Guidelines for Application of
ILE Collaborative Research for FY2023 (2nd Term)

1. Outline of Call for Applications

We are looking for proposals for the Institute of Laser Engineering (ILE) collaborative research for the second term of 2023. Please select appropriate research field and research method from the followings when submitting the proposal.

Research Fields (Please refer to **10. List of Research Fields** for details.)

1. High Energy Density Science (Laser Astrophysics, High Pressure / Laser Earth & Planetary Science, High Magnetic Field Science, Quantum Beam Science, Plasma Science)
2. Laser Science and Optics (Terahertz Science, Power Laser Science, Laser & Optical Material)
3. Initiative (Physical Informatics)
4. General Subjects

Research Methods (Please refer to **11. List of Research Methods** for details.)

B1. Collaborative Research using Medium Size Lasers and Computer Code
B2. Individual Collaborative Research
C. Workshop related to High Energy Density Physics

When applying for a research application, please make sure to discuss the details of the research (experimental method, implementation period, purpose, and application subject) with the host researcher at ILE. The research period will be until February 26, 2024 after the notification of acceptance. For the adopted projects, we will support research funds up to 50,000 yen per project.

2. Schedule of Application

September 1, 2023	Start of accepting applications	Applicants enter application information and upload the application forms through the Collaborative Research Application System (https://collabo.ile.osaka-u.ac.jp/)
September 15, 2023	Application deadline	
September 16-22, 2023	Liaison Scientists application period	Liaison scientists enter application information through the in-house Collaborative Research Application System (collabo-local.ile.osaka-u.ac.jp/)
Mid October, 2023	Notification of screening results	Screening results are posted in the Collaborative Research Application System (reviewable by the principal investigator and the applicant)

We will not be able to replace or accept the application after the deadline.

3. Application Procedure

Please submit your proposal and the collaborator list through the Collaborative Research Application System

(https://collabo.ile.osaka-u.ac.jp/signin) on or before the due date. Please note that we do not accept applications by email. For the input items in the Collaborative Research Application System, please refer to **6. Application through ILE Collaborative Research Application System**.

For liaison scientists, please enter your application information during the designated period from the in-house Collaborative Research Application System (collabo-local.ile.osaka-u.ac.jp/).

Application form and collaborator list format

The application form (MS Word file) is different for each research method. Please use the latest format that matches your research method. In order to prevent garbled characters and image distortion when sending, please convert to PDF (maximum 20 MB) before submitting.

Please submit the list of collaborators in Excel file format. Please download the application form and collaborator list format from the following web page:

https://www.ile.osaka-u.ac.jp/eng/collaboration/application/index.html

4. Selection Process

Each submitted proposal will be evaluated and ranked by multiple judges. The Collaborative Research Technical Committee will deliberate the proposal based on the evaluation report from the judges. The screening will also consider matching and positioning of the submitted research field.

The Collaborative Research Committee will decide whether to accept or reject the proposal after the review by the Collaborative Research Technical Committee.

5. Confirmation Items for Collaborative Research Application

The principal investigator must make sure that the approval of the head of the research collaborator is obtained when applying. The confirmation method at that time may be written document, email, or verbal. In addition, there is no need to submit a written document to ILE.

Based on the above, each principal investigator and research collaborator should obtain the approval of their respective directors to become a collaborator at ILE when the application is adopted.

6. Application through ILE Collaborative Research Application System

Applications for collaborative research should be made through the Collaborative Research Application System (https://collabo.ile.osaka-u.ac.jp/). Please apply on or before the due date. Anyone can make an application, but please note that information of the principal investigator and the liaison scientist (host researcher at ILE) are required. For necessary information, see the following section **Enter application information**.

Login to the Collaborative Research Application System

Access the page https://collabo.ile.osaka-u.ac.jp/, enter your email address in the box labeled ‘Email address’, and click SIGN IN. A one-time password will be sent to the email address you entered. Log in with the password and the email address you entered.

Move to the web page for proposal application

Click “Proposal Application” on the top page to move to the proposal application page.

Enter application information

The proposal application page has the following items. Items marked with (*) are required items. Enter them, upload the application form at the end and click the submit button to complete the submission.

