Call for proposals for experiments on the LMJ-PETAL laser facility from the Academic Community

ILP (Institut Lasers et Plasmas), CEA (Commissariat à l’Energie Atomique et aux Energies Alternatives) and Région Aquitaine invite research groups from the Academic Community to submit proposal for experiments to be performed on the LMJ/PETAL laser facility starting in 2017.

Context:
The LMJ-PETAL laser facility is becoming operational at the CESTA site of CEA at Le Barp near Bordeaux in 2016. In 2017 the facility will be open for scientific access to academic research groups.

Topics:
Researchers may apply for time on LMJ-PETAL to execute experiments in any area of science accessible on such facility and in particular in the 4 following topics:
1) Study of physics of direct drive approach to Inertial Confinement Fusion for the production of energy, including shock ignition and fast ignition.
2) High Energy Density Physics, including studies on matter in extreme pressure conditions.
3) Laboratory astrophysics, including nuclear physics in plasma environment.
4) High Energy Physics.

The ILP (Institut Lasers et Plasmas), which federates the French research groups working on the physics of laser produced plasmas, has taken the initiative of organizing several working groups in order to define the “Scientific Case” for Academic research on LMJ-PETAL for the 10-15 years to come. Submitted proposals will be judged also taking into account their coherence with the priorities for research on the installations defined within such scientific program.

However, proposals on any other subjects can also be submitted and will be evaluated on the basis of their scientific interest and feasibility.

Academic Access:
Experiments will be approved on a two-year basis. Selected experiments will be given a few laser shots in the first year, intended to demonstrate the feasibility of the experiment and debug any possible problems related to target design and diagnostics. On the basis of the results of the campaign of the first year, and subject to peer-review, more laser shots will be assigned on the second year.

We expect to select 3 successful proposals for the first year of operation (2017) each with a number of shots typically limited to 3-4. The call for proposals will regularly be issued on an annual basis. For the second year (2018) we will select 3
new proposals plus the continuation of the 3 proposals from the previous year (if all successfully reviewed).

The number of available laser shots, and the number of selected proposals (and possibly of laser shots allocated to each selected proposals) are expected to increase steadily as the facility enters in full operation in following years.

Successful applicants will be partnered with a facility liaison scientist who will help match the experimental goals with the facility’s capabilities, and facilitate the fielding of experiments on LMJ-PETAL.

Direct financial support for experiments is not available. Successful applicants will need to use the standard diagnostics provided by the facility and to be able to independently support target fabrication.

Proposals will be judged on their scientific merit and technical achievability. Proposals will be judged solely on the basis of their quality as fundamental science. The expected results of the experiment must be of significant interest.

The solicitation is open to international consortia of scientists from academic community. In all case, the Principal Investigator (PI) must be a scientist from an Academic Institution within the European Union. No proposals having a direct relevance for defense issues can be submitted.

All researchers involved in LMJ-PETAL experiments will be required to follow the policies and procedures jointly established by CEA and ILP regarding site access, computer use, and related topics.

Applicants are free to submit as many applications as they wish. A separate proposal must be submitted for each proposed campaign.

**The Facility:**

**LMJ (Laser Megajoule),** developed by the CEA, is under construction at the CEA/CESTA site (Centre d'Etudes Scientifiques et Techniques d’Aquitaine). It will include 176 beams and deliver 1.3 MJ of 0.35 µm light on targets. LMJ is designed to provide the experimental capabilities to study High Energy Density Physics (HEDP), and will be a keystone of the French Simulation Program.

**PETAL (PETawatt Aquitaine Laser)** is the short-pulse high-intensity companion of LMJ. PETAL has been funded by the Region Aquitaine, the French Ministry of Research and the European Union. The Region is the contracting owner of the PETAL facility, the CEA is the project manager and the prime contractor of PETAL, and the technical and scientific assistance is provided by the ILP. PETAL is also part of the “Pole de compétitivité” «Route des lasers» (one of the French “excellence clusters”) and it is intended to be the main French contribution to the European project HiPER (European High Power laser Energy Research facility).

PETAL is a short-pulse PETAL (500 fs to 10 ps) ultra-high-power, high-energy beam (3.5 kJ compressed energy, limited to 1 kJ on target in the first years of operation)
THE INITIAL CONFIGURATION of the LMJ/PETAL facility available for Academic experiments in 2017 will include 16 beams each delivering a typical energy of 5 kJ (max. 7.5 kJ per beam) and coming on target approximately in the same plane, as shown in the figure. PETAL will come at 90° with respect to LMJ beams and its initial energy on target will be limited to 1 kJ in 0.5 ps (due to damage threshold of the mirrors used for the final beam delivering). Typical focal spots will be a few hundreds µm in diameter. For more details, see the “User guide” (see link below).

Both the number of available LMJ laser beams and the energy on target delivered by PETAL will increase in time up to the final design values.

