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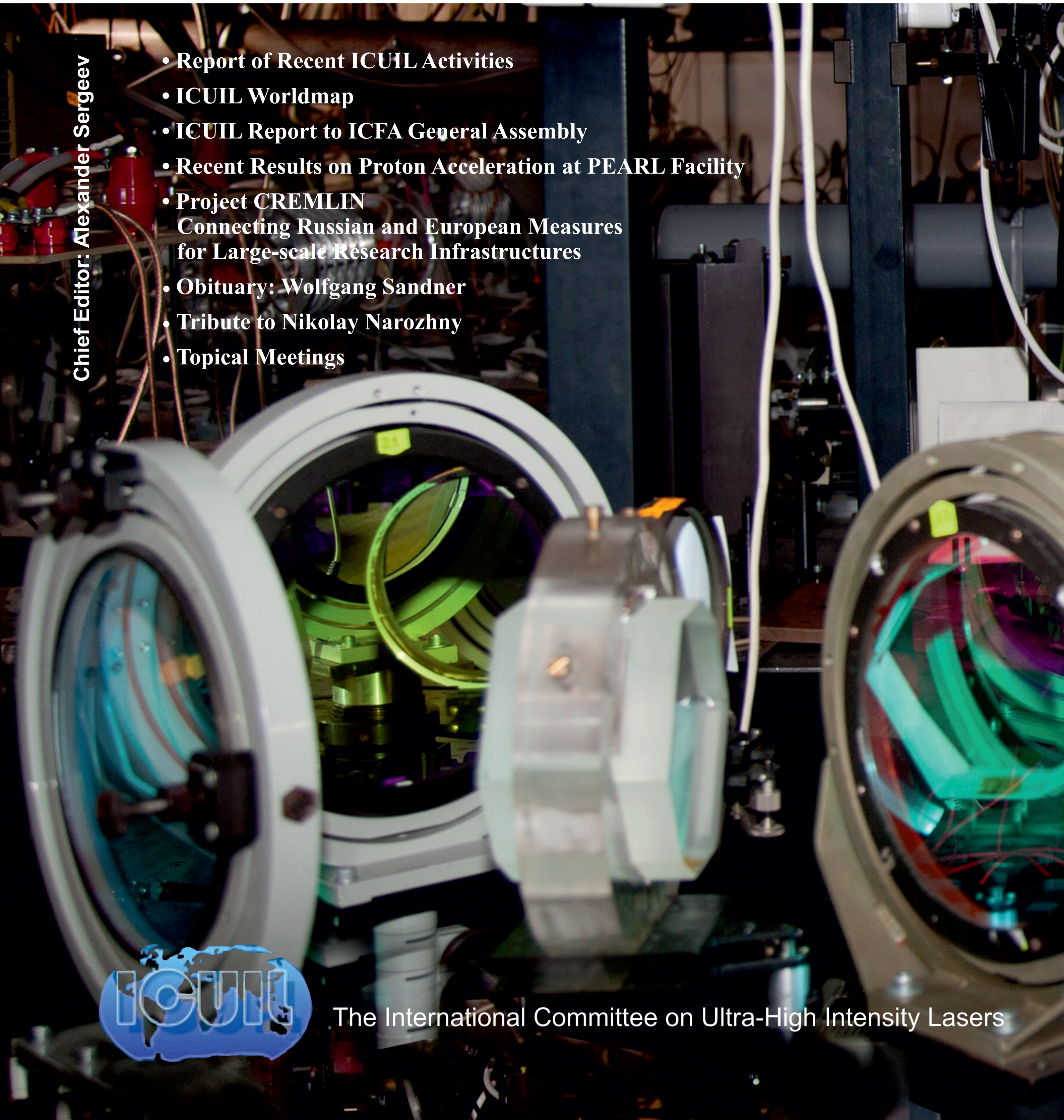

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The International Committee on Ultra-High Intensity Lasers

Report of Recent ICUIL Activities

T. Tajima
Chair, ICUIL
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ICUIL represents the community of utraintense (>10^{19} W/cm^2) lasers around the world. The community is exponentially increasing the world total cumulative laser power from 11PW in 2010 to the expected 132PW in 2017. The community projects total more than \$4B research investment and 1500 FTEs technical staff now around the world. Here I concentrate on some typical activities of ICUL accentuating the works that relate to collaborative works with other IUPAP Working Group ICFA and topics that encompass other fields and cross-Group activities.

Brief History of the ICUIL-ICFA collaboration

In 2008 the Chair of ICUIL (T. Tajima) spoke with the incoming Chair of ICFA (A. Suzuki) to initiate joint collaborative work on laser acceleration to examine its promise and challenge for its future collider application. In 2009 ICUIL and ICFA launched the Joint Task Force for laser accelerators (W. Leemans was named chair of the task force). JTF produced its report in 2011 (published in ICFA Newsletter in 2011, W. Chou et al. as editors). It was found that: (1) The science of laser acceleration has matured and validated; (2) The high rate rated, high fluence laser technology needs to be developed in order to meet the collider luminosity. Since then a fiber laser technology called CAN (coherent amplification network) was invented (2013) in order to meet the above challenge. Currently, the community is trying to develop this technology.

Meanwhile, the world-wide laser wakefield acceleration (LWFA) experiments have advanced to produce several GeV over a few cm in typically $10^{17–18}$ /cc plasma (Kim et al. 2013; Leemans et al. 2014).

The Higgs energy by laser wakefield acceleration

In order to reach and go beyond the Higgs energy (>100GeV), three paths have been considered. One path is to have multi-stages to boost the acceleration in the above mentioned technology.

