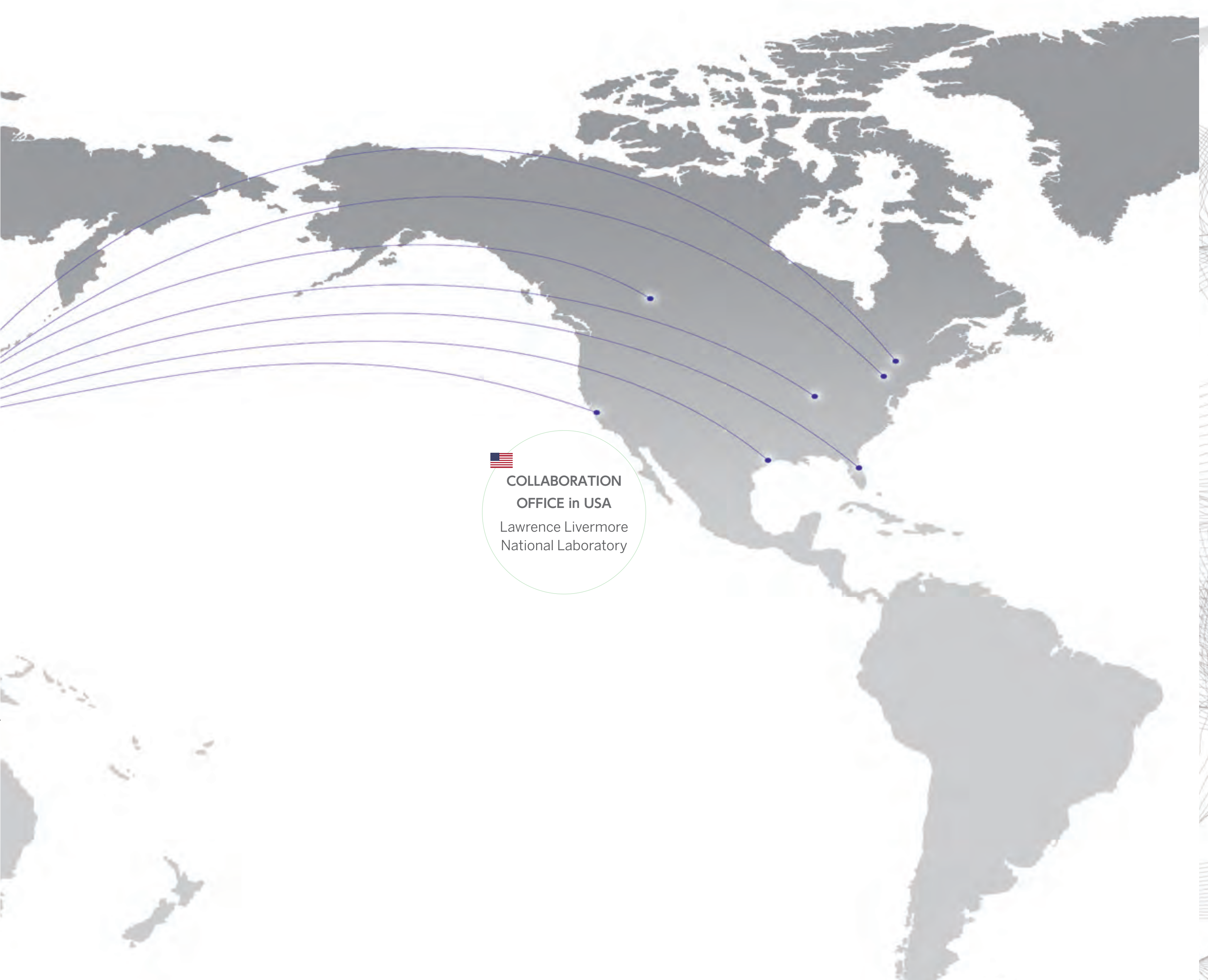
