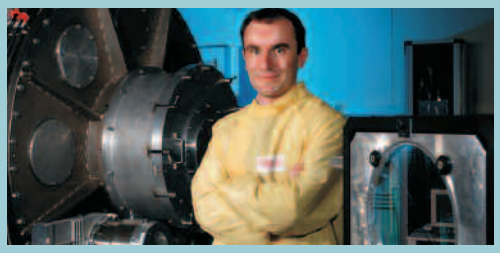
FSU-IOQ Laser facility is open for access through Laserlab-Europe access programme to perform a wide range of experiments comprising:

- Quantum Electronics and Novel Laser Development
- Laser Particle Acceleration and Application
- Laser Plasma Physics, Fusion Science and Applications
- Time-Resolved X-Ray Science
- Laser Remote Sensing, Analytical Chemistry and Combustion Diagnostics

Contact Dr Schwoerer: schwoerer@ioq.uni-jena.de

CLF

Laserlab would also like to welcome Dr Mike Dunne as the new contact within CLF following his recent appointment as Director of CLF. Dr Dunne's new role follows Professor Henry Hutchinson's recent appointment to the position of CCLRC Chief Scientist. However, Professor Hutchinson has kindly agreed to stay on as co-chair of the Laserlab Management Board.



Contact Dr Dunne: m.dunne@rl.ac.uk

Laserlab-Europe partners wish them success in their new positions.

ATLAS – A joint training initiative of Laserlab partners

Four Laserlab-Europe partners launched the ATLAS* project to provide young researchers with advanced training on laser-based science and technology. Twelve fellowships have already been awarded through this Marie Curie early stage training project funded by FP6.

With a mutual expertise encompassing cutting edge research in physics, chemistry, biology and nanoscience, IESL-FORTH (Greece), VULRC (Lithuania), LENS (Italy) and LCVU (The Netherlands) have a broad experience in collaborative research training projects.

Through ATLAS, they expanded upon an original multi-site training scheme where PhD students have the opportunity to carry out research at one or more of the other host laboratories. In this manner, they can take advantage of both the technological complementarities of the participating laser facilities and interact directly with senior researchers across the institutes.

That's why long-term stays, with a maximum of 36 months, have preference when attributing the twenty fellowships available for early stage researchers**.

In the selection process, the ATLAS management board evaluates, on the basis of excellence, the quality and ability of the candidate to complete the proposed research project.

So far, 12 PhD students with very different areas of interest (nanotube formation, Bose-Einstein condensation or laser biomedical applications) have started or continued their research training with the ATLAS scheme. Originating from EU member or associated states, they were willing to leave their home countries to serve their apprenticeship in the most appropriate institute: leaving Bulgaria for The Netherlands, Italy for Lithuania or France for Crete.

By providing well organized and high level training, the ATLAS initiative certainly contributes to increasing the laser-based science community while preserving and advancing its scientific expertise. In that perspective, it also reinforces Laserlab-Europe activities and, what's more, strengthens the links between consortium partners.

* ATLAS: Advanced Training in Laser Science

** Early stage researchers have less than 4 years of research activity including training

For more information: check ATLAS pages on IESL-FORTH (coordinator) website
http://www.iesl.forth.gr/programs/atlas/index.asp

Filming laser safety

Together with its Laserlab-Europe partners, the LOA centre in Palaiseau (France) is concerned about user safety in its laboratories. After co-organising a workshop last year with GSI and PALS on the topic, they have just released a 22 minute training documentary concerning CPA lasers. Viewing this film has become compulsory for any user before they can enter CPA laboratories at the LOA.

The goal of the LOA safety team, led by Yves-Bernard André, is to eliminate accidents by training each facility user to be cautious when working with laser beams.

Why choose the movie format? *"Because it makes the training much more lively than just a powerpoint presentation which can become pretty boring. When you talk about something as important as safety, you need people to listen carefully"*, explains Mr André. This type of training already existed with the CEA[1], but it had become obsolete not only because of the VHS tape format, but also because they were not dealing with the specific risks of CPA lasers.

Indeed, with their rapid development during the last decade, researchers are now exposed to invisible laser beams with ultra high peak power and kHz repetition rate. Sources of danger are all the more numerous. For instance, even after multiple reflections, the laser beam is still very energetic and harmful to the eye. Moreover, because of kHz repetition rate, the palpebral reflex[2] is not sufficient enough to protect the eye since a few hundred energetic impacts can damage the retina before the eyelid closes. Anyone entering a laser facility should be aware of all these risks.

