eli | beamlines

Newsletter

January 2016

No. 12

The ELI Beamlines centre is now open

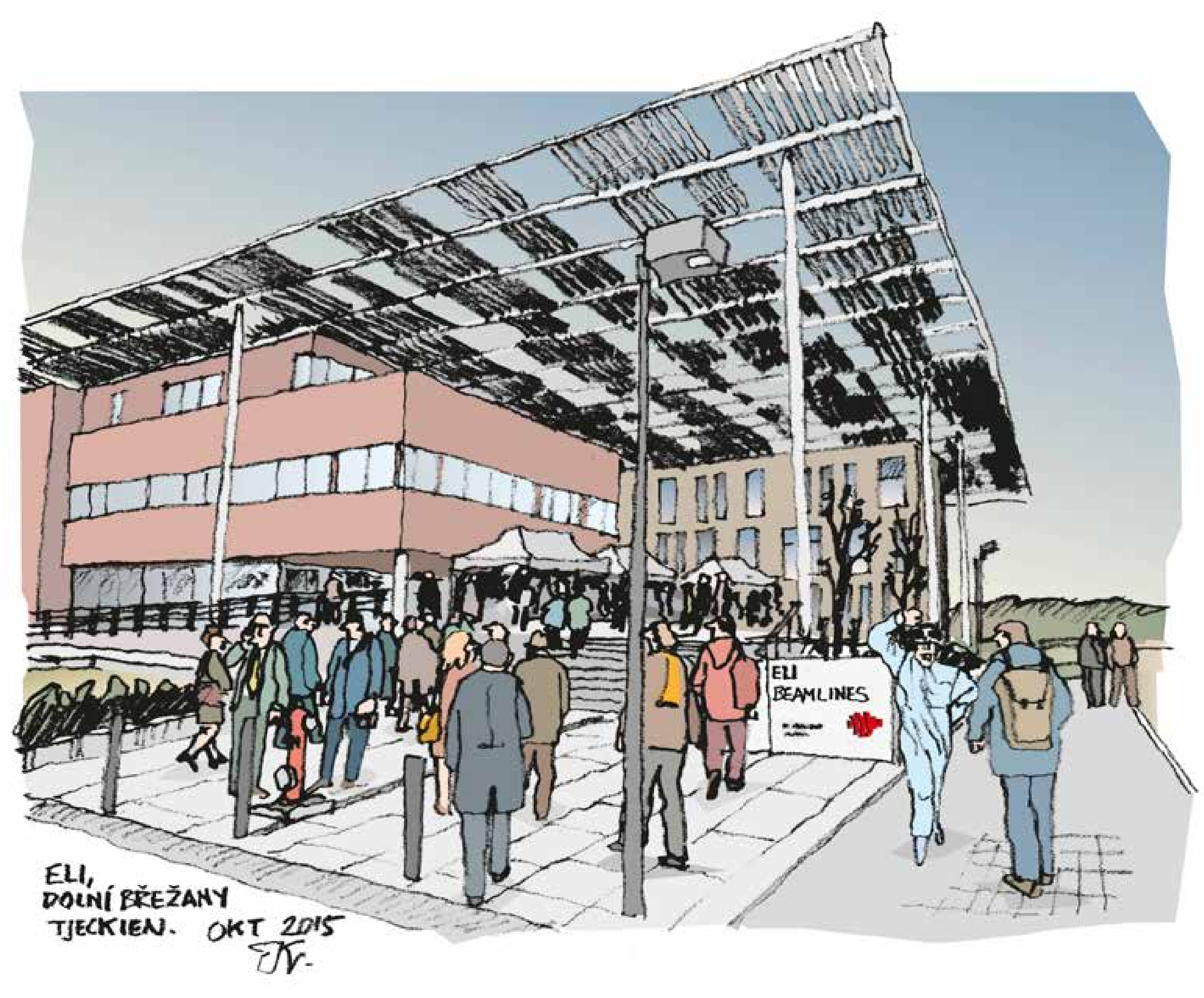
ELI Beamlines Science: Breaking the duration limit of plasma-based X-ray lasers
Interview: Michael Morrissey
Telegraphically: ELI Beamlines Scientific Challenges 2015

EDITORIAL

Dear readers of our ELI Beamlines Newsletter,
First of all I would like to greet you in the New Year 2016 and recapitulate the main milestones which were realized in the previous year. 2015 was very rewarding for the entire ELI Beamlines project. We are bringing you all these updates in the new issue of the ELI Beamlines Newsletter.
Starting with science - our scientists published their research results in the most prestigious scientific magazines. A team from French laboratory LOA led by Stéphane Sebban with the ELI Beamlines researchers Jaroslav Nejdl and Michaela Kozlová have published an article in journal Nature Photonics demonstrating, for the first time, that intense femtosecond pulse duration can be obtained (pg. 13).
The scientists Daniele Margarone and Andriy Velyhan (ELI Beamlines) together with scientists and engineers from Service des Basses Températures (INAC-CEA, Grenoble) have led the first worldwide experimental test of a cryogenic target delivering system made of a very thin solid hydrogen ribbon as a source of fast protons produces by high-power lasers (pg. 12).
It is also of great interest that Lawrence Livermore National Laboratory (LLNL, Livermore, USA) developed the highest-peak-power diode pumped solid state laser in the world, which in total can produce a peak power of 3.2 MW and is installed into the High-Repetition-Rate Advanced Petawatt Laser System (HAPLS). It is going to be integrated into the ELI Beamlines facility starting in 2017 (pg. 11).
In 2015 we organized two International Scientific Committee (ISAC) meetings. The second one was held already at the ELI Beamlines center in Dolní Břežany. We would like to introduce you to the new ISAC members (pg. 16) who set strategy for the development of scientific and user programs at ELI Beamlines.
We also organized summer school, conferences and workshop for scientists and students of relevant physical fields and you can read about them in the section Events.
Last but not least in October 2015 the ELI Beamlines laser facility was ceremonially opened in Dolní Břežany in the Czech Republic.
The first phase of the ELI Beamlines project was concluded and we received an official permit of use.
It was an unforgettable moment which was celebrated with many important people (scientists, engineers, policy makers and ELI Beamlines employees) who have contributed to this significant milestone together. In this place I would like to honor the memory of Professor Dr. Wolfgang Sandner (1949-2015) who celebrated the event with us. Unfortunately he unexpectedly passed away in December last year. Wolfgang Sandner was an excellent scientist who significantly contributed to this milestone and many thanks belong to him. I believe the ELI Extreme Light Infrastructure will become the "CERN of laser research" as he mentioned at the ELI Beamlines opening ceremony and for what he was intensively striving.

Prof. Jan Řídký, DrSc.
Director of Institute of Physics

Professor Dr. Wolfgang Sandner (1949–2015)



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The ELI Beamlines laser centre is now open

On October 19th, 2015 the ELI Beamlines laser facility was inaugurated in Dolní Břežany. The first implementation phase of the ELI Beamlines project was officially concluded in the presence of many major domestic and foreign guests from the world of science and politics.

