



PhD in FISICA / PHYSICS - 39th cycle

Number of scholarship offered	3
Department	DIPARTIMENTO DI FISICA

Description of the PhD Programme

The PhD Program aims at providing engineers and physicists with a general education in the basic areas of applied physics and specific knowledge in condensed matter physics, optics, lasers and photonics. To develop a research-oriented mind-set, the PhD students are guided to acquire problem-solving capabilities in a complex context, including in-depth problem analysis, identification of original solutions and capability of evaluating their applicability in given contexts. These skills will provide future doctors with major opportunities for their activities both in the academic field and in public and private companies and organizations.

The education contents are strictly related to the research activities carried out in the advanced experimental laboratories at the Department of Physics. In particular, 5 research lines can be identified:

- Ultrafast optics and spectroscopy: i) development of new nonlinear optics-based methods to generate broadly tunable pulses, from the infrared to the extreme-ultraviolet, with duration down to single optical cycle limit (from a few femtoseconds to attoseconds); ii) application to the study of primary photoinduced processes in atoms, molecules and solid state materials.
- Solid state lasers and photonic devices: i) development of ultra-broad band solid-state lasers and amplifiers for optical frequency combs; ii) femtosecond laser micromachining of transparent materials for novel optofluidic devices and integrated quantum optical circuits; iii) theoretical investigation and design of optical nanostructures for sensing applications.
- Photonics for health, food and cultural heritage. Development of innovative photonic systems and techniques and application in interdisciplinary fields relying on non-invasiveness and high diagnostic potential of optical means (e.g., fluorescence or photon migration). Projects involve theoretical investigations and simulations as well as extensive experimental work, including development of advanced laboratory set-ups and dedicated prototypes for use in real settings.
- Epitaxial growth and nanostructure fabrication (Milano-Leonardo and Como): i) synthesis of artificial materials for microelectronics, optoelectronics, plasmonics and spintronics; ii) optical and electron beam lithography; iii) spectroscopy and microscopy; iv) SiGe/Si heterostructures; v) graphene nanoelectronic devices; vi) magnetic thin films, oxide thin films.
- Electronic, optical and magnetic properties of low-dimensional systems (Milano-Leonardo and international synchrotron radiation facilities): i) x-ray spectroscopies with synchrotron radiation; ii)



ultrafast magnetic and electronic phenomena; iii) positron annihilation spectroscopy, antimatter production (at CERN); iv) nano-optics and plasmonics.

The specific research subject will be assigned within the first months of the PhD activity, with the agreement of the candidate and the Board of Professors of the PhD Program.

Most research is integrated with the activities of the Institute of Photonics and Nanotechnologies of the National Research Council (IFN-CNR) and with the Interuniversity Center LNESS (Laboratory of Epitaxial Nanostructures on Silicon and for Spintronics). Collaboration is also active with the IIT (Istituto Italiano di Tecnologia) Center for Nano Science and Technology. Several collaborations are on-going with high-level international institutions, both universities and advanced research centers (e.g., University of Cambridge, Massachusetts Institute of Technology, Stanford University, University College London, Harvard University). Students enrolled in our PhD Program will therefore have a real opportunity to gain experience also in prestigious laboratories abroad.

The Department of Physics is home to the PhD Program. Further information on the PhD Program and related research activities can be found at: www.fisi.polimi.it



PhD in FISICA / PHYSICS - 39th cycle

THEMATIC Research Field: EDIBLE SENSORS

Monthly net income of PhDscholarship (max 36 months)

€ 1300.0

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	<p>The emerging field of edible electronics is creating great scientific resonance by envisioning a technology which is safe for ingestion, environmentally friendly, cost-effective, and degraded within the body after performing its function, either digested or even metabolized. Long-term opportunities include smart pharmaceuticals and direct food tagging. Sensors are key to such applications. We offer one scholarship in the framework of the ERC project “ELFO: Electronic Food” https://elfoproject.eu/</p>
Methods and techniques that will be developed and used to carry out the research	<p>The study will be performed within the “Printed and Molecular Electronics” group, led by Mario Caironi in the Center for Nano Science and Technology @PoliMi, of the Istituto Italiano di Tecnologia. The study will require the fabrication and characterization of edible electronic sensors, especially targeted to sense parameters in the gastrointestinal tract (pH, temperature, pressure, different biomarkers).</p>
Educational objectives	<p>Expanding the knowledge of the electronic properties of food and food derivatives, learning solution-based fabrication techniques, exploring the toxicological properties of synthetic carbon based materials, developing sensor science with edible components, working in a multidisciplinary field.</p>
Job opportunities	<p>Edible Electronics is new multidisciplinary research field, providing a great opportunity to be exposed to several different environments, from academia to industry. Careers in academia, in industry, industrial R&D and</p>



	consulting are possible.
Composition of the research group	0 Full Professors 4 Associated Professors 6 Assistant Professors 9 PhD Students
Name of the research directors	Mario Caironi (PI), Alessandro Luzio (Researcher)

Contacts	
Mario.caironi@iit.it, tel. 0039 02 2399 9875; Alessandro.luzio@iit. ithttps://www.iit.it/research/lines/printed-and-molecular-electronics	

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	650.0 €
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 5.300,25 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 and desk availability: individual o shared use</p>



PhD in FISICA / PHYSICS - 39th cycle

OPEN SUBJECT Research Field: PHD IN PHYSICS

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

<p>Motivation and objectives of the research in this field</p>	<p>Translation of scientific knowledge into new technology and transfer of innovation to the production system represent a needed step for many companies, also dictated by an increasingly global market. For the purpose, individuals with broad cultural background are needed. In particular, many advanced sectors of industry and research require a good knowledge in topics such as condensed matter physics, optics, laser technology and instrumentation, and nanostructured materials.</p>
<p>Methods and techniques that will be developed and used to carry out the research</p>	<p>The PhD Program has application-oriented character that clearly distinguishes it from PhD Programs at the Schools of Science. Candidates are also encouraged to carry out part of their research activities in contact with other research groups in their field of interest, possibly abroad.</p>
<p>Educational objectives</p>	<p>The aim of the PhD in Physics at Politecnico di Milano is the training of personnel with strong research capacity, able to operate in basic and applied research and development facilities, and to manage and design high-tech and innovative products and processes in various industrial sectors.</p>
<p>Job opportunities</p>	<p>Manager of devices, equipment and systems in large industries and companies. Designer of new components and advanced optoelectronics devices in high-tech industries as well as small innovative enterprises. Researcher in industries, universities, research centres.</p>



Composition of the research group	21 Full Professors 36 Associated Professors 20 Assistant Professors 149 PhD Students
Name of the research directors	Cerullo, P. Laporta, P. Taroni, F. Ciccacci, L. Duò

Contacts	
<i>PhD Program Secretary:</i> Daniela Rossi, Giusi Calia: phd-fis@polimi.it	
<i>PhD Program Coordinator:</i> marco.finazzi@polimi.it, phd-fis@polimi.it +39-02-23996177	
http://www.fisi.polimi.it	

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 <i>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.</i></p> <p>Teaching assistantship: <i>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.</i></p> <p>Computer and desk availability: <i>individual o shared use</i></p>	