Therefore, in summer 2005, Yves-Bernard André, encouraged by the LOA's newly appointed director Gérard Mourou, launched the movie. He recalls: *"I had already written the synopsis a few years ago and then last year it finally turned into a concrete tool with the precious help of a little movie firm."*

A movie with "real researchers"

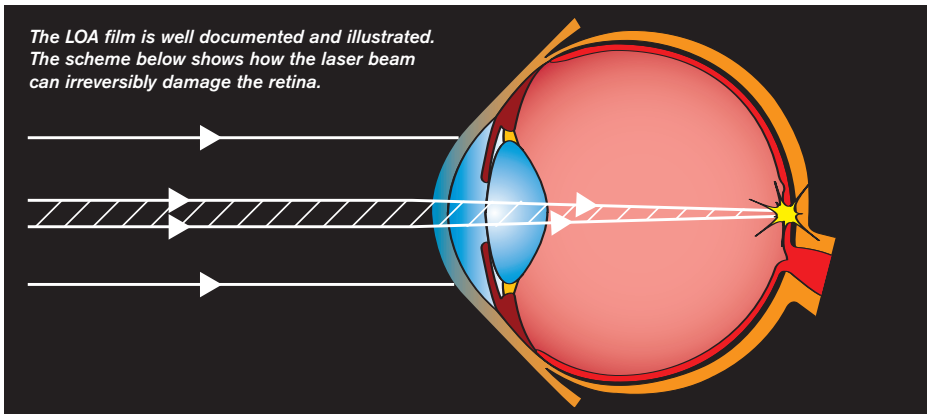
In a lively matter of fact way, the movie addresses most of CPA related risks and safety measures to avoid accidents. The overall production seems realistic because real researchers are filmed in their daily environment showing and explaining safe practices when working in a lab i.e.: remove any metallic jewellery (wedding rings, necklaces etc...), work in a well lit room because the eyes are even more vulnerable to laser impacts in the dark. Last but not least, the film also recalls that the best way to avoid an ocular accident is to wear protective glasses specific to the laser wavelength in use.

If these pieces of advice are overlooked, severe accidents can happen, *"and they happen!"* warns Mr André, *"even recently, a PhD student within Ecole Polytechnique became half blind which has prevented him from ending his thesis... To avoid these sad stories, we must educate people on laser risks and their consequences".*

Lively... but educative

However, the film remains a tool for training. Safe practices are not only explained but also recapped throughout the film because safety measures needs to be reviewed periodically. An annual viewing has become compulsory for the whole staff with a self-evaluation afterwards: a questionnaire has been designed to check whether people are ready to safely enter the lab.

This lively way of training users, including PhD students, about laser safety, is made even more interesting as it stimulates daily discussions between young and senior researchers: the real face of apprenticeship that a film, as good as it can be, cannot replace!



The LOA film is well documented and illustrated. The scheme below shows how the laser beam can irreversibly damage the retina.

[1] LOA and the Saclay centre of CEA are located in the same suburb of Paris
[2] When illuminated, the eye closes itself within one tenth of a second

Dubbed into English

"With 80 visiting scientists a year, we could not omit to supply an English version to our European and international access users", explains Dr Philippe Balcou, LOA representative inside Laserlab-Europe. With effect from spring 2006, users coming to the LOA, will be asked to view the English version and evaluate themselves before entering the laboratories. *"It also enables us to distribute our documentary to any other partner inside Laserlab-Europe interested by our approach of laser safety."*

Safety measures for CPA type of intense lasers, 2005 (23')

(DVD, VHS)
Version: English, French
Film director: ROCHEBOIS Vincent
Executive producer: Paul de Jenlis - Jaguanum
Copyright: CNRS Images
With the participation: Laboratoire d ' Optique Appliquée LOA - ENSTA
For more information: http://videotheque.cnrs.fr

Tailoring high energy proton beams with lasers

With the support of the Laserlab access programme, European researchers carried out a successful series of experiments using laser - proton acceleration at LULI (France) and MPQ (Germany). Novel techniques and predictive laws paving the way to complete control of the process were recently honoured in Nature and Science.

High-energy proton beams have numerous applications, notably in the field of cancer treatment with proton therapy. In order to pursue this application, the proton energy has to be high enough: 60 MeV protons are necessary to penetrate through several centimetres of tissue (e.g. eye tumours) and 200 MeV to reach deep-seated tumours (25 cm).

Considering these orders of magnitude, there is no doubt that researchers from Germany, France and Northern Ireland working on the acceleration of proton beams using lasers, have just passed important scientific and technological milestones.

Scaling laws: a necessary step towards proton energy increase

Indeed, if the laser driven accelerator has been demonstrated to produce high proton energies, reaching hundreds of MeV remains challenging and requires the knowledge of how proton energy scales with laser and target parameters (i.e. laser intensity, energy and pulse duration and target thickness).

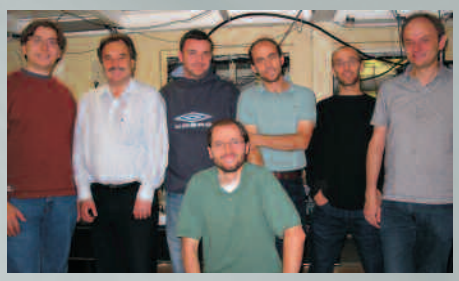
Now, the involved teams performed a systematic study of the proton spectra accelerated from laser-irradiated solid aluminium targets both at the LULI and the MPQ facilities. The analysis of the resulting extensive dataset led to the derivation of scaling laws for the maximum proton energy and flux. Laser and target parameters needed to produce high-energy proton beams for proton therapy of deep-seated tumours to be evaluated (see boxed insert).