The program of the ELI Beamlines grand opening ceremony was varied. The initial greetings were given by prominent Czech and foreign guests such as the President of Czech Academy of Sciences Jiří Drahoš, the President of the Senate of the Czech Republic Milan Štěch, Deputy of Ministry of Education, Youth and Sport Václav Velčovský, Governor of the Central Bohemian Region Miloš Petera, Archbishop of Prague Dominik cardinal Duka, Director General of the European Synchrotron Radiation Facility (ESRF) Francesco Sette, Director General of the ELI-DC International Association Wolfgang Sandner, Chairman of the European Strategy Forum on Research Infrastructure John Womersley, French physicist and founder of the ELI project Gérard Mourou, Deputy director for science and technology in the Lawrence Livermore National Laboratory in California Patricia Falcone and Director of the Institute of Physics Jan Řídký. After the guest speakers activities which introduced entire ELI Beamlines laser research center ensued.

The ELI Beamlines laser centre is now open

"The participation of distinguished guests representing the wide scientific community is for me a confirmation that ELI is a meaningful and sustainable project. It allows scientists to bring new knowledge and together with high-tech companies to find previously unknown technologies which are applicable in everyday life," – Jiří Drahoš, President of the Czech Academy of Sciences."

Guests had the opportunity to see laser and experimental technologies directly, in one of the laser halls. Here they were introduced to all of laser systems through the means of a virtual reality system.

"We are excited to be working with our colleagues on realizing new capabilities for lasers and looking forward to great scientific results from this wonderful facility", commented Dr. Patricia K. Falcone, LLNL Deputy Director for Science and Technology."

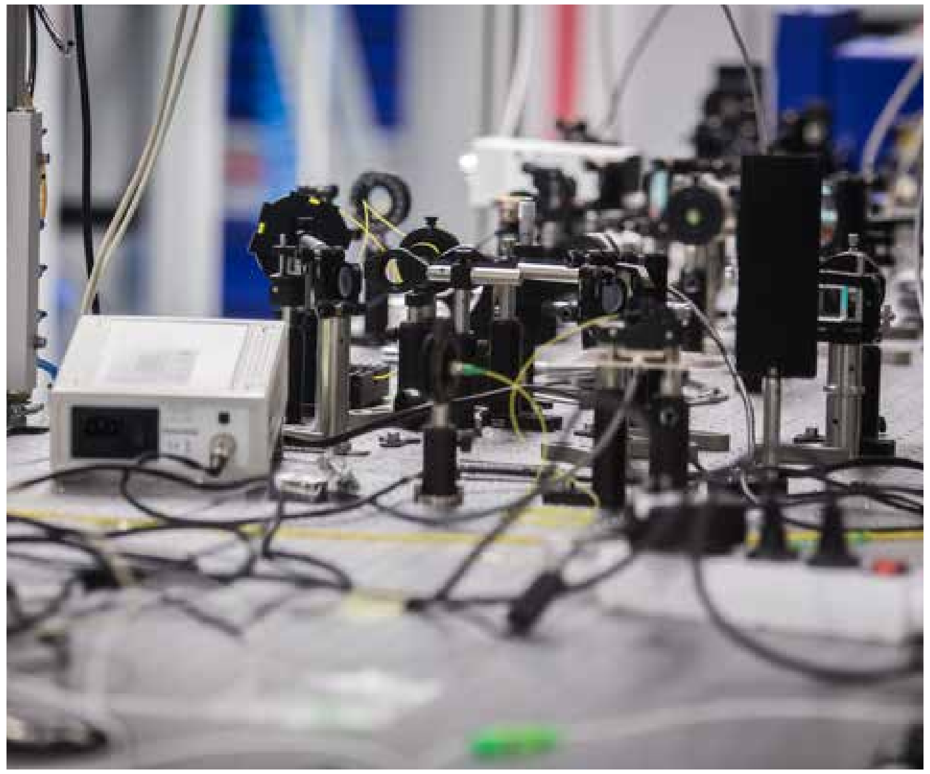
The visitors were able to see an exhibition of Bogle Architects in the red British double-decker bus which stood next to the laser center. Bogle Architects were awarded the Architectural Project of 2014 for the design of the building of the ELI Beamlines laser facility. All guests had an opportunity, as well as all inhabitants of the Czech Republic, to participate in the ongoing competition "name a superlaser" to invent names for the ELI Beamlines laser systems.

ELI Beamlines is a European laser center, which not only brings cutting-edge research and a technology base for future users, but also thanks to the project has established a long-term cooperation between the Czech, European and American companies and laboratories to develop the unique laser systems pushing the boundaries and parameters of existing research facilities.

"The development of the unique technologies at ELI Beamlines is only possible in cooperation with the best domestic and international laboratories and companies. We succeeded and I believe that we have created a solid base for longterm partnership" – Jan Řídký, director of the Institute of Physics.

The international scope of the center is focused on joint cooperation with European research infrastructures and is evident through the recent conclusion of a Memorandum of Cooperation with synchrotron Elettra in Trieste (Italy) and by the starting of the project ELITRANS, which is financed by European Commission for € 3.5 mil. This project will help to transform the three ELI pillars in the Czech Republic, Romania and Hungary into one unified pan-European research infrastructure.

ELI will have four laser systems which work in mutual synergy. This link of lasers is unique and thanks to it the ELI Beamlines scientists will be able to conduct experiments for which we have not yet had a suitable environment. No one laboratory in the world can offer four very high power laser systems with short (femtosecond) pulses in a single facility. L4 will also be the most powerful laser in the world.



Construction of the center is completed. Currently the final arrangements are underway and the laser hall is being prepared for installation of new technologies which will start at the beginning of the year 2016. The entire complex will be available for user research from January 2018.

Several world records have already been broken during the development of laser systems, for example: *"The laser system 3, which we are building together with the US Lawrence Livermore National Laboratory, uses the brightest laser diodes that have been ever made in the world."* Bedřich Rus, chief scientist of ELI laser technology.

Major technological development activities are the P3 chamber, which is the largest experimental chamber for civil and academic research of laser plasma in the world, as well as the delivery of the HHG device, which generates ultrashort coherent pulses of XUV radiation for material research and applications in biomolecular sciences (eg. imaging of biological samples with high temporal and spatial resolution).

Besides the technological development our research team has already published more than 200 scientific publications including articles in prestigious international journals (e.g. Physical Review Letters and Nature Photonics).

"Our publications result from the scientific and technology development being carried out in the preparation for the facility implementation in order to establish a solid basis for user research programmes," said Georg Korn, leader of the ELI Beamlines experimental team.

Currently, the ELI Beamlines has more than 280 employees, nearly 70% of these are scientific and technical staff (35% of foreigners – mainly from France, Italy, Germany, Poland, Spain, United Kingdom, also from outside of European countries – India Canada, USA, Mexico, Russia, China, Cuba).

As you can see, ELI Beamlines is a truly outstanding achievement. It is a challenge not only for the Institute of Physics of the Czech Academy of Sciences, which has been supporting the project from the beginning, but also for all other universities, research institutes, companies and public institutions across entire Europe. ■ ■

The ribbon-cutting ceremony.

Director of the Institute of Physics Jan Řídký is entering the ELI Beamlines facility.

Patricia K. Falcone, LLNL Deputy director for Science and Technology.

Ivan Wilhelm (ELI Beamlines) and the President of the Senate of the Czech Republic Milan Štěch.

Václav Velčovský, Deputy of Ministry of Education, Youth and Sport.

