



PhD in INGEGNERIA DELL'INFORMAZIONE / INFORMATION TECHNOLOGY - 38th cycle

Research Area n. 2 - Electronics

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|-------------------------------|---|
| Number of scholarship offered | 5 |
| Department | DIPARTIMENTO DI ELETTRONICA, INFORMAZIONE E BIOINGEGNERIA |

Description of the Research Area

The Area Electronics of the PhD Programme in Information Technology at the Department of Electronics, Information and Bioengineering (DEIB) carries out research and teaching activity in the various fields of Electronics. It originates from the activity of Emilio Gatti, who was called to cover the first full professor chair of Electronics established in Italy at the Politecnico di Milano in 1957. The research area currently has 11 full professors, 11 associate professors, 5 assistant professors, 61 students of the Ph.D. curriculum and about 13 contract researchers and post-doc appointees. An essential characteristic feature of the research in electronics is the imprinting given by Emilio Gatti: always challenge the research issues by facing the objective data coming from the experimental facts. Such attitude is necessary for detecting the problems to be solved and discovering the keys for the solution, for evaluating with critical mind any conjecture and solution devised. It is mandatory for staying competitive at international level in the development of electronic, microelectronic and optoelectronic technologies and their applications. Therefore, it is necessary to own significant experimental facilities and maintain them updated. This constitutes an important commitment in terms of cost, space for laboratories and working time of staff. This approach represents a distinguishing element, which implies specific operating modes and requirements that characterize the Electronics research areas. In the research activity, developments in the science and technology of electronic, microelectronic and optoelectronic devices, circuits and systems give rise and support to new developments in diversified fields of interest for the present-day society. Besides, aiming to typical themes of the ICT (Information and Communication Technology), the research work looks to other developments, such as application of nanoelectronic and diagnostic technologies to genetics and biomedicine, diagnostics of cultural heritage and astrophysics applications. The research framework is naturally dynamical, and it evolves continuously driven by prospects and new initiatives. The Research area in Electronics is organized in Research Lines as follows:

- **Circuit and System Theory and Applications**, which deals with models of circuit parasitic phenomena and numerical methods for circuit analysis.



- **Sensors and Instrumentation**, which deals with the development of advanced detectors for optical and ionizing radiation and of the related electronic systems, addressing applications in various fields that range from life sciences to space research.
- **Microelectronics and Emerging Technologies**, which is devoted to the design of integrated circuits for radio-frequency transceivers and power management, the characterization and modelling of non-volatile memories, and the investigation of electronic properties at the nanoscale and organic semiconductor devices.

Research lines in Electronics share a service for fast PCB prototyping and ad-hoc instrumentation development, bonders and a wafer scribe for device/sample preparation, safety cabinets for chemical handling. In addition to the computer rooms dedicated to integrated circuits CAD and/or devices simulations, labs are dedicated to specific research lines.

Further information:

- Research at the DEIB Department: <https://www.deib.polimi.it/eng/>
- PhD Programme in Information Technology (IT PhD): <https://dottoratoit.deib.polimi.it/>
- Electronics Section at DEIB: <https://www.deib.polimi.it/eng/electronics>



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**INTERDISCIPLINARY Research Field: COST-EFFECTIVE GERMANIUM SINGLE-PHOTON
DETECTORS FOR THE NEAR-INFRARED WAVELENGTH RANGE**

Monthly net income of PhDscholarship (max 36 months)

€ 1400.0

In case of a change of the welfare rates or of changes of the scholarship minimum amount from the Ministry of University and Research, during the three-year period, the amount could be modified.

Context of the research activity

Motivation and objectives of the research in this field

Interdisciplinary PhD Grant

The PhD research will be carried out in collaboration with research groups of the PhD programme in "**PHYSICS**". See <https://www.dottorato.polimi.it/?id=422&L=1> for further information.

A growing number of applications, from quantum communications to quantum computing, require cost-effective microelectronic photodetectors with single-photon sensitivity in the short-wave infrared range and with new advanced features for on-chip processing. The present research project aims at developing Ge-on-Si single-photon detectors (SPADs) by exploiting all the advantages of the silicon technology for integrating a near-infrared absorbing material (germanium) onto a silicon substrate.

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

The single-photon detectors will be modeled and designed with TCAD simulations. Detectors will be grown and fabricated at LNESS laboratory and POLIFAB, and fully characterized for assessing electrical and optical performance.

