



PhD in FISICA / PHYSICS - 38th cycle

THEMATIC Research Field: TIME-GATED HYPERSPECTRAL IMAGING FOR MATERIAL SCIENCE

Monthly net income of PhDscholarship (max 36 months)
€ 1195.5
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	<p>This fellowship will be in the context of the iPHOQS project, a large-scale Italian Research Infrastructure in the field of photonics and quantum science. Time-resolved photoluminescence spectroscopy is a fundamental tool to study the relaxation dynamics of solid-state materials, upon optical excitation. In photoinduced processes, like photocatalysis and solar energy harvesting and conversion, multiple deexcitation mechanisms can take place in materials at different timescales. To disentangle short living emissions from the long living ones, the project aims to develop a hyperspectral imaging workstation with time-gated detection to analyze de-excitation paths occurring at different timescales. The system combines a hyperspectral module with a time-gated camera to separate short living emissions (occurring at the picosecond and nanosecond timescales) from long living ones (occurring at microseconds and milliseconds timescales). This approach has already proved to be very effective to study photocatalytic materials where long living emission are correlated with highly reactive surface defects. In parallel, the workstation could be very useful also to study crystal defects in semiconductor and inorganic materials, with potential applications in the fascinating field of heritage science, where the study of semiconductor pigments in artworks is fundamental to chemically understand degradation and fading occurring in modern paintings.</p>
Methods and techniques that will be developed and used to carry out the	The PhD candidates will be involved in the development



research	of a hyperspectral imaging workstation that combines an innovative interferometer (TWINS) with a time-resolved detection module. The last is based on a sub-nanosecond resolution time-gated camera. The workstation will work in two configurations: macro and micro. The macro setup will have a field of view of a few centimetres and will be suited to study the deexcitation mechanism in large samples, like pigments and artistic materials. The micro configuration will be based on an optical microscope and will be tailored to study light mediated phenomena in material science, like photocatalytic reactions. The excitation light will be provided by a low repetition rate (kilohertz) Q-switch tuneable laser generating ≈ 1 ns pulses.
Educational objectives	The PhD candidate will receive a multidisciplinary training in topics including: lasers science, detection techniques, interferometry and microscopy. He/she will also become familiar with optical spectroscopy for material science analysis. Advanced data management and analysis will be also part of the training. He/she will have the opportunity to visit partner laboratories in the iPHOQS project.
Job opportunities	Due to the multidisciplinary training in optics and photonics as well as in material science, the scholar will have excellent job opportunities in industries developing analytical instrument and spectroscopic systems. Innovative companies and start-ups in green economy will also offer employment opportunities. In addition, he/she will be well positioned for a career in university or research center.
Composition of the research group	4 Full Professors 4 Associated Professors 3 Assistant Professors 7 PhD Students
Name of the research directors	D. Comelli, G. Valentini, C. D'Andrea

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	597.75 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
<p>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 4.872,90 euros per student.</p> <p>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.</p> <p>Computer availability: individual use</p> <p>Desk availability: shared use</p>