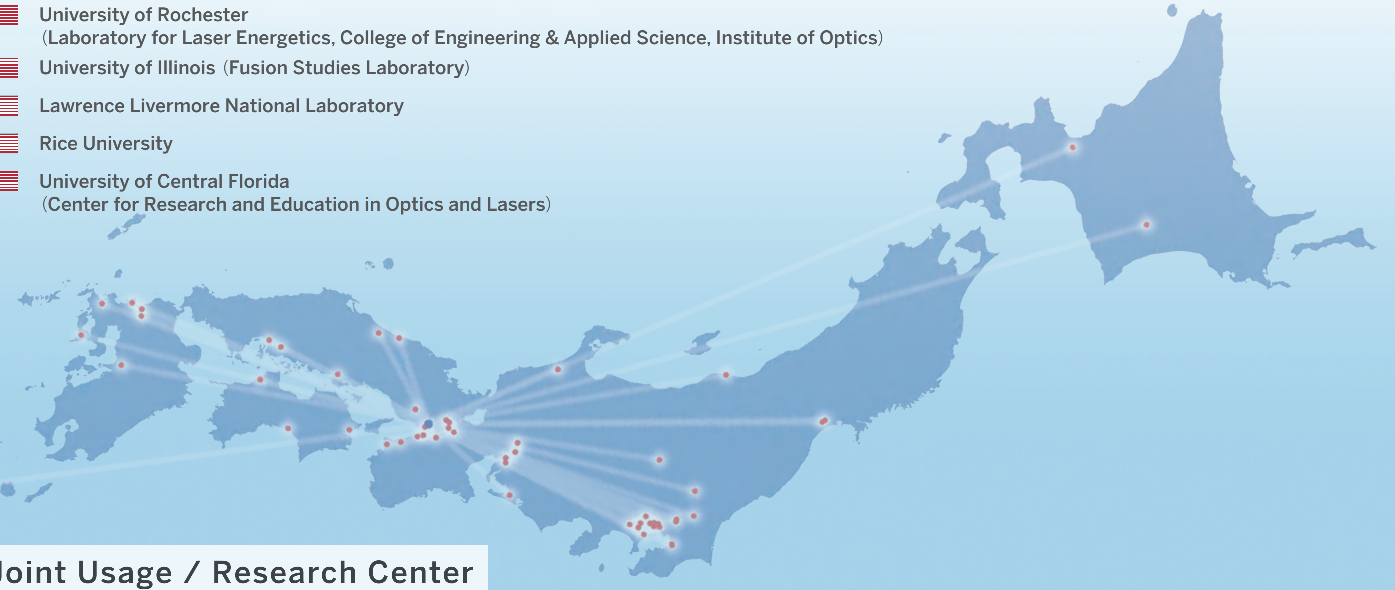