・Research Title
English*, Japanese

・Principal Investigator
E-mail address*, ILE-ID, Full Name*, Name in Japanese, Institution*, Position*, Post address*, TEL

・Liaison Scientist Select from the list*
・Research Field Select from the list*
・Research Method Select from the list*

・Necessary Funds (JPY)
Enter the amount in Japanese yen*

・Facility (Only for Research Method B1)
Select one of the facilities (medium size lasers and computer code) from the list*

・Status of application / recommendation for the Osaka University Kondo Prize
Please select from the list whether you have applied / recommended someone for the Kondo Prize*

7. About Presentation of Research Results

For the adopted projects, it is required to submit a report on the results at the end of the fiscal year, and also to report on the results at “OPTO Symposium on Photon and Beam Science”. Please refer to “Annual Report” in the following webpage: https://www.ile.osaka-u.ac.jp/eng/collaboration/format/index.html

When you present the collaborative research results externally, please specify that the research is an ILE Collaborative Research. For details, please refer to the following webpage: https://www.ile.osaka-u.ac.jp/eng/collaboration/logo/index.html

8. Use of Personal Information

Except when required by law, we will not use or provide personal information for any purpose other than the purpose of use without obtaining the prior consent of the person. For details, please see the Osaka University Privacy Policy (https://www.osaka-u.ac.jp/en/guide/information/kojinjoho).

9. Contact Information

Quadruple Matrix Center
e-mail: kyodokenkyu@ile.osaka-u.ac.jp

- For research activities and accepted researchers at ILE, please refer to “Research” and “ILE Groups” on the ILE website (https://www.ile.osaka-u.ac.jp/eng/). The Osaka University Researcher Directory (http://www.dma.jim.osaka-u.ac.jp/search?m=home&l=en) can be used to view the data of all faculty members at ILE.
- Please refer to “Collaborative Research” on the ILE website (https://www.ile.osaka-u.ac.jp/eng/collaboration/application/index.html) for procedures after the selection.

10. List of Research Fields

1. High Energy Density Science

Laser Astrophysics (Representative: Masahiro Hoshino (Professor), Contact scientist: Youichi Sakawa (Associate Professor))

Utilizing high-temperature, high-energy-density, and ultra-high flow-velocity plasmas observed only in the Universe, we aim to understand plasma physics and astrophysics using large-energy/high-power lasers in the laboratories. Many astrophysical phenomena such as collisionless shock generation, magnetic reconnection, plasma-jet collimation and instabilities are related to explosion and instantaneous energy-release. We simulate these phenomena in the laboratory using pulse lasers. Relativistic laser astrophysics, such as electron-positron plasma generation and particle acceleration using high-intensity lasers, is also an important topic of interest.

We also study theory and simulation on these topics shown above.

(a) Laser Plasma Astrophysics: Experiment
(b) Laser Plasma Astrophysics: Theory/Simulation

High Pressure / Laser Earth & Planetary Science (Representative: Toshimori Sekine (Professor), Contact scientist: Keisuke Shigemori (Professor))

High-energy lasers can generate extreme pressure and temperature conditions beyond the limit of traditional high-pressure apparatus such as large volume press, diamond anvil cell, and light-gas gun. It can be applied to study physical properties of the Earth and planetary materials, as well as various impact phenomena of planetary surfaces. We investigate the EOS of shocked materials, high-pressure phase transitions, physical properties of solids and liquids, deformation and breaking mechanism, acceleration and impact process, degassing and vaporization of shocked materials, synthesis and chemical reaction of prebiotic materials, gravitational instability simulating core formation, and so on, using newly developed in-situ measurements and recovery methods to clarify the formation process, internal structure and evolution of the Earth and other planets including Super-Earths.

(a) In-situ Measurements of Shock-compressed Materials
(b) High-speed Impact and Recovery of the Sample

High Magnetic Field Science (Representative: Joao Santos (Dr.), Contact scientist: Shinsuke Fujioka (Professor))

The combination of laser-produced strong magnetic field and high-energy-density plasma can open a novel field of plasma physics. The objectives of this subject are to develop an experimental platform utilizing 100 kT and to build domestic and international networks. We welcome your proposals to develop novel generation schemes of strong magnetic field, to control generation and transport of laser-accelerated beams, to understand high-energy-density-plasma physics under the strong magnetic field, and to apply the strong magnetic field to ICF and MCF plasmas. We also welcome interdisciplinary proposals, for example, plasma propulsion with strong magnetic field and x-ray spectroscopy under strong magnetic field for x-ray astronomy applications.

