



European Laser Research Infrastructures serving Science and Industry

Grant Agreement N° 101131771

WP 5

User training

D5.1

Training concept and first events

Lead Beneficiary: IDRYMA TECHNOLOGIAS KAI EREVNAS (FORTH)

Due date of deliverable: M12 – 30/09/2025

Type and dissemination level: Report, Public

Table of Contents

About Lasers4EU	1
1 Introduction and objectives.....	2
2 Task 5.1: User training schools.....	3
2.1 Scope, objectives and expected outcomes.....	3
2.2 Selection process for annual training events.....	3
2.3 Guidelines for training organisation	4
2.4 Guidelines for evaluation and reporting	4
2.5 Sustainability & follow-up	5
2.6 First internal call for training events	6
International Career workshop “Women in Photonics”, June 1-5, 2025 Jena, Germany	6
3 Task 5.2: Pre-project training scheme	8
4 Task 5.3: Online software tools.....	9
4.1 Online pilot software	9
4.2 Training videos.....	12

List of figures

Figure 1 Primary version of the User Interface	10
Figure 2 Temporal evolution of the electronic (Te) and lattice (TI) temperatures following laser irradiation.....	11
Figure 3 Temporal evolution of the surface reflectivity following laser irradiation.....	11
Figure 4 Map of surface profile vs. time following laser irradiation of the surface	12

Disclaimer

This document is part of the deliverables from the project Lasers4EU, which has received co-funding from the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Commission. Neither the European Union nor the granting authority can be held responsible for them.

About Lasers4EU

Lasers4EU is incorporating the major laser research infrastructures, in a large number of European member states, into a comprehensive virtual distributed laser research infrastructure that is offering to a broad user community, from academia and industry, access to an exceptional portfolio of technical and scientific capabilities. This unique set of instruments together with the specific scientific expertise at the host facilities allows Lasers4EU users to carry out high-level research in an extremely wide range of high-impact topics in life sciences, materials nano-processing, etc.

Laser technology has experienced remarkable advances and breakthroughs during the last 60 years and is now a key innovation driver for highly diversified societal applications and products, thereby substantially contributing to economic growth and to solving challenges in the areas of health, environment and energy. Through its strategic approach, Lasers4EU aims to strengthen Europe's leading position and competitiveness. It facilitates long-term coordination of the laser research activities within the European Research Area and provides concerted and efficient services to scientific, industrial and medical researchers. The main objectives of Lasers4EU are to:

- provide coordinated access to high-quality services based on a coherent and comprehensive consortium of 27 leading European laser installations offering to users from academia as well as from industry cutting-edge performances at the forefront of the laser technologies,
- structure the European landscape of laser Research Infrastructure through enhanced access, extended geographical coverage, novel science diplomacy activities, improved synergies with other European networks and projects,
- increase European human resources in the field of laser science by implementing training activities towards researchers from new domains of science and technology and from geographical regions where laser communities are still less developed.

1 Introduction and objectives

A central mission of Lasers4EU project is to foster the engagement and growth of future generations of laser users across Europe. This is pursued through the development and coordination of user training activities, alongside efforts to attract emerging user communities.

This mission translates into:

- I. The organisation of user training schools and the provision of openly accessible training materials, such as recorded lectures, slides and tutorials, derived from the Lasers4EU training schools and made available through the project's website and Youtube channel, supporting the education and upskilling of young researchers and technical staff and thereby enhancing scientific excellence in laser-based applications.
- II. The development of the pre-access training scheme intended for (young) team members who visit the access providing infrastructure a few days before the start of an access project to be trained on the equipment of the facility in order to increase the efficiency of the experiments.
- III. The preparation of a pilot online software tool package aimed at supporting users from disciplines outside Lasers4EU's core fields (e.g., biology, medicine, the arts). This tool will help them understand laser radiation and laser-target interactions, enabling them to better design and interpret their experiments.

To measure the success and impact of these initiatives, Lasers4EU has defined the following key performance indicators (KPIs):

- a. Organisation of at least one user training school per year;
- b. Participation of 1/4 of the users in the pre-access training scheme;
- c. Development and deployment of a pilot software package focused on laser-matter interaction for laser processing to support the design and analysis of experiments.