![Diagram of LMJ/PETAL facility](image)

**DIAGNOSTICS**: Several diagnostics will be available for first Academic experiments in 2017. These will include:

**DIAGNOSTICS developed within the PETAL+ project.** The PETAL+ project is an “Equipex” funded by ANR (the French national Agency for support to Research) and managed by the University of Bordeaux. Under this project, research groups from the French Academic Community (Universities, CNRS) and from CEA have collaborated to develop several diagnostics tools:

- **A radiography tool**: A box installed close to the LMJ chamber centre, which will contain a stack of RCF films (or IPs) separated by different filters to provide the plasma radiography at different proton energies;

- **SEPAGE**: A two-channel electron, ion and proton spectrometer, corresponding to low- and high- energy ranges (response [0.1-20] MeV and [10-150] MeV), based on Thomson parabolas for ions/protons discrimination and energy spectra measurements;

- **SESAME**: A set of two identical magnetic spectrometers attached to the LMJ chamber wall to detect both protons and electrons (above 4-5 MeV) to determine the angular distribution of the charged particles from the PETAL target, one at 0° and one at 40° with respect to the PETAL axis.

- **SPECTIX**: A two-channel hard photon spectrometer based on a Cauchois-type transmission optics with: Energy range: 6 to ~ 100 keV, Resolving power: ≥ 300 (except for the lowest energies in the range), Signal dynamics: $10^{10}$ to $10^{13}$ photons/sr
DIAGNOSTICS developed by CEA: over 30 diagnostics are considered with high spatial, temporal and spectral resolution in the optical, X-ray, and nuclear domains. Plans for LMJ diagnostics began with LIL laser facility and rely on decades of expertise in the design, fabrication and commissioning of advanced plasma diagnostics. The OMEGA laser facility has also been used and will continue to be the test bed for the development of CEA nuclear diagnostics. The early diagnostics, designed using the feedback of LIL’s diagnostics, consist of:

- four hard and soft X-ray imaging systems (30 eV to 15 keV range) with a 15 to 150 µm spatial resolution and a 30 to 100 ps time resolution, providing 30 imaging channels,
- a diagnostic set for hohlraum temperature measurements including an absolutely calibrated broadband X-ray spectrometer, a grating spectrometer, a time resolved imaging system of the emitting area,
- an optical diagnostic set dedicated to EOS measurements including 2 VISAR (Velocity Interferometer System for Any Reflector), 2 SBO (Shock Break Out), a pyrometer and a reflectivity measurement,
- a Full Aperture Backscatter System, and a Near Backscatter Imager to measure the power, spectrum, and angular distribution of backscatter light to determine the energy balance.

The main characteristics of the first set of diagnostics are described in the User guide (see link below).

How it works:
This is a two-stage call. Letters of Intent (LOI) are due by October 31, 2014. This will be followed by an invitation to submit a full proposal. The LOI should be no more than four pages long, following the attached template, and will need to include the following information:

1. **Title** (name of proposed experiment)
2. **Scientific discussion:** Describe the purpose for the proposed experiment, the key scientific questions that are addressed, the proposed experimental method (including laser energy and beam configuration), and expected results.
3. **Experimental feasibility:** Describe the degree to which the experiment is uniquely suited to LMJ-PETAL and the feasibility of LMJ-PETAL for conducting the proposed work. Please indicate where related experiments have been and/or will be done on other facilities.
4. **Required capabilities and resources:** Provide a short (approximately one paragraph) estimate of the capabilities and resources required within and external to LMJ-PETAL to execute the experiment, including required diagnostics. Include any additional information on target alignment requirements. More detailed resource information will be requested for those asked to submit full proposals.

In addition to the 4 pages, the proposal should contain all information on the experimental team: Identify the Principal Investigator (PI) and collaborators. Note that the PI has specific responsibilities for governance of data and publications on behalf of the team. For each individual, list: Full name; Affiliation; E-mail address; Phone number
Proposal Review: Letters of Intent will be reviewed by the International Scientific Advisory Committee of PETAL (SAC-P) charged by ILP with the task of reviewing and selecting proposals. For this goal, the SAC-P will be joined by scientists from CEA/CESTA in order to judge for the feasibility of the experiments and the compatibility with LMJ-PETAL set-up and the available diagnostics tools.

PI of selected proposals will be invited to submit a full proposal, which will need to include:
1) a detailed plan of use of the diagnostics available on LMJ-PETAL,
2) a detailed target design, including specification on how the targets will be produced and funded,
3) detailed results from numerical simulations showing that the proposed experiment will likely work,
4) a clear indication of preliminary experimental steps to be conducted on intermediate laser facilities in order to assure the success of the experimental campaign on LMJ-PETAL.

Due to the limited number of shots available for Academic Research, and to their high cost, experiments on LMJ-PETAL must be considered as the arrival point of experimental campaigns starting on smaller scale laser facilities. It is expected that the basic ideas of the experiments, and their feasibility, be tested on smaller laser facilities before proceeding to experiments on LMJ-PETAL.

Full proposals are expected to be submitted by beginning 2015 and final selection will take place shortly afterwards. Between the final approval of the experiment and its realization in 2017, 3 readiness reviews will be conducted in front of a small highly qualified panel jointly appointed by ILP and CEA for each of the selected proposal. Such panel will verify the progress of the proposing consortium towards the realization of the experiment. Whenever no progress is made in terms of providing target design, computer simulations, diagnostics use plan, the panel will give indication to SAC-P and ILP to postpone or cancel the experiment. The number of shots assigned to such experiment will be re-assigned to proposals in a waiting list (after the first readiness review) or to the other successful proposals (after the second and third reviews).

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