- University of Alberta (ALTECH Project) (Faculty of Engineering)
- National Research Council Canada
- University of Rochester
  (Laboratory for Laser Energetics, College of Engineering & Applied Science, Institute of Optics)
- University of Illinois (Fusion Studies Laboratory)
- Lawrence Livermore National Laboratory
- Rice University
- University of Central Florida
  (Center for Research and Education in Optics and Lasers)



Joint Usage / Research Center

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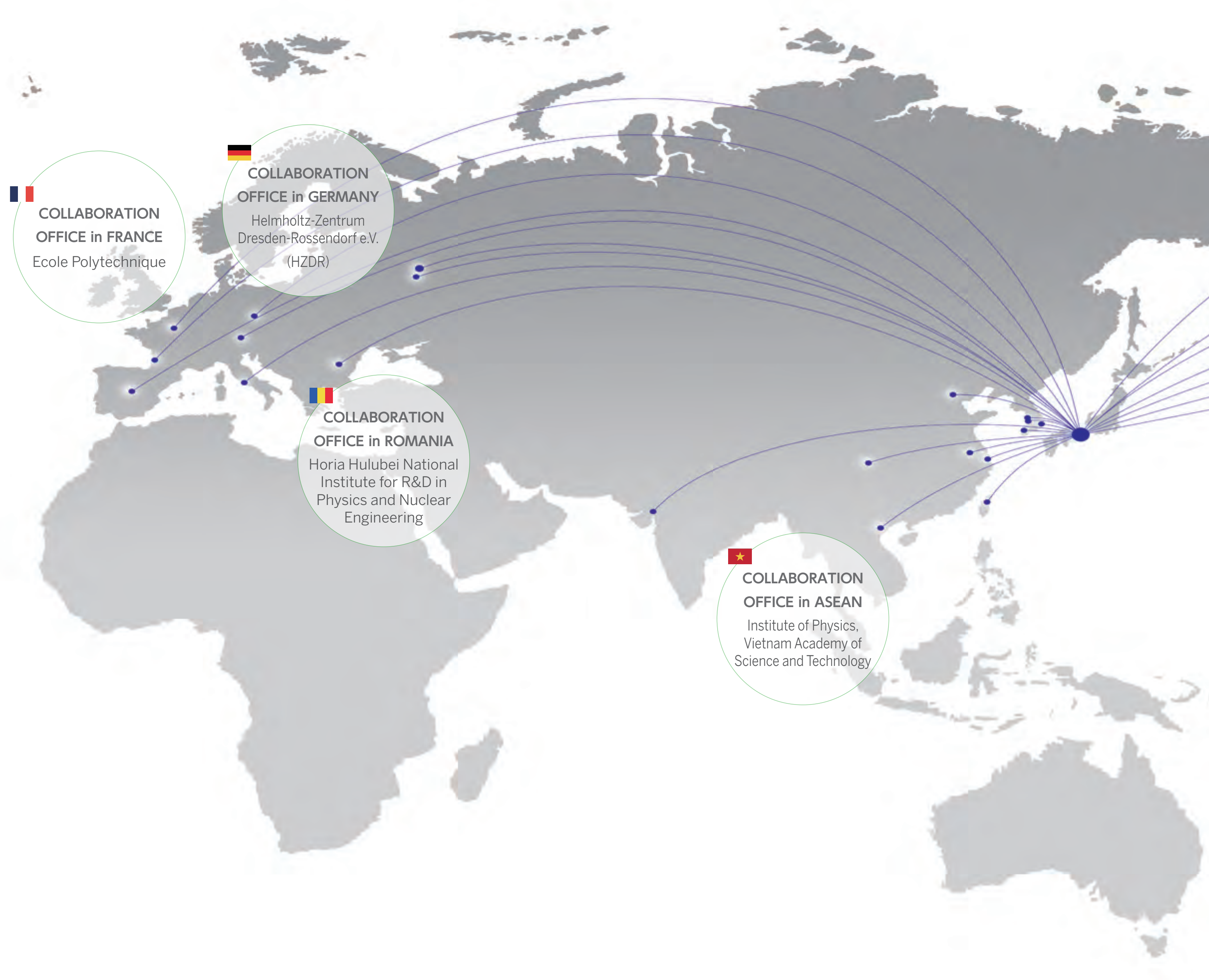
INSTITUTE OF LASER ENGINEERING
OSAKA UNIVERSITY