The second path and third path have been recently considered through examining the scalings of the LWFA (Tajima-Dawson, 1979; Nakajima et al. 2011). The energy gain in the wakefield is proportional to the inverse of the plasma density and proportional to the normalized vector potential of the laser $E_b = 2/3m_e c^2 a_0 n_c/n_e =$ $= 38[\mathrm{GeV}]a_0(1\mu\mathrm{m}/\lambda_L)^2((10^{16}\mathrm{cm}^{-3})/n_e)$. The accelerating length is typically decided by the dephasing length Ldp, which scales as the 3/2 power of the density of plasma, square of the frequency of the laser, and square-root of the laser vector potential (see, e.g., Nakajima, et al. 2011). They suggested that the density should be scaled from the typical of $10^{18–17}$/cc in the present day experiments to the typical of $10^{17–16}$/cc in the near future. This would increase the electron energy by 1–2 orders of magnitude of which the contemporary experimental energy gain from several GeV to on the order of 100 GeV.

However, in order to achieve this goal, we have to increase the laser power in inverse proportion to the plasma density. This is the main reason why we suggested to employ the world largest energy lasers that are available in a compressed fashion such as the laser at GSI, PETAL at LMJ and ARC at NIF.

Increase of the laser frequency: the third path

From the LWFA energy gain scaling, there is an alternative and third path by increasing the laser frequency (i.e. n_{cr}) using the 3ω frequency laser in place of 1ω, which would increase n_{cr} nearly by an order of magnitude and reduce the accelerating length nearly by 30.

The recent additional breakthrough in the laser compression (Mourou et al. 2014) indicates the possibility of single-cycle laser radiation, which opened up a path toward the single-cycled X-ray pulse (even at EW power). Because of this development, we can also follow the third path. This approach was suggested by Tajima (2014) to adopt nanomaterials driven by intense X-ray laser suggested above. This "TeV on a chip" acceleration allows accelerating the gradient on the order of TeV/cm staring from an originally PW optical laser driver.

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ICUIL Worldmap

Terry Kessler, ICUIL Secretary
University of Rochester, NY

The international committee on ultra-high intensity lasers (ICUIL) is actively engaged in the advancement of lasers and their scientific applications. Our goals are to provide a venue for discussions, among representatives of high-intensity laser facilities and members of user communities, on international collaborative activities such as the development of the next generation of ultra-high intensity lasers, exploration of new areas of fundamental and applied research, and formation of a global research network for access to advanced facilities by users. ICUIL continues to promote collaborations required to establish high-intensity laser infrastructures for the benefit of the international physics community.

Periodic teleconferences held throughout the year continue to be effective in maintaining progress in each of the following activities. One of the features of the ICUIL website is an interactive world map that highlights the high intensity laser facilities around the world as shown below. Surveys of the worldwide laser community are conducted by ICUIL in an effort to provide an accurate accounting of all existing and planned ultrahigh intensity laser facilities that are capable of reaching intensities above 10^{19} W/cm^2. An updated survey will be implemented at the 2016 ICUIL conference. The bylaws of the ICUIL Charter are being revised to maintain the experience and dedication of the current membership that has been assembled over the last decade. More than two terms of service would be allowed for members who continue to be active in this field and are able to provide service to the ICUIL community. A gradual member rotation will be used to maintain continuity and ensure that ICUIL continues to advance while maintaining balance both geographically and between the various high field science working groups of IUPAP. ICUIL has continued its corporate support program to afford maintenance of the ICUIL website, publish an annual newsletter, and support biennial conferences. The remaining funds are being targeted towards support of new outreach activities including student competitions held at the biennial conferences.

Extreme Light Infrastructure (ELI) is a pioneer among the research infrastructures contained in the European ESFRI Roadmap in using EU structural funds for construction. One of the three ELI pillars is Nuclear Physics (ELI-NP), a European research center to study ultra-intense lasers interaction with matter and nuclear science using gamma and laser driven radiation beams. The Technical Design Reports were approved by ELI-NP International Scientific Advisory Board, chaired by Toshiki Tajima, and submitted in July, 2015. ICUIL and ICFA (International Committee for Future Accelerators), another arm of the IUPAP Working Groups, are continually collaborating on laser-driven wakefield acceleration for future high energy accelerators. Since publication of the first ICUIL-ICFA Joint Taskforce Report on the laser accelerators in 2011, we worked to address one of the main points of the report, the need to improve laser technology, particularly its efficiency and repetition rate, so that the beam generated will have

ICUIL World Map of Ultrahigh Intensity Laser Capabilities sufficient luminosity. Along this line, the ICUIL community has invented the CAN laser technology based on the fiber laser technology. In addition, with the CAN laser having high rep rate and high efficiency, additional important applications have been found, including the driver for the management of space debris. These were further reviewed at the IZEST Conference at CERN in October, 2015.

Laser facilities around the world continue to push towards multi-petawatt power capability. For example, the Chinese initiative at the Shanghai Institute of Optics and Fine Mechanics (SIOM) is advancing rapidly towards a 10 PW laser facility. Lawrence Livermore National Laboratory (LLNL) is in the process of commissioning their Advanced Radiographic Capability (ARC) PW scale laser and the PETAL laser at CEA will begin operations at the 2 PW level this year. The University of Rochester's Laboratory for Laser Energetics announced its OPAL multi-phase laser initiative that could lead towards a 75 PW capability. In addition, the European ESFRI roadmap project, the Extreme Light Infrastructure (ELI), consisting of ELI-Beamlines, ELI-Nuclear Physics, and ELI-ALPS (attosecond science pillar), is moving towards an initial operation date of 2018.

