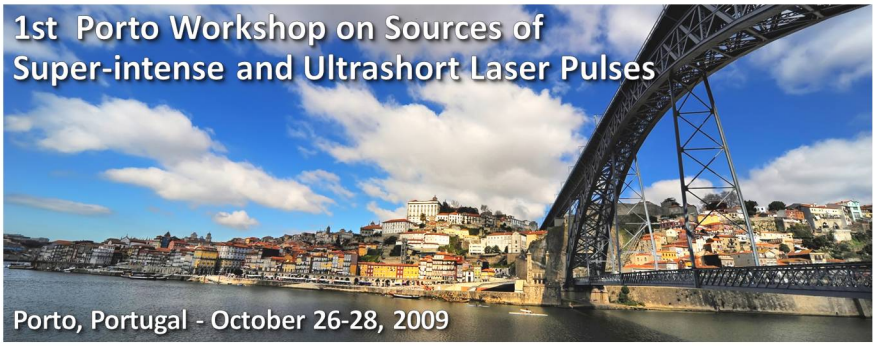

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First Porto Workshop on Sources of Super-intense and Ultrashort Laser Pulses

Scientific Report

Summary

The *1st Porto Workshop on Sources of Super-intense and Ultrashort Laser Pulses* was the first workshop organized within, and sponsored by, the ESF network programme "Super-intense Laser-matter Interactions" (SILMI). For three days, a group of 44 scientists and students shared their most recent work in super-intense and ultrashort laser pulse generation, diagnostics and applications. Besides providing an important meeting point for several SILMI programme members and collaborators in 2009, it also aimed at further promoting scientific collaborations with major European laser facilities and projects, while giving a comprehensive picture of the current state-of-the-art and latest developments in high-intensity/ultrashort pulse laser science and technology, including high-energy systems, pulse compression, and carrier-envelope phase stabilization. It should be pointed out that such advanced light sources and related methods are behind all experimental laser-matter interaction studies being considered within the SILMI programme, a fact that further added to the timeliness of the workshop.

The scientific programme comprised seven sessions for invited and regular oral presentations, distributed over the three days of the workshop and organized according to the main topics described in the next section, as well as a double poster session (for more details, please see the workshop programme below). An open forum dedicated to the current status, technological challenges and perspectives of two major European laser projects – ELI and HiPER – was also part of the workshop programme, and a visit to the femtosecond laser laboratory (Femtolab) at the Physics Department of the University of Porto was organized for all interested participants.

The workshop was mostly sponsored by the SILMI programme, through which it was possible to provide support to all invited and contributing participants as well as to attending students (travel expenses, hotel, coffee-breaks, and lunches). There was no workshop registration fee for academic participants, and the meeting was open to everyone. All logistics, from flight and hotel reservations to local management, was performed by the workshop's secretariat.

The workshop was hosted by IFIMUP/IN - Institute of Nanoscience and Nanotechnology, in the city of Porto, Portugal. The workshop venue was the auditorium and related support infrastructures within the modern Almeida Garrett Library building, located in the Crystal Palace Gardens (*Jardins do Palácio de Cristal*) overlooking the river Douro, and within walking distance to the city's historical centre. Lunches were served daily to all registered scientific participants in a modern buffet restaurant/cafeteria conveniently located within the gardens. The workshop also included a social programme that comprised a welcome reception and workshop dinner free of charge for all registered participants. Funding for these extra activities not supported by ESF was obtained through additional sponsors, which included the Municipality of Porto (who provided the venue), the Portuguese Foundation for Science and Technology (FCT), the Portuguese Physical Society (SPF) and the University of Porto.

A dedicated website was specifically created for the workshop, where relevant information was regularly posted and/or updated, from practical data to sponsor information (with proper links), as well as the workshop scientific program, schedule, etc. All presentations have been professionally recorded in digital video format, and can be made available to all participants through the website under restricted password access. The website will remain fully functional for a period not less than the duration of the SILMI programme, and can be found at:
http://faraday.fc.up.pt/superintense

Scientific content and discussion

The 44 participants (of which 17 were students) came from 13 different countries in Europe, as well as from Mexico (one participant) and the United States of America (one participant) – please see the *Assessment of the results and impact* section for a chart of the participants' geographical distribution. The programme comprised 35 contributions, namely 21 talks (12 invited), 11 poster presentations, and 3 open forum interventions. Of these, 22 have been later submitted in the form of short scientific papers (approx. 6 pages each) that will be published in a dedicated AIP proceedings volume before the end of 2010 (a reprint of the proceedings volume will be sent to ESF in due course).