INSTITUTE OF LASER ENGINEERING, OSAKA UNIVERSITY



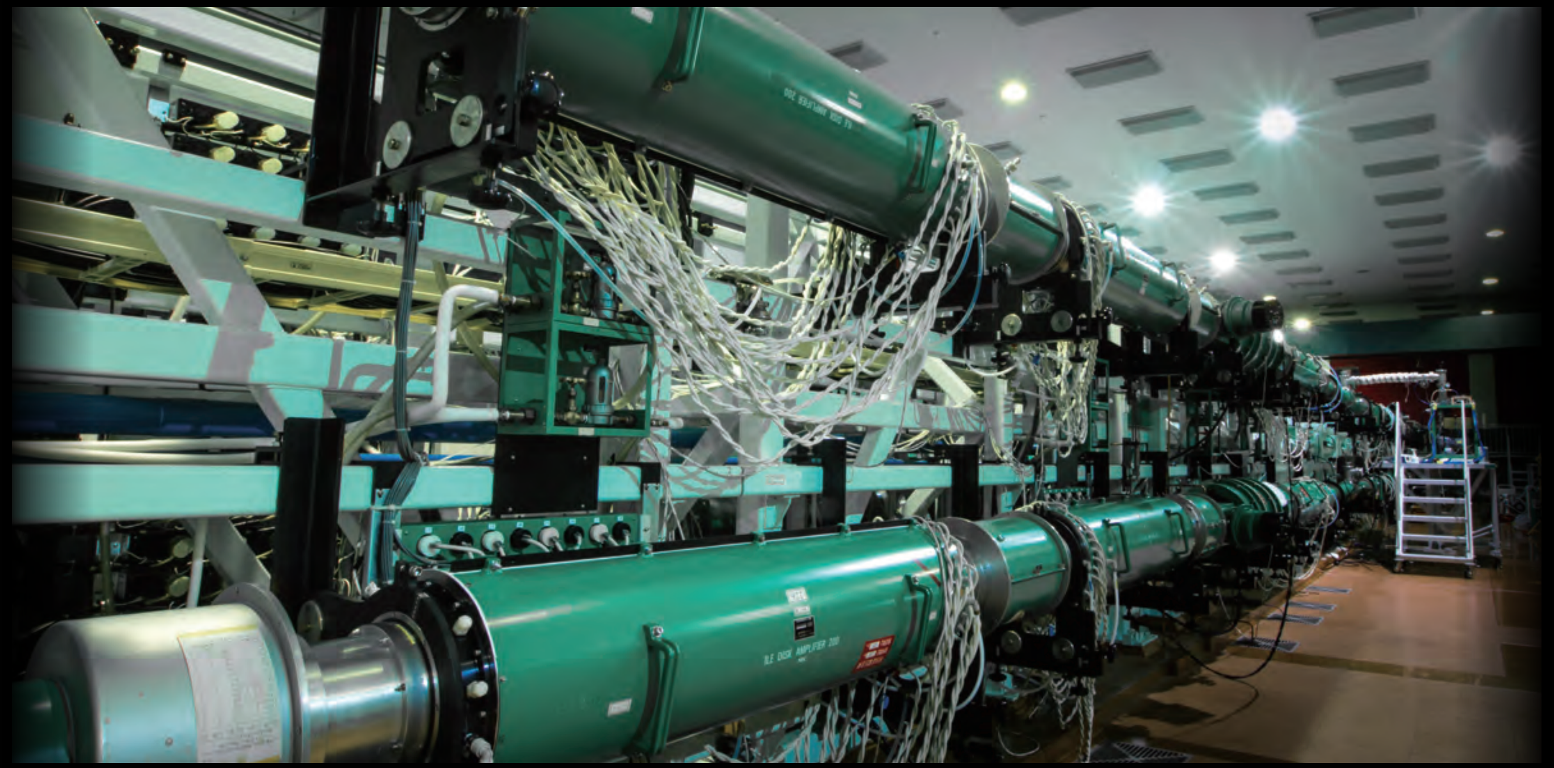
OSAKA UNIVERSITY

Academic Exchange Agreements with Universities and Research Institutes Abroad (As of 2018)