The commissioning of the Advanced Radiographic Capability (ARC) laser system in the National Ignition Facility (NIF) is currently in progress. ARC is designed to ultimately provide eight beamlets with pulse duration adjustable from 1 to 50 ps, and energies up to 1.7 kJ per beamlet. The beamlets will be used to create x-ray point sources for dynamic, multi- frame high-energy x-ray radiographs of the imploded cores of ignition targets. They are critical for creating precision x-ray backlighters needed for NIF experiments studying complex hydrodynamics and material strength at extreme high energy density regimes. ARC can also produce MeV protons and electrons for future experiments in advanced fusion, TeV acceleration and proton radiography. Recently, a new front-end was installed to achieve higher pulse contrast, resulting in 80 dB for the preceding 200 ps. The ARC laser is integrated into the NIF laser system utilizing four of the NIF beams (1 quad) to produce 8 beamlets. The quad of beams can either be configured for NIF 3ω operation or for high-energy ps pulses, using hardware controlled during the automated shot cycle. Commissioning of 4 of the 8 beamlets is currently underway to operate at 1.2 KJ energy in 30 ps pulses to irradiate Au-wire backlighting targets.

Center for High Energy Density Science researchers have completed a year-long project to improve the pulse contrast on the Texas Petawatt Laser. The new design started with two BBO-based OPCPA stages pumped by an optically synchronized pump laser. These stages amplify slightly chirped few ps pulses by six orders of magnitude and reduce the contrast pedestal width to a few ps. There are two LBO-based OPCPA stages that are pumped by 4 ns pulses. These have much less gain and the overall reduction in parametric fluorescence is about three orders of magnitude. All lenses in the glass amplifiers were replaced with off axis parabolic mirrors, eliminating all discrete prepulses. All problematic wave plates and thin transmissive optics in the laser were eliminated to prevent post pulses that would result in prepulses by nonlinear conversion. An Acousto-Optic Programmable Dispersive Filter was added to improve fourth order dispersion and steepen the rising edge of the compressed pulse. These enhancements resulted in a final contrast of nine orders of magnitude. This improvement enables the use of thin and reduced mass targets for ion acceleration and reduces pre-plasma effects for all experiments.

Petawatt Aquitaine Laser (PETAL) will allow unique experiments in the field of ultrahigh intensity sciences, extreme plasma physics, astrophysics, radiography, and fast ignition by a combination of its own multi-petawatt kilojoule beam and the nanosecond multikilojoule beams of the Laser Mégajoule (LMJ). The PETAL facility is designed and constructed by the French Commissariat à l'énergie Atomique et aux énergies alternatives (CEA) to deliver energy up to 3 kJ in 500 fs at the wavelength of 1053 nm and is an additional short pulse beam to the Laser MegaJoule (LMJ) facility. PETAL has recently achieved 1.4 kJ at 2 ns with a 3.5 nm bandwidth to produce 1.15 PW with a 700 ps pulsewidth. The focal spot was measured to have 60% of its energy contained within a 20 µm and 80% within an 80 µm diameter. The goal is to reach 10^{20} W/cm^2 on target. The facility will be operated at a 1 kJ energy level for initial experiments due to the current damage threshold of the final optics.

The University of Rochester's Laboratory for Laser Energetics is developing plans to construct a 15 PW laser system that is pumped by its existing OMEGA EP facility, with a potential upgrade to 75 PW. Optical parametric chirped-pulse amplification (OPCPA) provides broadband gain for large-aperture beams by using Nd:glass lasers to pump deuterated potassium dihydrogen phosphate crystals. Scaling to kilojoule energies would enable focused intensities exceeding 10^{23} W/cm^2 with 20 fs pulses. A mid-scale optical parametric amplifier line (OPAL) pumped by the Multi-Terawatt laser (MTW) is being constructed to produce 7.5-J, 15-fs pulses and demonstrate technologies that are suitable for a kilojoule system pumped by OMEGA EP (EP-OPAL). In parallel, a novel Raman plasma amplifier is being developed where MTW is the picosecond pump laser and MTW-OPAL provides a tunable femtosecond seed. The ultra-broadband front end consists of a white-light continuum seed that is amplified by three noncollinear optical parametric amplifiers (NOPA's). The pulses are stretched to 1.5 ns before further amplification in NOPA4. The radial group delay of the lens-based image relays is compensated before the final DKDP amplifier, NOPA5, which is pumped by MTW using three switchyards to provide narrowband pump pulses at 526.5 nm. Completion of MTW-OPAL would lead to the final design and planning for an EP-OPAL laser system.

Chris Barty presented his vision of the next generation of high intensity lasers at several conferences this year. With the implementation of chirped pulse amplification (CPA), it is possible for beam lines at the National Ignition Facility at the Lawrence Livermore National Laboratory, the Laser Mega-Joule (LMJ) facility in Bordeaux, France, the LFEX laser at the Institute for Laser Engineering in Osaka, Japan and the Omega EP facility at the Laboratory for Laser Energetics in Rochester, New York to create petawatt peak power laser pulses of nominally 1-ps duration and 1-kJ energy. New short pulse amplification architectures based on chirped "beams", novel pulse compressors and existing beam phasing technologies are capable of extracting the full, stored energy of a NIF or NIF-like beam line and in doing so produce from one beam line a near-diffraction-limited, laser pulse whose peak power would be in excess of 200 petawatts. This architecture is well suited to either low-f-number focusing or to multi-beam, dipole focusing concepts. With dipole focusing, it is anticipated that a single beam line of a NIF exawatt or so called Nexawatt system will be capable of reaching intensities in excess of 10^{26} W/cm^2 or more than 5 orders of magnitude beyond existing systems. The novel amplification architecture is based entirely on existing technologies, proven optical damage performance and straightforward extensions of existing manufacturing technologies.