High beam quality and energy selection with innovative focusing device

What's more, another requirement to achieve many applications is to convert poly-energetic and divergent beams into **high quality and quasi mono-energetic proton source** ($\Delta E/E << 1$). In the LULI experiments, researchers achieved **simultaneous** focusing and energy selection of high current MeV proton beams using an ingenious laser driven microlens arrangement (see figure 1).

Scalability of the microlens up to higher energies was tested numerically: reduction of divergence of 270 MeV protons is foreseeable with laser intensities up to 10^{20} W x cm^{-2}.

Roads towards scientific, technological and medical applications of laser-proton acceleration are definitely wide-open!



(L to R) Mr T Toncian (HHUD), Prof O Willi (HHUD), Mr C A Cecchetti (QUB), Dr J Fuchs (LULI), Mr P Antici (LULI), Dr L Romagnani (QUB/LULI) and Dr M Borghesi (QUB).

Predicting laser and target parameters to achieve high flux and high proton beam

Using scaling laws derived by Fuchs *et al*, a laser pulse of 0.5 ps duration, 8 x 10^{20} W.cm^{-2} intensity and 3 µm full-width at half-maximum (FWHM) focal spot irradiating a 10-µm-thick target could produce 10^9 protons of 200 MeV ($\Delta E/E = 10^{-2}$) for a single laser shot. A laser with a repetition rate of 10 Hz could be appropriate to generate the required particle flux for proton therapy (10^{10} particles per second). Such conditions are technologically foreseeable with the development of future petawatt facilities.

References:

- *Laser-driven proton scaling laws and new paths towards energy increase.* J Fuchs *et al*, Nature Physics **2**, 48-54 (01 Jan 2006)
- *Ultrafast Laser-Driven Microlens to Focus and Energy-Select Mega-Electron Volt Protons.* T Toncian *et al.* Science **312**, 410-413 (21 April 2006)

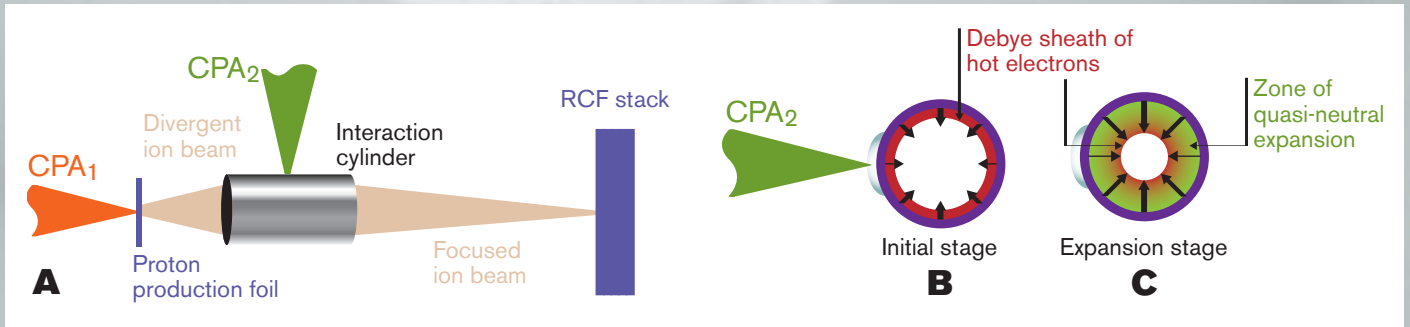


Figure 1: Schematic of the focusing and energy selection of proton beam (A) using a laser driven micro lens device (B and C). The proton beam interacts with transient and radial electric field created inside a hollow laser-irradiated cylinder. It produces selective focusing of quasi mono-energetic protons (E = 6,25 and 7,5 MeV in the experiment) within a small bandwidth (ΔE ≤0,2 MeV) out of the broadband spectrum of the initial beam.

"It is a real scientific collab access should continue!"

Senior Researcher at the Spanish National Research Council, Dr Marta Castillejo is also user representative in the Laserlab Access Board. Her field of research, laser-material interaction and its applications in Art Conservation and Biomedicine, has led her to collaborate with the ULF-FORTH facility in Crete within the Laserlab access programme.

Tell us about the experiment you performed at the ULF-FORTH facility?

We carried out pulsed laser deposition in order to produce thin films of polymers doped with fluorescent probes. These molecular dopants show interesting fluorescent emission variations upon change of pH, polarity or viscosity in their microenvironment. Thus, they could be used as sensors to detect the presence of contaminating environmental agents. Until now, these fluorescent probes work in solutions, but, inserting them in thin polymeric films could prove advantageous because the surface of exposure to contamination would increase and the response time would decrease. Therefore, we would be able to monitor in real-time very low level concentrations of contaminating agents.


