

## **FOREWORD**

### **EXTREME LIGHT INFRASTRUCTURE – NUCLEAR PHYSICS (ELI-NP)**

The Extreme Light Infrastructure (ELI) is a major European Infrastructure project, part of the 2006 Roadmap of ESFRI (European Strategic Forum for Research Infrastructure), to be implemented in three locations in the Czech Republic, Hungary, and Romania.

**The Nuclear Physics pillar, ELI-NP** is located in the Magurele Physics Research Campus, near Bucharest, Romania. Valued at more than 300 MEuro, the project is cofinanced by the European Commission and the Romanian Government from Structural Funds, via the European Regional Development Fund. Romania's ELI-NP – overseen by the Horia Hulubei National Institute of Physics and Nuclear Engineering (IFIN-HH) – has started to be implemented in 2013, and it is scheduled to be finished by the end of 2018. In 2019, when the project is going to be operating, it will be the most advanced research facility in the world focusing on nuclear physics studies with photons and applications – a task that will be accomplished with the help of two 10 PW ultra-short pulse lasers and the most brilliant tunable gamma-ray beam machine currently available in the world. The brilliant gamma ray beam provides tunable energy of up to 20 MeV, which is obtained by the back-scattering of optical photons on electrons from a LINAC beam of energy of up to 720 MeV.

ELI-NP will be implemented using the highest concentration of researchers from Central and Eastern Europe specialised in laser and nuclear physics. The high density of innovative companies located in the region, as well as top-ranked universities in Bucharest, will provide the basis for the creation of a pole of excellence and an innovation cluster at the facility. ELI-NP will thus impact positively not only fundamental science, but also on the industrial community at both a local and international level.

Its social impact in Romania is of major importance to counteract the country's brain drain, by providing motivation for top young researchers – who might otherwise seek to go abroad in search of better professional opportunities at large scale research centres – to remain in Romania. A cutting edge infrastructure to serve the worldwide scientific community, ELI-NP will be a catalyst for innovation in industry and the private sector, able to enhance technological transfer both to

small- and medium-sized enterprises and to large firms, and to train scientists and engineers in numerous disciplines associated with Extreme Light.

During the first phase of implementation (2013 – 2015), ELI-NP accomplished all the steps stipulated by its own timeline: recruitment of specialized staff, the components of the first 10 PW laser in the world, the first part of the gamma beam system, and, last but not least, civil constructions.

At ELI-NP two well-established scientific communities, high-power lasers and nuclear physics, have joined their efforts to build a new interdisciplinary facility and to define its research program. As a result of this collaboration, the scientific interest of ELI-NP is covering a broad range of key topics in frontier fundamental physics, nuclear physics, and applied physics.

The scientific case for ELI-NP, based on the unique features of the high-power laser and gamma beams, was elaborated by an international collaboration of more than 100 scientists from 30 countries and published as the ELI-NP White Book. The main research topics of interest are: laser driven nuclear physics experiments, characterization of the laser-target interaction by the means of nuclear physics methods, photonuclear reactions, exotic nuclear physics and astrophysics. In addition to fundamental themes, applications of High Power Laser System (HPLS) and Gamma Beam System (GBS) are under study. Ionizing radiation metrology, radiation induced damage and gamma beams induced nuclear reactions are major active research area in nuclear physics and engineering. Their applications extend from the nuclear power plants to medicine and from space science to material science.

The ELI-NP team, together with their collaborators from the international scientific community, shaped the future scientific program of ELI-NP in a series of workshops and defined the development directions for the facility. The Technical Design Reports (TDRs) are finalized and approved by the scientific community and by ELI-NP International Scientific Advisory Board. These TDRs are presented in the current issue of the *Romanian Reports in Physics*.

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