2016 ICUIL Membership

Toshiki Tajima	Chairman	International
Chris Barty	Co-Chairman	United States
Alexander Sergeev	Co-Chairman	Russia
Terry Kessler	Secretary	United States
Tsuneyuki Ozaki	Treasurer	Canada
Gerard Mourou		France
Hiroshi Azechi		Japan
John Collier		UK
Dino Jaroszynski		UK
Thomas Kuehl		Germany
Ravi Kumar		India
Christine Labaune		France
Wim Leemans		United States
Ruxin Li		China
Chang Hee Nam		Korea
Bedrich Rus		Czech Republic
Heinrich Schwoerer		South Africa
Ken-ichi Ueda		Japan
Associate Members		
Ryosuke Kodama		Japan
Sandro de Silvestri		Italy
Nilson Dias Vieira Jr.		Brazil
Claes-Goran Wahlstrom		Sweden

ICUIL Report to ICFA General Assembly

Takayuki Saeki, KEK

The 76th International Committee for Future Accelerators (ICFA) meeting was held at the J-PARC site (KEK Tokai campus) in Japan on 25th and 26th February 2016. The meeting summary is found on the web page of ICFA at http://icfa.fnal.gov/. I presented the activities related to the collaborations between ICUIL and ICFA at this meeting, which is entitled "Report on ICFA-ICUIL activities". Such a report at the ICFA meeting was initiated between two Chairs of ICFA and ICUIL in late 2008, i.e. between Prof. Suzuki and Prof. Tajima. Prof. Suzuki was Director General of KEK at that time and I was working with him as a staff member of KEK on the International Linear Collider (ILC). I also was working with Prof. Tajima on the application of plasma deceleration to the beam dump of ILC. In such a situation, I was asked to present the report on behalf of Prof. Tajima at this meeting. I would like to write about the report in this article.

Since the participants of the ICFA meeting are mostly from the High Energy Physics (HEP) community, I briefly explained in the presentation that ICUIL is providing a venue for discussions among representatives of high-intensity laser facilities and members of user communities, and IZEST is mastering the scientific community based on the concept of Laser-based High Field Fundamental Physics which might lead to the new alternative ways to provide more compact and cheaper accelerators by amplifying laser to extreme energy. The main part of the presentation was about the workshop "Outlook on WAKE FIELD ACCELERATION: The next Frontier" which was held at CERN on 15th and 16th October 2015. The workshop was organized by Prof.

Mourou (Polytech), Prof. Tajima (UCI) and Prof. Holzer (CERN), and more than 60 participants joined, most of them are somehow related to the HEP activities. I also joined the workshop and I really was convinced that the plasma acceleration is the new promising technology to be the alternative to the conventional acceleration techniques. The Large Hadron Collider (LHC) at CERN, which is the largest conventional collider discovered the Higgs particle at 126 GeV in 2013, but the new physics or new particles beyond the Standard Model have not been discovered yet. This means we need more acceleration and higher energy to open the new frontier. The workshop fully covered the possibilities of plasma acceleration to open the new frontier. I also introduced the international conference Ultrahigh Intensity Laser at Goa during 12th – 17th October 2014, which covered the ultra-intense lasers, pump lasers, and the applications. Following such workshop and conference, I showed an example of collaborative work between ICUIL and ICFA, which is organized by myself, i.e. an application of plasma deceleration technique to the beam dump of ILC. The ILC is a future accelerator to collide electrons and positrons at the center of mass energy of 500 GeV in the first phase and 1 TeV in the second phase. The energy consumption of ILC is estimated as 200 MW including surrounding facilities. In particular, at the beam dump, 10 MW is lost and the radiative activity is very high. In order to improve the existing design of ILC beam dump, we started studying the possibility to replace the conventional beam dump with the novel technique of plasma deceleration, where almost no radiation is expected because the beams are decelerated by electromagnetic reaction instead of nuclear reaction. Moreover, there is a possibility that we might recover the electric power from the plasma in the beam dump because the energy is in the purely electromagnetic shape. The working group started in 2015 with a small funding from the Japanese government. The organization members of the group includes KEK, UCI, SLAC and LAPP/IN2P3/CNRS as shown in Fig. 1. The new concept of beam dump was named the Green ILC Beam Dump because the new design is more environmentally friendly. This work is a very good example of collaboration between ICUIL and ICFA community.

To summarize the experiments of plasma acceleration, I presented a plot shown in Fig. 2, which is representing the state-of-the-art experiments and the resultant data for beam energy vs. plasma density. I also showed the laser acceleration experiment at LMJ/NIF aiming at the energy of 100 GeV which would be eventually reaching the Higgs mass (100 GeV UV LWFA experiment at ARC) as an example of the state-of-the-art experiments.

Finally, I introduced and advertised the 2016 ICUIL conference at Montebello/Quebec during 11th – 16th September 2016, which will cover ultra-high intensity lasers, pump lasers, laser acceleration, and so on.

As shown in my presentation at the ICFA meeting, recently, the activities of ICUIL community are becoming more and more closely related to the activities of ICFA community. I would say that the report on ICUIL-ICFA activities will be more and more intense and higher density in the next ICFA meeting.

