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## Stepping into the light with High Power Laser and Brilliant Gamma beams at ELI-NP

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Laser intensities have increased by 6 orders of magnitude in the last few years. These are now so large that the laws of optics change in fundamental ways, thus opening up the new field called relativistic optics. The development of high power lasers and the combination of such novel devices with accelerator technology has enlarged the science reach of many research fields, in particular particle and nuclear physics, astrophysics as well as societal applications in material science, nuclear energy and applications from cultural heritage to biology, medicine, and space.

The European Strategic Forum for Research Infrastructures has selected a proposal based on these new premises called the Extreme Light Infrastructure (ELI). One important aspect of ELI is the possibility to produce ultra-short pulses of high energy photons, electrons, protons, neutrons, muons, and neutrinos. In this time-domain (femto to attoseconds, 10<sup>-15</sup>s and below) experimental studies will allow unravelling the dynamics in atomic, molecular physics, plasma and sub-nuclear physics.

The ELI will be built as a network of three pillars in Hungary, Czech Republic and Romania at the frontier of laser technologies. The ELI-NP pillar (NP for nuclear physics) is under construction near Bucharest (Romania) and will develop a scientific program using two 10 PW lasers and a Compton back-scattering high-brilliance and intense low-energy gamma beam. This unique combination of beams worldwide allows us to develop an experimental program at the frontiers of present-day knowledge as well as society driven applications. In particular ELI-NP particle acceleration experiments will explore uncharted territory of high power femtosecond laser (HPL) interaction with matter, like for Table-Top Laser-based source of femtosecond, collimated, ultra-relativistic electrons beams, and high energy of ions and neutron beams.

In the present paper, after an introduction to high power laser science and of its development worldwide, we will describe the present status the implementation of the ELI-NP facility as well as the new perspectives in Nuclear Physics and Astrophysics and their applications. We will illustrate through specific examples the impact of this emerging science on the some hot societal issues (health, energy) and on the economical and educational potential of this Large Scale Facility in the host country.

**Apply to be considered for a student award (Yes / No)?**

No

**Level for award (Hons, MSc, PhD, N/A)?**

N/A

**Would you like to submit a short paper for the Conference Proceedings (Yes / No)?**

No

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