Quantum Beam Science (Representative: Takehito Hayakawa (Guest Professor), Contact scientist: Yasunobu Arikawa (Associate Professor))

Laser-produced plasma generates high energy particles, including ions, electrons, neutrons, and intense radiative emission ranging from extreme ultra violet (EUV) to gamma-ray. This research project aims to investigate Laser Quantum Beams mentioned above, especially on its generation mechanism, energy scaling, demonstration of applications, and improvement of performances (e.g., generation efficiency, monochromaticity, highest energy, stabilization, control of emittance, etc.). This research project will be collaboratively carried out by a few groups using facilities at ILE and possibly at other institutions. Major subjects will be

(a) Laser-driven Particle Acceleration and Neutron Generation and Applications
(b) Laser-driven x- or gamma-rays and Applications
(c) Laser-driven Nuclear Physics and Application

Plasma Science (Representative: Ryosuke Kodama (Professor), Contact scientists: Yasuhiko Sentoku (Professor))

A research proposal on plasma science related to high energy density science excluded in the above subjects is welcome for both theoretical and experimental research.

2. Laser Science and Optics

Terahertz Science (Contact scientist: Makoto Nakajima (Associate Professor))

The development of terahertz (THz) devices such as terahertz emitter, detector, and other THz components will be performed. Various applications of THz waves using femtosecond pulsed laser such as THz time domain spectroscopy and THz imaging will also be investigated. THz properties of semiconductors, superconductors, magnetic materials, biological materials, and nonlinear optical crystals, etc. can be evaluated and utilized for THz devices. Superconducting photonics and strongly correlated electron photonics will be explored using these devices, together with the application of metamaterials which are new artificial materials to THz technology.

(a) THz Technology
(b) Superconducting Photonics and Strongly Correlated Electron Photonics
(c) Metamaterials

Power Laser Science (Contact scientist: Akifumi Yogo (Professor))

Novel techniques and technology for the next high power laser operation with a high pulse energy and repetition

rate are required for the advancement of science, medicine, and industry. In addition, the introduction of information and communication technology (ICT) such as AI and IoT into the next power laser increases and extends application fields due to its autonomously controlled operation for multiple purposes.

(a) Basic technical elements and technology for the next high power laser
(b) Phase, wavefront and spectral control
(c) Introduction of ICT into the next power laser and its operation

Laser & Optical Material (Contact scientists: Nobuhiko Sarukura (Professor) and Masashi Yoshimura (Professor))

Next-generation light sources open infinite possibilities in optical technology for basic and applied research from environmental monitoring to high-power laser development. For example, ultrashort optical pulsed lasers in the ultraviolet (UV) to deep ultraviolet (DUV) region can be used for material processing and gas sensing applications. We are then investigating various laser and optical materials, both experimentally and theoretically, such as oxide and fluoride glasses, crystals, and nanostructures. We aim to (1) develop and characterize novel optical materials, (2) understand their properties and applications, (3) reduce detrimental crystal defects, (4) develop damage-resistant lenses, windows, and scintillators, and (5) realize high-power DUV lasers and processing machines. Together with researchers inside and outside of Japan, the general topics of our research include:

(a) Deep ultraviolet lasers
(b) Laser and optical materials research
(c) Terahertz studies and applications

3. Initiative

Physical Informatics (Contact scientist: Hideo Nagatomo (Associate Professor))

Data that grows with the advancement of simulation and experimental measurement methods will be applied to information science to deepen understanding of physical phenomena, which can lead to new discoveries. Alternatively, we will conduct research such as improving the controllability of laser plasma. (If you want to link with this cross-cutting field even if you are applying in another field, please enter "Please link in the physical informatics field" in the remarks column when applying.)

4. General Subjects

The theme is based on a free conception of the researcher to use the device and the calculation code, etc. The application is examined/evaluated every single fiscal year.

11. List of Research Methods

B1. Collaborative Research using medium size Lasers and computer code

Collaborative research is also designed to promote advanced research with host researchers using medium-size devices. When submitting multiple applications for Research Method B1 or B2, please indicate both the differences from the other applications in your application form.

