International Committee on Ultrahigh Intensity Lasers - April 2018 Report to IUPAP

On behalf of the committee and as Chairman of the International Committee on Ultrahigh Intensity Lasers (ICUIL), I submit this report of ICUIL-related activities and events over the past 6 months to IUPAP.

The International Committee on Ultrahigh Intensity Lasers (ICUIL) was established in 2004 as an IUPAP working group devoted to the promotion and outreach of ultrahigh intensity laser capabilities around the world. By the committee's estimate there are approximately $5B of world wide projects and facilities today devoted to the creation and use of ultrahigh intensity laser capabilities.

On a biennial basis, ICUIL sponsors the International Conference on Ultrahigh Intensity Lasers. The 2018 meeting will occur in Lindau, Germany September xx to yy, 2018. The Lindau meeting will be the 8th in the ICUIL series. As with previous meetings, ICUIL 2018 will bring together both the developers of next-generation capabilities, the scientists that intend to use these capabilities and representatives from related industries. Efforts are being made at this year's meeting to assist student participation with a goal of also supporting student participation from traditionally under-represented regions, e.g. South America and Africa. More information regarding the 2018 meeting may be found via the conference web page at https://indico.gsi.de/event/6381/

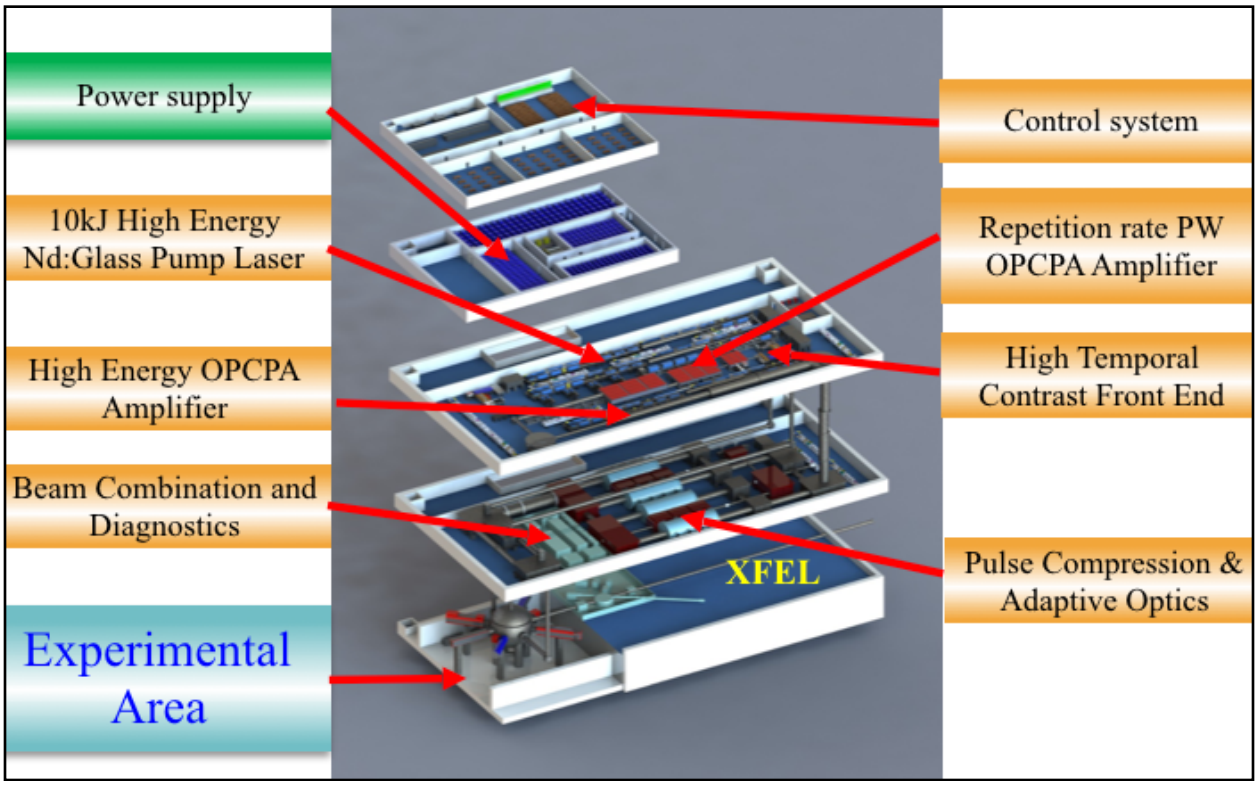
Several international, IUCIL-related activities of note have occurred over the past 6 months.

