LASERLAB-EUROPE

The Integrated Initiative of European Laser Research Infrastructures III

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Final report on Technical Workshops

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1 Introduction and objectives

Each member of the Laserlab-Europe Consortium possesses unique expertise in some domains of laser science and technology and infrastructure management. At the consortium level, the sum of this expertise is outstanding; at the individual level, the sharing of expertise benefits many members and increases the overall effectiveness of the Laserlab-Europe Consortium. The objective of this work package is to pool this distributed know-how and good practices concerning essential practical issues such as security, laboratory management and data acquisition procedures, as well as crucial scientific issues of relevance for many Laserlab-Europe participants. The outcome of this scientific and technological networking will be increasingly unified efforts from all members of the Consortium, pushing forward laser science and technology in the European Community at large.

2 Task 1: Technical workshops

Task leader: CNRS and the Laserlab-Europe Networking Board

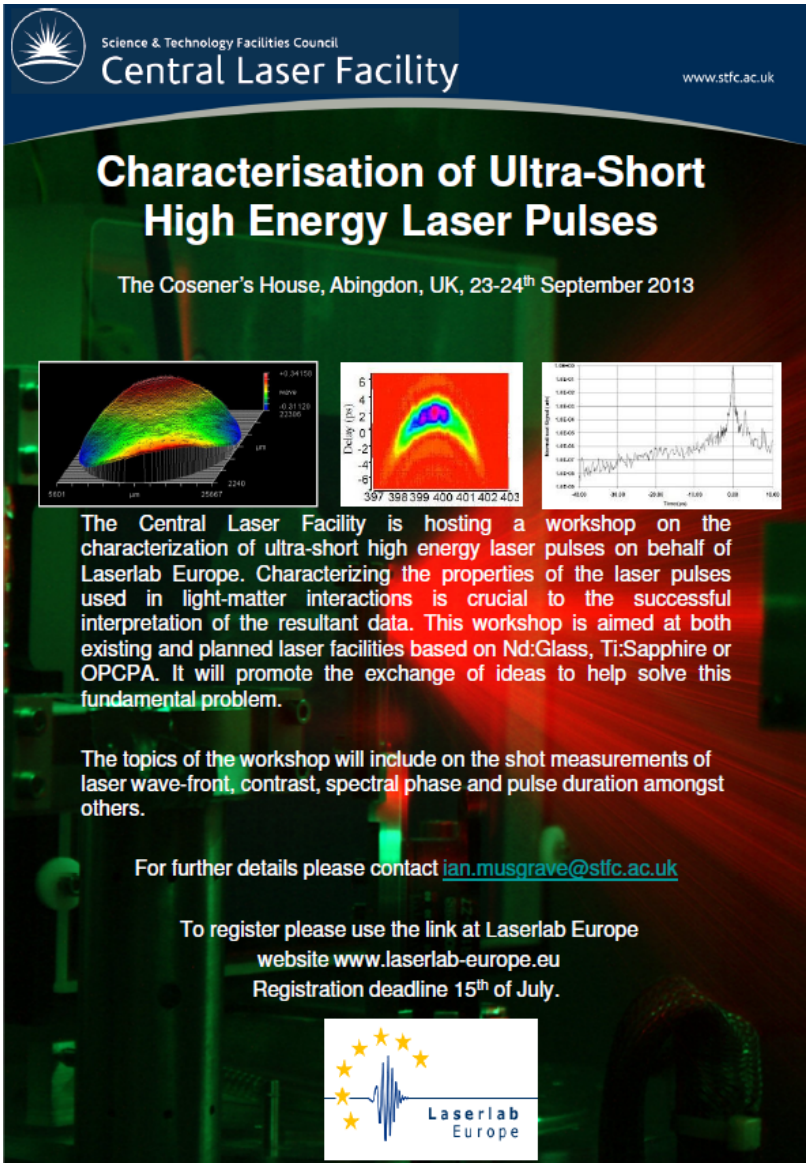
Pooling of know-how is a very effective method to stimulate the overall expertise of the consortium. Technical workshops within the Laserlab-Europe Consortium have proved extremely beneficial in the past. Several issues are of general concern to many members of the Consortium. Examples include data acquisition procedures and standards, eye safety, radiation protection, simulation tools and interactive diagnostic techniques. The actors involved in this task furthermore aim at establishing and strengthening links to industry since many items pertaining to the Laserlab infrastructures are custom-made. Involving industry at an early stage will increase the afore-mentioned effectiveness. At least two technical workshops will be organized.

During the lifetime of the project, the Laserlab Networking Board launched three internal calls for proposals for technical workshops, to be primarily organized by Laserlab-Europe. This bottom-up approach enabled the consortium to select topics of highest relevance for the Laserlab partners and to ensure broad participation. Evaluation of the proposals and selection of workshops was made by the Laserlab Networking Board.