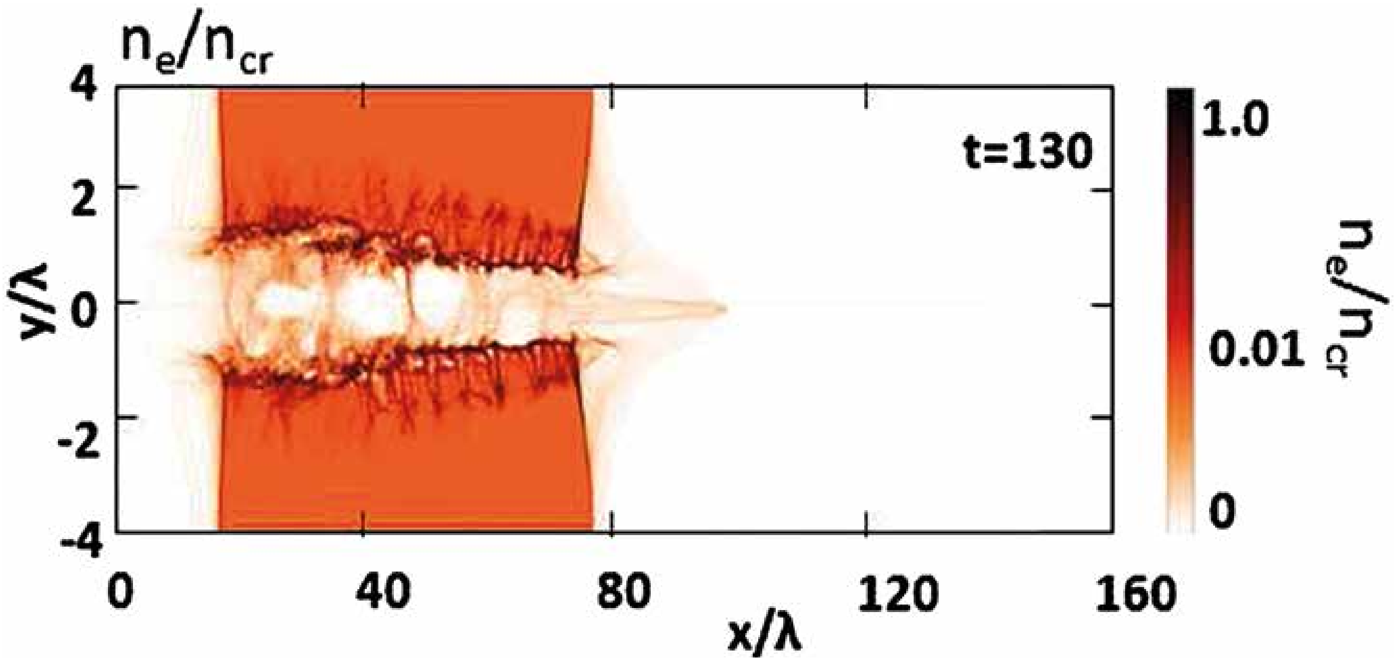
Archbishop of Prague Dominik cardinal Duka.

French physicist and founder of the ELI project Gérard Mourou.

The first press conference at the ELI Beamlines centre.

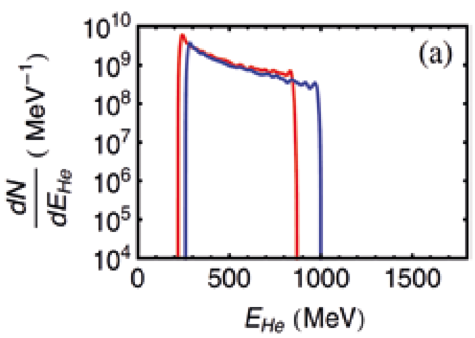
An exhibition of Bogle Architects in the red British double-decker.
Photo by Václav Hodina

Helium-3 and helium-4 acceleration by high power laser pulses for hadron therapy



He4 ion density distribution in the course of a 1 PW laser pulse interaction with a He near critical density target.

On 24th June a scientific paper on Helium-3 and helium-4 acceleration by high power laser pulses for hadron therapy was published in Physical Review as a result of the cooperation between LBNL – Lawrence Berkeley National Laboratory (University of California, Berkeley, USA), ELI Beamlines (Institute of Physics, CAS) and University of Heidelberg (HITHeidelberg Ion Therapy Center).



The paper emphasizes the acceleration of helium ions involving the interaction of a petawatt-class laser with He targets, showing He ions require less laser power to be accelerated to the required energy for hadron therapy. He ions have higher radiobiological efficiency in comparison to protons. Thus, these findings are important for future consideration of laser accelerated He ions used in therapy.

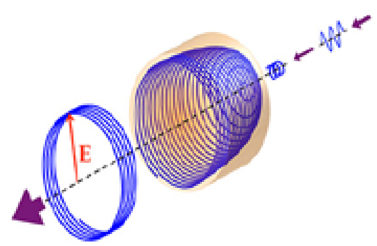
On behalf of the ELI Beamlines project, Georg Korn, Chief Scientist and Head of Department of Experimental Programs, and Daniele Margarone, leader of the ELI Beamlines Research Program 3 – Particle Acceleration by Lasers, contributed to this important article.

The laser driven acceleration of ions is considered a promising candidate for an ion source for hadron therapy of oncological diseases. Though proton and carbon ion sources are conventionally used for therapy, other light ions can also be utilized. Whereas carbon ions require 400 MeV per nucleon to reach the same penetration depth as 250 MeV protons, helium ions require only 250 MeV per nucleon, which is the lowest energy per nucleon among the light ions (heavier than protons). This fact along with the larger biological damage to cancer cells achieved by helium ions, than that by protons, makes this species an interesting candidate for the laser driven ion source. Two mechanisms (magnetic vortex acceleration and hole-boring radiation pressure acceleration) of PW-class laser driven ion acceleration from liquid and gaseous helium targets are studied with the goal of producing 250 MeV per nucleon helium ion beams that meet the hadron therapy requirements. We show that He 3 ions, having almost the same penetration depth as He 4 with the same energy per nucleon, require less laser power to be accelerated to the required energy for the hadron therapy. ■

ELI Beamlines scientists published an article in Physical Review Letters

The results of a joint international efforts of LOA* and ELI Beamlines in the field of seeded soft X-ray lasers led by Stéphane Sebban was recently published in a scientific paper entitled Demonstration of a Circularly Polarized Plasma-Based Soft-X-Ray Laser as the editor's suggestion in highly impacted Physical Review Letters.

The team has reported the first experimental demonstration of a laser-driven circularly polarized soft-x-ray laser chain. They have used a circularly polarized beam of high-order harmonics to seed a krypton plasma amplifier in order to generate fully coherent light pulses at wavelength of 32.8 nm.



A. Depresseux et al., Phys. Rev. Lett. (2015)

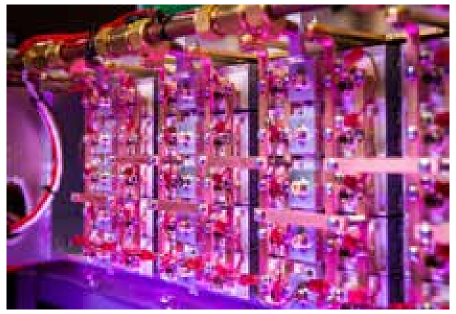
The researchers have demonstrated that this approach amplifies the number of photons in the seed beam by nearly a factor of 10,000, delivering more than 10 billion photons in picosecond pulses while keeping the radiation coherent and circularly polarized. This source is thus suitable for photon-hungry applications such as imaging proteins and viruses. Sebban and his colleagues suggest that their compact architecture can be scaled to shorter wavelengths and shorter pulse durations.

