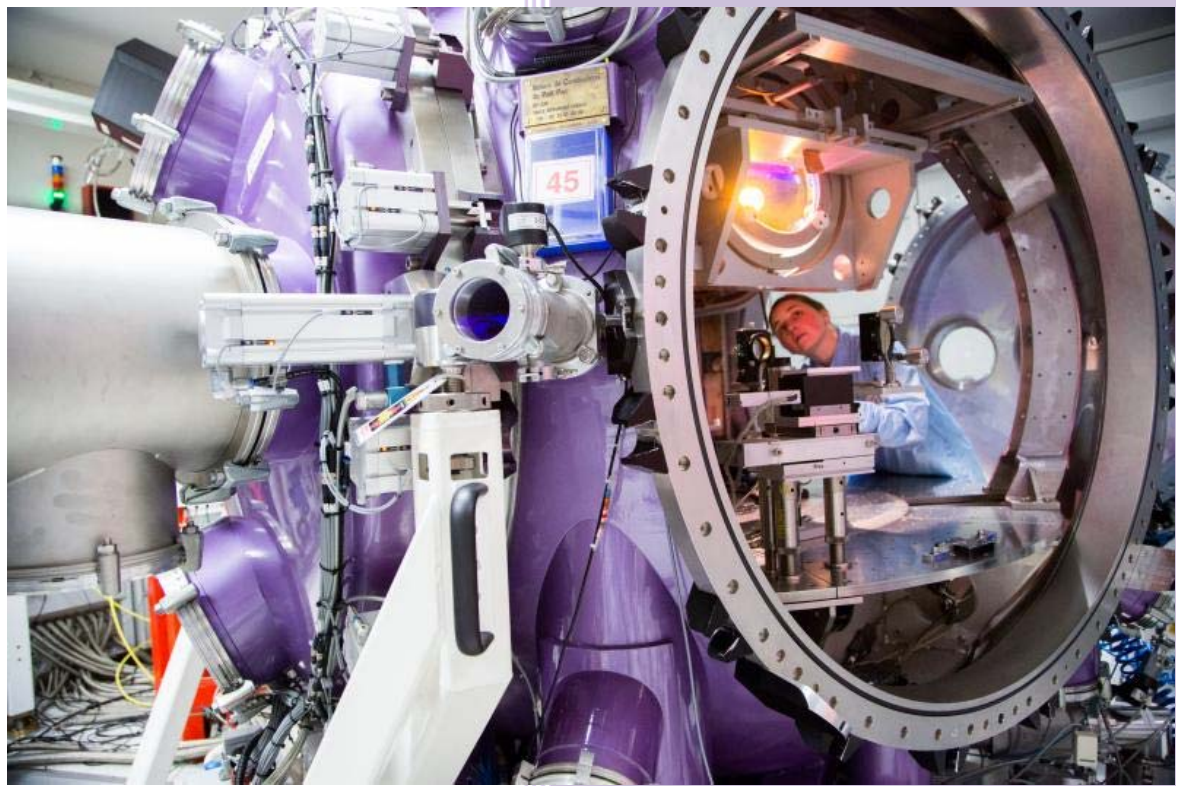


# LULI2000 User Guide



June, 2019



**Your proposal on the LULI2000 facility has just been approved. As Principal Investigator (PI), a number of actions are under your responsibility and engage your liability. You will find in this guide all the necessary information required to ensure the success of your experiment.**

## The different steps

It is important to follow the following instructions to prepare your experimental campaign in the most efficient manner possible.

### First meeting « - 6 months»

First contact between the users and the support teams (mechanics, optics, laser, targets, instrumentation and experimental assistance), this meeting is organized by the person in charge of the LULI2000 experimental rooms. It could be done by videoconference but it is recommended to come on site, especially if you are not familiar with the facilities. The objectives of the experiment and its set-up (laser parameters, diagnostics, instrumentation, targets) are then presented by the PI.

This first meeting initiates CAD and mechanics studies.

### Second meeting « - 4 months»

This meeting definitively sets the experimental set-up and the list of participants in order to launch all the procedures to access the LULI2000 restrictive areas of LULI2000 (ZRR).

### CAD validation «- 3 months »

A meeting is not mandatory; the PI (or the LULI host) has just to validate the CAD drawings with the Mechanical Engineering support group (BEM). Such a validation authorizes to order manufacturing of the required mechanical elements and have them delivered well in advance for control and assembly.

### Debriefing and reporting

It is important to debrief as soon as possible (even at the end of the experimental campaign) in order to collect valuable information on how to improve experimental processes (especially if a continuation campaign is scheduled), underline positive or negative features, etc.