2 Task 5.1: User training schools

2.1 Scope, objectives and expected outcomes

Given the wide range of laser technologies and their diverse applications, Lasers4EU supports a comprehensive set of training topics. All training activities should align with the following core objectives:

- Equip the next generation of scientists with advanced skills in laser technologies and laser science;
- Support non-specialist users from diverse scientific backgrounds in overcoming technical and scientific barriers associated with the complex laser systems provided by Lasers4EU;
- Attract new user groups from a variety of research and industrial fields;
- Enhance operational efficiency and foster collaboration with other European research facilities, networks, projects, and industry partners.

Following participation in these training activities, participants are expected to demonstrate significant progress in several areas. They will deepen their theoretical understanding of laser technologies and better grasp their relevance in both research and, where applicable, industrial contexts. Participants will also develop practical competencies through hands-on training, including experimental design, data analysis, and safe operation of laser systems. These experiences are intended to support individual career development by exposing participants to new professional pathways and clarifying how laser technologies can be applied within their specific research fields. Finally, the training schools will provide valuable opportunities for networking, allowing participants to build lasting connections with peers and experts, promote knowledge exchange, and gain access to collaborative opportunities within the wider European laser community.

2.2 Selection process for annual training events

To ensure that training activities align with the objectives named above and deliver meaningful outcomes, Lasers4EU organises annual calls to project partners to submit proposals, which are evaluated by the Activity Boards on their relevance, quality, feasibility, and expected impact on user capacity-building and community engagement.

The Activity board is composed of fourteen members, including the Work Package and Task Leaders of WP2 (*Communication and Outreach*), WP4 (*Cross-Facility Services*), and WP5 (*User Training*),

the Scientific Coordinator, a representative of the Coordinator, and one elected User Representative. This diverse composition ensures that the selection process considers scientific excellence, training relevance, diversity, and communication impact.

2.3 Guidelines for training organisation

Training activities may be delivered on-site (e.g., workshops or schools) or remotely via webinars, ensuring accessibility while maintaining high standards of engagement and content. Each training will combine both theoretical instruction and a strong practical component, including lab-based experiments or hands-on sessions on simulation tools for experimental design and analysis.

Collaboration with industrial partners is highly encouraged in the organisation of training events, such partnership strengthens the bridge between fundamental research and real-world applications, helping participants understand industry's needs and facilitating the transfer of academic knowledge into innovation. Industrial involvement may include the co-development of content, equipment demonstrations and co-sponsorship.

The trainings are recommended to last 2 to 3 days and will be organised via competitive calls launched on an annual basis, subject to funding availability.

Participant numbers will be limited to ensure quality. Selection made by the training organisers will be based on applicants' background and motivation, with a focus on supporting first-time users, early-career researchers, and promoting gender equality and diversity.

2.4 Guidelines for evaluation and reporting

To continuously improve the training programme, participants will be asked to complete anonymous feedback surveys at the conclusion of each event.

For documentation and impact assessment purposes, organisers of Lasers4EU training events are required to submit a report including the following details:

- Event title, date(s), and location
- Name and institution of the organiser(s)
- Brief description of the training's scope, topics covered, and primary objectives
- Brief description of the training's format and session descriptions (e.g. lectures, hands-on sessions, panel discussions)
- Target audience (e.g. early-career researchers, non-specialist users, industrial participants)
- Number of participants
- Participant and applicant statistics, including:

- Number of applications and accepted participants
- Nationalities (based on home institutions)
- Gender distribution
- Scientific background and career status (e.g. PhD student, postdoc, technical staff)
- Academic level, where applicable (e.g. young researchers, year of study)
- Selection criteria
- Results and conclusions, including participants' feedback and key outcomes
- Final schedule/programme
- Impact summary, highlighting contributions to Lasers4EU goals
- Photos

2.5 Sustainability & follow-up

To ensure that the impact of Lasers4EU training extends beyond the duration of each event, the following sustainability and follow-up measures will be implemented.

- **Access to training materials**

Training organisers will be asked to provide materials such as recorded lectures, presentation slides, tutorials, and supporting documentation. Subject to their availability and consent, these resources will be published on the Lasers4EU website and YouTube channel, contributing to a long-term knowledge hub accessible to both participants and the broader user community.

