Form B1_EN - Project Summary

Programme / Sub-programme / Module	5/5.1/ELI-RO
Project type	RDI
ELI-NP thematic	RA35/IV.1 Laser-plasma interaction and laser driven radiation generation – experiments, theoretical models and simulations
Project title / Acronym	Femtoseconds PW laser applications on advanced particle acceleration / FLAP
Project duration	26 months

PROJECT SUMMARY

In just a couple of years at ELI-NP, for the first preparatory experiments several acceleration mechanisms will be exploited, like Target Sheath Normal Acceleration (TNSA), Radiation Pressure Acceleration (RPA) and Laser Wakefield Acceleration (LWFA). Especially, TNSA and LWFA mechanism will be used for proton and electron acceleration, respectively as these are the most used and best understood acceleration schemes.

The principle leading this project is 'Start before Start' with a complete set of experiments that will not only enhance our exposure to high power laser experiment and facility management but also generate a steady scientific output. Due to the similar characteristics of its high power laser source and close proximity to ELI-NP, the best place for this project is at CETAL.

We propose a three-year experimental program to explore several fundamental acceleration mechanisms for negative and positive ions and their applications. Beyond these mechanisms we plan to test an advanced acceleration scheme that is scalable to 10 PW level: the use of high power helical beams for ion acceleration, both in solid and gas targets. Our ultimate goal is to evaluate the qualitative and quantitative impact of the helical beam on the acceleration mechanisms.

The accelerated proton beams will find use in a Proton Radiography Diagnostic, one of the most promising imaging method with respect to its applications in various domains (astrophysics, medicine and plasma physics). Due to the way protons interact with matter (by strong and electromagnetic interactions) they represent an excellent analysis tool for a wide variety of materials. High energy protons are used as probing particles by illuminating the target that absorbs or scatter the beam, which is afterwards focused with a magnetic lens into an imaging detector.

One of the applications of high power laser systems that has been extensively studied is acceleration of electrons in a gas target, this being one of the benchmark experiments for laser facilities. Laser wakefield acceleration promises to produce electron beams at laser facilities without the complex and expensive infrastructure of an accelerator, shrinking the acceleration distance to the order of millimeters. Our approach is to aim for lower electron energies, of the order of a few hundred MeV, but to achieve high beam charges, of the order of nanocoulombs. Improving the beam charge will allow performing experiments that are currently limited by low cross sections, as well as prepare the path for industrial applications of laser accelerated electrons.