Terahertz Spectroscopy System (Contact scientist: Makoto Nakajima (Associate Professor))

Application of Terahertz waves (0.05–4THz) such as spectroscopy, sensing, imaging, and devices can be performed in the collaborative research.
We can offer the spectroscopy from terahertz region, infrared region (FT-IR), to visible region hence having the range of 350nm – 6mm (0.2meV – 3.5eV).
Target: Semiconductors, insulators, magnetic materials, biological materials, metamaterials, etc.

- THz time domain spectroscopy (THz-TDS) can be performed.
- THz imaging, Polarization measurement, Temperature dependence (4K-750K), Femtosecond or Picosecond Time resolved spectroscopy with THz and optical pulses,
- High intensity THz excitation measurements such as nonlinear optic phenomena.

Please contact us (M. Nakajima) about the measurement of THz wave.

If you apply for collaborative research using this system, please contact the person in-charge in advance:

Makoto Nakajima (Associate Professor) E-mail: nakajima.makoto.ile@osaka-u.ac.jp
Acceptance Research Group: Ultrabroadband Photonics (UP)

Optical property evaluation of laser systems (Contact scientist: Nobuhiko Sarukura (Professor))

Supported collaborative research themes:

- Search for solid-state laser
- Search for nonlinear optical materials
- Search for scintillator materials
- Development of new optical elements
- Search for new terahertz functional materials
- Development of measurement and technology in the new wavelength range

Available equipment for the research themes stated above

- Vacuum ultraviolet-infrared streak camera
- Titanium sapphire regenerative amplifier
- Q-switched YAG laser
- THz spectroscopy system
- Fluorine laser

etc.

If you apply for collaborative research using this system, please contact the person in-charge in advance:

Nobuhiko Sarukura (Professor) E-mail: sarukura.nobuhiko.ile@osaka-u.ac.jp
Acceptance Research Group: Laser Advanced Material (LAM)

Terahertz (THz) wave measurement system (Contact scientist: Masayoshi Tonouchi (Professor))

THz time-domain spectroscopy (THz-TDS) and laser THz emission spectroscopy on various materials (semiconductors, dielectric materials, oxides, organic materials, etc.) are possible in temperatures down to about 10 K
In addition to these measurements, laser terahertz emission microscopy (LTEM), time-resolved pump-probe THz imaging & spectroscopy, and broadband (~7 THz) THz-TDS measurement, etc. can also be performed. Please contact us for details.

If you apply for collaborative research using this system, please contact the person in-charge in advance:

Masayoshi Tonouchi (Professor) E-mail: tonouchi.masayoshi.ile@osaka-u.ac.jp
Acceptance Research Group: TeraHertz Photonics (THP)

High-Performance Computer System (Contact scientist: Hideo Nagatomo (Associate Professor))

Supercomputers

In laser plasma researches, simulation study using supercomputers is becoming important. For example, simulations can be executed relatively easier even for problems that are experimentally challenging, so we will perform a simulation study first. Sometimes it may lead to new discoveries in the process. It is also important to predict the target design and experiment results based on the simulation before performing the experiment. Simulation study also plays an important role in the early stages of experimental research, such as improving the quality of experiment measurement.

NEC SX-ACE Specification
Main Memory: 2 TB
Node: 32 Nodes 4 Cores/Node
Performance: 8.1 TFLOPS

Computational Simulation Code

In order to investigate the high energy density physics generated by high power lasers, computational simulation codes have been developed. As a collaborative research base, some of the simulation codes can be used for joint collaborative research by comparing various experiments and simulation. There are radiation hydrodynamic codes and Particle-in-Cell codes for relativistic laser plasma interaction. In order to select the appropriate simulation code for each problem, specialists are available for consultation.

If you apply for collaborative research using this system, please contact the person in charge in advance:

Hideo Nagatomo (Associate Professor) E-mail: naga@ile.osaka-u.ac.jp
Acceptance Research Group: Physics Informatics (PIF)

B2. Individual Collaborative Research

Collaborative research promotes advanced research with the host researcher using equipment other than those mentioned above. It is desirable to develop into Research Methods A and B1. When submitting multiple applications for Research Method B1 or B2, please indicate both the differences from the other applications in your application form.

C. Workshop related to High Energy Density Physics

To hold a study group to link research development in the field of laser energy science.