- Academy of Sciences of Russian Federation (General Physics Institute)
- Russian Academy of Sciences
- National Research Nuclear University MEPhI
  (Moscow Engineering Physics Institute)
- Helmholtz-Zentrum Dresden-Rossendorf e.V. (HZDR)
- Max-Planck-Institut für Quantenoptik
- Université Paris-Saclay
- Ecole Polytechnique
- University of Bordeaux 1 (Centre Lasers Intenses et Applications)
- Horia Hulubei National Institute for R&D in Physics and Nuclear Engineering
  (Extreme Light Infrastructure - Nuclear Physics)
- Università degli Studi di Roma "La Sapienza"
  (Dipartimento di Scienze di Base e Applicate per l'Ingegneria)
- University of Polytechnic Madrid
  (Escuela Tecnica Superior de Ingenieros Aeronauticos Espacio)
- Institute for Plasma Research
- Institute of Applied Physics and Computational Mathematics
- Nanjing University
- National Laboratory on High Power Laser and Physics
- Shanghai Jiao Tong University (Laboratory for Laser Plasmas)
- Southwest Institute of Nuclear Physics and Chemistry
- Institute of Physics, Vietnam Academy of Science and Technology
- National Central University (Department of Physics)
- Dankook University (Medical Laser Research Center)
- Laser Science Research Center,
  Korea Advanced Institute of Science and Technology
- Institute for Basic Science (Center for Relativistic Laser Science)
- Center for Advanced Meta-Materials
- Pohang Institute of Science and Technology
  (Pohang Accelerator Laboratory)
- Gwangju Institute of Science and Technology
  (Center for Electronic Materials Research)
- Korea Photonics Technology Institute (KOPTI)

INSTITUTE OF LASER ENGINEERING, OSAKA UNIVERSITY

Joint Usage / Research Facility



◀ GEKKO XII : The Most Powerful Laser System in Japan

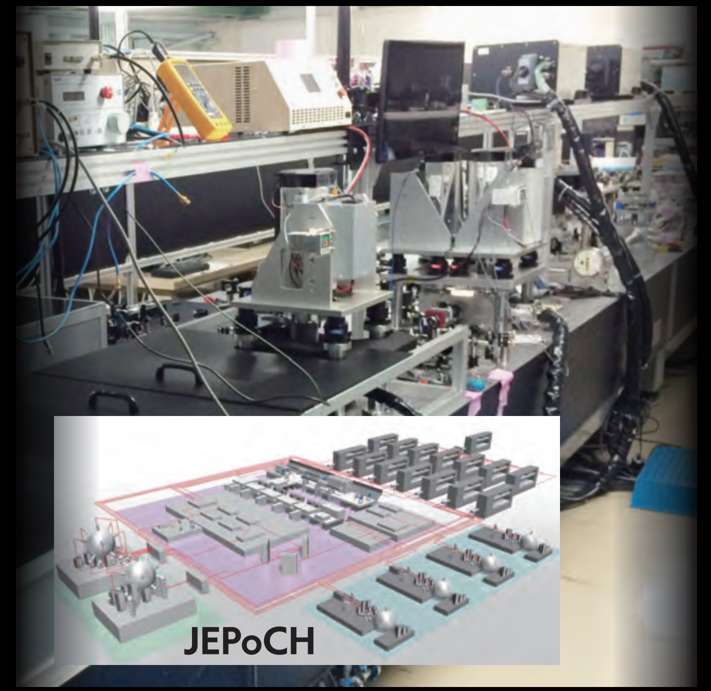
GEKKO XII is one of the world's largest laser systems in Japan. It consists of 12 beams which can accurately propagate a distance of 270 m from the oscillator to the focusing chamber with an accuracy of 0.01 mm or less and can freely control the pulse duration from 100 ps to 10 ns. The laser system enables experiments useful for both academia and industry such as laser nuclear fusion research, astrophysics, ultrahigh pressure physics, new laser processes, and creation of new field of sciences.

◀ LFEX : An Ultra Intense Laser System with the World's Highest Output Pulse Energy

The Laser for Fast Ignition Experiments (LFEX) is the world's most powerful picosecond laser in terms of output pulse energy. The output pulses are generated by the chirped pulse amplification method which stretches the pulse in time and spectra in the system. In 2009, LFEX was initially developed for research on laser fusion. In 2014, it started operating its four beam lines not only for laser fusion but also for academic and industrial research such as astrophysics and particle beam acceleration.

Experimental Vacuum Chamber Creating Extreme Conditions with Large-scale Lasers

At the center of the vacuum chamber with around 1-m radius, the twelve beams of the high-power GEKKO XII laser and the four beams of the ultra-intense LFEX laser are simultaneously focused on a target with high accuracy. This makes it possible to instantaneously create extreme conditions like those in the sun and supernova explosions with less than millimeter sizes.

