CATALOGO DEI SERVIZI 2024

Il catalogo dei servizi comprende la strumentazione messa a disposizione per gli utenti nell'anno 2024, aggiornato rispetto allo stesso del 2023. La strumentazione riportata fa riferimento alle due facility che costituiscono l'ERIC (ELI-Beamlines e ELI-ALPS) a cui si aggiunge quella messa a disposizione da ELI-NP. Tale strumentazione è stata resa disponibile per le "call for users" congiuntamente per le tre facility.

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USERS ACCESS POLICY

The Extreme Light Infrastructure (ELI) is the world's most advanced laser-based research infrastructure. The ELI Facilities provide access to a broad range of world-class high-power, high repetition-rate laser systems and secondary sources. This enables cutting-edge research and new regimes of high intensity physics in physical, chemical, medical, and materials sciences.

ELI ERIC's mission is to provide effective access to the ELI Facilities, enabling scientific excellence and innovation and maximising ELI's impact on science and society. Access to the ELI Facilities is free, competitive, international, and open to users from within and outside the ELI ERIC Member countries, based on principles established in the European Union Charter for Access to Research Infrastructures. ELI ERIC provides Users with a single point of access to all capabilities available at the ELI Facilities. Access to ELI is provided through the following modes:

- Excellence-Based Access - Scientific evaluation of proposals by and international peer-review panels composed of independent peer-reviewers. Results of experiments based on excellence must be published and open.
- Mission-Based Access - Thematic areas of research granted on the basis of specific scientific missions pursuing clearly defined challenges. Scientific evaluation of proposals by and international peer-review panels composed of independent peer-reviewers. Results of experiments generally published and open.
- Proprietary Access - Paid access for industrial or other users, where results are retained by the user.

The Excellence-Based Access mode is granted following a competitive evaluation of the excellence and scientific merit of Experiment Proposals by ELI's international Peer Review Panel (PRP)and assessment of their technical and safety feasibility. Results of Experiments performed as part of this access process should be published and made open. The PRP consists of independent experts appointed by ELI responsible for evaluating the excellence and scientific merit of the Experiment Proposals submitted to ELI via the ELI ERIC User Portal and for providing advice on the Proposals that should be awarded access to the ELI Facilities. The procedure is the following

- Step 1 - Submission: Proposals for Experiments are submitted only via the ELI ERIC User Portal, using the dedicated online submission form. The proposal submission should be done by the Principal Investigator on behalf of the Experimental Team and is subject to acceptance of the Terms and Conditions for access.
- Step 2 - Feasibility Assessment: Proposals, once submitted, are assessed by authorised ELI Staff to confirm their technical and safety feasibility.
- Step 3 - Peer-review: The scientific merit of proposals is assessed by the ELI Peer Review Panel (PRP), which consists of independent scientific experts. The PRP provides advice to the ELI management by assigning a score and a rank to the proposals.
- Step 4- The status and outcome of the evaluation: they are communicated via the User Portal and email notifications to the Principal Investigators. The Principal Investigators of Proposals selected for access will then be contacted for scheduling of their experiments.

ELI ERIC has already officially launched three Call for Proposal under the Excellence-Based Access mode joint with ELI-NP. The first joint call for users was launched in June 2022 and two other calls followed a time distance of six months each.

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LASER SYSTEMS, BEAMLINES AND EQUIPMENTS

ELI-ALPS

LASER HR1 (100 kHz, 1mj, 8 fs)

The High Repetition rate laser system provides millijoule level, few-cycle laser pulses at 100 kHz repetition rate, ideally suited for experiments relying on high statistics. The laser system works in the near infrared, at 1030 nm wavelength. Long-term CEP stability is only <900 mrad for now (work in progress), but phase-tagging is possible.