"During our ongoing research in the field of laser driven short-wavelength sources of radiation we have proven that plasma amplifiers preserve polarization state of the seed. Our compact source of coherent circularly polarized XUV pulses can be for example employed for investigation of fast dynamics of magnetically induced dichroism in thin films used in the electronics industry," said Jaroslav Nejdl a scientist from the ELI Beamlines team.

The publication was also selected as one of the research highlights in recent issue of Nature Photonics. ■

* *Laboratoire d'Optique Appliquée (ENSTA-Paris Tech, CNRS, École Polytechnique), Palaiseau, France.*

ELI Beamlines and the highest peak power laser diodes in the world



To drive the diode arrays, LLNL needed to develop a completely new type of pulsed-power system, which supplies the arrays with electrical power by drawing energy from the grid and converting it to extremely high-current, precisely-shaped electrical pulses.

Photo by Damien Jemison.

Lawrence Livermore National Laboratory (LLNL; Livermore, CA) has the highest-peak-power laserdiode arrays in the world, which in total produce a peak power of 3.2 MW. The diode arrays, which were developed and fabricated by Lasertel (Tucson, AZ), will act as the primary pump source for the High-Repetition-Rate Advanced Petawatt Laser System (HAPLS), currently under construction at LLNL.

HAPLS is designed to be capable of generating peak powers greater than one petawatt (1 quadrillion watts, or 10^15) at a repetition rate of 10 Hertz, with each pulse lasting 30 femtoseconds (30 quadrillionths of a second). This very high repetition rate will be a major advancement over current petawatt system technologies, which rely on flashlamps as the primary pump source and can fire a maximum of once per second. In HAPLS, the diode arrays fire 10 times per second, delivering kilojoule laser pulses to the final power amplifier.

The HAPLS is being built and commissioned at LLNL and then installed and integrated into the ELI Beamlines facility starting in 2017.

The high repetition rate is possible because, unlike existing petawatt lasers, which are flashlamp-pumped, HAPLS is pumped by diode arrays capable of delivering kilojoule pulses at high repetition rates to the final power amplifier.

Each laser-diode array supplied by Lasertel supplied contains multiple 888 nm laser-diode bars mounted on water-cooled stacks (see figure). The array operates at a brightness of 10 kW/cm², which Lasertel notes is a world record, at a repetition frequency of 10 Hz. Each array operates at a total peak power of 800 kW, with four such arrays combined and used as the primary pump sources for the HAPLS laser. More than 500,000 combined laser diode emitters combine to produce the total diode optical input power of 3.2 MW.

More information can be found here: http://cms.psu.edu. ■

ELISE: hydrogen "ice" for future laser-based proton therapy

A close look at the solid hydrogen ribbon flow from the ELISE nozzle.

The intense scientific and technological collaboration between a group of scientists and engineers coming from ELI Beamlines (IoP-ASCR, Prague) and Service des Basses Températures (INAC-CEA, Grenoble) has led to the first worldwide experimental test of a cryogenic targetry delivering system made of a very thin solid hydrogen ribbon as a source of fast protons produced by high-power lasers.
The kilojoule PALS laser facility in Prague, a joint laboratory of the Institute of Plasma Physics and the Institute of Physics of the Academy of Sciences of the Czech Republic and also part of the Laserlab Europe consortium, was chosen as test facility for this first experiment. The technologies available at PALS, together with the know-how of its highly specialized technical staff, who strongly contributed in the preparation of the experimental setup, led to the success of this preliminary campaign and further laser beam time is planned in November.
This and further planned experimental tests of this innovative cryogenic device named ELISE will be crucial to assess advantages and disadvantages of its future implementation at ELI Beamlines in the ELIMAIA beamline which will provide proton/ion beams to users coming from different multidisciplinary fields, with a special emphasis on medical applications and in particular on innovative approaches to cancer therapy. Thus, these results are expected to contribute to the world leading capabilities of the ELI Beamlines facility.
The original idea was to produce a syringe with a virtual piston and with a nozzle aperture suitable for the given H ribbon thickness. *"The virtual piston is obtained by heating at -233 °C the top of the syringe, which makes the pressure rise in the syringe, whilst maintaining the extrusion nozzle, at the bottom of the syringe, at -261 °C (2 °C below the hydrogen triple point),"* explains Dr Jean-Paul Perin from SBT. *"Understanding the specific behavior of the flow of solid hydrogen required numerous experiments and numerical modeling,"* adds Dr Denis Chatain also from SBT. A cryostat was constructed for this purpose. The functional tests conducted at SBT (CEA) have been achieved with three nozzles (100, 62 and 32 micrometer thick) and the size of the syringe used allowed extrusion of a hydrogen ribbon for several hours.
Three years on from the first conceptual design ELISE has been successfully tested. Dr Daniele Margarone from ELI Beamlines explains: *"This is the result of a complex development which required the use of sophisticated cryogenic techniques in harsh laser-plasma environment. There is still a way to go; however the possibility to produce a continuous flow of "pure" solid hydrogen clearly paves the way towards the use of laser driven protons for applications in hadrontherapy."*
"This is the first time ELISE has been tested with a high power laser and several technical challenges were uncovered during the experiment at PALS," says Dr Andriy Velyhan from ELI Beamlines. We have produced an extremely high temperature gradient through the generation of a very hot (hundreds millions degrees) plasma and a hydrogen ice ribbon (-233 °C). Beside the potential for proton acceleration and future applications in hadrontherapy, this result is also very interesting to the field of laser plasma physics and will certainly enable the scientific community to investigate new phenomena. ■

D. Margarone and J. P. Perin during ELISE functional test at SBT-CEA in Grenoble.

A. Velyhan and D. Chatain during the ELISE installation at PALS in Prague.

Breaking the duration limit of plasma-based X-ray lasers

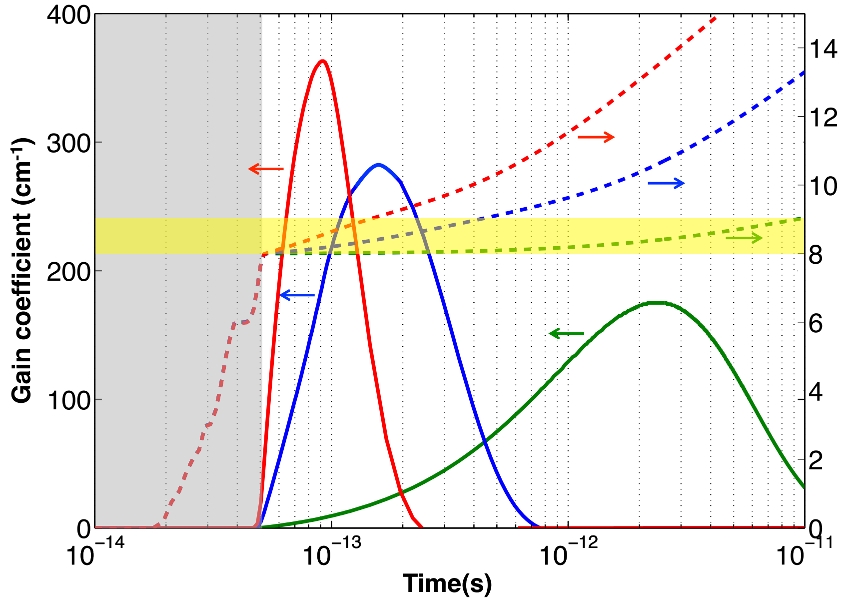


Fig. 1: Computed temporal dependence of the average charge state and gain coefficient of a krypton-plasma amplifier for ne = 6 × 1018 cm−3 (green), ne = 1.2 × 1020 cm−3 (blue) and ne = 4 × 1020 cm−3 (red).
Photo: A. Depresseux