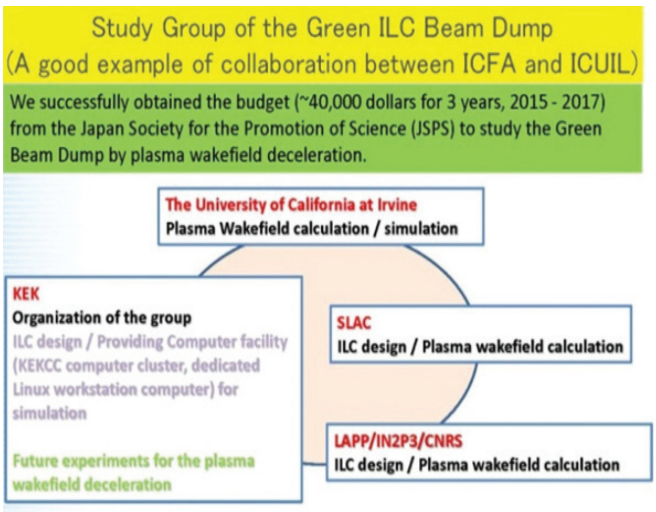


Fig. 1. *The organization of study group of the Green ILC beam Dump*

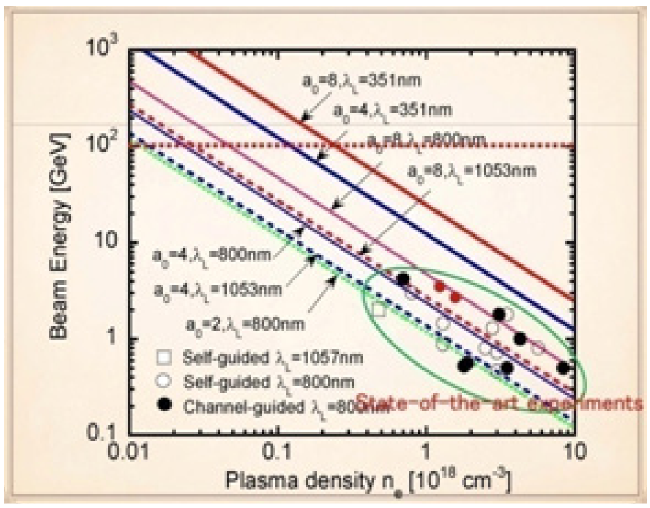


Fig. 2. *Current experimental data for beam energy vs. plasma density*

Recent Results on Proton Acceleration at PEARL Facility

Mikhail Starodubtsev, Institute of Applied Physics RAS

The peak of investigations on laser-driven ion acceleration was in the middle of the first decade of the 21-st century. By now, quite a number of laser-plasma interaction schemes have been developed that provide accelerated ion energies up to 40-70 MeV/nucleon.

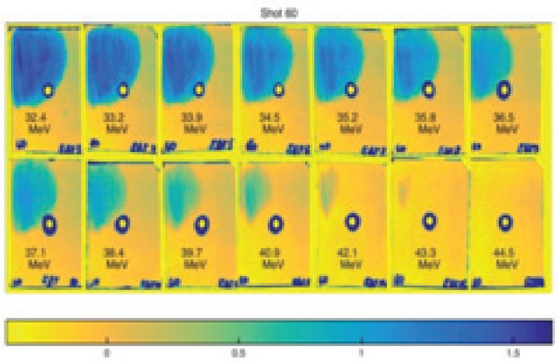


Fig.1. *Radiochromic films exposed to a record proton beam accelerated by 7J laser pulse. The depicted energies correspond to the proton Bragg peak in energy deposition for a sensitive layer of particular film. Maximum proton energy is 43.3 MeV.*

Recently, experiments on TNSA proton acceleration (target normal sheath acceleration) were started at the IAP RAS laser facility PEARL with laser radiation (7.5 J, 60 fs) focused on the surface of a thin (0.1-10 μm) foil. The laser radiation intensity on the foil surface amounted to $3 \cdot 10^{20}$ W/cm^2, the foil was ionized, and the laser-accelerated electrons were escaped from its opposite side. The formed negatively charged electron cloud produced an electric field that accelerated ions at the rear surface of the foil (hydrogen ions, i.e., protons, in the first place).

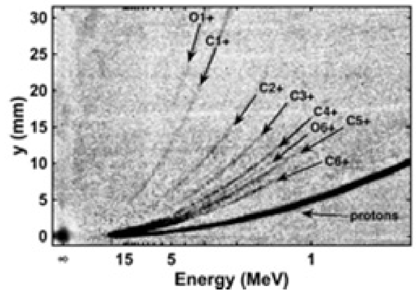


Fig.2. *Measurement of emitted ion spectra obtained using Thomson parabola. Traces of H+, C1+– C6+, O1+ and O6+ ions are marked according to calculations of ion trajectories. Proton energy is laid off on the horizontal axis*

The angular and energy distribution of the protons accelerated from the foil rear surface was measured by means of RCF films (fig.1) and by a Thomson parabola spectrometer (fig. 2).

Project CREMLIN Connecting Russian and European Measures for Large-scale Research Infrastructures

Alexander Sergeev, Institute of Applied Physics RAS

This project was launched in October 2015 aimed at fostering scientific cooperation between the Russian Federation and the European Union in the development and scientific exploitation of large-scale research infrastructures.

19 European research centers, including 6 Russian institutions, established a consortium the principal goal of which is development of concrete coordination and support measures for each research infrastructure and common best practice and policies on internationalisation and opening. The project is intended for 3 years during which each consortium member will organize working meetings and/or focus workshops with participation of other CREMLIN members to discuss problems of mutual interest and find ways for their solution. In addition, meetings of Consortium Board (CB) and Project Management Board with representatives of each party will be held regularly. An external Science Policy Advisory Board (SPAB) appointed by the CB shall assist and facilitate the CB decisions.

The CREMLIN kick-off meeting took place on 06-07 October 2015, at the National Research Center "Kurchatov Institute" in Moscow, Russia.

The objectives, management and financial issues, exchange platform, milestones and other issues were addressed at the meeting.

It was agreed that the CREMLIN project should be seen as a vehicle and platform to move the discussions around large-scale research infrastructures and as a means to establish links between the project participants and the European Strategy Forum on Research Infrastructures (ESFRI) and other relevant EU organizations.

