



PhD in FISICA / PHYSICS - 38th cycle

PARTENARIATO PNRR Research Field: NOVEL FREQUENCY COMBS FOR BROADBAND SPECTROSCOPY (I-PHOQS EXTREME PHOTONICS) .

Monthly net income of PhDscholarship (max 36 months)

€ 1200.0

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

The aim of this PhD project, in the framework of the Italian I-PHOQS infrastructure (**CUP B53C22001750006, Decreto di concessione n.126 del 21/06/2022**), is the development of innovative photonic architectures for the synthesis of optical frequency combs (OFCs) over a very wide spectrum, from the UV to the mid infrared (IR), and the use of these sources for ultra-broadband absorption as well as scattering vibrational spectroscopic investigations with unprecedented precision and sensitivity. The performance of the proposed OFCs and related spectroscopic methods will be pushed beyond the state-of-the-art in terms of spectral coverage, frequency resolution, sensitivity and measurement speed, making this infrastructure of unique interest for a variety of applications.

Methods and techniques that will be developed and used to carry out the research

The scholar will develop novel OFCs as well as mid-infrared spectroscopy techniques. Specifically, the following activities will be carried out:

- i) Development of novel mid-IR OFCs covering the 2-20 μm region based on ultrafast lasers (both in bulk and fiber configurations), synchronously pumped optical parametric oscillators, and electro-optic modulation.
- ii) Spectral extension of near IR OFCs to the mid-IR by means of difference frequency generation and optical rectification processes and to the UV by high-order harmonic generation.
- iii) Development of broadband precision vibrational spectroscopy methods based on OFCs such as, comb-



	assisted coherent anti-stokes Raman spectroscopy of gas samples and direct frequency comb hyperspectral methods for multispecies gas detection (environmental monitoring and real-time combustion applications).
Educational objectives	The scholar will receive a multidisciplinary training in topics including laser physics, nonlinear optics, frequency metrology, and molecular spectroscopy. He/she will be exposed to steps required for the implementation of broadband precision spectroscopy in the mid-infrared spectral region based on novel optical frequency comb sources.
Job opportunities	Due to the multidisciplinary training in cutting edge techniques of optical frequency comb synthesizers as well as broadband spectroscopy, the scholar will have excellent job opportunities in high-tech industries. In addition, he/she will be well positioned for an academic career.
Composition of the research group	2 Full Professors 4 Associated Professors 1 Assistant Professors 2 PhD Students
Name of the research directors	Gianluca Galzerano, Marco Marangoni

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	600.0 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information

Educational activities: Educational activities (purchase of study books and material, funding for participation to courses, summer schools, workshops and conferences): financial aid per PhD student per 3 years: max 4.892,40 euros per student.

Teaching assistantship: 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: shared use