



PhD in INGEGNERIA DELL'INFORMAZIONE / INFORMATION TECHNOLOGY - 41st cycle

Research Area n. 2 - Electronics

Number of scholarship offered	3
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.



PhD in INGEGNERIA DELL'INFORMAZIONE / INFORMATION TECHNOLOGY - 41st cycle

Research Area n. 2 - Electronics

**THEMATIC Research Field: DEVELOPMENT OF A ELECTRONICS READOUT SYSTEM FOR
A GAMMA-RAY DETECTOR USED ON RADIONUCLIDE THERAPY**

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

In the framework of the EC project AIDER (Advanced Imaging DETector for targeted Radionuclide therapy), goal of this PhD is the development of an electronics readout system for a gamma-ray detector, able to reconstruct energy, position of interaction and time stamp of the gamma-ray event interacting in the detector. The PhD activity will include the experimentation of the readout system in the final detector, in collaboration with the partners of the EC project AIDER.

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

The electronics readout system will be based on readout ASICs which will acquire and filter the signals from silicon photomultipliers (SiPMs). The signals will be digitized by ADCs and then processed in a FPGA to extract time stamp, energy and position of interaction. The position of interaction will be based on the use of Machine Learning algorithms (e.g. Neural Networks), directly embedded in the FPGA.

Educational objectives

The educational objectives belong to different levels from (i) lead the design and application of readout electronics for an instrument in an innovative medical field, (ii) learn to work in team, mentor master thesis students, self-organize, lead a research project, interact with international research partners and disseminate technical



	results through publications and conferences.
Job opportunities	There is a growing demand in industry and academia for PhD candidates with robust expertise in medical instrumentation, sensors and detectors, signal acquisition and software based on machine learning.
Composition of the research group	1 Full Professors 2 Associated Professors 3 Assistant Professors 15 PhD Students
Name of the research directors	Prof. Carlo Fiorini

Contacts
carlo.fiorini@polimi.it

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents	--

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

Stage and period abroad	
Institution or company where the candidate will spend the period abroad (name and brief description)	
By number of months abroad	0

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
<p><u>EDUCATIONAL ACTIVITIES</u> (purchase of study books and material, including computers, funding for participation in courses, summer schools, workshops and conferences).</p> <p><u>TEACHING ASSISTANTSHIP</u>: 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.</p> <p><u>COMPUTER AVAILABILITY</u>:</p>



1st year: Yes

2nd year: Yes

3rd year: Yes

DESK AVAILABILITY:

1st year: Yes

2nd year: Yes

3rd year: Yes



PhD in INGEGNERIA DELL'INFORMAZIONE / INFORMATION TECHNOLOGY - 41st cycle

Research Area n. 2 - Electronics

**THEMATIC Research Field: DEVELOPMENT OF INNOVATIVE ASICS FOR BROAD BAND,
HIGH-RESOLUTION SPECTROSCOPY OF PLANETARY SURFACES**

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

Assessing the chemical composition of planets' and asteroids' surfaces is a key part of the investigation of these bodies. The relative abundance of the surface (down to a few m) major elements with atomic number $Z \geq 20$ can be estimated using fluorescent X-ray spectroscopy, using solar X-rays to excite element's atoms. The main goal of X-ray fluorescence is to determine the intensity of Fe-L, Fe-K, Al-K, Mg-K, Si-K complexes and S-K α , S-K β fluorescent lines. From these lines mass abundance ratios can be determined (Mg/Si, Fe/Si, etc.). The comparison of these abundance ratio to those of meteorites and mineral analogs measured in laboratory can provide a first classification of planetary surfaces complementary to other analysis techniques. Gamma-ray spectroscopy of nuclear lines can also be used to assess abundances of elements in the planetary surface down to 20 cm and can provide information on high atomic number elements. A space-qualified X-and gamma-rays spectrometer, covering a unique wide energy band, from a few keV to several MeV, is going to be designed as one of the payload foreseen in the project TASTE (Terrain Analyser and Sample Tester Explorer) of the Italian Space Agency (ASI). The spectrometer is also involved in a study for an application on a rover to search for precious elements and Rare Earths on the surface of



	the Moon. A core-element of the spectrometer will be an advanced mixed-signal CMOS ASIC (Application Specific Integrated Circuit) with ambitious goals of low power consumption, wide dynamic range, ultra low noise, high stability and radiation resistance, whose design, tests and space qualification will be the main topic of the PhD research.
Methods and techniques that will be developed and used to carry out the research	The research activity will include all the phases related to the design and development of all the stages of the ASIC: from the conception to the design, simulation, fabrication and full experimental characterization.
Educational objectives	The PhD student will acquire skills in the design, simulation, layout and experimental characterization of advanced mixed signal CMOS ASICs for scientific applications. Professional simulators and laboratory instrumentation will be used. Collaboration in team with other PhD students and with external national and international research groups will complete the training.
Job opportunities	At the end of the PhD, the candidate will be ready to consider job opportunities both in companies requiring researchers or engineers skilled in advanced electronic instrumentation and ASIC design or in national or international Institutions for Scientific Research.
Composition of the research group	1 Full Professors 0 Associated Professors 2 Assistant Professors 1 PhD Students
Name of the research directors	Prof. Giuseppe Bertuccio

Contacts	
Giuseppe.Bertuccio@polimi.it Tel. +39 02 2399.7346	

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--



Housing - Out-of-town residents	--
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Scholarship Increase for a period abroad	
Amount monthly	700.0 €
By number of months	6

Stage and period abroad	
Institution or company where the candidate will spend the period abroad (name and brief description)	
By number of months abroad	0

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).

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

The Research Project is within a scientific collaboration between Politecnico di Milano and the Trieste Astronomical Observatory of the Italian National Institute of Astrophysics (INAF).

The main Laboratory in which the research activity will be carried out is the "Semiconductor Devices and Integrated Circuit Laboratory (SDIC Lab)" located at Politecnico di Milano, Como Campus, Via Anzani 42, 22100 Como (<https://sdiclab.deib.polimi.it/>).

Research activities in collaboration with other scientific laboratories located in Trieste, Pavia, Bologna and Rome are scheduled. The Politecnico di Milano residence "La Presentazione" in



Como offers apartments to PhD students (subjected to availability).



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Research Area n. 2 - Electronics

OPEN SUBJECT Research Field: ELECTRONICS

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Context of the research activity

Motivation and objectives of the research in this field

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.

<http://www.deib.polimi.it/eng/electronics>

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

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 an interdisciplinary framework. Laboratory activity is usually part of the research workplan.

Educational objectives

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.



	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. Ivan Rech Coordinator of the Electronics area E-mail: ivan.rech@polimi.it Phone: +39 02 2399 3700 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	--
Housing - Out-of-town residents	--

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