POLITECNICO DI MILANO

PhD in INGEGNERIA AEROSPAZIALE / AEROSPACE ENGINEERING - 39th cycle

PNRR 117 Research Field: ADVANCED CONCEPTS OF PLASMA PROPULSION SYSTEMS FOR SPACE APPLICATIONS

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	Electric propulsion plays a fundamental role in modern satellites. In recent years, the conversion of some kinds of space platforms (e.g., GEO satellites) from chemical to electric propulsion is mostly driven by the possibility to achieve longer operative life for the same propellant mass budget, in light of higher specific impulse. Moreover, electric propulsion can use nuclear or radiant primary energy sources and can be used in long-duration missions. The application field of this propulsion family is constrained due to its typical low thrust level. A potential improvement is represented by the adoption of high-power plasma propulsion units, such as microwave electrothermal, helicon plasma or electron-cyclotron resonance heated thrusters. In this research, the PhD student will explore the use of innovative plasma-driven propulsion systems and will address the different consequences on the spacecraft, its architecture, its mission, etc. The development of such innovative propulsion solutions is an enabler for improved telecommunication or Earth observation satellites, thanks to a longer lifetime and reduced operative costs. This specific activity will have important fallout towards the industrial space sector and its ecosystem (as planned by the PNRR, Mission M1C2 – Investment 4.1: Satellite Technology and Space Economy). Moreover, it will ease the implementation of SDG 12 (Responsible consumption and production) through the introduction of propulsion units with nontoxic propellants and of SDG 13 (Climate

	action) through the development of satellite monitoring systems capable of longer orbit lifetime.
Methods and techniques that will be developed and used to carry out the research	Advanced electric propulsion systems are complex and need specific competencies to deal with the power source, the nonlinear plasma medium, the constraints imposed by the environment and the mission. The student will perform a modelling activity and will merge disciplines from physics and electromagnetism (partially, plasma physics) with those typical of propulsion engineering (propulsion performance, thermal fluid dynamics, orbital mechanics, aerospace systems, and nuclear power sources). The project will be developed in cooperation with the company D-Orbit where the candidate will spend 6 months. The PhD candidate will also be hosted for 6 months (non-continuing) by URA Thrusters, Westcott Innovation Centre, Buckinghamshire.
Educational objectives	The student will learn disciplines related to electric propulsion concepts, architectures, and fundamental principles, as well as skills related to modern missions and space platform configurations. In addition, by working in a mixed and vibrant academic and industrial context, the candidate will have the opportunity to learn on the job several transferable skills, including communication skills, team working, leadership, and ethical aspects associated with the use of innovative technologies. In support of this, the PhD School of Politecnico di Milano provides a complete and rather diverse offer of courses. Each candidate must include in their syllabus at least 10 ECTS in transferable skills, to complement at least other 5 ECTS in technical disciplines associated with Aerospace Engineering, for a total of at least 20 ECTS.
Job opportunities	The candidates will find natural opportunities in the national, European and worldwide space systems industry, in a sector that is currently growing very rapidly. At the national level, strong competitiveness is needed to position the national industry at the top-level role. The candidates may also find opportunities in numerous other high-tech industrial fields, in which competencies in plasma physics, high power and high energy density

	power sources, and mission design, gathered in the integrated design of complex systems play a fundamental role, centred on but not limited to industrial engineering.
Composition of the research group	0 Full Professors 1 Associated Professors 2 Assistant Professors 4 PhD Students
Name of the research directors	Prof. Filippo Maggi

Contacts
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Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

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

National Operational Program for Research and Innovation	
Company where the candidate will attend the stage (name and brief description)	D-Orbit
By number of months at the company	6
Institution or company where the candidate will spend the period abroad (name and brief description)	URA Thrusters, Westcott Innovation Centre, Buckinghamshire (UK)
By number of months abroad	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
The PhD candidate will receive a desk, possibly through a hot-desking procedure, and a personal computer, if needed. Apart from the compulsory ones, the PhD candidate will have the opportunity to follow additional courses and receive economic support to attend summer schools and participate in conferences. There will be the possibility of paid teaching assistantship.