Several major European laser facilities, many of them part of the Laserlab consortium, were represented and contributed with presentations to the workshop, including PALS (Czech Republic), LOA (France), RAL (UK), FLASH/DESY (Germany), MPQ (Germany), among others. Three international laser technology manufacturers were also represented at the workshop, namely Amplitude Technologies (France), Femtolasers GmbH (Austria) and Multiwave Photonics (Portugal), as well as two commercial distributors of laser equipment coming from Spain.

The workshop was primarily focused on the development, characterization and applications of new sources of super-intense and/or ultrashort laser pulses, with emphasis on two major directions in technology:

- Generation of infrared and optical pulses of higher repetition rates (beyond the kHz) with shorter durations (down to a few optical cycles) and/or higher peak intensities (above 10^{18} W/cm^2) capable of accessing extreme regimes in laser-matter interaction;
- Development of more efficient laser-pumped high-order harmonic sources, capable of generating attosecond pulse trains or even isolated pulses for sub-femtosecond control and pump-probe experiments.

Considering the two main directions presented above, the main topics of the workshop were:

- High intensity and ultrashort pulse lasers, including (but not limited to)
  - Chirped pulse amplification (CPA) Ti:sapphire and glass/hybrid laser systems
  - Free electron lasers (FELs)
- Pulse compression techniques, including
  - Hollow fiber / chirped mirror compressors
  - Filamentation and self-compression
- Optical parametric chirped pulse amplification (OPCPA) and related methods
- Ultrafast diagnostics, including
  - SPIDER, FROG
  - High dynamic-range methods
- Pulse cleaning and contrast enhancement techniques
- Carrier-envelope phase stabilization
- High-field applications, including:
  - Extreme ultraviolet and soft X-ray pulses from high harmonic generation and free electron lasers
  - High harmonic generation and attosecond pulses
  - XUV optics

Furthermore, the open forum on HiPER and ELI provided a means for the informal interchange of ideas and information on these major laser projects.

(Please see the workshop programme below for more detailed information on the actual talks and presentations.)

Assessment of the results and impact of the event

The study and development of novel super-intense and ultrashort light sources is an important part of the scientific objectives of the ESF SILMI programme. The workshop provided participants with up-to-date accounts on the present state-of-the-art in high-intensity and ultrashort laser technology, as well as on existing and upcoming opportunities in several laser laboratories throughout Europe (such as the Laserlab consortium). Strategically, it is important to gain access to this information already at an early stage of the SILMI programme, since it directly influences the development of subsequent activities within the programme.

This workshop was also a forum for communication of new ideas and methods in these fields, and the participation of students and post-docs was highly encouraged. It was also aimed at promoting further collaborations with major European laser facilities and laboratories. Several scientists and representatives from these laboratories were invited to participate and gave talks on the latest developments, present state-of-the-art, and existing opportunities regarding access to beam time and possible joint collaborations.

Workshop group photo (taken outside the Almeida Garrett Library, Porto, Portugal)

Final Workshop Schedule and Programme

(The detailed programme is given in the following pages.)

1st Porto Workshop on Sources of Super-intense and Ultrashort Laser Pulses
Almeida Garrett Library Auditorium, Porto, Portugal, Oct. 26-28, 2009
Final Programme

	Sunday, Oct. 25 Ipanema Hotel	Monday, Oct. 26 Auditorium	Tuesday, Oct. 27 Auditorium	Wednesday, Oct. 28 Auditorium	
9:15		**Welcome address** **Presentation of SILMI programme** H. Crespo, C. Joachain	**Session 4** ***CEP stabilization / High-power*** F. Kärtner (invited) S. Karsch (invited) M. Lisowski		9:15
9:30		**Session 1** ***High intensity and ultrashort pulses*** K. Jungwirth (invited) D. Giulietti (invited) F. Canova		**Session 6** ***High intensity and ultrashort pulses*** L. Gizzi (invited) C. Hernandéz-Garcia	10:00
10:45			***Coffee Break***		10:45
11:00		***Coffee Break***		***Coffee Break***	10:55
11:15			**Session 5** ***XUV and soft X-ray pulses*** S. Toleikis (invited) S. Sebban (invited) M. Fajardo (invited) J. T. Mendonça		11:15
11:30		**Session 2** ***HHG and attosecond pulses*** J. Biegert (invited) Aart Verhoef (Invited) J. Pérez-Hernandéz		**Session 7** ***OPCPA; XUV and soft X-ray*** C. Hernandéz-Gomez (invited) B. Ziaja **Closing remarks**	11:30
13:00	***Arrival (afternoon)***	***Lunch***	***Lunch***	***Lunch***	12:45
14:30		**Session 3** ***High intensity and ultrashort pulses*** R. Pattathil (invited) O. Kakabee T. Imran F. Giambruno	**Open forum** ***Laser technology issues in ELI and HiPER*** Chair: D. Batani	***End of Workshop***	14:30
16:00			**Poster session** **(includes Coffee Break)**		16:00
16:20		**Poster session** **(includes Coffee Break)**			
17:00			***Excursion to the historic riverside quarter and wine cellars***		17:00
18:00					
19:00	***Early registration at Hotel***				
19:30					
20:00	***Dinner at Hotel***	***Welcome reception at Solar do Vinho do Porto***	***Workshop banquet***		20:00

