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## ELI-NP project overview

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Extreme Light Infrastructure - Nuclear Physics (ELI-NP) is a new research infrastructure installed in Bucharest-Magurele (Romania) dedicated to Nuclear Photonics with extreme photon beams. At ELI-NP high-power laser and gamma beams with unprecedented characteristics will be provided to be used for nuclear physics, laser plasma physics, quantum electrodynamics, material science research and related fields.

The high-power laser system consisting of 2 x 10 PW lasers with ultra-short pulses will reach irradiance values as high as  $10^{23}$  W/cm<sup>2</sup> and will create ultra-dense, ultra-short, high-energy ion beams as well as coherent X-ray sources. The operation of the laser system at 10 PW has recently marked a world premiere in the field of high-power lasers.

The gamma beams to be delivered at ELI-NP will exhibit high spectral density of about  $10^4$  photons/s/eV, average relative bandwidth of less than 0.5%, continuously tuneable energy up to about 20 MeV, linear polarization of more than 95%.

The experimental setups are currently under commissioning and the first experiments with high-power lasers aim at measuring the magnitude and scaling of the achievable laser intensity via laser-gamma conversion efficiency, finding new ion acceleration schemes and achieving a better understanding and control of high-intensity laser-driven ion sources.

The outstanding characteristics of the gamma beams that will be provided at ELI-NP are opening new perspectives in Nuclear Photonics. Nuclear Resonance Fluorescence experiments will allow for the direct, model-independent determination of key information about the nuclear excited states, such as: excitation energy, spin quantum numbers, parities, branching ratios as well as level widths and gamma decay branching ratios. Photonuclear reactions experiments will largely benefit of the outstanding features of the gamma beams allowing for the study of electromagnetic dipole response of rare nuclei available in nature in extremely low quantities, such as *p-nuclei*.

A broad research program on technologies for biomedical applications, anchored in the unique ELI-NP capabilities, is currently being developed and addresses topics, such as: production of radiotherapy relevant nuclear beams, radiobiological effects of laser and gamma nuclear beams, medical imaging research with laser X-ray sources and medical isotope production research with laser-driven nuclear beams.

An overview of the ELI-NP research infrastructure and of selected research topics to be investigated at ELI-NP will be given.

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