Dr Marta Castillejo

This new technique would be particularly interesting in Art Conservation. I should mention that some of our research on laser ablation is dedicated to protecting and restoring works of art and our pulsed laser deposition (PLD) experiments performed in Crete are part of it. We would like to develop these thin films notably to use them inside museums where we need to detect for instance contaminating agents emitted by wooden objects which can damage metals.

However, the experiment was only the first step towards the development of this technique. We proved that PLD using a femtosecond Ti: Sapphire Laser system was an appropriate way to deposit thin films of doped polymers. However, the technique needs to be developed further to the complete characterization of the fluorescence properties of those films upon exposure to contaminating agents.

What is the added value of the ULF-FORTH facility for your project?

While we had the fluorescent probes and the material, they had the laser and the deposition chamber, but the added-value goes beyond the equipment! We have also established a long term scientific collaboration with some of the researchers there. We performed the deposition experiments while we were there; back in our Institute in Madrid we characterized the deposits by a range of analytical techniques. The discussion of results followed our visit. It was more than access time; it was a real

Access promotes excellen


Dr Dimitri Batani

Dr Dimitri Batani is a senior researcher and leader of the laser-plasma group at the University of Milano – Bicocca (Italy). He has been participating in European access programmes for 7 years at different levels. As a regular user of Laserlab large scale infrastructures, he was re-elected as a user representative on the access board at the Participants council 2006. He reports on his experience in the consortium.

In your opinion, what is the main benefit of the Laserlab Access programme?

Undoubtedly, it is an opportunity to access unique laser installations in order to investigate the hot topics of advanced research fields. In our case we studied the new concept of fast ignition in the field of fusion energy. The goal of an academic research group is neither to develop technologies nor to perform integrated experiments but rather to understand physical mechanisms underlying inertial fusion with 'simpler' set-ups. We aim at resolving important key issues. But still, a 'simpler' experiment remains very complicated to implement. That is why we need to establish or pursue collaborations with researchers at large scale infrastructures as we have done in the past with LULI and LOA (France), RAL (UK), MPQ (Germany), or PALS (Czech Republic). In that perspective, the Laserlab access programme is an essential support.

Concerning fast ignition, what are the key issues you already addressed?

We have been one of the very first groups to address, and systematically study the problem of fast electron transport in gas and solid targets; which is crucial to assess the feasibility of fast ignition. We have run a series of experiments where we

oration:

scientific collaboration with an exchange of expertise. The experiment was also the occasion to train two PhD students, one from each Institute. They have completed or will soon attend their PhD viva.

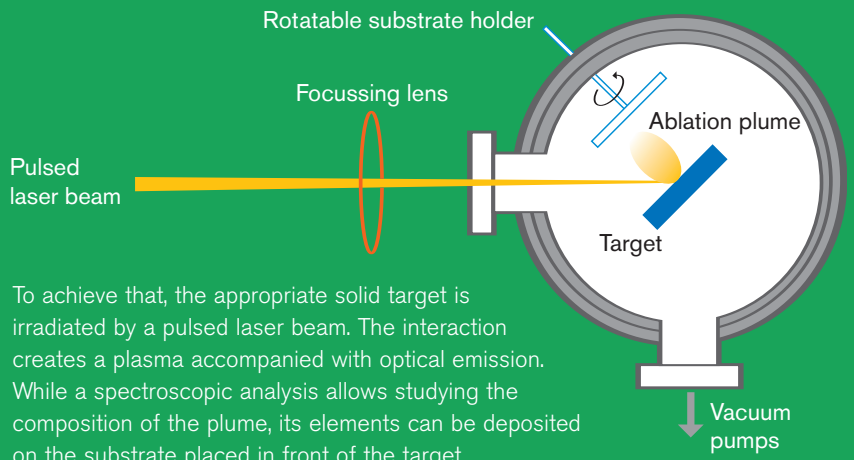
From the discussions I have had with other users, I know that this is usually how access goes. We not only go and use the lasers but we also collaborate with the team. Of course, sometimes, an access project only requires laser beam time, but less frequently...

Would you consider using or building in your home institute, the kind of laser system at your disposal in Heraklion?

Yes, but, even if we have such a system, it could not be used as a substitute for access in Laserlab type of facilities. The interesting thing about them is they supply a wide variety of laser systems. Not every laboratory or research centre can afford that! For instance, for one type of laser, a range of pulse durations from nanosecond to femtosecond can be available, enabling comparison of the mechanisms in different temporal regimes.

Pulsed laser deposition, in a nutshell

This process allows the transfer of material onto a substrate in order to produce multilayer deposits or to grow thin films with specific properties.