The first CREMLIN working meeting on exchange on policy and ESFRI-related issues was held at the Joint Institute for Nuclear Research in Dubna, Russia on the 20th April 2016. The meeting was intended to stimulate and enable mutual learning and exchange of best practice within the community, with a focus on policy issues.

The next working meeting is schedule for 28–30 June 2016 and will be dedicated to internationalisation aspects of megascience facilities. It will be held at the European Spallation Source in Lund, Sweden.

Still another forthcoming CREMLIN event is organized by the Institute of Applied Physics of the Russian Academy of Sciences (IAP RAS). It will be a workshop on novel applications of exawatt laser sources, with a focus on the XCELS facility developed at IAP RAS. The workshop will be held on board a river ship cruising from Nizhny Novgorod to Saint Petersburg, Russia from the 17th to the 23d of July 2016.

The consortium members believe that their close collaboration will be mutually beneficial for all the parties.

Recent ICUILERS' awards

Enrico Fermi Prize 2015

Toshiki Tajima
Norman Rostoker Chair Professor, University of California at Irvine, USA

For the invention of the laser-wakefield-acceleration technique which led to a large number of fundamental and interdisciplinary applications ranging from accelerator science to plasma physics and astrophysics

Frederic Ives Medal / Quinn Prize 2016

Gerard Mourou
Distinguished Professor Emeritus from the University of Michigan and the Ecole Polytechnique in Palaiseau, France

For numerous pioneering contributions to the development of ultrafast and ultrahigh intensity laser science and for outstanding leadership of the international and commercial communities impacted by these technologies.

The Infosys Prize 2015 in Physical Sciences

G. Ravindra Kumar
Tata Institute of Fundamental Research, Mumbai

For his pioneering experimental contributions to the physics of high intensity laser matter interactions. In particular for providing, for the first time, unequivocal evidence of turbulent magnetic fields and the discovery of terahertz frequency acoustic waves, in laser produced hot dense plasmas. These results have significance to testing stellar and astrophysical scenarios.

Harold E. Edgerton Award 2016

Christopher P. J. Barty
Lawrence Livermore National Laboratory

In recognition of his efforts in the development of foundational techniques that have enabled ultrafast, intense lasers and for pioneering contributions to time-resolved, x-ray and gamma-ray science conducted with such lasers.

Obituary: Wolfgang Sandner

We suddenly lost Professor Wolfgang Sandner, a beloved laser scientist and the international leader in high intensity laser, on Dec. 5, 2015. He was attending the Extreme Light Infrastructure (ELI) Workshop in Romania just a few days prior to his passing, chatting with our colleagues affably. He left a gaping hole in the ELI-Delivery Consortium's General Directorship, which leads the world's highest intensity laser initiative. He was GD of ELI-DCfrom its inception in 2013. This followed his leadership activities in ELI-Preparatory Phase 2008-2011 (which was initiated by Prof. G. Mourou). Under his leadership Europe was firmly set as the undisputed world leader in the field of intense laser research.

Among other services (I won't list all of his illustrious career and positions here, as other such pronouncements no doubt have been written) he served as Director of Max Born Institute from 1993 till 2013, as the leading advocate of high field science there. At MBI he launched a strong team of intense laser matter interaction research. His team published, among other important papers, the first experimental observation of what is called the Radiation Pressure Acceleration of ions driven by intense laser (I had a privilege to be part of the paper) in 2009. (He was also Professor at Technical University of Berlin, 1994-2014). As a member of MBI Science Advisory Board (2009-2013) I had a pleasure of advising and interacting with him and his team deeply. During his tenure (2003-2013), he had become the leader in Europe (and the world) to integrate many intense (and not so intense) laser labs in Europe, most active in the world, serving as Coordinator of Laser Lab Europe, a shining example how best different labs can complementally coordinate with each other to produce far more than the sum of the all. His scientific leadership also included his Presidency of German Physical Society, the world's largest physical society (2010-2012).

He was among a couple of dozens of internationally prominent intense laser scientists when Prof. Yoshiaki Kato invited them and hosted an OECD-sponsored inaugurating meeting of what had become International Committee for Ultrahigh Intensity Lasers (a Chapter of International Union of Pure and Applied Physics) at Kyoto's Advanced Photon Research Center in 2002. These people including Wolfgang pushed the envelope of the development of world's highest intensity laser ever since. Dr. Sandner led ICUIL activities and served as Co-Chair of ICUIL from 2008 till 2012.

Before he came back to Germany, he served as full professor at the University of Tennessee from 1991-1994. He was a Fellow of American Physical Society. He graduated from the University of Freiburg with PhD in atomic physics in 1979.

He was an avid sportsman such as enjoying a long oceanic cruise by yacht every so often. He was survived by a wife and two children. He was 66.

Toshiki Tajima
Chair, ICUIL Chairman,
ELI-NP International Scientific Advisory Board
Norman Rostoker Chair Professor, University of California at Irvine

It was so sudden! so unexpected! The earth seemed to stop when I heard "Wolfgang Sandner is dead" from Cathy. The optics community, he worked so much to shape, had just lost his flag captain. I was invaded by a tremendous sense of nothingness. We were together only a few days before at the ICEL conference in Bucharest. During light moments we chatted about swimming, which was our favorite topics and the number of laps we would do the week-end. How ironic?

WS personality combined a great scientist, an architect, a great manager and an accomplished diplomat with a knack for the unification and organization of science. Over the years his influence in the field of laser physics grew to become global.