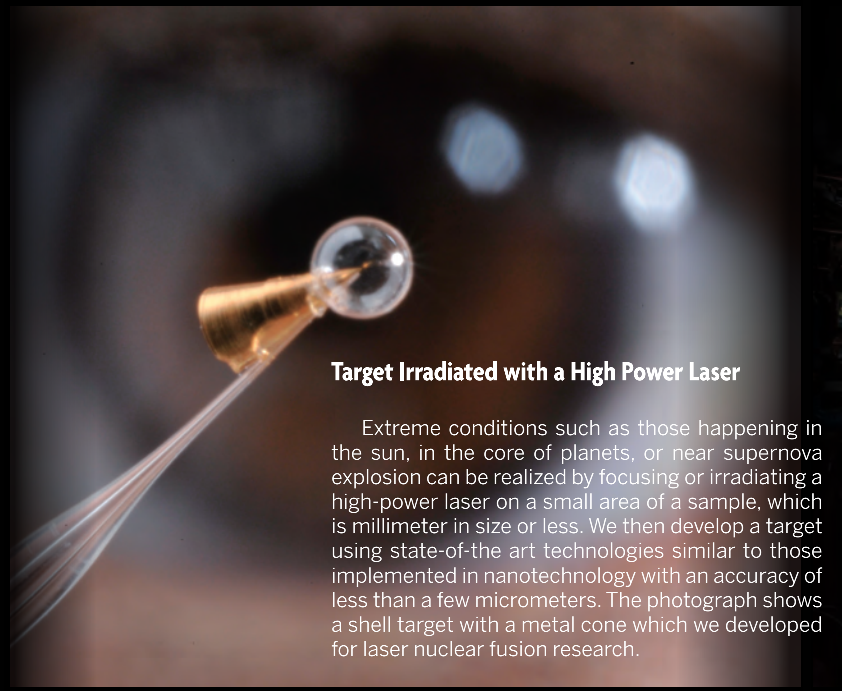


◀ Research Platform for Next-generation Large-scale Laser System (JEPoCH)

We are developing repetitive high-power laser for open research and open innovation to realize the next generation large scale laser systems. This advanced system under the Japan Establishment for Power laser Community Harvest (JEPoCH) initiative will exceed the average output power of 100 kW and will have high-power, ultrahigh-intensity, and laser quantum beam lines for academic and industrial applications.

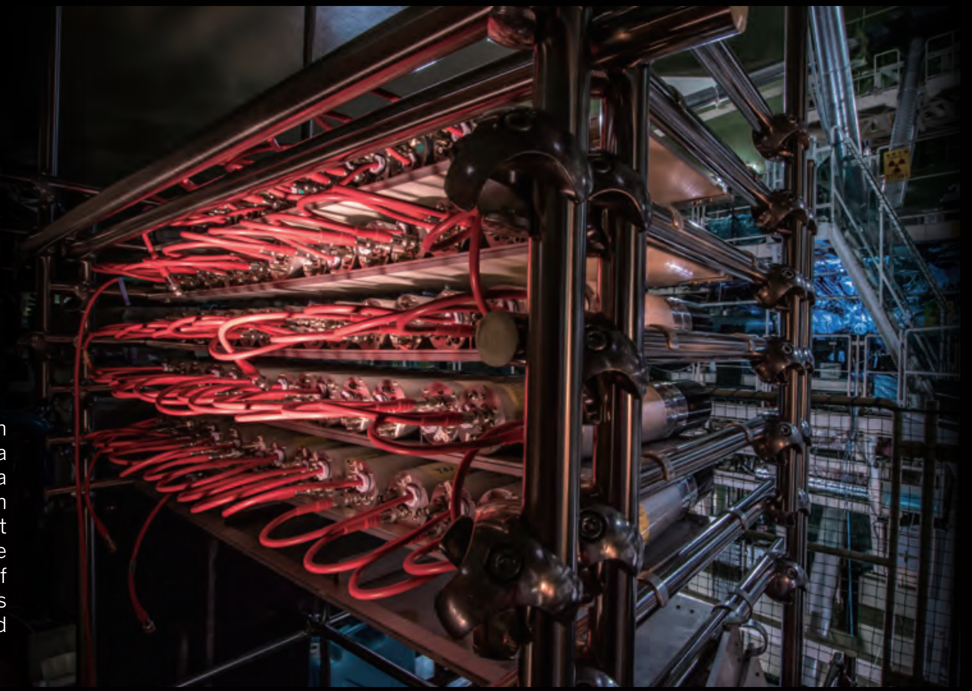
◀ HERMES Laser Facility Synchronized with XFEL