To achieve that, the appropriate solid target is irradiated by a pulsed laser beam. The interaction creates a plasma accompanied with optical emission. While a spectroscopic analysis allows studying the composition of the plume, its elements can be deposited on the substrate placed in front of the target.

In short, the scope of experimental possibilities is higher. Besides, access visits are always the best way to meet other users doing other kind of research...

You seem to be very positive about Laserlab access programme...

I think it is very interesting and I really hope that the 7th Framework Programme of the European Commission will strongly support access to infrastructures. So far, considering the Laserlab project, the only limitation I can think of is a financial one. It is so successful that we face oversubscription. If the budget was higher, the facilities might welcome even more users...

But, beyond that, I personally think that the consortium manages very well to keep 'under the same umbrella' different types of laser infrastructures. A coherent selection procedure for access projects was set up in spite of the operating differences between facilities aiming at more integration, service and transparency. It was a real challenge that they dared take up!

ce in scientific exchanges

emphasized the essential role of the density of the background material for allowing the propagation of fast electrons, by studying the latter in a large variety of materials: solids, foams, gases. In our experiment with gases, we implemented several novel diagnostics, such as proton radiography, which revealed, in agreement with numerical simulations, the presence of very strong electrostatic field in the gas ($E > 10^{10}$ V/m). Chirped shadowgraphy also allowed us to photograph real-time fast electron cloud expansion...

Our latest experiment in the framework of Laserlab was aimed at testing the new concept of 'cone guided targets' recently developed by Kodama and Norreys. For the first time, they achieved D-D fusion and collected neutrons by implementing the fast ignition concept. Moreover, they showed that the 'cone guided target' scheme enabled the enhancement of the neutron compared with a 'cone-less' experiment. Until now however, the physical mechanisms for this enhancement are not yet understood.

Therefore, in our last experiment performed at LULI, we addressed the influence of the target geometry by studying the interaction of an ultra-intense laser pulse interaction with a three layer target in presence of the cone. In our conditions, we observed no significant cone effect. Compared to Kodama and

Cone experiment

Norreys' experiment, our preliminary result seems to indicate that the propagation of fast electrons itself is not influenced by the presence of the cone, which is therefore only useful to 'keep the

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expanding plasma away from the incident laser beam' and making its absorption easier.

Apart from using laser infrastructure, how does an academic user group benefit from the access programme?

One of our main concerns is obviously students' research training. There is regular participation from our Ph. D. or MSc students thanks to the Laserlab programme. It offers them the possibility to perform hot topic experiments in major research centres. In return, our hosts meet young scientists who might become their future post docs.

To summarise, Laserlab encourages various kinds of scientific exchange thanks to which we avoid being isolated. This is a matter of great concern amongst academic laboratories.

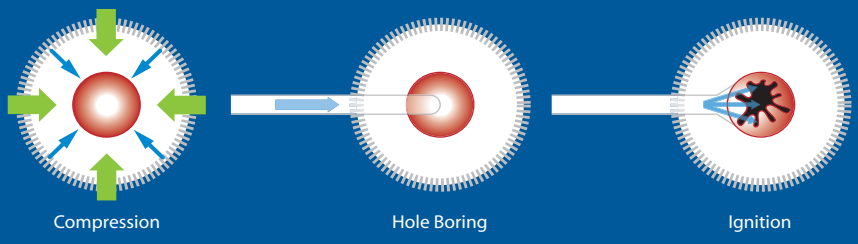
In your opinion, what are the limitations of this access programme?

The enlargement of our plasma community is no easy task. It is an objective which the European Commission is pursuing with their 'new user' criterion, but, I don't think that the access selection process can really help attracting new members in our field. With fusion energy research, our community is facing a very important challenge; therefore, the scientific quality of the access programme should always prevail!

Fast ignition at a glance

The rapid development of short-pulse laser beam technology has opened a new road towards inertial confinement fusion. The principle of fast ignition is to dissociate the fuel ignition phase from its compression. It is based on a three step process where a fast electron beam, created via laser-plasma interaction, ultimately deposits its energy in the super-compressed fuel and brings it to ignition.

The electronic energy transport in matter of various densities is therefore a key issue to be addressed in the research field of energy fusion.



Contact your user representatives

As user representatives, both Dr Castillejo and Dr Batani can pass user's messages to the Access Board. Other user representatives were elected to the different Laserlab bodies. They will all welcome users' comments on the consortium activities.