1st Porto Workshop on Sources of Super-intense and Ultrashort Laser Pulses

Daily events planner and workshop schedule

Each paper's number is indicated in the first column in the table below.

MONDAY 26th October

Morning sessions

	9:15 – 9:30	**H. Crespo** – *Welcome address* **C. Joachain** – *Presentation of the ESF SILMI Programme*
Session 1: High Intensity and Ultrashort Pulses I		**Chair: Dimitri Batani**
1	9:30 – 10:05 Invited	**K. Jungwirth**, Institute of Physics ASCR / PALS, Czech Republic. *PALS, HiLASE, ELI, HiPER - the milestones on the road toward super-intense and ultrashort laser pulses*
2	10:05 – 10:40 Invited	**D. Giulietti**, Physics Department and INFN, University of Pisa, Italy. *The INFN Strategic Program on Laser Plasma Acceleration*
3	10:40 – 11:00	**F. Canova**, Amplitude Technologies, France. *New developments in PW-class laser systems: ultra-high contrast front ends and ultra-stable power amplifiers*
11:00 – 11:30		**Coffee Break**
Session 2: HHG and Attosecond Pulses		**Chair: Franz Kärtner**
4	11:30 - 12:05 Invited	**J. Biegert**, ICFO-Institut de Ciencies Fotóniques, Barcelona, Spain. *Attoscience and Ultrafast Optics at ICFO*
5	12:05 - 12:40 Invited	**A. Verhoef**, Technische Universität Wien, Institut für Photonik, Wien, Austria. *Attosecond Ionization Dynamics in Solids and Gases*
6	12:40 - 13:00	**J. P.-Hernandéz**, Departamento de Física Aplicada, Universidad de Salamanca, Salamanca, Spain. *Modeling high-order harmonic generation beyond Strong Field Approximation (SFA+): Mid-infrared yield scaling*
13:00 - 14:30		**Lunch**

Afternoon session

Session 3: High Intensity and Ultrashort Pulses II		**Chair: Stephane Sebban**
7	14:30 – 15:05 Invited	**R. Pattathil**, Rutherford Appleton Laboratory, Central Laser Facility, Didcot, UK *The Astra-Gemini Laser Facility*
8	15:05 – 15:25	**O. Kakabee**, ICFO-Institut de Ciencies Fotóniques, Barcelona, Spain. *Multi-GHz-Repetition-Rate High-Power Wavelength-Tunable Femtosecond and Picosecond Sources in the Near-Infrared*
9	15:25 – 15:45	**T. Imran**, Grupo de Lasers e Plasmas – IPFN, IST, Lisbon, Portugal. *Broadband white-light continuum generation in sapphire and fused silica glass by focused 250 fs pulses at 1053 nm*
10	15:45 – 16:05	**F. Giambruno**, LOA, ENSTA, École Polytechnique, Palaiseau, France. *Gain narrowing and spectral shifting control in Apollon-10P, Multi-petawatt hybrid CPA laser system*
16:05 – 18:00		**Poster session and Coffee Break**
19:30 – 22:00		**Welcome reception at Solar do Vinho do Porto**