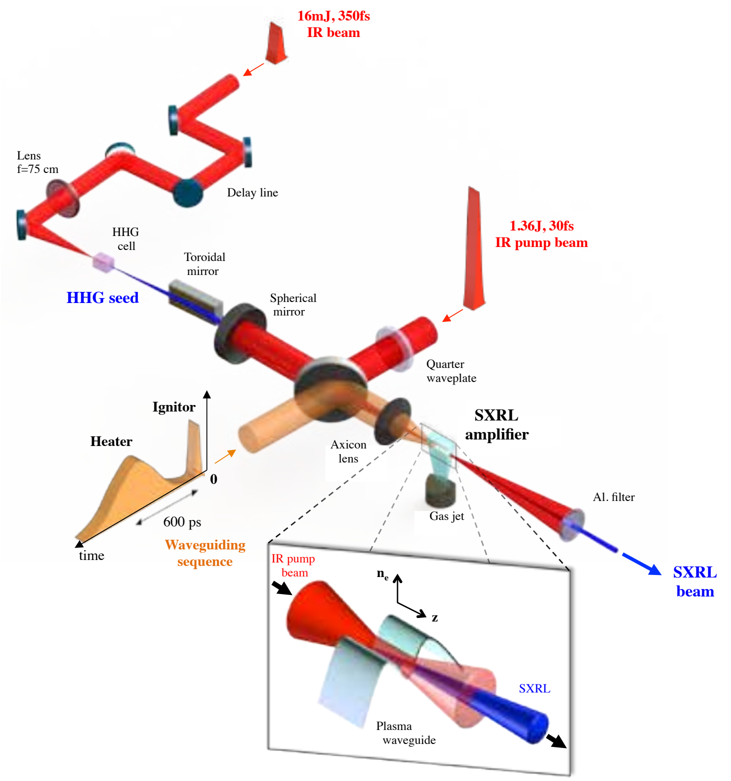
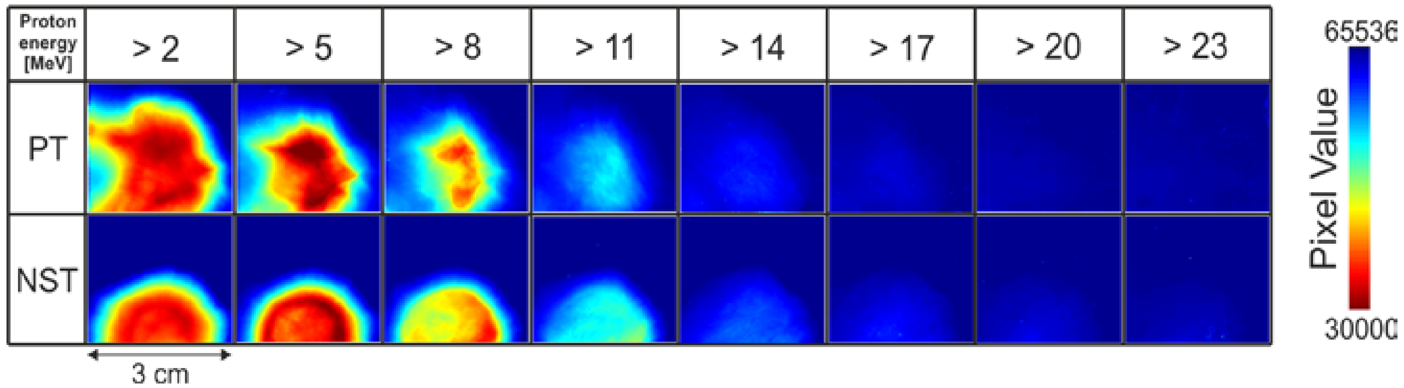


Fig. 2: Schematic of the experimental arrangement.
Photo: A. Depresseux

The advent of X-ray free-electron lasers has granted researchers an unprecedented access to the ultrafast dynamics of matter on the nanometer scale. Aside from being compact, seeded plasma-based soft X-ray lasers (SXRLs) turn out to be enticing as photon-rich sources (up to 1015 photons per pulse) with high quality optical properties. For over a decade, however, the duration of pulses generated from laser-plasma interaction was limited to a few picoseconds, reducing access to many pioneering and innovative applications in the ultrafast region. A team from LOA (Laboratoire d'Optique Apliquée (ENSTA-Paris Tech, CNRS, École Polytechnique), Palaiseau, France) led by Stéphane Sebban together with RP2 ELI Beamlines researchers has published an article in the journal Nature Photonics demonstrating, for the first time, that intense femtosecond pulse duration can be obtained. This goal was achieved by gating the gain through ultrafast collisional ionization in high-density plasma generated by an ultra-intense infrared pulse (a few 1018 W cm−2) guided in an optically pre-formed plasma waveguide. For electron densities that ranged from 3×10^{18} cm^{-3} to 1.2×10^{20} cm^{-3}, the gain duration was measured to drop from 7 ps to an unprecedented value of about 450 fs, which paves the way for compact and ultrafast SXRL beams with performances previously only accessible in large-scale facilities.
Another achievement towards shortening the pulse duration was the successful bandwidth measurement of "quasi-steady state" x-ray lasers. These devices compared to other X-ray lasers generate high energy pulses with relatively long durations (~100ps). The results from recent PALS experiment published in journal Physical Review A show that using their gain medium as an amplifier for sub-picosecond soft X-ray pulses is possible.

Laboratory-size applications previously limited to large infrastructures such as synchrotrons or free electron lasers are becoming feasible with compact sources. ■

Laser-driven high-energy proton beam with homogeneous spatial profile from a nanosphere target



A high-energy, high-yield proton beam with a good homogeneous profile has been generated from a nanosphere target irradiated by a short, intense laser pulse. A maximum proton energy of 30 MeV has been observed with a high proton number as well as a homogeneous spatial profile. The homogeneous spatial properties obtained with the nanosphere dielectric target will be advantageous in developing laser-driven proton sources for practical applications in which high-quality beams are required.