Materials which has never existed on earth before can now be produced by instantaneously creating an ultrahigh-pressure state. These ultrahigh-pressure conditions which exceeds 1 million atmospheres can be realized using a high-power laser such as the **Osaka High Energy density Revolution of Matter in Extreme States (HERMES) laser which is coupled with the XFEL and set near the SACLA facility in RIKEN.**



Target Irradiated with a High Power Laser

Extreme conditions such as those happening in the sun, in the core of planets, or near supernova explosion can be realized by focusing or irradiating a high-power laser on a small area of a sample, which is millimeter in size or less. We then develop a target using state-of-the art technologies similar to those implemented in nanotechnology with an accuracy of less than a few micrometers. The photograph shows a shell target with a metal cone which we developed for laser nuclear fusion research.



◀ MANDALA : Multi-channel Detector of Neutrons from Nuclear Fusion Reactions

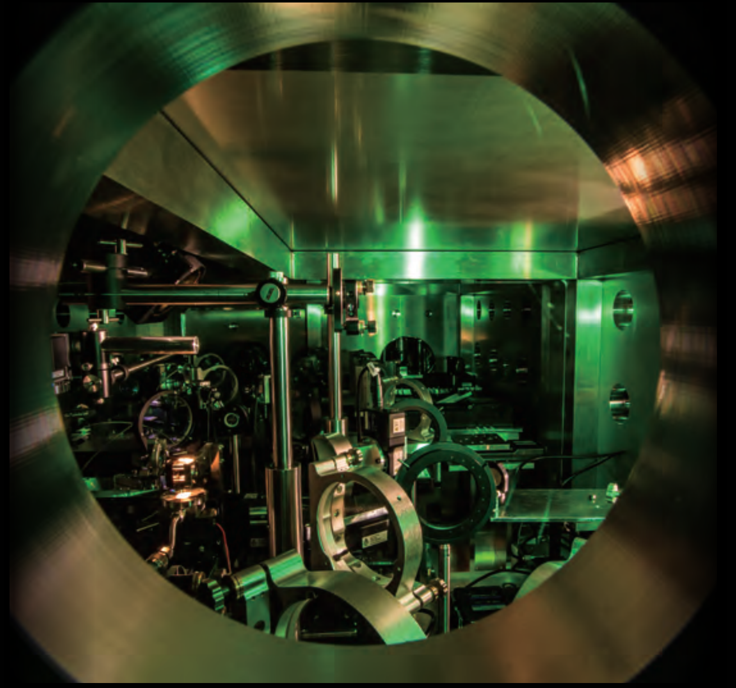
We can investigate high-density plasmas by measuring the neutrons generated by the nuclear fusion reaction. Neutrons are measured using scintillator materials which convert the absorbed energy from the neutrons into light and then into an electric signal. An accurate measurement is possible by acquiring a lot of neutron signals with multi-channel detectors as a compound eye. The Multiple Arrayed Neutron Detector at Large Area (MANDALA) has 960 eyes and can measure the neutron spectrum with several percentage accuracy to precisely investigate the ion temperature of high-density plasmas during a nuclear fusion reaction.

