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Contribution to high-performance Laser Science at the Extreme Light Infrastructure (ELI)

Wednesday 4 June 2025 09:00 (1h 15m)

The Extreme Light Infrastructure (ELI) is a research facility that provides a wide range of scientists with access to the largest and most diverse set of high-performance laser systems in the world [https://eli-laser.eu]. Lasers are used to study the fundamentals of interaction between matter and ultra-high-intensity, ultra-fast light pulses, including plasma physics and relativistic acceleration of electrons and ions, or drive secondary sources of ultra-short, high-intensity beams of light or particles which are used for imaging, diffraction and fast spectroscopic studies of materials and biological systems. Such technology is also developed to explore potential applications in laser-driven compact accelerators that could provide alternatives to current central facilities for synchrotron radiation and ion/neutron beams on a scale that could be located more readily in university departments, industrial laboratories or hospitals.

ELI operates as a single multi-site organisation with complementary facilities: (i) the ELI Attosecond Light Pulse Source (ALPS) facility in Hungary for the exploration of ultra-fast processes with uniquely high time resolution [https://www.eli-alps.hu]; (ii) the high-energy ELI Beamlines facility in the Czech Republic, with a particular emphasis on high peak laser intensity and delivery of secondary sources [https://eli-beams.eu]; and (iii) the Nuclear Physics (NP) facility in Romania for the combination of ultra-intense lasers with brilliant gamma-ray beams [https://www.eli-np.ro].

A particular feature and potential strength of ELI is the complementarity of the facilities, allowing for the support of a particularly wide range of multidisciplinary science and enabling the co-development of new, enabling technology –for example in laser optics, diagnostics or targets for the generation of secondary sources. The three ELI Facilities have been available to user access based on peer-reviewed excellence through open calls for proposals since 2022 and have attracted scientists across the globe requesting access (~360 proposals) to approximately 40 different instruments.

An overview of the current instruments offered by ELI, designed to support a wide range of scientific disciplines and research methodologies, will be given along with highlights of recent user experiments and planned commissioning and R&D activities.

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