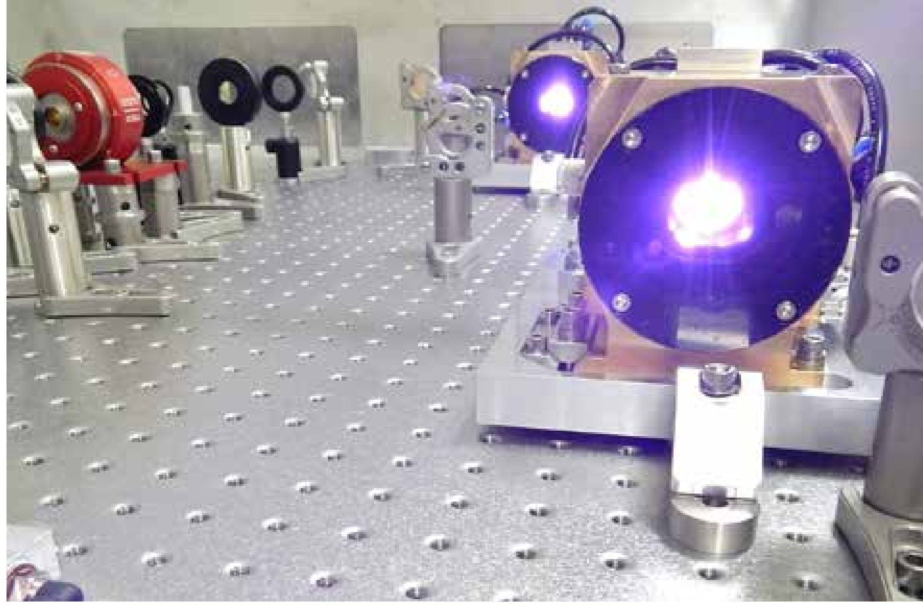
This scientific paper was published in Physical Review (Phys. Rev. ST Accel. Beams 18, 071304 – Published 10 July 2015). It is a result of the cooperation among scientists from Czech research facilities and universities D. Margarone, I. J. Kim, J. Psikal, J. Kaufman, T. Mocek, I. W. Choi, L. Stolcova, J. Proska, A. Choukourov, I. Melnichuk, O. Klimo, J. Limpouch, J. H. Sung, S. K. Lee, G. Korn, and T. M. Jeong.
Picture 1: Proton beam profile for a planar target (PT) and a nanoshpere target (NST) obtained from radiochromic film diagnostics. ■

L1 milestone completion

> 5 mJ, 1 kHz, compressible to <20 fs

The 4th and final stage of the L1 front end OPCPA chain has been demonstrated at the ELI test laboratory. Over 8 mJ at 1 kHz was generated. At over 5 mJ, a portion of the pulse was split off and compressed to < 20 fs with a chirped mirror test compressor.

4th stage OPCPA: The MLD grating compressor and SHG crystal are in the enclosure on the left side of the table and the OPCPA stage on the right side.

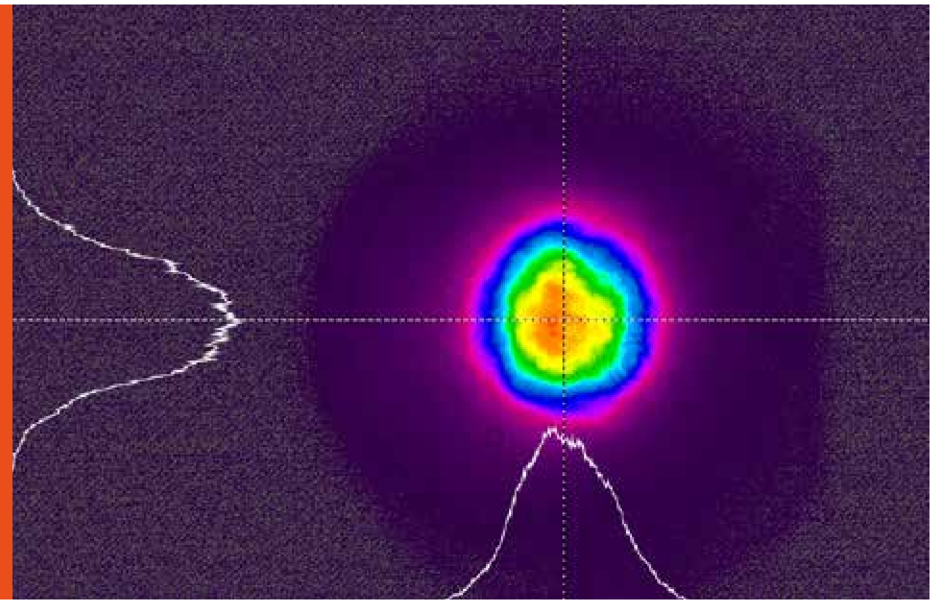


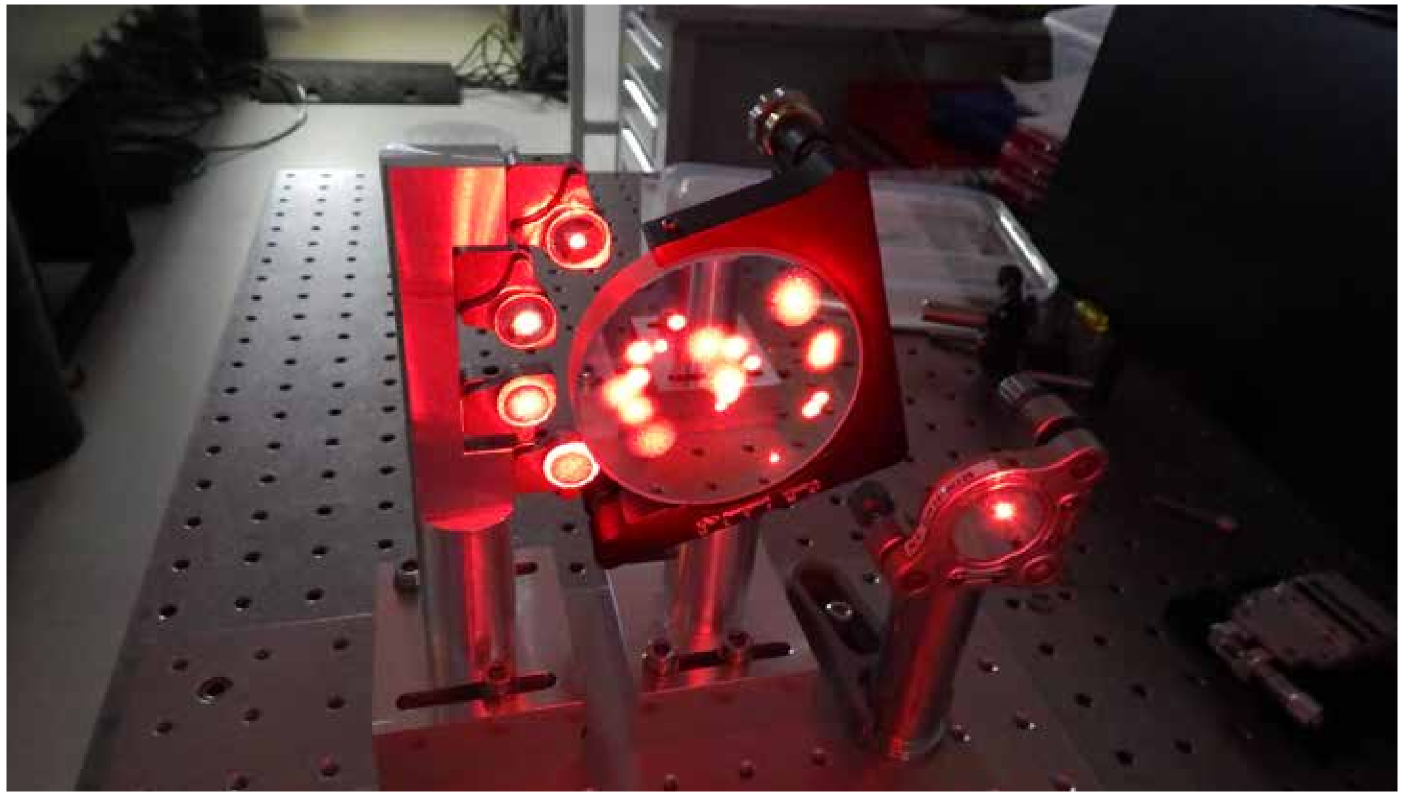
The pump laser is a 100 mJ, 1 kHz thin disk laser developed in house using laser heads from Trumpf Scientific Lasers. This is one of the highest energy, kHz repetition rate, picosecond lasers ever reported.