TUESDAY 27th October

Morning sessions

Session 4: CEP Stabilization / High-power		**Chair: Jens Biegert**
11	9:15 – 9:50 Invited	**F. Kärtner**, Department of Electrical Engineering and Computer Science and Research Laboratory of Electronics, MIT, USA. *Carrier-Envelope Phase Control Laser Sources*
12	9:50 – 10:25 Invited	**S. Karsch**, Max Planck Institute for Quantum Optics, Garching, Germany. *Status of ultrahigh intensity laser systems at MPQ*
13	10:25 – 10:45	**M. Lisowski**, Femtolasers GmbH, Vienna, Austria. *High-contrast CEP-stabilized ultrafast laser amplifiers*
10:45 – 11:15		**Coffee Break**
Session 5: XUV and soft-X-ray pulses		**Chair: Rajeev Pattathil**
14	11:15 - 11:45 Invited	**S. Toleikis**, Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany. *Photon Science at the Free-Electron Laser Facility FLASH at DESY*
15	11:45 - 12:15 Invited	**S. Sebban**, LOA, ENSTA, École Polytechnique, Palaiseau, France. *Progress on laser driven x-ray sources at the Laboratoire d'Optique Appliquée*
16	12:15 -12:45 Invited	**M. Fajardo**, Grupo de Lasers e Plasmas – IPFN, IST, Lisbon, Portugal.
17	12:45 - 13:00	**J. T. Mendonça**, IPFN, IST, Lisbon, Portugal. *Gamma Ray sources using imperfect mirrors*
13:00 - 14:30		**Lunch**

Afternoon session

	14:30 -16:05	**Open Forum: Laser Technology Issues in HiPER and ELI** Chair: Dimitri Batani
16:05 - 17:00		**Poster session (cont.) and Coffee Break**
17:00 - 20:00		**Excursion (bus leaves at 17:00)**
20:00 -		**Workshop Banquet**

WEDNESDAY 28th October

Morning sessions

Session 6: High Intensity and Ultrashort Pulses III		**Chair: Cristina H.-Gomez**
17	10:00 – 10:30 Invited	**L. Gizzi,** HiPER / INFN / CNR, Italy. *The HiPER way to Inertial Fusion Energy*
18	10:30 – 10:50	**C. Hernández-García**, Departamento de Física Aplicada, Universidad de Salamanca, Salamanca, Spain. *Spectral alignment of tiled-grating compressors for PW-class laser systems*
10:50 – 11:30		**Coffee Break**
Session 7: OPCPA; XUV and soft-X-ray pulses		**Chair: Stefan Karsch**
19	11:30 -12:00 Invited	**C. Hernández-Gómez**, Central Laser Facility, Science and Technology Facilities Council, Didcot, UK. *The Vulcan 10 PW Project*
20	12:00 -12:30 Invited	**R. Pattathil**, Rutherford Appleton Laboratory, Central Laser Facility, Didcot, UK *The Astra-Gemini Laser Facility*
21	12:30 -12:50	**B. Ziaja**, CFEL, DESY, Hamburg, Germany. *Dynamics within Atomic Clusters Irradiated with VUV and Soft X-ray Radiation*
12:50 - 13:10		**Closing Remarks**
13:00 - 14:30		**Lunch**
End of Workshop		

Poster list

P1	*"Numerical Studies of Advanced Schemes for Ion Acceleration by Laser"* **Jiri Limpouch[1], O. Klimo[1], J. Proska[1], J. Psikal[1,2], S. Kawata[3] and V. T. Tikhonchuk[2]** [1]Czech Technical University in Prague, FNSPE, Brehova 7, 115 19 Prague, Czechia [2]Centre Lasers Intenses et Applications, Université Bordeaux 1, Talence, France [3]Utsunomiya University, Utsunomiya 321-8585, Japan
P2	*"Generation of Intense Attosecond Pulses and High-order Harmonic Emission from Laser-Dense Plasma Interactions"* **R. Ondarza-Rovira[1], T.J.M. Boyd[2]** [1]Instituto Nacional de Investigaciones Nucleares, A.P. 18-1027, Mexico 11801, DF, Mexico [2]Centre for Theoretical Physics, University of Essex, Wivenhoe Park, Colchester CO4 3SQ, UK
P3	"Carrier-Envelope Phase Stabilization of a Multi-Millijoule Laser System" **T. Fordell[1], M. Miranda[1,2], A. Persson[1], A. L'Huillier[1]** [1]Department of Physics, Lund University, P.O. Box 118,SE- 221 00 Lund, Sweden [2]IFIMUP-IN Departamento de Física da Faculdade de Ciências da Universidade do Porto, Rua do Campo Alegre, 687, 4169-007 Porto
P4	*"Characterization of tilted ultrashort pulses using a second harmonic inverted field autocorrelator"* **R. Banici, R. Dabu, D. Ursescu** Solid State Lasers Laboratory, National Institute for Lasers, Plasma and Radiation Physics - INFLPR, Atomistilor 409, Magurele, Ilfov, Romania
P5	*"Application of high-order harmonics to nanostructuring of materials surfaces"* **Krzysztof Jakubczak** Institute of Physics, Academy of Sciences of the Czech Republic, Prague, Czech Republic
P6	*"Versatile Yb-Fiber-Amplifier-Based CEP-Stable Front-end for OPCPA"* **Alma Fernandez, Lingxiao Zhu, Aart Verhoef, Dmitrii Sidorov-Biryukov, Audrius Pugzlys, Andrius Baltuska, Chi-Hung Liu, Kai-Hsiu Liao, Almantas Galvanauskas and Steve Kane** Institut für Photonik, Technische Universität Wien, Gusshausstrasse 27-29/387, A-1040 Wien, Austria Center for Ultrafast Optical Science, University of Michigan, Ann Arbor, MI 48109-2099, USA HORIBA Jobin Yvon, Inc., 3880 Park Avenue, Edison, NJ 08820, USA

