IMPULSE

The Extreme Light Infrastructure

EXTREME SCIENCE

A European Research Infrastructure Consortium



From Nobel Prize to Extreme Light A Technological Breakthrough Enables ELI

Gérard Mourou and Donna Strickland won the 2018 Nobel Prize for Physics for proposing "Chirped Pulse Amplification" for highpower, ultrafast, extremely intense lasers. Mourou proposed ELI in 2004.





Images of stretched and compressed pulses, from Strickland's 1985 paper on Chirped Pulse Amplification (CPA) which led to petawatt-class lasers



Chirped Pulse Amplification (CPA)



- Europe leads the world in laser and photonics production and installation, especially state-of-the-art systems
- Investment in high-power laser systems in Europe is world-leading
- The ELI ERIC Facilities are introducing 3 PW-class lasers, (10PW and 2xPW@10Hz) plus a diverse set of high-repetition systems and secondary systems.





Science Using Lasers

IMPULSE-



Laser Development



Radiation Physics and Electron Acceleration Soft to hard x-rays, GeV electrons



Particle Acceleration 250 MeV Ions Acceleration by lasers



Applications in Material Science and Biology



Plasma Physics and High Energy Density, Astrophysics, Nuclear Photonics



Ultra High Intensity Interactions High-field physics and theory

ELI ERIC is a single, multi-site organisation A European Research Infrastructure Consortium – an ERIC

This new legal form enables the participation of States as member countries to govern the ELI Facilities jointly and make them available to the scientific community as a single international organisation. Its headquarters are in Dolní Břežany in the Czech Republic.



ELI ERIC involves the Czech Republic, Hungary, Italy and Lithuania as founding Members. Both Germany and Bulgaria are Founding Observers. *Romania and ELI-NP are also expected to join the ELI ERIC consortium, which is open to European and non-European countries to join its membership.*



Portugal and Spain Involved in ELI Early



Advantages:

- Pan-European intergovernmental Organisation, with full legal personality in all EU Member States
- Enables the easiest, most legally supported entity for countries
- The **Member countries financially support** the operations
- Offers legal **flexibility** and better mobility for staff
- Allows self-determined *Procurement Rules*
- Allows for VAT and excise tax exemption
- Countries outside the EU may join!

Why an ERIC?

ERIC

Practical

quidelines

Legal framework for a

European Research Infrastructure Consortium



The ELI ERIC Facilities

The mission of ELI ERIC is to provide effective access to the ELI Facilities, ensuring excellence and interoperability to maximise ELI's impact on science and society.



ELI-NP at IFIN-HH Romania ELI Beamlines www.eli-beams.eu



The ELI ERIC Governance and Management



ELI ERIC is a single, multi-site organisation

- ELI ERIC Confirmed by EC on April 30, 2021
- First GA Meeting on June 16, 2021
- AFC Sept. 2, 2021
- Introductory ISTAC Sept. 16, 2021
 - John Collier (Chair) & Marta Fajardo (Vice-Chair)
- Second GA Oct. 14, 2021
- ISTAC on December 1-2, 2021
 - Engagement with potential new partner Countries is ongoing
 - Six key policies and the Operating Agreements have been developed by IMPULSE Reported



User Access to ELI ERIC There are three modes of access

- Excellence-Based Access Scientific evaluation of proposals by and international peer-review panels composed of qualified scientists. 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. Results of experiments generally published and open.
- **Proprietary Access** Paid access for industrial or other users, where results are retained by the user, consistent with ELI ERIC's Data and IPR Policy.





High-power ultra-short laser pulses for ground

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ELI Attosecond Light Pulse Source [Szeged, Hungary]

Annual User Meeting Nov. 8-9, 2021 https://www.eli-alps.hu

ELI ALPS isleading in ultrafast physical processes as well as a world-class centre for generating outstanding biological, chemical, medical and materials science results.

- Development of attosecond light sources and measurement techniques
- Research into biological imaging technologies
- Medical applications
- Energy research: from solar cells to artificial photosynthesis
- High-peak-power photonics
- Information technology, materials science and nanoscience

ELI Attosecond Light Pulse Source

Research Fields and Applications

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ELI Beamlines [Dolní Břežany, Czech Republic]

Just outside of Prague, ELI Beamlines covers the interaction of light with matter at intensities that are 10 times higher than previously achievable. Ultra-short laser pulses last only a few femtoseconds with outputs up to **10 PW enables new techniques** and tools for research such as medical imaging and diagnostics, radiotherapy, new materials and Xray optics. Laser driven hadrontherapy, proton-boron nuclear fusion, and non-destructive heritage testing.





ELI Beamlines

Research Fields and Applications Laser technologies developing new techniques for laser crystals, solutions for the cryogenic cooling of high-power repetition rate laser amplifiers, femtosecond synchronization, advanced repetition rate diagnostics of femtosecond pulses, advanced control systems, and innovative solutions for petawatt (PW) pulse compressors.

In addition to basic research and development in the field of lasers, ELI Beamlines deals with research in material sciences, electronics and engineering.

- Material science
- Biomolecular Applications
- X-ray Sources Driven by Ultrashort Laser Pulses
- Plasma and High-field Physics
- Particle Acceleration



IMPULSE

The IMPULSE project is a Horizon 2020 sponsored project to move ELI ERIC into operations and provide access to users while merging into ELI ERIC.

To that end, the IMPULSE Project has Scientific and non-Scientific objectives, including Flagship Experiments

https://impulse-project.eu/

The IMPULSE Project **15** Partners 10 Countries 42 Months €19.9 Million



• STFC





IMPULSE

IMPULSE Aims and Objectives

Main goal: support the swift and effective transition of the ELI Facilities to sustainable operations within a single organization, **ELI ERIC**

Expected outcomes at project end:

- Expansion of user community and ERIC membership
- Efficient integrated organization, ELI ERIC
- World-class, cost-effective operations
- Excellent user-access enabling breakthrough science
- Enhanced innovation capacity

19,9 M EUR project over **42-month timeframe** matching the "Initial Operations Period" during which the ELI Facilities integrate into a single organisation, ELI ERIC.



IMPULSE Project Structure



WP1: Setting-up and project management

ELI ERIC Leads Innovation and Technology We train a generation of scientists and experts

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The ELI Facilities have awarded over €455 million in contracts to companies from 19 European countries

The global high-power, directed laser market should reach \$14.6 billion by 2024 up from \$8.9 billion in 2019, a compound annual growth rate (CAGR) of 10.3%.
The global ultrafast lasers market should reach \$8.1 billion by 2022 up from \$2.7 billion in 2017 at a compound annual growth rate (CAGR) of 24.7%.

DCC December

For more information about how to become an ELI user, or if you are interested in how your country can become a member of ELI ERIC, please contact us at

> The Extreme Light Infrastructure ERIC info@eli-laser.eu tel +420 266 051 109

> > or visit our website at https://eli-laser.eu

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