Beamlines/Equipment available:

- Gas High-order Harmonic Generation attosecond beamline for Gas targets (***HR GHHG Gas***) is driven by HR-1 laser system and produces attosecond pulse trains (APTs) for extreme ultraviolet (XUV) – infrared (IR) pump-probe measurements on gas-phase targets.
  The beamline may be used for scientific experiments with its built-in diagnostics (e-TOF, photon spectrometer, XUV photodiode), or with its dedicated end-station, a COLd Target Recoil Ion Momentum Spectrometer, also known as reaction microscope (COLTRIMS/ReMi). A VMI end-station (currently not installed) has also been commissioned with the HR GHHG Gas beamline and is available upon request.
- Gas High-order Harmonic Generation attosecond beamline for Condensed targets (**HR GHHG Cond**) is driven by HR-1 laser system and produces attosecond pulse trains (APTs) for extreme ultraviolet (XUV) – infrared (IR) pump-probe measurements on condensed-phase targets. The beamline may be used for scientific experiments with its built-in diagnostics (e-TOF, photon spectrometer), or with dedicated end-stations (e.g. NanoESCA).
- The Reaction Microscope (**ReMi**) is suited for studying many-particle quantum-dynamics of atoms, molecules and small clusters initiated by the interaction with pulsed, ionising laser radiation. The instrument permits kinematically complete measurements of photoionisation fragments (electrons and ions) over the full solid angle and with high momentum resolution.
- The **NanoESCA** end-station is a photoemission electron microscope (PEEM) with energy, spin and time resolution. It can be used for both real space and momentum space imaging of condensed phase samples in order to reveal the electronic structure of solid surfaces through static and dynamic (time resolved) studies. By energy resolved real space imaging a photoelectron spectrum is obtained at each pixel of the surface (spectromicroscopy). Energy resolved imaging in momentum space (momentum microscopy) is similar to ARPES, but all azimuthal directions are measured simultaneously. The system consists of a Preparation Chamber and an Analysis Chamber.
- The Chemical Reaction Control Station – Transient Absorption Spectrometer setup (**TAS**) is suitable for pump and probe experiments in liquid and thin film samples. Photophysical and photochemical processes can be followed in the ultrashort time scale (50 fs- 2 ns) and an electrochemical control is also available for the measurements. Can be driven by the attenuated beam of the HR1 laser.

LASER SYLOS 2 (1 kHz, 30 mJ, 8 fs, 3,75 TW)

The laser provides more than 3.75 TW peak power pulses with less than 8 fs duration at 1 kHz repetition rate. The laser system is based on a sequence of noncollinear optical parametric chirped pulse amplifier (NOPCPA) stages consisting of BBO crystals, which are driven by diode-pumped Nd:YAG lasers.

Beamlines/Equipment available:

- Gas High Harmonic Generation Compact beamline (**GHHG Comp**) is a gas target based Attosecond XUV beamline. It produces isolated attosecond pulses (IAP) using polarisation gating technique and "high" flux attosecond pulse trains (APTs) for pump-probe measurements with the following wavelength combinations: XUV-IR, XUV-XUV. The beamline provides full laser and attosecond XUV characterisation. There is a dedicated chamber for end-station with a Calibrated XUV photodiode, XUV beamprofiler, XUV wavefront sensor, XUV spectrometer, bipolar Time of Flight (ToF) tube, Ion Microscope. Furthermore, the beamline is designed to accommodate custom made equipment (detectors, spectrometers, end-stations etc.).

- The Gas High Harmonic Generation Long beamline (**GHHG Long**) is a gas target based attosecond XUV beamline. It produces "high" flux attosecond pulse trains (APTs) for pump-probe measurements with the following wavelength combinations: XUV-IR, XUV-XUV, IR-XUV-XUV. The beamline provides full laser and attosecond XUV characterisation. There is a dedicated CAMP chamber for endstation with a supersonic gas-jet and an electron Time of Flight (ToF) tube. Furthermore, the beamline is designed to accommodate custom made equipment (detectors, spectrometers, endstations etc.). The beamline is well suited for attosecond XUV radiation optimisation due to its extra loose focusing and the adjustability of the length of the generating gas cells.
- The Gas Phase Reaction Control (**GPRC**) setup is suitable for pump -probe experiments in gas phase. The focused ultrashort laser pulses generate plasma in which radicals are generated from small molecules in the reaction chamber. The emitted light can be monitored from the excited radicals. Following the ultrashort excitation pulse, the spectral changes in the emitted light can be monitored in the first few hundred nanosecond time range.
- Chemical Reaction Control Station – Transient Absorption Spectrometer setup (TAS) is suitable for pump and probe experiments in liquid and thin film samples. Photophysical and photochemical processes can be followed in the ultrashort time scale (50 fs- 2 ns) and an electrochemical control is also available for the measurements. Can be driven by the attenuated beam of the HR1 laser.

