POLITECNICO DI MILANO

PhD in SCIENZE E TECNOLOGIE ENERGETICHE E NUCLEARI / ENERGY AND NUCLEAR SCIENCE AND TECHNOLOGY - 41st cycle

THEMATIC Research Field: ADVANCED TARGETRY FOR THE DEVELOPMENT OF LASER-DRIVEN PARTICLE BEAMS

Monthly net income of PhDscholarship (max 36 months)
1400.0 In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	Laser-driven particle acceleration is a rapidly evolving field with the potential to revolutionize applications in science, medicine, and industry, offering compact and cost-effective alternatives to conventional accelerator technologies. A key component in achieving high-performance, reliable laser-driven ion beams is the development of advanced targets and targetry systems capable of supporting high-repetition-rate operation, beam quality control, and tailored particle spectra. The European research infrastructure ELI (Extreme Light Infrastructure) has identified target development as one of the main technological bottlenecks for the next generation of laser-driven accelerators. In particular, the need for reproducible, scalable, and application-oriented targets is critical to enable routine operation of laser-plasma sources in user facilities. This project focuses on the design, fabrication, and testing of innovative target concepts for laser-driven ion acceleration, with special emphasis on double-layer targets incorporating near-critical density materials such as nanofoams. The objective is to optimize target architectures for enhanced acceleration performance—both in terms of energy and particle yield—while ensuring compatibility with the stringent requirements of high-repetition-rate laser systems. The research is carried out in strong collaboration with ELI Beamlines and will contribute

	directly to the development of operational targetry platforms for future user campaigns
Methods and techniques that will be developed and used to carry out the research	The project will be primarily experimental and will combine advanced target design, fabrication, and testing activities, both at the home institution (Politecnico di Milano) and at ELI Beamlines, where dedicated high-power laser campaigns will be conducted. Target fabrication will rely on thin-film deposition techniques, particularly Physical Vapour Deposition (PVD), for the realization of multi-layer structures. A key focus will be the integration of near-critical density layers in the form of nanofoam or nanostructured materials, requiring precise control over morphology, thickness, and uniformity. The candidate will also contribute to the mechanical and logistical development of target delivery systems, addressing challenges related to alignment, stability, and rapid replacement for high-repetition-rate operation. The experimental validation of the developed targets will take place during irradiation campaigns using ultra-intense laser systems, primarily at ELI Beamlines. The candidate will be involved in the preparation, execution, and data analysis of these experiments, including diagnostics of accelerated particle beams and post-shot characterization of targets. Feedback from experimental results will drive iterative improvements in the target design and fabrication processes. The collaboration with ELI Beamlines ensures access to cutting-edge laser infrastructure and facilitates the integration of the developed targets into operational platforms serving a broader scientific user community.
Educational objectives	Education of people to be launched in the world of research and high technology industry in the fields of physics and engineering of materials, able to manage interdisciplinary issues, perform and interpret complex experiments and produce new equipment.
Job opportunities	Private and public R&D. Highly qualified positions in a wide range of industries, for examples related with production, development, and use of advanced materials. The present research will be performed in collaboration with national and international partners.

Composition of the research group	3 Full Professors 3 Associated Professors 1 Assistant Professors 15 PhD Students
Name of the research directors	Alessandro Maffini

Contacts
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Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents	--

Scholarship Increase for a period abroad	
Amount monthly	700.0 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
Educational activities: Financial aid per PhD student is available for purchase of study books and material, funding for participation in courses, summer schools, workshops and conferences, instrumentations and computer, etc. This amount is equal to 10% of the annual gross amount, for 3 years. **Teaching assistantship**: Availability of funding in recognition of supporting teaching activities by the PhD student. There are various forms of financial aid for activities of support to the teaching practice. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations. **Computer availability**: individual use. **Desk availability**: individual use.