Chinese 100 PW laser project. China has recently put forth a plan to build in Shanghai a new, superconducting, 3-15 keV x-ray free electron laser facility, the Shanghai Coherent Light Facility (SCLF). As part of this facility a proposal was also made to include a Station of Extreme Light (SEL) which would house a 100 PW laser system that would be 10x more powerful than the largest system currently under construction and would enable unique, combined x-ray and FEL experiments.
An international review meeting for the Station of Extreme Light (SEL) under the Shanghai Coherent Light Facility (SCLF) was organized in Shanghai in July of 2017. The reviewing committee members included leading scientists from Germany, U.S.A, U.K., France, Japan, Canada and China. The committee reviewed the Conceptual Design Report (CDR) presented by the SEL working group led by Prof. Ruxin Li, the director of the Shanghai Institute of Optics and Fine Mechanics (SIOM) and a member of ICUIL.

The combination of the hard XFEL and a world-leading 100PW laser would initiate exploration of effects such as vacuum birefringence, one of the most prominent strong-field QED effects, acceleration mechanisms leading to ultra-high energy cosmic rays, simulation of black hole physics, and generation of new forms of matter. The explicit scientific pursuits set by SEL are of fundamental importance and may renew our knowledge on the nature of the vacuum or the interior of planets.

As a user facility, SEL will significantly broaden the research scope of an XFEL facility and create unique opportunities for new discoveries in many disciplines.

The SEL 100 PW laser system will be based on the optical parametric chirped-pulse amplification (OPCPA) approach to realize 1500J/15fs output, with a designed intensity of 10^{23} W/cm2. The SIOM group produced 5.3PW laser pulses last year with a Ti:sapphire based chirped-pulse amplification laser system, which is currently the highest laser pulse peak power achieved. According to the plan, the 100PW laser will be available in 2024.



Schematic layout of the 100 PW laser system at the Station of Extreme Light of the proposed Shanghai Coherent Light Facility.

US National Academies of Science Report. In December of 2017 the US National Academies released their report "Opportunities in Intense Ultrafast Lasers". (https://www.nap.edu/download/24939). This study surveyed worldwide high intensity laser activities and in particular investigated the science and motivation behind the $B-scale, high-intensity-laser, infrastructure projects ongoing or recently completed in Europe and Asia. The ICUIL world map of intense laser facilities (https://www.icuil.org/activities/laser-labs.html) was in part used to motivate this study and many members of ICUIL provided input.

Progress on Europe's ELI Projects. The Extreme Light Infrastructure (ELI) is a 800M euro European enterprise to create three world-leading, intense laser capabilities within the emerging countries of the EU. The ELI-Beamlines facility located in the Czech Republic aims to create beamlines of high repetition, state of the art, ultrahigh intensity laser capabilities that may be used to develop laser-driven secondary sources of energetic particles and radiation and to develop applications of these secondary sources. The ELI-Nuclear Physics facility in Romania,

aims to create the first 10 PW capability and to combine this capability with a world-leading, laser-Compton gamma-ray source and to devote these systems to the study of photon-based nuclear physics and applications, so-called “Nuclear Photonics”. The ELI-ALPS facility in Hungary aims to create few-femtosecond duration high intensity light and use these systems to create secondary soft x-ray sources of attosecond pulses for ultrafast materials studies. The three ELI facilities are being administratively combined into a European Research Infrastructure Consortium (ERIC) which will oversee operations and coordinate contributions from member countries. Over the past 6 months, the ELI-ERIC has been officially created and plans for its operation were presented to an international review committee in December of 2017. The overall capabilities of ELI will come on line over the next two years. Many members of the ICUIL have participated and continue to participate in the design, construction, administration or oversight of ELI.

Nuclear Photonics 2018. As mentioned above, the ELI-Nuclear Physics facility in Romania is designed to enable the pursuit of Nuclear Photonics, i.e. the photon-based investigation of nuclear physics and the photon-based development of nuclear applications, e.g. photon-based production of medical isotopes. In 2016 the international community with the participation of many from the ICUIL community, organized Nuclear Photonics 2016 as the first international conference specifically devoted to nuclear photonics. At the conclusion of the 2016 meeting the representatives of the ELI-Nuclear Physics project agreed to host Nuclear Photonics 2018 which will occur this June xx to yy in Brasov, Romania. Tours of the ELI-NP facility outside of Bucharest will feature prominently in the meeting agenda.

US Budget. In the United States (and in France, Japan and China) historically there has been a strong and synergistic connection between the ultrahigh intensity laser science and inertial confinement fusion (ICF) communities. Many of the highest intensity capabilities have been constructed at ICF facilities either to study related high energy density science (HEDS) or to provide ultrafast sources of x-rays and particles as probes of ICF experiments. The proposed US budget for FY19 suggested large cuts in US ICF activities that would have significantly impacted ICUIL-related projects and science in the US. Many in the ICUIL committee provided letters of support opposing these budget cuts which ultimately did not occur and in fact support for ICF in FY19 grew.

Russian Academy of Science. ICUIL’s co-chair, Dr. Alexander Sergeev of the Institute for Applied Physics in Nizhny Novgorod was elected in 2017 as the president of the Russian Academy of Science.

Sincerely,

Professor Chris Barty

Chairman of ICUIL