LASER SYLOS 3 (1 kHz, 8 fs, up to 120mJ, 15 TW)

The laser system can be considered as the next-generation light source of the SYLOS family of ELI ALPS, delivering three times more energy and peak power than SYLOS 2. The laser provides more than 15 TW peak power pulses with less than 8 fs duration at 1 kHz repetition rate. The laser system is based on a sequence of noncollinear optical parametric chirped pulse amplifier (NOPCPA) stages consisting of BBO crystals (produced by Light Conversion Ltd.), which are driven by diode-pumped Nd:YAG lasers (produced by EKSPLA Ltd). This laser system shares the 1 kHz beamlines with SYLOS2.

Beamlines/Equipment available:

- The **SYLOS SHHG** beamline is designed to investigate the interaction of relativistic intensity few-cycle laser pulses with near solid density surface plasma, and explore the subsequent generation of secondary particles and radiations resulting from the interaction. The beamline consists of multiple vacuum chambers housing several sub-systems. It is equipped with pulse-width measurement diagnostics, near-field and far-field monitors, and wave-front sensor for characterization and monitoring of the laser beam profile in space and time. The beamline houses a chirped mirror-based pulse compressor (fixed). A Deformable Mirror is available for beam shaping, and focal spot optimization is possible using a specialized phase-retrieval based wave-front sensor. A setup for pre-pulse generation and recombination with a precise delay (± 150 ps with respect to the main pulse) has also been implemented for controlled pre-plasma generation. The interaction chamber is capable of supporting reflection based solid and liquid surface targets. Depending on the specific experiments, the user may need to bring their own target system. During the preliminary commissioning phase, the setup has been tested with different targets.
- **eSYLOS** generates up to 1 kHz ultrashort relativistic electron beams via the laser-plasma acceleration (LWFA) mechanism in a sub mm-long gaseous plasma. The electron beam parameters (energy, current, divergence angle) are tuneable by tuning the laser-plasma parameters. The eSYLOS beamline is designed to be driven by 2 laser systems; these lasers are: SYLOS Experimental Alignment and SYLO 3. The eSYLOS acceleration chamber and its user end station installed the bunker laboratory of ELI-ALPS. The laser beam enters the chamber and is then steered towards a focusing optical element, called "off-axis parabolic mirror" (OAP), which focuses the laser beam down to a 10 µm spot size in a gas cell having a few 100s µm in length of helium gas or a mixture He & N2 gases. By increasing the local gas (plasma) density to > 1019/cm3, the laser pulses can drive LWFA at up to 1kHz repetition rate

in the ionised plasma gas. An electron beam from the background plasma will be trapped and accelerated in the forward direction by the plasma wave to about 10's-100's MeV of energy [3]. Simultaneously, a probe laser beam is crossing the plasma for an interferometric diagnostic (outside the chamber) of the plasma's index of refraction, for online plasma density profile measurements.

Mid-Infrared (MIR) laser system (100 kHz, 150 µJ, 40 fs, 3 µm)

The MIR laser emits extremely short (few optical cycle) light pulses in the mid-infrared around 3 µm wavelength at a very high repetition rate of 100 kHz, with < 1% RMS stability over 8+ hours of operation per day. One very important feature is that the pulses are "phase-stable", meaning that the phase of the actual electric field is almost the same for each shot and can be set to the desired value via a precise control system. The system has unique c.a. 100 mrad CEP stability together with precise CEP control during experiments. The energy can be varied continuously from 0 µJ to 90 µJ via a pair of wire grid polarizers. The CEP target can be adjusted continuously between 0 and 2 π. The pulse duration can be optimized on-target via the pulse shaper or via material dispersion. Two main configurations are offered to Users as follows: (i) configuration A, the OPCPA output (4 cycles, 120 µJ) is delivered to the user setup; (ii) in configuration B, the OPCPA output is injected into the post-compression unit in order to bring down the pulse duration below 2 optical cycles with 70 µJ energy per pulse.