In addition to the training materials from the Lasers4EU training schools, this knowledge hub will also be enriched with content from the Laserlab Talks - monthly scientific and technical webinars that showcase research and applications enabled by laser-based technologies.

Furthermore, Lasers4EU webinars dedicated to cross-cutting topics will be included, covering themes such as diversity and inclusion, intellectual property rights, open science, data management, and patenting and technology transfer. These additional resources will provide valuable insights and support for users across disciplines and career stages, strengthening the long-term educational impact of Lasers4EU.

- **Opportunities for access**

Participants will be informed about the opportunity to apply for transnational access to Lasers4EU partner facilities for conducting experiments. This follow-up path will allow deepening of the knowledge gained in the training schools by performing real-world experiments with the support of local experts in the field.

2.6 First internal call for training events

To initiate the user training programme, Lasers4EU launched its first internal call for training event proposals on 12 December 2024, with a submission deadline of 1 February 2025. In response, four proposals were submitted by different consortium partners.

Proposals received and evaluation results

Title of proposal	Organiser	Estimated no. participants	Days	Days of practical training	Result
High-Power Lasers for Industrial Applications	HiLASE Centre	12	1	1	approved
International Workshop "Women in Photonics"	Leibniz IPHT	70	5	3	approved
HANDS-ON COURSE on MINDLAB	ICFO	30	4	1,5	approved
Handle and use of pulsed lasers for additive fabrication at the microscale	CNRS-LP3	min. 2 - max. 4/day	1	0,5	rejected

The three approved proposals received financial support from Lasers4EU, with co-funding provided by the organising institutions or external sources. Of the approved events, the International Workshop "Women in Photonics", organised by Leibniz IPHT, has taken place successfully during the first reporting year.

International Career workshop “Women in Photonics”, June 1-5, 2025 Jena, Germany

The Women in Photonics Workshop was held as an in-person event, bringing together 49 female participants from across the globe, primarily from Europe (71.43%), followed by America (14.39%), Oceania (10.20%), and Asia (4.08%). The academic background of participants was very varied, including physics, engineering, medicine, pharmacy, chemistry and biotechnology.

The workshop began with an informal meet-and-greet, offering participants the chance to get to know each other and collect workshop materials in a relaxed and welcoming atmosphere.

The scientific programme officially started on Monday, June 2, with a practical career workshop that explored fundamental questions such as:

- What are employers looking for in academia and industry?
- How can researchers identify and build the strengths, skills, and experiences needed for specific careers?
- What do researchers need to know to succeed in their chosen career path?

The programme also included keynote speeches, scientific talks, a poster session, career reports from leading female scientists in photonics and laser technology and a career opportunity session with supporting companies and research institutes (ams OSRAM International GmbH, Fraunhofer IOF, ZEISS, Jenoptik, Leibniz IPHT) offering insight into professional development paths in photonics.

The core scientific topics covered during the event included:

- Nonlinear imaging techniques, such as SHG/THG microscopy and coherent Raman microscopy for medical diagnostics
- High-resolution imaging of biological structures
- Fibre optics and photonic data science
- Ultrafast time-resolved spectroscopy, with applications in studying biological systems, including protein folding dynamics using 2D spectroscopy

The workshop concluded on June 5 with a practical session. Participants were divided into groups of five to visit the IPHT laboratories and gain hands-on experience with advanced laser-based technologies.

This training closely aligns with the Lasers4EU objective to support non-specialist users from diverse scientific backgrounds in overcoming technical and scientific barriers related to complex laser systems. The most significant outcomes of the workshop were tied to career development, supported through the career-focused sessions, inspiring testimonials from women in the field and direct engagement with companies.

<https://www.biophotonics4future.com/wip-2025>

<https://lasers4.eu/empowering-women-in-photonics-2025>

3 Task 5.2: Pre-project training scheme

As an innovative component of the Lasers4EU training concept, a pre-access training opportunity is available to user groups who have been granted access to an access-providing facility. This scheme enables one team member, preferably a young researcher, to visit the hosting facility prior to the main access period for a focused training.