Two thin disk laser heads being pumped in the 100 mJ regenerative amplifier.

The excellent spatial profile of the pump laser (M2<1.2) and careful management of the nonlinear amplification at each OPCPA stage result in an excellent spatial profile of the amplified broadband beam.

Profile at 5 mJ while a portion of the pulse is compressed to 20 fs.





ELI Beamlines Open Days

The students of Faculty of Nuclear Sciences and Physical Engineering were the first visitors of the ELI Beamlines laser halls.

The ELI Beamlines facility has already opened its door for interested people four times in 2015. The historical first ELI Beamlines open day was organized on the 7th August last year. On the ELI Beamlines open days the visitors have an opportunity to learn more about four laser systems which the scientists will use for conducting the experiments at ELI Beamlines. The laser and experimental technologies are introduced them through the means of a virtual reality system. The guests are also able to see the newly opened spaces of the ELI Beamlines laser center which was designed by British architecture and design studio Bogle Architects who were awarded the Architectural Project of 2014 for the design of the building of the ELI Beamlines laser facility. The door of the ELI Beamlines laser center was also opened for visitors during the Week of Science and Technology which is the most extensive science festival in the Czech Republic. More information about the ELI Beamlines open days can be found here: http://www.eli-beams.eu/cs/blog/eli-events/dny-otevrenych-dveri-laserove-unikaty-v-cr. ■

ISAC 2015

The International Scientific Advisory Committee (ISAC) for the ELI Beamlines project convened on December 2-3, 2015 at the ELI Beamlines facility in Dolní Břežany to evaluate the progress towards building a facility that will enable new science using lasers, particle beams, and secondary radiation. ISAC brought an open and friendly discussion in following areas: Project and Facility Management; Technical Systems; Scientific directions, first user and flagship experiments; ELI experiments operation plan and Future organization of advisory committees. ELI team was represented by the management and all research program leaders. We greatly appreciate that we could welcome four new ISAC members: Thomas Cowan (Institute of Radiation Physics, Helmholtz-Zentrum Dresden-Rossendorf), Claes-Göran Wahlström (Lund Laser Centre, Sweden), Thomas Tschentscher (European XFEL, Germany) and Milena Králíčková (Charles University in Prague, Czech Republic). All ISAC members can be found here: http://www.eli-beams.eu/cs/o-projektu/isac-members. ■

ISAC members (from the left: Roger Falcone, Sergei Vladimirovich Bulanov, Wim Leemans, Matthew Zepf and Thomas Cowan).

Warm Dense Matter User Workshop

WDM workshop participants on a tour of the ELI Beamlines facility construction site.

A Warm Dense Matter user workshop was organized at ELI Beamlines last May by Kateřina Falk, a member of the Research Program 5 (Plasma and High Energy Density Physics) which is led by Dr. Stefan Weber. The primary objective in organizing this workshop was to obtain initial feedback from world class scientists in the research field of warm dense matter (WDM) and to provide a direction for the development of the infrastructure and instrumentation necessary for the successful implementation of experiments specializing in the study of dense plasmas. Therefore the natural theme of this meeting were talks and discussions focusing on diagnostic capabilities, different schemes for creation of WDM and most importantly the flagship experiments related to the WDM research that would demonstrate the P3 capabilities in this field. David Riley from Queens University Belfast in the UK then provided a very nice overview of the WDM research with emphasis of different techniques used to create and diagnosis WDM. Markus Roth from Technische Universität Darmstadt closed off the talks section with his overview of the work carried out by his group in Germany. Markus gave a wonderful introduction to the work on target fabrication at Darmstadt and has shown that they have demonstrated a truly remarkable capability in high precision target development and manufacturing. ■

ELI Beamlines Scientific Challenges 2015

The third ELI Beamlines Scientific Challenges meeting was held October 2015 in the scenic baroque Štiřín castle which is situated nearby the newly built ELI Beamlines laser center in Dolní Břežany. The conference was combined with a prospective user meeting to introduce the experimental capabilities of the ELI Beamlines facility and to get feedback on user needs concerning experimental capabilities and organizational support. The participants of the ELI Beamlines Challenges meeting could see lectures given by outstanding scientists and research facility directors from universities and research institutes all over the world. For instance, Wim Leemans (Lawrence Berkeley National Laboratory, USA) introduced the experiments at BELLA center towards colliders and light sources, Gerard Mourou (IZEST, France) talked about the topic "Extreme Light from Atomic to Subatomic Physics and Applications" and Stefan Karsch (LMU, Munich, Germany) presented "All-optical hard X-ray sources." ■

ELI Beamlines and HiLASE Summer School 2015

The third year of the ELI Beamlines and HiLASE Summer School ELISS 2015 was organized at the end of summer 2015. The students were invited from a variety of fields in physical sciences and had an opportunity to spend one week in Prague and participated in 29 different seminars held by scientists from the ELI Beamlines and HiLASE projects. This year, more than 90 PhD students attended ELISS 2015 from all over the world.

ELISS 2015 was opened by the director of Institute of Physics Jan Řídký. He together with the scientific coordinators Georg Korn (ELI Beamlines) and Tomáš Mocek (HiLASE) introduced students the main scientific missions of these two projects. Jonathan Tyler Green laser physicist and senior researcher described the four laser systems which are going to be installed at the ELI Beamlines laser facility at the end of 2017. The leaders of particular research programs focused on concrete topics of all ELI Beamlines research programs, which are oriented to particle acceleration by lasers, X-ray sources driven by ultrashort laser pulses, applications in molecular, biomedical, material science and plasma and high energy density physics. For example Jaroslav Nejdl focused on laser driven sources of energetic radiation and Stefan Weber talked about plasma and exotic physics.

The ELISS students could also participate in the seminars held by leading scientists from abroad. Pascal Salières (CEA-Saclay, France) talked about high harmonic generation and attosecond pulses (TBC) and Victor Malka (ENSTA, France) focused on basic principles of plasma based electron acceleration and applications.

The main part of the ELISS 2015 was a poster session and a visit of the ELI Beamlines and HiLASE laser centers which are situated in Dolní Břežany. The participants of ELISS 2015 saw new laboratories at the HiLASE facility and newly completed administrative and multifunctional buildings of the ELI Beamlines center. Among the visitors a virtual tour of the laser and experimental halls had a great reaction. They looked through special glasses into laser and experimental space and so they could see from near the technology that will be installed in the halls. ■

G. Korn (ELI Beamlines, Scientific Coordinator for Research Programmes)

B. Rus (ELI Beamlines, Scientific Coordinator for Laser Technology)

V. Malka (Laboratoire d'Optique Appliquée ENSTA ParisTech – Ecole Polytechnique – CNRS, France)

C. Riconda (Pierre and Marie Curie University, France)

J. Nejdl (ELI Beamlines, Postdoc - Development of X-ray sources and rays)

J. Andreasson (ELI Beamlines, Leader of Research Programme 4)

K. Falk (ELI Beamlines, Senior Researcher)

T. Mocek (HiLASE, Project Manager)

A. Lucianetti (HiLASE, Leader of Research Programme 2)

Participants of the ELISS 2015 Summer School

Poster Session

From Quantum Optics to Ultrashort Pulses

Why did you choose the Czech Republic as the place for living and working? What do you like about Prague and the Czech Republic?
Prior to moving the Prague, I had visited the city as well as its surroundings several times in the last decade and had always left the Czech Republic being impressed in one way or another. After receiving a job offer from ELI Beamlines I made a list of pros and cons regarding living in Prague and the Czech Republic. It was not long before I realised that the 'pros' column was going to much larger than the 'cons'.