Available target system:

- Compact arrangement dedicated to the generation and study of VIS-UV harmonics from semiconductor crystals such as ZnO or various types of metamaterials. The interaction can be driven by both configurations (4 cycle or 2 cycle pulses) with continuous power, chirp and CEP control. and other solid targets. The long wavelength enables to benefit from the power scaling laws (λ^N) specific to strong field physics. During the interaction with the high intensity laser, electrons from atoms or molecules experience a quiver motion and acquire an energy proportional to the ponderomotive energy U_p scaling again like λ^2.

SYLOS Experimental Alignment (SEA) Laser (10 Hz, 40 mJ, 12 fs)

The laser can be used to prealign SYLOS experiments (see above) or to drive experiments where low repetition rate is sufficient, like solid target experiments, or studies of laser induced damage threshold. The laser can be used for experiments with user-owned experimental setup. Laser diagnostics is included, for other detectors, diagnostics, please contact local personnel.

Low Energy Ion Acceleration beamline (LEIA)

- The LEIA Beamline is suited for acceleration of ions with the use of the SYLOS Experimental Alignment (SEA) laser to cut-off energy up to 2MeV, at a repetition rate between shot-on-demand and 10Hz, and pulse durations from sub-two cycle onwards. The beamline may be used for scientific experiments, supported by the beamline diagnostics as three Thomson ion spectrometers, a time-of-flight neutron detection system nTOF, and a bubble detector system.

THz Pump lasers

THz pump lasers are two standalone laser sources that have different technical parameters. The THz pump#1 laser system provides 500 fs, 500 mJ laser pulses at 50Hz repetition rate at 1030 nm central wavelength. The system consists of a synchronizable fiber oscillator, a fiber stretcher, a regenerative amplifier, several thin disk multipass amplifiers and a grating compressor. The THz pump#2 laser system provides 92 fs, 4 mJ laser pulses at 1 kHz repetition rate at 781 nm. The system consists of a synchronizable fiber oscillator, an Öffner-stretcher, a regenerative amplifier, a multipass amplifier and a grating compressor. The oscillators of the lasers can be synchronized electronically resulting in a timing jitter of the output pulses close to 10ps. The pulse energy of the THz pump #1 can be continuously controlled and lowered to 15mJ without change of any other beam parameter. The pulse duration of the THz pump #2 can be tuned up to about 6ps by adjusting the distance of the gratings in the compressor. Table 1. shows the specifications of THz pump#1 and #2 laser systems. These light sources can be used for carrying out a wide variety of experiments that require synchronised near infrared femtosecond laser pulses.

HE-THz – High-Energy Terahertz Source:

- The High-Energy Terahertz Source (HE-THz, Fig. 1) is driven by a multi-100-mJ femtosecond pump laser (THz pump#2) and consists of two main units: the THz source and the electro-optic sampling unit. The HE-THz (High-Energy Terahertz) secondary source provides intense terahertz (THz) pulses in the 0.1 – 1 THz frequency range for field-driven experiments at 50 Hz repetition rate. The electric-field waveform of the THz pulses is fully characterized by electro-optic sampling. The HE-THz source is a unique tool for accessing a new regime of THz-matter interaction in experiments requiring high THz field at low frequency for studying THz-induced strong-field phenomena. It can be used to study strongly excited systems, for example hot electrons in semiconductors, anharmonic crystal lattice vibrations, and strong-field ionization.

NLTSF – Nonlinear Terahertz Spectroscopy Facility

- NLTSF is driven by the multi-mJ femtosecond pump laser (THz pump #2), enabling THz pump—THz probe measurements up to 450 kV/cm peak electric field and from 6 K to 800 K sample temperatures at 1 kHz repetition rate. Optical spectroscopy and electrooptical sampling is available. THz radiation enables resonant excitation of fundamental motions such as phonons, electron intraband transport, and magnons. Driving these modes to large amplitudes can enable new insights into their properties. A time-delayed probe pulse of suitable photon energy probes the response of the system.