First technical workshop: "Characterisation of ultra-short high energy laser pulses", 23-24 September 2013, Abingdon, UK (CLF, M16)

A two day workshop was held in Abingdon, UK, on the characterisation of Ultra-short high-energy laser pulses and was attended by over 30 participants from 11 institutions. The workshop enabled the delegates to discuss the challenges surrounding the characterisation of laser pulses used in laser matter interactions. This is fundamental to the understanding and interpretation of the resulting data. The workshop was attended by delegates from established facilities and those that are developing their own systems. The sentiment throughout the presentations and discussions was one that enabled common problems to be aired and potential solutions identified. The format of the workshop was arranged so that the overall topic was divided into sessions, with a series of talks that were then used as discussion points for the rest of the session.

The first session concentrated on measuring the pulse durations of high energy Nd:Glass lasers, where the biggest problem is to ensure that there is a reliable pulse length measurement on a shot-to-shot basis. The discussion revolved around the issues of B-integral and its impact on the pulse shape and pulse length tuning and on pointing stability into the measuring devices. The methods used to attenuate the incident energy on the shot to reduce the B-integral for the diagnostics arms fell into two camps with the relative merits of reflective and transmissive schemes being discussed. In addition the technique of using a sub-aperture sample beam to measure the pulse length was also explored.



The second session was targeted at Ti:Sapphire laser systems with the higher repetition rate than Nd:Glass lasers. It was felt that the average pulse length measurement was appropriate for diagnosing the laser. With the shorter pulse lengths operated on these systems the pulse-front tilt is an additional problem and the talks in the session lead to discussions on the use of inverting interferometers for pulse front tilt measurements and the availability and reliability of commercially available diagnostics. There was a later session dedicated to different techniques for measuring the pulse front tilt, and this enabled a thorough discussion as to the limitations and advantages to the different schemes being developed by the speakers.

The third session discussed the difficulty associated with measuring the contrast of laser pulses. The talks from the session showed that whilst there are reliable schemes for determining the nanosecond contrast 'on the shot', the contrast within picoseconds of the arrival of the pulse still requires the use of a scanning device for stable measurement. It was also discussed that with the difficulty measuring pulse duration on the high-energy systems then measuring the contrast would be an even greater challenge.

Measurement of the spatial beam quality measurements on the shot was also an area that brought together a consensus that it was a difficult measurement to make; the best approach seemed to be an equivalent plane measurement or one that recreated a spot from a wave-front measurement.

With the advent of multi-PW laser systems the diagnostics challenges associated with these schemes lead to an interesting discussion on the relative merits of using parabolas for beam expansion for very broad bandwidths and how to maintain their alignment. Techniques for measuring and characterising damage to the final gratings were also discussed.

The problems associated with higher repetition rate laser systems lead to a discussion about automated processing of diagnostics and the potential problem with large amounts of laser diagnostic data and whether an average or sampling approach should be taken. Other highlights from this discussion included the use of reflective optical systems for polarisation control and the potential benefits of a dark-field imaging system for damage detection.

The delegates were then able to participate in a tour of some of the laser facilities operated by the CLF.

All presentations are available for download on the Laserlab webpage at

http://www.laserlab-europe.eu/networking/scientific-and-technological-exchanges/workshop-characterisation-2013-clf

Second technical workshop: "5th Target Fabrication Workshop", 6-11 July 2014, St Andrews, UK (in collaboration with CLF, M26)

Target Fabrication Workshop 5
St Andrews Scotland
6 - 11 July 2014

The fifth target fabrication workshop took place at St Andrews University, Scotland, on 6-11 July 2014. 60 delegates took part, originating from UK, USA, Japan, Spain, Italy, Russia, France and Germany. The workshop addressed various subjects all relevant to the laser community and included: cryogenic targets, high repetition-rate targets, porous target materials, new techniques for the production of spherical targets, target manipulation and micro engineering, and spectroscopy of materials related to laser targets. Attendees included representatives from institutions and companies such as Rutherford Appleton Laboratory, St Andrews University, University of Michigan, Lawrence Livermore National Laboratory, LULI, CEA, University of Darmstadt, Lebedev Physical Institute (Moscow), the Institute of Laser Engineering (Osaka), Tokyo Institute of Technology, Hamamatsu Corporation and Scitech Ltd.

Among other subjects, several speakers addressed the topic of high repetition-rate targets needed for the future production of energy by means of Inertial Confinement Fusion (ICF). In this context, the low temperature laboratory of CEA in Grenoble developed a cryostat able to produce a continuous film of solid molecular hydrogen of some tens of microns in thickness and one millimetre in width. This type of target could be used to produce neutrons for ICF. Furthermore, representatives from Lebedev Physical Institute presented their ideas to use magnetic levitation as a means to manipulate cryogenic ICF targets, and another talk was about employing microfluidics to produce shells for the fuel pellets used in ICF.