Educational objectives

The PhD student will acquire solid background in physics of semiconductor devices, integrated circuit design,



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| | electronic systems. To this aim, the doctorate activity will include attendance of academic courses, conferences, summer schools and workshops. |
| Job opportunities | Like recent PhD graduates from our research group, this PhD experience, spanning from electron devices to electronic systems, will give access to a wide variety of jobs, from semiconductor industries to application-oriented companies, from academia to start-ups. |
| Composition of the research group | 1 Full Professors 2 Associated Professors 0 Assistant Professors 6 PhD Students |
| Name of the research directors | Alberto Tosi |

| Contacts |
|---|
| alberto.tosi@polimi.it +39 02 2399 6174 http://www.everyphotoncounts.com/ |

| Additional support - Financial aid per PhD student per year (gross amount) | | | |
|---|--|-------------------------|-------------------------|
| | 1st year | 2nd year | 3rd year |
| Housing - Foreign Students | 1500.0 € per student | 1000.0 € per student | 1000.0 € per student |
| | max number of financial aid available: 2, given in order of merit .. | | |
| 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 |

| Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information |
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| <p>LIST OF UNIVERSITIES, COMPANIES, AGENCIES AND/OR NATIONAL OR INTERNATIONAL INSTITUTIONS THAT ARE COOPERATING IN THE RESEARCH: LNESS, Como; Micro Photon Devices srl</p> <p>EDUCATIONAL ACTIVITIES (purchase of study books and material, including computers, funding for participation in courses, summer schools, workshops and conferences): financial aid per PhD student 5.707,13 Euro per student</p> |



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:

1st year: individual use

2nd year: individual use

3rd year: individual use

DESK AVAILABILITY:

1st year: individual use

2nd year: individual use

3rd year: individual use



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OPEN SUBJECT Research Field: ELECTRONICS

| Monthly net income of PhDscholarship (max 36 months) | |
|--|--|
| <p style="text-align: center;">€ 1250.0</p> <p>In case of a change of the welfare rates or of changes of the scholarship minimum amount from the Ministry of University and Research, during the three-year period, the amount could be modified.</p> | |
| Context of the research activity | |
| <p>Motivation and objectives of the research in this field</p> | <p>In the research activity, developments carried out in electronic, microelectronic, and optoelectronic devices, circuits, and systems find use in a variety of topics of interest in today's society. Beside typical themes of the ICT (Information and Communication Technology), the research work looks to other developments, such as application of nanoelectronic and diagnostic technologies to genetics and biomedicine, diagnostics of cultural heritage and analysis of materials. The research framework is naturally dynamical and it evolves continuously driven by prospects and new initiatives.</p> <p>http://www.deib.polimi.it/eng/electronics</p> |
| <p>Methods and techniques that will be developed and used to carry out the research</p> | <p>The research is carried out typically within a research group under the guidance of a supervisor. The activity is frequently carried out in international collaborations as well as in a interdisciplinary framework. Laboratory activity is usually part of the research workplan.</p> |
| <p>Educational objectives</p> | <p>The doctoral program offers advanced training in the hot topics explored by the scientific community and industry. A period of study within one foreign research institution is encouraged and financially supported by the doctoral school.</p> |



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| | http://dottoratoit.deib.polimi.it/ |
| Job opportunities | Careers in the leading electronics companies are facilitated by the strong connection between the academic and industrial research. Post doc positions in the university are frequently offered. |
| Composition of the research group | 11 Full Professors 11 Associated Professors 5 Assistant Professors 61 PhD Students |
| Name of the research directors | Any faculty member can act as research director |

| Contacts | |
|---|--|
| <p>Prof. Carlo Ettore Fiorini Coordinator of the Electronics area E-mail: carlo.fiorini@polimi.it Phone: +39 02 2399 3733 Web: http://www.deib.polimi.it/eng/people/details/194086</p> <p>Prof. Angelo Geraci Vice-coordinator of the Ph.D. IT Programme for the Electronics area E-mail: angelo.geraci@polimi.it Phone: +39 02 2399 6095 Web: https://www.deib.polimi.it/eng/people/details/212366</p> <p>Prof. Luigi Piroddi Coordinator of the Ph.D. IT Programme E-mail: luigi.piroddi@polimi.it Phone: +39 02 2399 3556 Web: https://www.deib.polimi.it/eng/people/details/318548</p> | |

| Additional support - Financial aid per PhD student per year (gross amount) | | | |
|--|-------------------------|-------------------------|-------------------------|
| Housing - Foreign Students | 1st year | 2nd year | 3rd year |
| | 1500.0 € per student | 1000.0 € per student | 1000.0 € per student |
| max number of financial aid available: 2, given in order of merit .. | | | |
| Housing - Out-of-town residents (more than 80Km out of Milano) | -- | | |

| Scholarship Increase for a period abroad |
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|---------------------|---------|
| Amount monthly | 625.0 € |
| By number of months | 6 |

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

EDUCATIONAL ACTIVITIES (purchase of study books and material, including computers, funding for participation in courses, summer schools, workshops and conferences): financial aid per PhD student
5.095,96 Euro per student

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:

1st year: Yes

2nd year: Yes

3rd year: Yes

DESK AVAILABILITY:

1st year: Yes

2nd year: Yes

3rd year: Yes