The proactive training visit, lasting up to one week, aims to provide the visiting researcher with hands-on experience in the facility's equipment, experimental setups, data acquisition systems, and analysis methods. By enhancing technical preparedness, this training is expected to significantly improve the efficiency and productivity of the subsequent experiments carried out by the full user group.

Core aspects:

- **Eligibility:** One person per user group
- **Timing:** Conducted immediately before the main access period; duration typically not exceeding 1 week
- **Scope:** Training on facility equipment, procedures, safety, and data workflows
- **Process:** The training request is submitted during the TNA proposal stage and must be confirmed by the facility during the feasibility check, prior to scientific evaluation

Host facilities are expected to offer this training as an in-kind contribution, showcasing their readiness to support users and enhancing their attractiveness as access providers within the Lasers4EU network.

As of month, 12, 119 access proposals have been received: 40 projects completed, 55 scheduled, 24 cancelled or rejected. Among the accepted proposals, 9 pre-project training requests were submitted (2 for CLF, 2 for FORTH, 1 for LOA, 1 for HiLASE, 1 for LULI and 2 for VULRC).

In the coming months, we will verify whether the trainings have been implemented and will collect more data on the progress of this scheme. To further increase awareness of this option, the opportunity will be promoted on the project's website and through social media.

4 Task 5.3: Online software tools

4.1 Online pilot software

It is quite common for users from disciplines outside the core research areas of Lasers4EU (e.g. biology, medicine, the arts, etc.) to lack sufficient knowledge about laser–material interactions relevant to the samples they intend to study. To address this, an online pilot software tool package is under active development at FORTH to help users familiarise themselves with laser radiation and the outcomes of laser–target interactions.

This tool is expected to provide valuable data to interested users:

- (i) **prior to access**, by predicting experimental observables and helping to identify a narrow window of radiation parameters for effective laser–material interaction;
- (ii) **on-site**, to allow adaptation of these parameters to real experimental conditions; and
- (iii) **post-access**, to support data analysis.

In doing so, it will contribute to the efficient dissemination and impact of access-related achievements.

The online software tool simulates laser–material interaction using machine learning approaches, offering optimised laser parameters for both additive and subtractive laser-induced processing, and enabling the fabrication of micro- and nano-structures on solid materials.

Following successful development and initial testing of the pilot package, Lasers4EU partners will have the option either to adopt it, potentially customising it through modular add-ons, or to draw inspiration from it in order to develop new, specialised software packages as in-kind contributions to the work package.

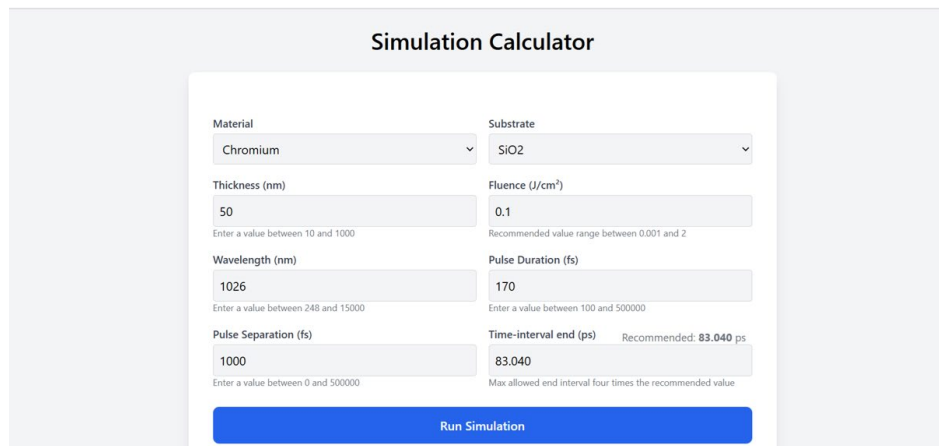
At month 12 FORTH has performed the following progress towards realisation of this task:

- Derivation of evolution of thermal and optical response of a set of most commonly used materials in various laser conditions (both figures and data for postprocessing are derived):
 - List: Au, Cr, Cu, Ag, Al, Ni, Ti, Mo, Stainless Steel, on various substrates: SiO₂, Si, Fused Silica, Air.
- Production of maps of laser conditions that induce material damage and allow nano/micro-structuring (both figures and data for postprocessing are derived)
- Testing of Artificial Intelligence codes for predictive modelling (i.e. identification of laser parameters leading to onset of texturing)

- Build-up of primary version of a user-friendly interface that enables user intervention
- Development of user-friendly interface is being performed using Django (i.e. in Python)

Currently a primary version of the user interface has been developed, Fig. 1.