Laserlab body	Name	Research Institute (Country)	email
Access Board	Dimitri Batani	Dipartamento di Fisica, Università degli Studi di Milano-Bicocca (Italy)	batani@mib.infn.it
	Marta Castillejo	Instituto de Quimica Física Rocasolano, Consejo Superior de Investigaciones Científicas (Spain)	marta.castillejo@iqfr.csic.es
	Jouko Korppi-Tommola	Department of Chemistry, University Jyväskyla (Finland)	ktommola@jyu.fi
Management board	Annie Klisnick	Laboratoire d'interaction du rayonnement X avec la matière, Université Paris XI et CNRS (France)	annie.klisnick@lixam.u-psud.fr
Participants Council	Emile Biemont	Département de Physique, Université de Liège (Belgium)	e.biemont@ulg.ac.be
	Rosa Weigand	Departamento de Óptica, Universidad Complutense de Madrid (Spain)	weigand@fis.ucm.es
	Annie Klisnick	Laboratoire d'interaction du rayonnement X avec la matière, Université Paris XI et CNRS (France)	annie.klisnick@lixam.u-psud.fr
Access Selection Panel	Jerzy Wolowski	Institute of Plasma Physics and Laser Microfusion (Poland)	wolowski@ifpilm.waw.pl

Professor Roland Sauerbrey

New Director for the Forschungszentrum Rossendorf

The internationally renowned laser physicist Professor Roland Sauerbrey has been appointed as the new Scientific Director at the Forschungszentrum Rossendorf (FZR) in Germany. With a staff of approximately 550 employees and an overall budget of about 60 million Euros, the FZR is one of the biggest research institutions outside the universities in the new federal states.

Professor Sauerbrey, who is considered to be one of the leading experts in high intensity laser beam physics, wants to establish the Forschungszentrum Rossendorf as an internationally renowned center in the fields of structure of matter, safety research, and life sciences. *"Our goal must be to rank first in the scientific fields we have identified as our main focus"*, Professor Sauerbrey says.

'Fascination of light' the European tour begins...

Berlin and Athens were the first two stops of the European tour of the 'Fascination of Light' exhibition, and they proved to be an enormous success drawing in large crowds.

The exhibition is part of a campaign in Germany aimed at the promotion of education and training in optical technologies. It specifically addresses children, students and teachers by using interactive hands-on exhibits, multimedia stations, functional models and simple experiments. With the support of the European Union the exhibition will now tour through several European cities where LASERLAB EUROPE partners are established. An additional partner in this project is the Network of Excellence in Micro-Optics (NEMO) which contributes its educational kit in micro-optics.

The starting point for the European tour was the 'Long Night of Science' in Berlin where the exhibition was displayed for three weeks (13 May - 1 June) and attracted more than 15,000 visitors, among them 1,600 students, ranging in age from 6-19, who signed up for guided tours together with their teachers. A special opening event introduced the visitors to the important role that light and optical technologies have within our daily lives, the technical advancements that have taken place to date, and the scientific developments that have been achieved in Europe.

At its second venue, the Greek Science and Technology Week in Athens (28 June to 6 July), the exhibition was a major highlight with more than 2500 visitors of all ages. Local support and guided tours of the exhibition in Athens as well as brochures and documentation in Greek have been organised by the LASERLAB EUROPE partner IESL-FORTH in Heraklion, Crete.

For more information please visit www.fascination-of-light.net.

Overcoming the Technology Barriers

Introduction

Throughout the European Union there has been considerable success over the last decade or so in the development and exploitation of Ultra-High Intensity (UHI) laser facilities. Indeed, it is probably fair to say that given the degree, number, success and application of these facilities, this European infrastructure, that now forms Laserlab-Europe, leads the world.

The development of this infrastructure resulted from a technological breakthrough many years ago – the invention of the *Chirped Pulse Amplification (CPA)* technique. This technique overcame the limits imposed by the non-linear process that are encountered in amplifying an optical laser pulse to very high intensity. It breathed new life into existing installations and encouraged the prolific development of new ones.

We have however, reached a point, where continued progress is limited essentially by available technology, and where further optimisation is essentially no longer available. Further progress is not going to be possible without addressing some of the technological barriers that we are faced with for the longer term. It is also important to note that as the science advances within these facilities, so do the demands of the User programmes. It's not just a desire to increase the direct performance capabilities of these facilities, but also secondary parameters become important. Issues such as repetition rate are becoming increasingly important in the provision of increased access to this level of scientific capability.

Thus, the primary goal of this second Joint Research Activity within Laserlab-Europe is to try to address some of the key technology barriers that we face in future for the successful development of our European high power laser research infrastructure. Consequently, this second JRA is named "**O**vercoming **t**he **T**echnology Barri**er**" – or "OTTER" for short. It is divided up into 3 key areas.

Inxreasing energy

Addressing some of the issues that are limiting the energy capability of current facilities is undertaken in two ways:

First there is an element looking at understanding and improving the damage threshold of critical optical components, in particular the end of chain compressor gratings and certain key mid chain components. All CPA installations world-wide currently use certain key components that are based on gold coated optics and this is the technology barrier. The objective of this element is to understand better damage mechanisms with extremely short duration pulses (tens fs) and to have demonstrated the successful operation of a CPA system using key components that are not based on gold coatings.