Biomedical Research Laboratories

The facility comprises two fully equipped rooms housing a diverse array of laboratory instruments tailored to support a broad spectrum of biomedical research. From cell culture and molecular analysis to histology, radiobiology, zebrafish studies, microscopy, and injection procedures, our setup provides researchers with the necessary tools to conduct a wide range of in vitro and in vivo experiments within the biomedical field.

Equipment for biomedical research

Biomedical research: cell culture laboratory for normal and tumor cell lines, co cultures and spheroid. Maintenance: sterile laminar flows, inverse microscope, refrigerators and freezers (ultra-freezer), micro- and high capacity ultra- centrifuge, incubator and thermostat.

Analytical equipments: 2 analytical balance; pH meter; Lambda35 (Perkin Elmer) double-beam UV/VIS spectrophotometer, with variable bandwidth (190-1100nm) for measurements in absorbance range up to 3.2A., with nanodrop adapter.

Molecular analysis equipments: EnSight Multimode plate reader for high-throughput screening, fluorescence imaging, AlphaLISA/AlphaScreen, time-resolved fluorescence and intensity detection, filter- and optional monochromator-based absorbance, ultra-sensitive luminescence for low signals, temperature control etc. qT-PCR machine (Roche Lightcycler 480) and PCR machine.

Histological laboratory equipments: automatic tissue processsor, paraffin embedding station with cold plate, heatable forceps, automated slide stainer, semi-motorized rotary microtome and water bath.

Radiobiology equipment

Irradiator: self-contained cell and small animal x-ray irradiator, with 300kV voltage and max. 30mA current x-ray tube. Dosimetry equipments including reference class dosimeter, Farmer type ionization chamber, micro diamond detector and soft x-ray ionization chamber, phantoms and film dosimetry scanner.

Zebrafish laboratory equipments: The ZebTec Multilink system gives the opportunity to improve the zebrafish welfare and research quality. Viewpoint Zebrabox (revolution for high throughput monitoring of larvae) and the ZebraTower (for fish monitoring) is at our disposal.

Microscopes: Axio Observer Z1 Inverted fluorescence microscope. Apochromatic Stereo Microscope (Zeiss Stemi 508).

Pico Injector: (Harvard Apparatus Model PLI-100A) The IFIR LDP is a multipurpose, modular irradiation facility which uses ELI ALPS's primary and secondary laser/particle sources for assorted scientific applications carried out in atmospheric conditions. The primary aim of the endstation is to provide a technical platform for such experiments. The terminal can be remotely controlled and programmed, and its basic components can be customised and extended as required.

Irradiation Facility for Interdisciplinary Research with Laser Driven Particles

A multipurpose platform for interdisciplinary experiments with laser driven particle sources. Due to its nature, it is primarily recommended for applied research such as radiobiology and dosimetry.The backbone of the end station is a movable frame made of aluminium profiles, equipped with three independent, motorised and programmable long travel linear slides. The linear slides can be used to position and/or continuously move the samples or detectors. The maximal travelling length is 300mm in each directions. The linear slides are located at the very top of the end station, so the samples or detectors can be suspended from above in the useable space designated to the experiment.

ELI-BEAMLINES

LASER L1 ALLEGRA (1 kHz, 55 mJ; 15 fs, 4 TW):

The laser is based on amplification of picosecond pulses in broadband OPCPA and compression to <16 femtoseconds using chirped mirrors. The pump lasers are based on Yb:YAG thin disk technology. The central wavelength is in the range of 820-860 nm, beam profile is Gaussian-like and the polarisation is linear polarisation (vertical). Pre-pulse temporal contrast (up to 5 ps before pulse) is 10^{-10}. The system can currently deliver up to 55 mJ in 15 fs at a repetition rate of 1 kHz.