Figure 1 Primary version of the User Interface



The user inserts the appropriate values for the material of choice and the laser parameters and the program calculates important function properties of the irradiated material such as the temporal evolution of the electronic and lattice temperatures, Fig. 2, the temporal evolution of the surface reflectivity, Fig. 3, and a map of the depth vs time which gives the material's surface morphological profile following laser irradiation, Fig. 4.

Figure 2 Temporal evolution of the electronic (T_e) and lattice (T_L) temperatures following laser irradiation

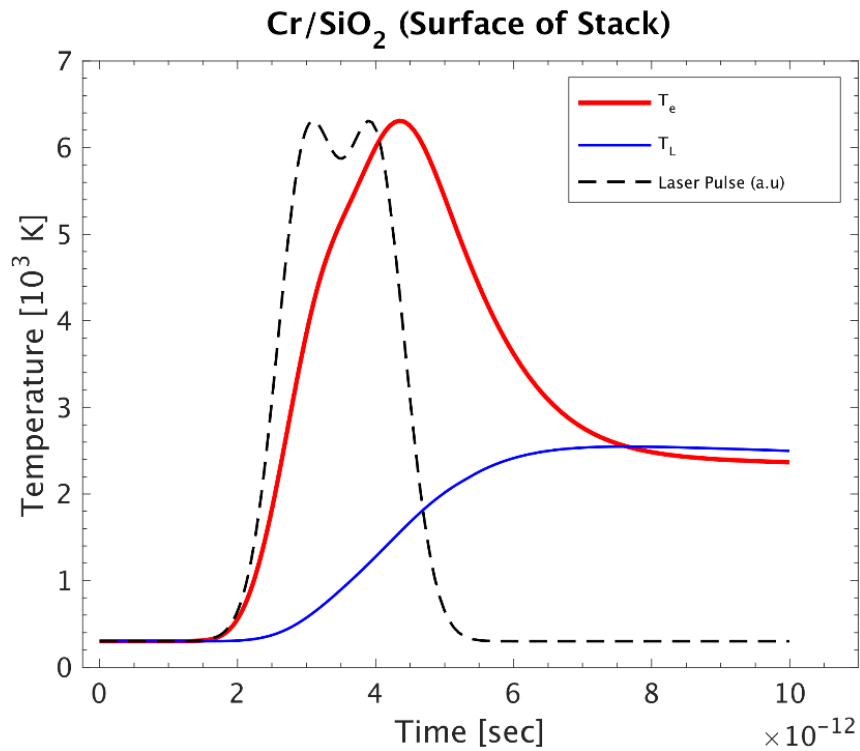


Figure 3 Temporal evolution of the surface reflectivity following laser irradiation