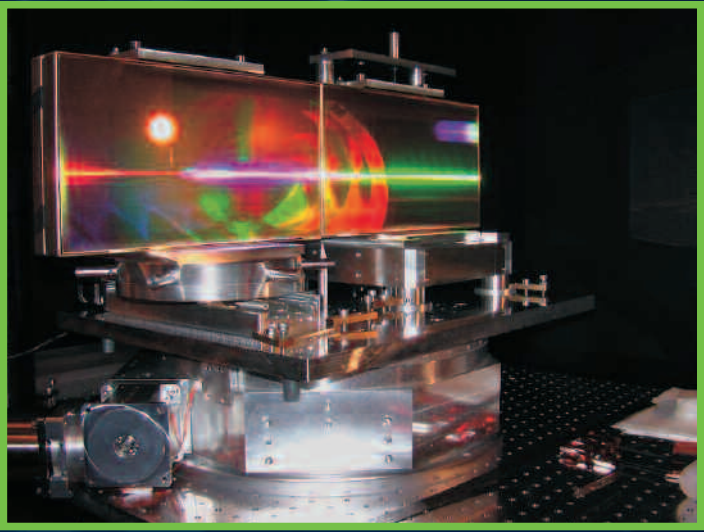
Secondly, there is an element looking at using small grating components in such a way as to deliver an increase in energy handling capability. This is centred on using an optical array of these components dynamically locked together to form effectively a single larger element, a so called *"phased array"*. The objective of this is a demonstration of the successful operation of such a device, in a CPA system. (see Box 1)

Pulse length reduction

An important factor in CPA installations is the laser media that is used to amplify the propagating chirped pulse. Amongst a variety of required important characteristics is its fluorescence bandwidth. The larger this is the shorter the duration output pulse it can support. For the shortest of pulses we are essentially limited to the choice of one material, Ti:Sapphire. Even for such a material, the limited bandwidth at high gain means output pulses are typically limited to 30 - 50 fs, some 10 times greater than the single cycle limit of the optical carrier field. However, a powerful new technique has recently been developed that offers the prospect of both approaching the single cycle limit and is suitable for high energy extraction. The technique, *Optical Parametric Chirped Pulse Amplification (OPCPA)*, is a variation of the CPA technique whereby chirped pulse amplification takes place inside a non-linear crystal through the optical parametric effect. The objective of this element of the proposal is to study issues and limitations of this technique in a way that is directly deployable to existing installation. This is an important point because the OPCPA technique has the potential to be applied either in part or in total to an existing installation. A key objective is therefore to have demonstrated its use on one of the existing European installations. (See Box 2)

Repetition rate increase

Almost without exception, the CPA laser installations that operate within Europe are pumped by flash lamp derived technology, which, whilst established, suffers from a number of serious drawbacks. These



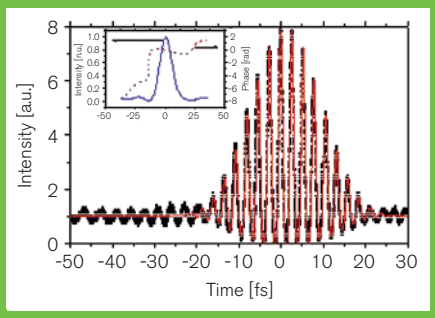
For example, researchers at the Friedrich Schiller University in Jena, Germany and the Laboratoire pour l'Utilisation des Lasers Intenses in Paris, France are working to develop phased array grating technology. The image illustrates two separate large aperture diffraction gratings that are precisely controlled to behave effectively as a single optical component. This hybrid component has been used to compress optical pulses in the POLARIS laser system in Jena. The key point is that this technology is scaleable to multiple gratings of larger size opening up a route to increasing the energy handling capacity of existing high power lasers.

1

drawbacks are overwhelming if the repetition rate of such facilities is to be increased . Flash lamp technology would simply be unable to deliver the requisite performance increase and this is the technology barrier that we face.

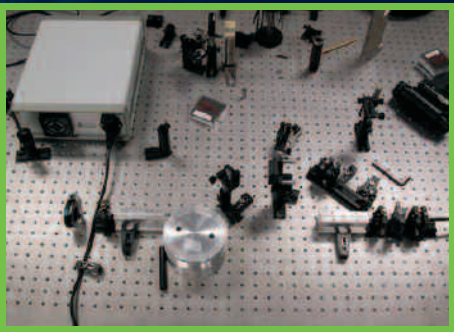
Thus, repetition rate issues are examined by an exploration of laser diode pumped technology, but with particular emphasis on ultra-short CPA based schemes. The use of laser diode pumping could bring substantial advantage due to their high electrical - optical efficiency. Diode pumping is a vastly more efficient means of providing laser excitation than conventional flash lamps. As such, it offers the possibility of significantly increased repetition rates due to the reduced thermal loading. Within the Laserlab-Europe there are a number of laboratories that are now developing this technology. (See Box 3)