When I arrived in Prague I rediscovered its beauty, history and culture. I enjoyed visiting touristic sites, parks, walking through the city and its narrow cobble-stoned streets. I also like the nature in the Czech Republic including the availability of a wide range hiking trails. The Czech Republic also has the advantage of being closely connected to many cities in Europe which allows many adventures for weekend trips and holidays Given the vast difference in climates between the summer and winter, it allows the availability of a multitude of outdoor sports and activities, such as skiing, skating, hiking, climbing, biking etc. From a social and lifestyle point of view, there are many events in Prague to occupy yourself no matter what your interests are.

How did you get to know about the ELI Beamlines project? Why is ELI Beamlines attractive for you?
Towards the end of my Postdoctoral Fellowship in South Africa, I began to look for projects in Europe. I wanted to change research field from experimental Quantum Optics but remain in laser-physics related research. On seeing a job position available in ELI Beamlines I began to research the project and it did not take long to realise the large scale and scope of the project. The project itself contains many part of physics collaborating together in various experiments; nuclear physics, particle physics, plasma physics, laser physics and even biomedical sciences. For this reason the ELI Beamlines project was very interesting for me. Due to the enormous undertaking, the proposed experiments require stateof-the-art equipment, measurement instruments and control systems which provide a great opportunity for a vast expansion of skill-set in learning how such a large-scale facility is developed.

What are you responsible for at the ELI Beamlines project? What do you like the most about your job?
In ELI Beamlines I am responsible for the performance work package in the Infrastructure Engineering group. Our objective is to assist, assess and model the design and performance of laser related sub-systems to aid in the determination of system set-points to ensure increased accuracy and efficiency at a facility level. One of the main tasks at the moment is to provide laser beamline simulations of the facility and to determine all the properties of the laser beams as they propagate through the relevant optical system and come to a focus at the target. Having moved to Prague I changed research fields from Quantum Optics to Ultrashort Pulses. This has lead me to adapt and learn various new physical concepts, technologies and skills to be able to work in this field. One of the things I like most about my job is being part of such a huge project and with such ambitious aims.

Could you tell us something more about your working experience? Where did you work before? Which working position did you like the most?
In 2009 I completed my PhD in the field of laser cooling and trapping of neutral atoms in Tyndall national Institute, Cork, creating Ireland first Magneto Optical Trap (MOT).

After passing through the long education system required to obtain a PhD, I wanted to travel and experience more of the world, as well as experience different cultures and ways of life. So I decided to combine my aspirations to travel with postdoc opportunities which could also advance my career. After a lifetime of wet and cold Irish weather, I was inclined to believe that a warmer climate would suit me better. I therefore I accepted a postdoctoral research position on the island of Crete, Greece at the Institute of Electronics Structure & Lasers - Foundation for Research and Technology – Hellas. Here I build a Bose-Einstein Condensation (BEC) experiment and subsequently used this apparatus to investigate properties of ultra-intense atomslaser sources.

After two years on the beautiful island of Crete, I again maintained the fun-sun-sea theme and accepted a postdoctoral position in Durban, South Africa where I enjoyed a year round summer climate. Here I worked on building a cold atom experiment. After two years in South Africa I decided to come back to Europe and enjoy the many advantages, luxuries and facilities we are lucky to have available to us.

How can the ELI Beamlines research be beneficial for European and worldwide physical science?
ELI Beamlines is a state of the art facility with the aim to build laser systems that have never been built before. The monumental task is to use these lasers to develop short pulse secondary sources of radiation and particles. This will be the first facility of its kind and therefore also has the opportunity to perform an abundance of experiments for the first time spanning across several fields of science which will not only impact science in Europe but also across the globe.

Have you ever felt in your life that you are really proud of what you are doing? Could you describe more your success?
Be it sports, work or in social life, I like to think that I do things to the best of my ability. In general, I have the impression that most scientists, engineers and researchers have a love for their research topic and feel they are making a contribution to the advancement of the knowledge and technology of this field. I am thus quite proud that I can be part of the scientific community, however large or small a role I play. ■

ELI Beamlines: Oscar Awards for Invention

Lawrence Livermore National Laboratory (LLNL) and Lasertel Inc. were named finalists by R&D Magazine for the 53rd Annual R&D 100 Awards, which honor the 100 most innovative technologies and services of the past year. This year's winners were presented with their honors at the annual black-tie awards dinner on November 13, 2015 at Caesars Palace in Las Vegas. The finalists were selected by an independent panel of more than 70 judges. This year's finalists represent many of industry's leading organizations and national laboratories, as well as many newcomers to the R&D 100 Awards, often referred to as the "Oscar Awards for Invention."

LLNL and Lasertel were named to the IT/Electrical category for the High-Power Intelligent Laser Diode System (HILADS), a segment of the High Repetition-Rate Advanced Petawatt Laser System (HAPLS) being developed for the Extreme Light Infrastructure (ELI) Beamlines facility under construction in the Czech Republic. HAPLS will be used to create a new generation of secondary sources for interdisciplinary applications in physics, medicine, biology and material sciences. ■

The representatives of the Embassy of Canada to the Czech Republic visited the laser centers ELI Beamlines and HiLASE

On 23rd June 2015 the Senior Trade Commissioner Mr. Henri Proulx, together with his colleagues from the Trade Commissioner Service Mrs. Martina Taxová and Ms. Marie-Pier Brunelle, visited the laser centers ELI Beamlines and HiLASE in Dolní Břežany.

The ELI project, which aims to build high output laser system which will rank among the most intense in the world, was introduced by the Technical Manager Bruno Le Garrec and Aleš Hála, team leader of CITT – Centre for Innovation and Technology Transfer. The sister project HiLASE, responsible for developing laser technology with breakthrough technical parameters which will be mostly used for industry, was represented by the Deputy Project Manager Lukáš Masopust.

Members of the delegation from the commercial section of the Embassy of Canada to the Czech Republic had the opportunity to visit the new laboratory at the HiLASE center. Then they saw newly completed spaces of the ELI Beamlines laser center. ■

Memorandum for Scientific cooperation

The ELI Beamlines scientists (Institute of Physics CAS) signed memorandums for scientific cooperation with these international institutes and universities in 2015. The Memorandum of Understanding for a scientific collaboration on "Warm Dense Matter physics induced by laser-matter interaction" was signed with Institut National de la Recherche Scientifique (INRS) in Quebec, Canada. The Letter of Intent for a joint experimental campaign on "Laser driven proton acceleration from a H2 cryogenic target" was subjected with CEA in Paris and Institute of Plasma Physics of the CAS. The Memorandum of Understanding for a scientific and technological collaboration was approved with Elettra-Sincrotrone Trieste S.C.p.A. (Elettra, Italy). ■

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