P7	*"Third order single shot cross-correlator, with enhancement of the contrast by spatial shaping of the second harmonic spatial profile"* **P. Oliveira[1], Moana Pittman[2], and F. Augé-Rochereau[1]** [1]Laboratoire d'Optique Appliquée (LOA), ENSTA Paristech, Ecole Polytechnique, CNRS, chemin de la hunière, 91761 Palaiseau Cedex, France [2]Laboratoire d'Interaction du rayonnement X avec la Matière (LIXAM), Université Paris Sud, bât 350, 91405 Orsay Cedex, France
P8	*"Highly nondegenerate cascaded four-wave mixing of femtosecond pulses: 2D simulation and experiment"* **João L. Silva[1], Rosa Weigand[2], Helder M. Crespo[1]** [1]IFIMUP and IN- Institute of Nanoscience and Nanotechnology Departamento de Física da Faculdade de Ciências da Universidade do Porto, Rua do Campo Alegre, 687, 4169-007 Porto, Portugal. [2]Departamento de Óptica, Facultad de Ciencias Físicas, Universidad Complutense de Madrid, Ciudad Universitaria s/n, 28040 Madrid, Spain.
P9	*"Sub-two-cycle pulses by soliton self-compression in highly-nonlinear photonic crystal fibers"* **A. A. Amorim,[1,2] M. V. Tognetti,[3] P. Oliveira,[1] J. L. Silva,[1] L. M. Bernardo,[1] F. X. Kärtner,[4] and H. M. Crespo[1]** [1] IFIMUP and IN – Institute of Nanoscience and Nanotechnology, Departamento de Física, Faculdade de Ciências, Universidade do Porto, R. do Campo Alegre 687, 4169-007 Porto, Portugal [2] Departamento de Física, Instituto Superior de Engenharia do Porto, R. de S. Tomé, 4200 Porto, Portugal [3] CNISM – Unità di Siena, Dipartimento di Fisica, Università degli Studi di Siena, Via Roma 56, 53100 Siena, Italia [4] Department of Electrical Engineering and Computer Science and Research Laboratory of Electronics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139-430, USA
P10	*"Efficient generation of ultrashort narrowband dispersive radiation with mm-long highly-nonlinear photonic crystal fibers"* **A. A. Amorim[1,2], H. M. Crespo[1], J. L. Silva[1] and L. M. Bernardo[1]** [1] IFIMUP and IN – Institute of Nanoscience and Nanotechnology, Departamento de Física, Faculdade de Ciências, Universidade do Porto, Rua do Campo Alegre 687, 4169-007 Porto, Portugal [2] Departamento de Física, Instituto Superior de Engenharia do Porto, Rua de S. Tomé, 4200-072 Porto, Portugal
P11	*"Cancer Detection by Terahertz Time-Domain Spectroscopy and Imaging"* **Faustino Wahaia[1], Gintaras Valusis[2], Juras Banys[3], Luis M. Bernardo[1], Agostinho Moreira[1], Albino Oliveira[4], Jan Macutkevic[2], Irmantas Kasalynas[2], Dalius Seliuta[2], Ramunas Adomavicius[2], R. Suzanovicinie[2]** [1]IFIMUP–IN - Institute of Nanoscience & Nanotechnology, FCUP, Oporto Portugal [2]Institute of Semiconductor Physics of Vilnius, Terahertz's Electronics Laboratory, Lithuania [3]University of Vilnius, Lithuania [4]Lab. Anatomia Patológica – Espinho/Hospital São Sebastião, Portugal
P12	*"Sub-two-cycle compression of mJ-level pulses using octave-spanning double-chirped mirrors"* **Francisco Silva[1], Miguel N. Miranda[1], Helder M. Crespo[1], Franz X. Kärtner[2]** [1]IFIMUP-IN and Departamento de Física, Faculdade de Ciências, Universidade do Porto, Portugal [2]Department of Electrical Engineering and RLE, Massachusetts Institute of Technology, Cambridge, USA