

Towards Nuclear Physics Driven by Extreme Light at ELI-NP

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Extreme Light Infrastructure - Nuclear Physics (ELI-NP) is the pillar of the pan-European ELI project dedicated to nuclear physics driven by extreme electromagnetic fields. ELI-NP will host two systems that generate extreme light beams with unique features: (1) a system of two high-power ultra-short-pulse lasers with the highest proven power in the world (10 PW each) and (2) a variable energy gamma (VEGA) system to deliver quasi-monochromatic gamma beams with energy up to 20 MeV.

ELI-NP is currently in a transition phase from implementation to operation. The 2 x 10 PW high-power laser system is fully operational and the experimental set-ups are gradually made operational. As a first step, commissioning experiments, designed to demonstrate the technical performance of the experimental set-ups and the quality of the laser beams, are being performed for all the experimental set-ups and they are made gradually available to users during 2022 and 2023. The first call for users was launched this year in collaboration with ELI ERIC.

The high-power laser system will provide pulses on target with irradiances as high as 10^{23} W/cm². This opens unprecedented possibilities in nuclear physics, high-energy radiation beam science, non-linear field theory, and ultra-high-pressure physics. First experiments with the high-power lasers at ELI-NP aim at: measuring the magnitude and scaling of the achievable laser intensity via laser-gamma conversion efficiency, investigation of new ion acceleration schemes, nuclear reactions in plasma.

A broad research programme on applications of extreme light is currently being developed at ELI-NP and addresses topics such as: production of radiotherapy relevant nuclear beams; radiobiological effects of short-duration particle pulses; high-contrast medical imaging with laser-driven X-ray sources; use of intense, short-duration, and mixed radiation pulses to study the behaviour of materials under extreme radiation conditions.

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