Following his return from the University of Tennessee in 1993 he was one of the Max Born Institute's Directors. In 2001, under the leadership of the OECD, Wolfgang was one of the founders of a IUPAP working group called ICUIL. He was its vice-chair for the past 4 years. ICUIL was created to organize the community around the field of ultra intense laser and their applications.

His pieces of advice were sought after by many scientific organizations and scientific boards. His role reached to the governmental level to define the science of German and European policies.

In 2002 he managed to weave an extended network, named LASERLAB Europe (2002-2012) formed by the top laser laboratories in EU. It has been a resounding success that arguably is at the root of the optics European leading position in the world.

Building the Highest Intensity Laser: how ELI came to be?

In 2005 when I came back from the University of Michigan, I proposed the first ultra high intensity laser infrastructure, ELI for Extreme Light Infrastructure. Wolfgang was a strong supporter of this initiative. In 2006 after only one year, ELI made it to the ESFRI Road Map. For the EU, ELI had the making to become the first European Infrastructure that could be installed in a European emerging country like Czech Republic, Romania and Hungary. After numerous fruitless meetings trying to select a country to build ELI "under one roof", it dawned on us that the only way was to build an integrated infrastructure based on 4 pillards, specialized in different emerging fields of extreme light; namely Beam Generation in Prague, Nuclear-Physics in Bucharest and Attosecond Physics in Szeged. It was decided to give priority to the 3 first pillars. The last one will focus on Extreme Intensity Physics and would be dealt within a few years later. At the cost of almost 1B€, this integrated facility will form the world largest civilian laser facility. However, the budget was far more expensive than we expected and we had to find solutions to circumvent this major showstopper. Wolfgang's role here was invaluable to convince the EU to use its Structural Funds normally reserved for civilian infrastructures, Roads, Bridges, Hospitals, and the like, to build these three research infrastructures. In 2010 the ELI Preparatory Phase was completed and the project was transitioned to the ELI Delivery Consortium.

In 2013, because of his recognized scientific aptness combined with his seasoned experience and incomparable managerial skills WS was rightly selected General Director of the world's largest, civilian laser research, the ELI-Delivery-Consortium.

Wolfgang Sandner has contributed to make Europe arguably the top place in laser research and applications. But his most extraordinarily teaching, so much needed today, has been that science is an unifying element that makes possible to endeavor with serenity together to the benefit of all.

Gerard Mourou
Distinguished Professor Emeritus the University of Michigan and Ecole Polytechnique in Palaiseau, France

Tribute to Nikolay Narozhny

Professor Nikolay Borisovich Narozhny, an eminent Russian theoretical physicist and Head of the Department for Theoretical Nuclear Physics at the National Research Nuclear University MEPhI, died on February 15, 2016 in Moscow. With his passing away, physics of intense electromagnetic fields lost one of the most outstanding representatives.

In 1964 he graduated from the Moscow Engineering Physics Institute and began work on his PhD under supervision of Anatoly Nikishov, one of the founders of the physics of superstrong electromagnetic fields. The first paper by Nikolay "Quantum processes in the field of a circularly polarized electromagnetic wave" published in JETP jointly with Anatoly Nikishov and Vladimir Ritus is widely quoted and appreciated up to now.

Since then and up to the end of his life Nikolay's scientific interests were concentrated on the theory of strong field phenomena. For more than 50 years of research N. Narozhny pioneered a number of problems, including radiation corrections in superintense electromagnetic fields, the theory of relativistic ponderomotive scattering in tightly focused laser pulses, collapse and revival in quantum systems, the dynamical Casimir and Lamb effects, mistakes around the theory of the Unruh effect and many more.

His most recognized contribution was to the theory of electron-positron pair production from vacuum by superstrong electromagnetic fields. Being one of the founders of the theory of laser vacuum breakdown in the mid 1960s, Prof. Narozhny recently returned to that topic again when the plans for construction of new high-power laser facilities showed prospects for attaining the QED critical field in a foreseeable future. Recently, he predicted a new effect of laser-induced QED cascades generation. That work gave rise to a new branch of the strong field physics – simulation of laser plasma in extreme light fields.

In the nearest future, several laser facilities of unprecedented exawatt-scale power are expected to come into operation. At these new facilities, at a laser intensity of 10^{24} W/cm^2 and above, it will be possible to study the fundamental effects of nonlinear QED that have been long considered experimentally inaccessible. Such novel opportunities boomed the field of extreme light science, and Prof. Narozhny was at the center of this activity. Nikolay's life was never restricted by his routine scientific interests. It was always interesting and instructive to speak with him about the history of physics, arts, literature, sports, cuisine and wines – the list would be difficult to complete. He was deeply involved in the life of his *alma mater* where he ruled the Department for Theoretical Nuclear Physics for more than 30 years, was Head of the Dissertation Council on Theoretical and Solid State Physics and Vice-Head of the Scientific Council. His life was full of activities and he was exceptionally successful in each of them. Still, physics always remained his greatest devotion.

Sergey Popruzhenko, MEPhI

International School on Ultra-Intense Lasers

Evgeny Perevezentsev, Institute of Applied Physics RAS

The International School on Ultra-Intense Lasers was held not far from Moscow, Russia, from 4 to 9 October, 2015.

The School was organized by the International Committee on Ultra-Intense Lasers (ICUIL), the Institute of Applied Physics of the Russian Academy of Sciences (IAP RAS), the National Research Nuclear University MEPhI and the Russian Federal Nuclear Center VNIIEF.

The main objective of the School was to give an opportunity for postgraduate students and other early career researchers working in ultra-intense laser science to meet in person and listen to the lectures given by world renowned experts in high power laser physics, laser-matter interaction physics, laser-plasma accelerators, laser-based x-ray sources and inertial confinement fusion. Also, a poster session was organized for the young participants where they could present and discuss their own results.