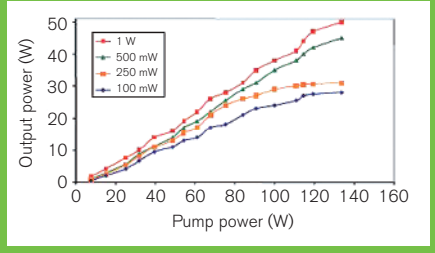
Overall, the programme is a challenging one that benefits from close collaboration of both the partner institutes and specialist industrial manufacturers, encompassed in a robust management framework. All of the partners in this JRA are already investing heavily in the development of tomorrow's technology and the JRA therefore attempts to bring an added value by the sharing of ideas, technology and concepts long before they appear in the scientific press. The benefits from a successful conclusion of this work will have a significant long term impact on Laserlab-Europe and the European high power laser infrastructure for ultra high intensity laser physics which in turn should help cement Europe's leading position in this field.



For example, researchers at the Czech Academy of Sciences in Prague, Czech Republic collaborating with researchers at the Rutherford Appleton Laboratory, UK are developing a prototype high power OPCPA system that is specifically designed to be pumped by an Iodine dissociation laser. This prototype called SOFIA (inset) will act as a technology demonstrator prior to implementation on the large scale PALS laser (main picture). The key point is that the output power of PALS could be increased by three orders of magnitude to 5 PW with this technology.

2



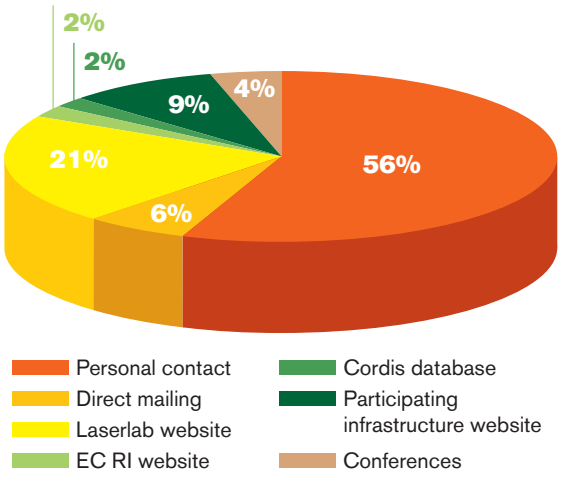


For example, researchers at Centre Lasers Intenses et Applications in Bordeaux, France have developed a novel high repetition rate high power laser. This laser combines conventional diode pumping techniques with large mode photonic crystal concepts to produce a "photonic rod" amplifier. This chirped pulse femto-second laser is capable of producing high power pulses at a repetition rate of up to 10 MHz and an average power of 50 W.

3

Laserlab partners are the best promoters of the access programme...

56% of the 2004 user groups found out about Laserlab activities through personal contact with one of the Laserlab Partners.



Thirty five user group leaders, who benefited from the Laserlab access programme during its first year of implementation (2004), completed the user questionnaire, set up by the Access Board, which included questions on the publicity of the access programme. The analysis of their answers shows that more than half of the user groups already knew the existence of the access programme thanks to their acquaintances among Laserlab partners.

However, websites and notably www.laserlab-europe.net are useful tools to promote the access opportunities offered by all the infrastructures since a third of the users learnt about Laserlab while surfing the net.

Access rules: Local ranking process to handle oversubscriptions

During the Participant's Council 2006, the Access Board (AB) presented the new rules for implementation of the access plan.

Given the success of this programme, host infrastructures that accept proposals could at any time face situations where beam-time scheduling of positively evaluated proposals will become impossible due to budget constraints.

While the initial scientific evaluation of proposals by the external Selection Panel under the Chairmanship of Professor Demtroeder will remain untouched, it then will become necessary to introduce local secondary ranking.

The Participants Council has released rules for this procedure. In general, scientific excellence will prevail also in the local ranking process but, while, in case of comparable proposals, priority will be given to new applicants.

For any given proposal, if local scheduling turns out to be impossible, the host infrastructure must inform the applicants and the access board (AB) within a given time, no later than 4 months, justifying the choice. The AB makes the final decision and supervises the subsequent procedures including possible re-direction to other host infrastructures within 3 months, which requires the consent of both the applicants and the new host infrastructure.

If re-direction is not feasible, the proposal will either be rejected or be put on a waiting list visible to all host infrastructures and reviewed regularly by the access board.

It is the main purpose of these implementation rules to provide the users with a reliable time frame for final decisions on beam time scheduling or, in case of insufficient budgets, for information about rejection for reasons of financial constraints.

Announcements

Forthcoming events 2006

Laserlab meetings

Laserlab N4 Workshop on EU Target Fabrication Capabilities CLF, Coseners House, Abingdon, UK
13 November 2006

Laserlab User Meeting CUSBO, Department of Physics (Politecnico) in Milan, Italy
23-24 November 2006

Laserlab Access Board Meeting CUSBO, Department of Physics (Politecnico) in Milan, Italy
25 November 2006

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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