Of particular significance was the format of the conference, which was conducted in presentation/workshop style, where delegates were encouraged to take part in questions and discussions after each presentation. Thus all the delegates had more chances to get involved not only in question-and-answer sessions, but also in real problem solving deliberations.

One other important aspect of this conference was that younger scientists were specifically encouraged to attend. As a result, more than 50% of the delegates were younger scientists and their contributions and the levels of complexity and quality of their research was outstanding. It is hoped that this will continue in the future and younger generations will contribute positively in this area of research, which is vitally important for the future of this field, or indeed any other field.

In a survey conducted after the conference the feedback for the workshop and also the venue and facilities was very positive, particularly from the younger scientists who felt that their work was valued and considered important and who benefitted enormously from this workshop. One conclusion of the conference was that it would be useful to have more interaction between the designers of laser experiments and the materials people involved in realising the targets that make these experiments possible. For that purpose, the experimentalists should attend this type of conferences, so they can learn about the trends in target fabrication affecting their experiments. Overall it was an extremely successful workshop.

This was the fifth target fabrication workshop and it was decided that if possible, this workshop should be organised again in two years' time with the same format encouraging younger scientists to attend.

A book of abstracts is available for download on the Laserlab webpage at

http://www.laserlab-europe.eu/events-1/laserlab-events/2014/target-fabrication-st-andrews-scotland

Third technical workshop: "Targetry for Laser-Driven Particle Sources and Attosecond Science", 20-22 April 2015, Paris, France

The international Laser Plasma Targetry workshop second edition (TARG2), co-organised by French Laserlab-Europe partner LOA, its spinoff company SourceLAB, Ludwig-Maximilians-Universität Munich and Université Pierre et Marie Curie (Paris), was held in Paris on 20-22 April 2015.

The workshop, which gave priority to PhD students and young scientists, attracted about seventy attendees keen on debating the pivotal topic of targetry and diagnostics for enhanced control of the interaction between intense lasers and plasmas.

The participants discussed which developments should take place in order to make laser plasma sources a tangible reality for scientific and societal applications. The main short-term goals that emerged from the discussions were: reliable and reproducible targetry systems, high repetition rate (10 Hz to 1 kHz) refreshment of targets, target positioning with high precision (micron level and below), high density jet and liquid targetry, efficient management of debris and minimization of contamination.

In addition, the participants agreed on the creation of an international cluster to bring together the academic and industrial players from the targetry fields. Its objectives would cover the following actions: increasing the international visibility of the field, gathering experts around central issues and identifying the main barriers to broad impact applications, organising seminars and future symposiums, proposing a portal to internship offers and learning for students, collectively preparing funding applications in response to calls for targeted projects (both European and non-EU).

Finally, it was decided that the next edition of the workshop, TARG3, will be held in 2016 in Salamanca (Spain), under the direction of the Cluster Board to be appointed and the local organizing committee.

Fourth technical workshop: "Application of Laser Plasma X-ray and EUV Sources in Technology and Science", 6-9 July, Warsaw, Poland

The 1st Workshop on Application of Laser Plasma X-ray and EUV Sources in Technology and Science (ALPS 2015) was organized from 6 to 9 July in Warsaw as a joint initiative of Laserlab-Europe and the EXTATIC programme. Development and application of laser-driven secondary sources, including sources of X-rays and extreme ultraviolet (EUV) is one of the main topics addressed in Laserlab-Europe. EXTATIC is an Erasmus Mundus Joint Doctorate programme of the European Union that offers high-level training in extreme ultraviolet (EUV) and X-ray science (www.extatic.eu).

The aim of the ALPS 2015 Workshop was to provide an international forum for the doctoral candidates and post-docs participating in Laserlab-Europe and EXTATIC involved in the research on application of laser plasma sources of X-rays and EUV in various fields of technology and science, including nanolithography, micro- and nanoprocessing of materials, modification of polymers for biocompatibility control, radiation damage of solids, imaging of nanostructures, microradiography and tomography, radiobiology, photoionization of small quantum systems, etc. The practical application of laser plasma sources of X-rays and EUV that are developed in Laserlab-Europe and demonstration of their capabilities and suitability for potential users were the main technical issues considered and discussed.

More than 40 participants from 11 countries took part in the workshop. During ten plenary sessions 18 introductory lectures were given by invited experienced scientists, while the same number of oral presentations was given by early-stage researchers and doctoral candidates, mainly from the EXTATIC programme, who reported results of their investigations using the laser plasma sources.

The ALPS 2015 Workshop was organized by the Laser-Matter Interaction research group at MUT-IOE, which participates both in Laserlab-Europe and the EXTATIC programme. It was the first scientific and technical meeting dedicated to applications of laser plasma X-ray and EUV sources in various fields and we believe that it started a regular series of workshop on this subject.