Beamlines/Equipment available:

- HHG source uses high-order harmonic generation in gas to produce a stable source of coherent femtosecond pulses in the XUV spectral range. The source is set to a 5 m focal length (although other lengths can be considered) and is prepared to run with different noble gases with conversion efficiencies up to 5 x 10-6 for argon. The source supports 2nd harmonic generation before the HHG and can thus be operated in two colour (ω+2ω) mode, or by the 2nd harmonic only.
- The MAC end station is a Multipurpose end station for AMO (Atomic, Molecular and Optical) and CDI (Coherent Diffractive Imaging) science using the HHG source. The design of the MAC vacuum chamber allows a large number of ports for mounting equipment and diagnostics.

***LASER L3 HAPLS (3.3 Hz; 13 J, 27 fs, 0.5 PW)**:*

The laser is a Ti:Sa system which employs two Nd-doped glass amplifiers pumped by high power laser diode arrays. The system can currently deliver up to 13 J in about 27 fs at a repetition rate of 3.3 Hz.

Beamlines/Equipment available:

- **ELIMED** is an ion beam transport and dosimetry line connected to the ELIMAIA laser-plasma Ion Accelerator. ELIMED is based on conventional ion beam magnetic optics for handling and selecting the L3-ELIMAIA driven ion beam in vacuum. In addition, the energy-selected ion beam can be delivered into the in-air dosimetry station, characterised in dose and used for user sample irradiation.
- **ELBA** (Electron Beamline for fundamental science) is the first all-optical laser electron collider of its kind, being designed on the unique capabilities of the high average power, high repetition rate (30 J, 30 fs, 10 Hz) L3-HAPLS laser. ELBA is designed to enable users to carry out laser-electron interaction experiments approaching χe ≈ 0.18E0[GeV]I1/2[1021 W/cm2] ≈ 0.1-1 at high repetition rate (3-10 Hz,100s thousands shots/day).

LASER L4n-P3

L4n is one of the operating modes of the L4 ATON laser system which is based on amplification in two types of Nd:glass laser discs. The L4n-P3 infrastructure provides kilo-Joule class, nanosecond, repetition-rate (1 shot per 3 min). L4n offers ns-kJ class pulses at an unprecedented repetition rate for this energy level can be temporally shaped in a wide range of pulse durations. The laser also has pulse-shaping capabilities at 2ω for high-energy-density-physics (HEDP). At present a variety of unique passive diagnostic systems allows dedicated science studies in laser-plasma interaction in the context of direct-drive inertial confinement fusion as well as shock-based physics for the study of EOS (equation-of-state). The repetition-rate allows for highly improved statistics of the experimental data.

Equipment available:

- Spherical X-ray spectrometer (0.6 keV – 10 keV, precise range determined by the crystal used)
- 2D spherical Kα imager (Ti or Cu)
- Electron spectrometer (up to 25 MeV)
- VISAR and SOP (detailed parameters can be discussed with the POC)
- Time-resolved resolved back-Scattering Devices (BSD) for Stimulated Raman/Brillouin Scattering (SRS/SBS) and Two-Plasmon Decay (TPD)
- Gamma-ray spectrometer (> few hundred MeV range)

ASTRELLA:

Table-top laser delivering pulses up to 7 mJ in less than 40 fs at a repetition rate of 1 kHz.

Equipment available:

- Time resolved ellipsometry with femtosecond time resolution (trELIps) is a technique for monitoring ultrafast changes in the dielectric function of a material after the excitation by an ultrashort laser pulse. The technique is based on the pump-probe approach. The current setup enables spectroscopic measurements in 350-750 nm spectral range with 100-200 fs temporal resolution. The Ultrafast Nanoscience Group at ELI-ALPS is developing a complementary setup with ~80fs resolution operating in the 700-900 nm range.
- The Transient Current Technique (TCT) is a tool for the characterisation of ultrafast semiconductor detectors. The technique is based on the recording and analysis of the transient current pulse, originating from the drift of charge carriers generated by ultrashort laser pulse in the electric field inside a biased sensor. The signal can be measured at different conditions with various parameters such as bias voltage, laser pulse energy, position of the charge generation and temperature.