In addition to the lectures and poster session, evening interactive classes were conducted by distinguished specialists in the field. The main idea behind them was to make contact of students and teachers as close as possible. The classes were divided into 4 topics:

- High average power and high-energy lasers.
- Femtosecond-laser-plasma interaction and particle acceleration.
- Laser ceramics: fabrication and application.
- Interaction of strong lasers with quantum systems.

An excursion to Moscow was organized for the school participants. They walked around the Kremlin and visited the cathedrals inside. Special priority was given to the Armoury chamber with its collections of precious items that had been preserved for centuries in the tsars' treasury and the Patriarch's vestry.

The participants were free of any charges except travel expenses. The number of available places was, however, limited and the registration was open until the limit was reached. About 80 young scientists from Asia, Western Europe and Russia took part in the school.

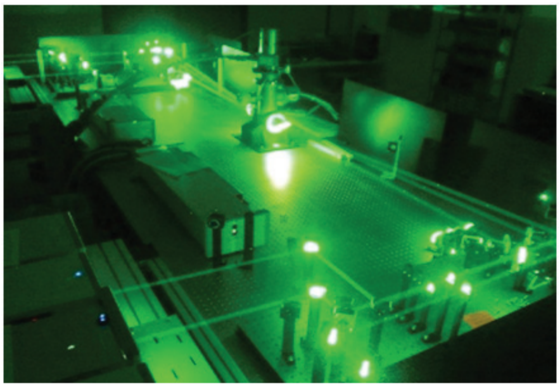
ICUIL 2016 Conference in Montebello Canada (11-16 Sep. 2016)

Tsuneyuki Ozaki, INRS-EMT, Varennes, Quebec

The ICUIL 2016 conference will welcome high intensity laser enthusiasts from across the world, to the Fairmont le Château Montebello from the 11 to the 16 September. The hotel is located between Ottawa and Montreal, about 80 minutes by car from both international airports. The conference site is situated within a 65,000 acre forested wildlife sanctuary including 70 lakes, on the shores of the Ottawa River. The conference will be held in the hotel's newly renovated congress centre, with plenty of adjacent space for participants and vendors to interact.

ICUIL 2016 is also expected to showcase the latest on multilateral projects like the ELI. Following past successful conferences, this biennial meeting will focus on the following themes: (i) ultra-intense laser design and performance (such as Nd:glass-based, Ti:sapphire-based, DPSSL-based and OPCPA-based ultra-intense lasers, as well as their pump lasers); (ii) novel technologies for ultra-intense lasers (such as grating and compressor modelling and fabrication, high-damage-threshold and ultra-broadband laser components, devices for spatial and temporal pulse control, diagnostics for ultra-intense lasers), and (iii) applications of ultra-intense lasers (such as laser acceleration, short-wavelength sources, attosecond sources, high-field physics and applications with extreme light). XCELS and IZEST as well as the efforts in individual institutions across the world.

Preparation for the conference is going forward at full speed. The Conference Co-Chairs, Dino Jaroszynski (U. Strathclyde, UK) and Tsuneyuki Ozaki (INRS, Canada), and the Technical Programme Committee Co-Chairs, Marco Borghesi (Queen's U. Belfast, UK), Hiromitsu Kiriyama (JAEA, Japan) and Christophe Dorrer (U. Rochester, USA) along with the 24 members of the Technical Programme Committee have been working hard to come up with an exciting conference programme. The list of confirmed invited speakers currently counts 16, who are all prestigious, world-renowned researchers from around the world. The conference website (www.icuil2016.org) was open for several months, and abstract submission was closed on the 25th of April. We have received enthusiastic 150 contributed abstracts from around the world, which underlines the strong interest and passion from the community. I have received many comments from the programme committee that there are numerous strong papers, and we are looking forward to organizing a conference with many exciting presentations.



In December 2015 the ICUIL community learned with deep regret about passing of one of its true leaders and colleague, Professor Wolfgang Sandner. Among his many illustrious roles (including Director of the Max Born Institute, Coordinator of Laserlab-Europe, President of the German Physical Society, and the General Director of the ELI-Delivery Consortium), Wolfgang served as Co-Chair of the ICUIL committee. To pay tribute to Prof. Sandner, the ICUIL 2016 conference will dedicate one of its plenary sessions in his honour. This special session is being organized by Dr. Catalin Miron of the ELI-DC, and will include invited speakers who worked closely with Wolfgang.

The ICUIL 2016 conference will be supported by many companies, agencies and universities one of which is the Institut national de la recherche scientifique (INRS). The Énergie Matériaux Télécommunications (EMT) Centre of the INRS is located about 20 minutes by car east of Montreal, focusing on research and development in the fields of ultra-fast optics, advanced materials, telecommunications and sustainable energy. The Centre offers a unique educational environment for its students, welcoming each year approximately 140 graduate and postgraduate students and 30 postdoctoral fellows. The Centre is also the host to the Advanced Laser Light Source (ALLS), an international laser user facility that houses an array of intense femtosecond lasers. This national laboratory for laser science was financed through the "International Joint Ventures Fund" program of the Canadian Foundation for Innovation (CFI) with an investment of $20.95 million. With the powerful lasers at ALLS, a series of new ultrafast light sources for revolutionary applications have been developed, with wavelengths from the terahertz regime (300 micron wavelength) to hard X-rays (Angstrom wavelength). Since these light sources are generated in an all-optical way, light pulses of different wavelengths can be spatially and temporally synchronized. This opens the door to explore the potential of dynamic imaging of atomic, molecular and condensed matter systems and provides the unique tools to explore the fundamental questions of physics and chemistry.

We look forward to welcoming many of you to the ICUIL 2016 conference this September!

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