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Perpectives and opportunties at ELI-NP

Thursday 10 July 2025 09:00 (30 minutes)

Extreme Light Infrastructure - Nuclear Physics (ELI-NP) was implemented as part of the pan-European Extreme Light Infrastructure project with the aim to use extreme electromagnetic fields for nuclear physics studies and related topics. The physics case of ELI-NP is based on two state-of-the-art sources of extreme light: a high-power laser system and an intense gamma beam system. A broad range of research topics is being developed at ELI-NP aiming to push scientific and technological knowledge beyond nowadays frontiers. The main research field pursued at ELI-NP is nuclear photonics.
The ELI-NP high-power laser system consisting of two 10 PW ultra-short pulses laser arms represents a unique system worldwide and it is operational since 2020. The main research topics are focused on: understanding the fundaments of the laser-matter interactions, new paradigms for the acceleration of electrons and ions driven by high-power lasers, nuclear reactions in plasma of astrophysical interest, generation of brilliant neutron sources, applications in medicine and industry. Since 2022 the high-power laser system is operated as user facility at the power exits of 100 TW and 1 PW. The experimental setups dedicated to 10 PW laser power levels are in the final stage of testing their performance. An overview of the laser experimental setups and of the first results will be presented. Extreme acceleration fields as high as 100 GV/m were achieved during the first experiments. The capability of reaching unprecedented laser intensities of the order of 10 W/cm was demonstrated. A rich scientific program dedicated to the development of technologies with potential use in medical applications will be illustrated.
The intense gamma beam system, is under implementation aiming to provide quasi-monochromatic gamma beams with high spectral densities tailored for nuclear physics experiments covering a range of energies of interest up to Pygmy and Giant Dipole Resonances. A set of complex experimental devices for high resolution and high efficiency detection of gamma rays, charged particles and neutrons was developed to take advantage of the properties of the gamma beams.

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