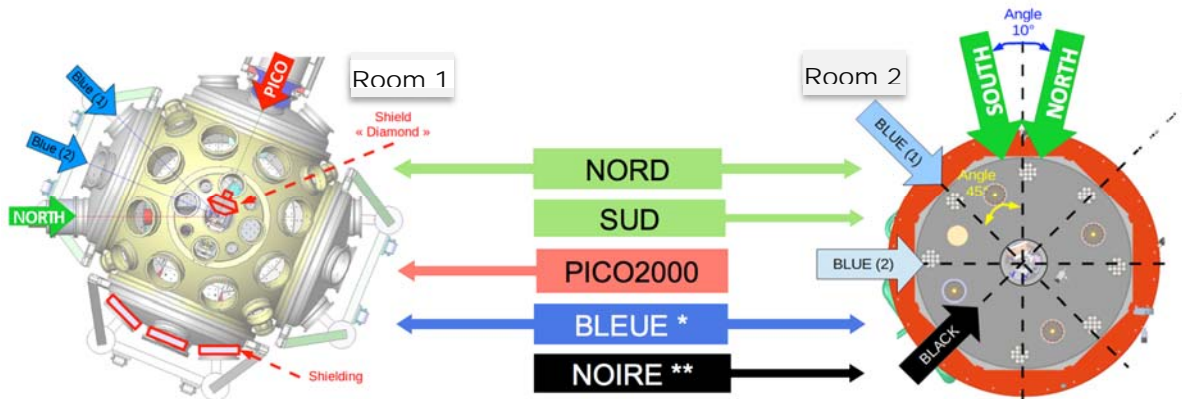
A form with wage types, to be filled out by the PI, is sent at the end of each campaign. It is the last step of the procedure: the report to the LULI Governing Board, which includes marks for the facility's operation and for quality of the support. It could be written in English and must be returned **mid-November**.

The graph below summarizes the different steps of the experimental procedure, from proposal's submission to reporting.



## Experimental Rooms

The LULI2000 facility has 5 laser beams distributed in 2 experimental rooms - Room 1 (MILKA) and Room 2 – which each have their own specifications.



BLEUE has, in each room, 2 possible incidence angle on target.

All the beams could be frequency doubled except NOIRE (operated only at 1  $\mu\text{m}$ ), the conversion efficiency depending on the laser parameters.

	Room 1	Room 2
$\varnothing$ Vacuum chamber	2 m	1,8 m
Focal (lens / PHA)	800 mm / 800 mm	1600 mm
Height stage / TCC	400 mm	300 mm

During shot sequences, users are located in the **acquisition room**:



⇒ The number of persons in the experimental rooms is restricted to 8 and to 10 in the acquisition room. The PI should organize shifts within his team to comply with this rule.

⇒ Users can access the local computer network and the internet, once the dates of their stay and the MAC address of their computer provided to the Data Processing support group (GSI).



Access to the experimental rooms is only authorized for an external user if:

- he/she has presented an updated laser clearance; a training may be undergone on site if necessary;
- he/she has watched the rooms' presentation (Health & Safety rules);
- he/she has visited the experimental rooms under the supervision of the person in charge;
- he/she has signed the prevention plan dedicated to the campaign and followed all the required training sessions.

**Warning:** all equipment to be implemented inside target chambers shall be vacuum-prepared (strict cleaning with alcohol, vacuum-compatible motors and stages...) in order not to pollute the chamber. In addition, users must obey cleanliness rules (wearing overshoes and closed gowns in the experimental rooms).

## ALIGNMENT BENCH

Each experimental room has a target alignment bench located in the acquisition room. These benches are motorized - which allows precise alignment of several targets on the same holder - and equipped with 4 cameras for accurate space positioning. The bench dedicated to Room 2 is equipped with color cameras for photo acquisition of the targets aligned on the holder.



## INSTRUMENTATION

The LULI makes available to users a number of “common” instruments (streak cameras, CCD, oscilloscopes ...). A wish list has to be provided once the proposal is accepted, for finalization at the «-6 months» meeting. In the case of several users request the same instrument, the LULI Board of Directors will arbitrate.

The full list of the “common” instruments can be accessed at:

[http://web.luli.polytechnique.fr/instrumentation/list\\_luli\\_instru.php](http://web.luli.polytechnique.fr/instrumentation/list_luli_instru.php).

In addition, two transportable probe lasers - **Quanta Ray** and **CFR200** (~7 ns, a few millijoules at 1,06  $\mu\text{m}$  and 0,53  $\mu\text{m}$ ) - are available in the rooms for auxiliary diagnostics: ombroscopy, interferometry, VISAR... An electromagnetic pulser, allowing magnetic fields of several tens of teslas to be delivered, can be implemented in the 2 rooms (the coils shall be supplied by the users).

## TARGET LAB

The LULI provides the opportunity for manufacturing or simply assembling targets, according to the capabilities of the target lab. The available instruments are listed in the document linked below and can only be used under supervision of the target lab manager.

[http://web.luli.polytechnique.fr/labocible/Data\\_Sheet\\_EXP\\_LULI.PDF](http://web.luli.polytechnique.fr/labocible/Data_Sheet_EXP_LULI.PDF)

## EXPERIMENTAL CAMPAIGN AND ACCESS

The experimental campaign can be divided into 3 successive phases:

- set-up installation: starts on Tuesday of the week preceding the campaign;
- experiment: runs from Monday to Friday on the weeks allocated to the campaign (according to the laser planning established annually);
- dismantling: carried out at the end of the experimental campaign, either Friday evening or the following Monday. Please leave in proper condition the alignment bench, the acquisition room and the experimental rooms.