Large-aperture Laser Interferometer for Optical Quality Inspection

One of the key issues to fully exploit the performance of large laser systems is to accurately inspect optical devices such as large mirrors and lenses with a diameter up to 600 mm. We inspect all our optical components with a high precision of several tens of nanometers by using a large-aperture laser interferometer installed in a Class 100 clean room similar to a semiconductor factory.

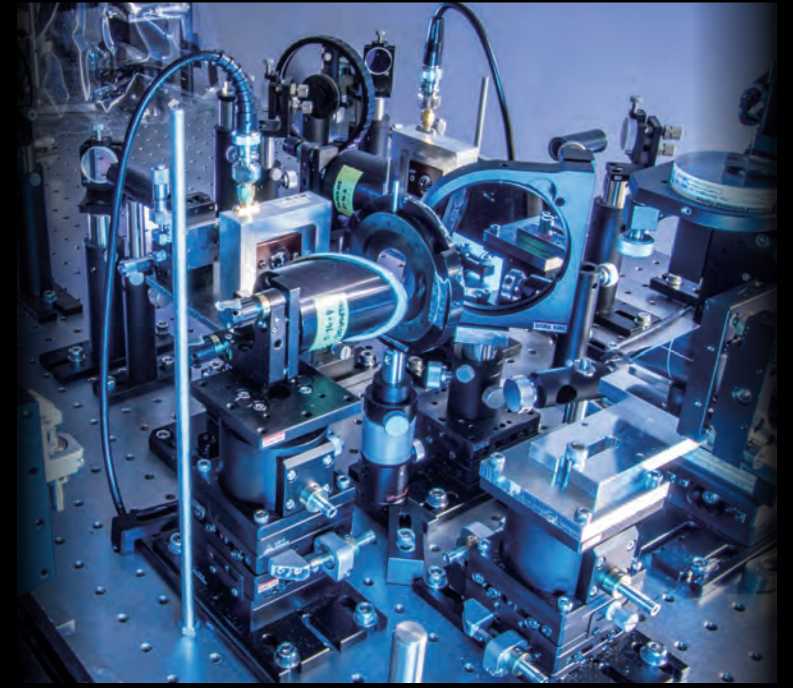
◀ High-performance Computer for Theoretical Simulations

The high-performance computer system can reproduce extremely small and ultrashort phenomena which are difficult to observe directly in experiments. The simulated phenomena and results can be visualized by computer graphics and can be analyzed by using artificial intelligence (AI) among others.



◀ Research Platform for Plasma Photonic Devices

We are developing a novel plasma photonic device for extreme states using a high-power laser. A significant progress has been made in the field of particle acceleration using laser Wakefield in plasmas. With the plasma device, we expect quantum leaps toward the next generation accelerators, i.e., the size of which will be reduced by a factor of 100 or more compared with the conventional ones, leading to an enormous impact on science and society.



◀ Terahertz Time-domain Spectrometer for Material Investigations

Various properties of materials are investigated using a time-domain spectrometer utilizing terahertz waves with lengths of 0.1 to 10 mm (0.03 to 3 THz) generated by a femtosecond laser. The terahertz time-domain spectrometer can be used to examine the material response such as carrier response in a semiconductor, molecular dynamics like rotation and vibration, ion acoustic wave or photon in material, and wave property representing magnetism due to electron spin (magnon).

◀ Compact Terahertz Spectrometer for Material Analysis

Solid and liquid materials such as semiconductors, dielectrics, and organic materials can be analyzed easily using a wide range of terahertz waves generated using organic crystals and fiber lasers.

◀ Ultrahigh-speed Camera for Vacuum Ultraviolet Spectroscopy

Capable of drawing fine patterns, short-wavelength light such as vacuum ultraviolet (VUV) is essential for developing advanced semiconductors and integrated circuits that require ultrafine structures. VUV light is also important for the exploration of new materials and efficient photo-chemical processes. To measure the temporal response of materials in VUV region, an ultrahigh-speed VUV spectrometer with a streak camera was developed under a collaboration with a company.