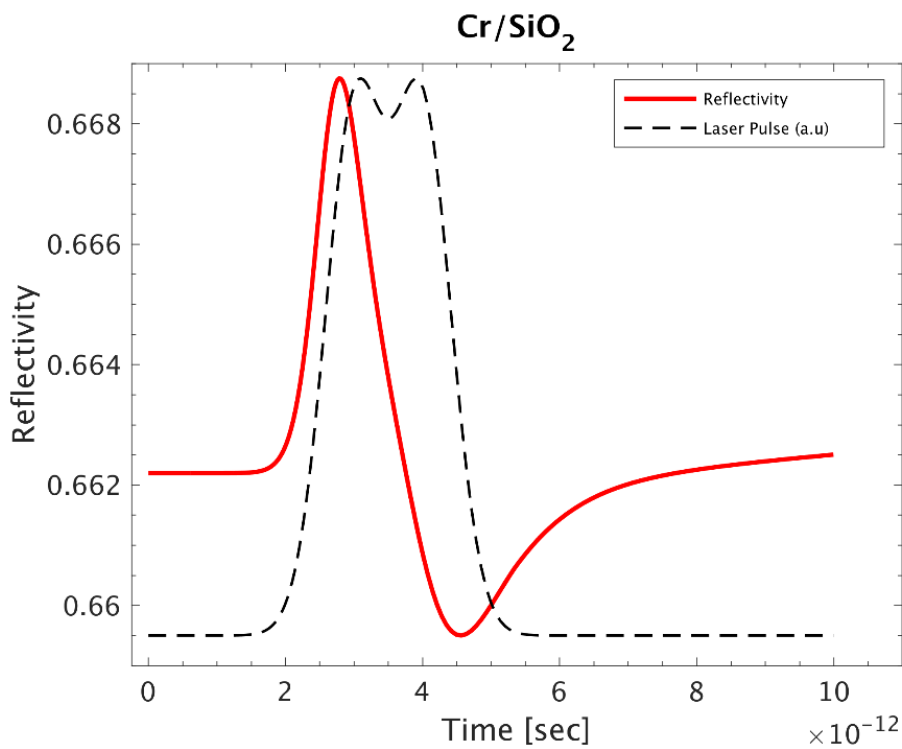
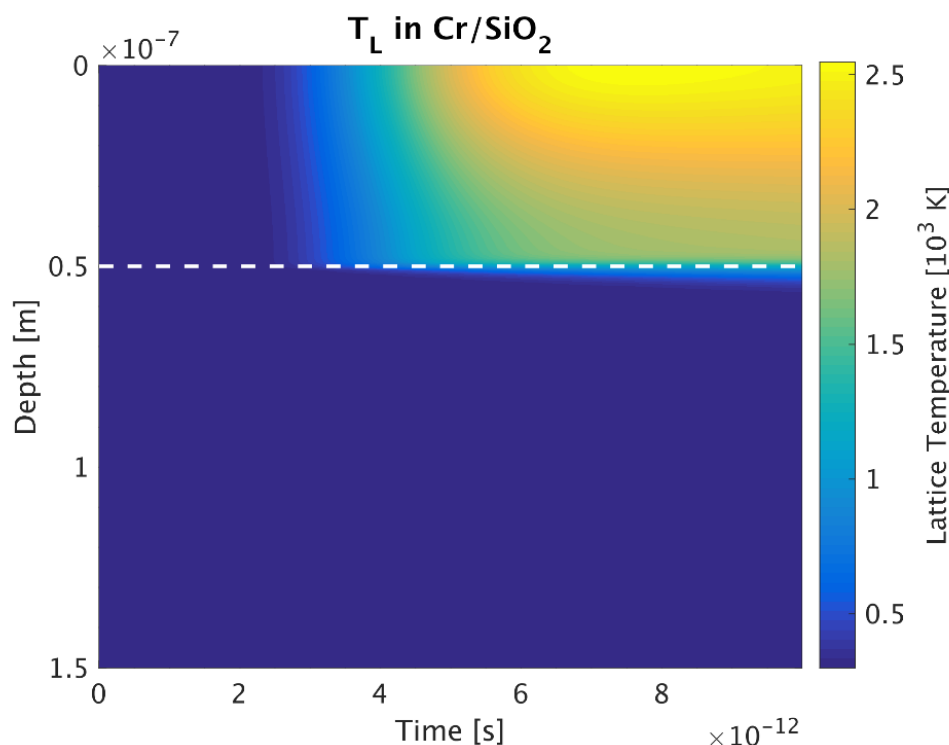


Figure 4 Map of surface profile vs. time following laser irradiation of the surface



The next steps of development of the pilot software include:

- Efficient coupling of physics-based modelling with predictive modelling
- Incorporation of physics-informed and data-driven models in a user-friendly interface
- Maps (fluence vs #pulses) for a specific material & laser
- A.I.-backed-up determination of the conditions required for the onset of nanostructuring
- Evaluation of the module via feedback from partner facilities
- Discussion on extra add-on modules from partners

4.2 Training videos

An effective way to inform and train users is through short instructional videos—for example, demonstrating a particular technique used at a Lasers4EU facility. Selected training videos (including technical demonstrations and data analysis examples), as well as general informational content, will be produced for external users, students, and staff. These will be made widely accessible to the entire community, regardless of geographical location or disciplinary background.