Femtopower-Solstice doublet: table-top laser system delivering two indipendent pulses up to 5 mJ each in 20 fs (Femtopower) and 35 fs (Solstice) at a repetition rate of 1 kHz (synchronized at fs-level and with a relative delay up to 1 ms)

Equipment available:

- Femtosecond stimulated Raman (FSR) spectroscopy is an experimental tool that allows monitoring Raman active vibration of molecules with sub-ps time resolution. When used with reactions that can be triggered, ideally photo-triggered, it is a powerful tool to follow reaction dynamics and structural changes with high time resolution and high acquisition speed.
- Laser-induced transient (TA) change of absorption of liquid and solid samples at UV/VIS/NIR spectral region at room temperature. Resolvable timescales range from tens of fs to 0.5 ms.

Nanofabrication laboratory

The Nanofabrication laboratory operates a RAITH e-LINE Plus electron microscope and electron lithography system (EBL) and a Scios 2 HiVac electron microscope and focused ion-beam device (FIB). The two devices are accessible for electron microscopy investigations and for the fabrication of nanostructured samples. The nanolithography capabilities of the EBL system allow the writing of high-resolution nanostructures, like metallic nanostructure arrays for plasmonic applications. For the nanolithography, the whole technological chain is available with a plasma cleaner, spin coater, fume-hood, hotplate, ultrasonic bath and metallization.

The FIB system is accessible for the direct writing of nanopatterns, milling of thin film cross-sections, and preparation of transmission electron microscope lamella.

ELI-NP

100 TW LASER

The laser systems are based on an optical parametric chirped-pulse amplification (OPCPA) front end, followed by chirped-pulse power amplifiers based on state-of-the-art Ti:Sa crystals and dedicated pulse compressors. The parameters for each laser are: (i) energy 2.2-2.7 J; (ii) rep. rate 10 Hz; (iii) pulse duration 22-27 fs; (iv) peak power 100 TW.

Equipment available:

- Two large vacuum chambers are installed, one for high vacuum and one with ultra-high vacuum specifications. Both use DN250 and DN160 CF flanges for viewports and other components of the setups. The ultra-high vacuum chamber (VE2) has bake-out capabilities up to 200°C and cryopump in addition to two high-capacity turbomolecular pumps. The vacuum system has a centralised command and control system. The chambers are equipped with gas jet targets.

1 PW LASER

The laser system has an optical parametric chirped-pulse amplification (OPCPA) as front end, followed by chirped-pulse power amplifiers based on state-of-the-art Ti:Sa crystals and dedicated pulse compressors. The laser parameters are: (i) energy 25 J (each beam), (ii) rep. rate 1 Hz; (iii) pulse duration 24 fs - 1 ps; (iv) maximum peak power 1 PW.

Equipment available:

- Three large vacuum chambers have been built and installed, denominated C1, C2, C3, along with turning boxes for the beams transport. The C1 chamber is the main interaction chamber, while the other two are used to deliver the beam for the short focal (C2) and the beam for the long focal (C3) into the interaction chamber (C1), and also allow for further setup to be installed (e.g., waveplates, laser back reflection monitoring). This experimental station is for production/detection of up to 2 GeV electrons and up to 100 MeV ions, and for preliminary studies for the 10 PW system using gas and solid targets.

10 PW LASER

The laser system has an optical parametric chirped-pulse amplification (OPCPA) as front end, followed by chirped-pulse power amplifiers based on state-of-the-art Ti:Sa crystals and dedicated pulse compressors. The laser parameters are: (i) energy 240 J (each beam), (ii) 1/60 Hz, single-shot; (iii) pulse duration 24 fs - 1 ps; (iv) maximum peak power 10 PW.

Equipment available:

- Made of aluminium, the interaction chamber is approximately 5 m in length x 4 m in width x 2 m in height. The laser beam optical axis is 800 mm from the optical table and 1,500 mm from the floor. The system is optimized for running long focal experiments with a single 10 PW beam. Several optical tables are available outside the interaction chamber for diagnostics.