**Warning: working alone is prohibited!**

**Note:** the PI is asked to make - at the beginning of the campaign - a pedagogical presentation to the on-site operation teams of the scientific objectives of the campaign, its principle and the expected results.

## OPERATING HOURS

Operation teams (laser and experimental rooms): 8:30 a.m – 5:30 p.m

Laser beamtime: from 9:00 a.m to 5:15 p.m from Monday to Thursday - 4:30 p.m on Friday

Lunch between 11:30 a.m and 2:00 p.m

Every morning, between 9:00 and 9:15am, team briefing involving the PI, the operation managers (laser and experimental rooms) and - if necessary - the target lab manager - to define the daily objectives, detail the tasks of each person and schedule the shots

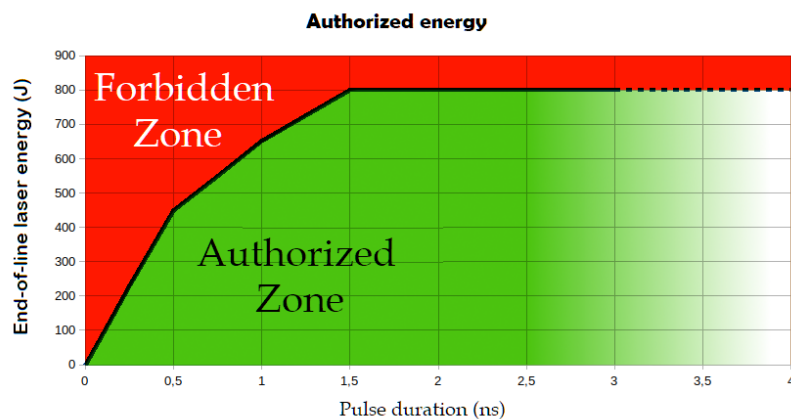
## LASER PARAMETERS

### Energies / durations

The following table summarizes the laser pulse durations, the maximum laser energies and the laser beam diameters.

	Duration	Maximum energy on target (1 $\omega$ )	Beam diameter
<b>NORD (kJ)</b>	0,5 ns – 15 ns	800 J	175 mm
<b>SUD (kJ)</b>	0,5 ns – 15 ns	800 J	175 mm
<b>BLEUE</b>	0,5 ns – 15 ns	50 J	70 mm
<b>PICO2000</b>	1 – 10 ps	60 J	175 mm
<b>NOIRE</b>	1 – 10 ps	10 J	70 mm

Depending on the laser pulse duration, the maximum energy delivered by the kJ chains vary according to the graph below.



Above 1.5ns, the output energy of the kJ chains will always be capped at 800 J.

The laser pulses of the ns chains (NORD, SUD and BLEUE) can be **temporally shaped**. For any new or special request, please provide the requested temporal shape during the « -6 months » meeting to let the laser operation team studying it.

Depending on the requested energy for the kJ chains (NORD and SUD), the repetition rate can vary.

Maximum energy (J)	Waiting time before the next shot
2	30 min
50	45 min
150	60 min
800	90 min

PICO2000 can shoot at maximum energy every hour while the auxiliary chains (BLEUE and NOIRE) can deliver shots every 20 minutes.

### Synchronization

The chains are, independently, temporally synchronizable. Note however that, when used, the ps oscillator (PICO2000 or NOIRE) is the temporal reference ( $t_0$ ).



## Focalisation

➤ *kJ chains* :

HPP phase plates (for « top hat » spatial profiles) can be used to modify focal spot diameters and energy distribution of the kJ beams. Three series are available per experimental room. You will find in the table below the corresponding focal spot diameters.

Ø in µm focal spot room 1 (MILKA)	Ø in µm focal spot room 2
300	500
500	800
800	1300

**NB: the phase plates only work at 2ω.**

➤ *ps beams*

The PICO2000 and NOIRE chains are focused thanks to off-axis parabolas. It is not possible to implement phase plates on these CPA beams; the focal spot sizes and shapes thus depend only on the beam and parabola adjustments. At best focus, the focal spot size is ~15 µm at 1ω.

## Radiosafety

After one PICO2000 shot, access to the target chamber is only possible once absence of activation checked by the operation team of the experimental room.

**Note:** for PICO2000 shots, the presence inside the target chamber of a lead shield protecting against radiation risks is mandatory. *Attention to its footprint shall be drawn before implementing diagnostics.*

**Warning:** if not specified in the proposal, it is forbidden to change - during the campaign - the set-up of the campaign (in terms of beams' configuration and targets) without the consent of the facility's PCR (Radiation Protection Officer).

## CONTACTS

	Names ( <i>leaders</i> )	e-mail
<b>Experimental room</b>	Fabien Serres	<a href="mailto:luli2000.experience@luli.polytechnique.fr">luli2000.experience@luli.polytechnique.fr</a>
<b>Laser operation</b>	Jordan Andrieu	<a href="mailto:luli2000.laser@luli.polytechnique.fr">luli2000.laser@luli.polytechnique.fr</a>
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