



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

Research Area n. 2 - Electronics

**THEMATIC Research Field: DEVELOPMENT FGPA-BASED ELECTRONIC PROCESSING  
PLATFORMS FOR GAMMA CAMERAS**

**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

Gamma cameras are widely adopted in nuclear imaging for both diagnostics (SPECT, PET) and monitoring tools for particle therapy in oncology. The goal of the research is to develop a multichannel (from 32 to 64 channels) platform based on a FPGA per embedded processing of the signals (energy and timing) from arrays of SiPMs coupled to scintillators. Such a platform will represent the common hardware adopted in different experimentations in nuclear medicine from Prompt Gamma Imaging (PGI) to determine the particle range in Proton and Ion (Carbon) Therapy, as well as in Boron Neutron Capture Therapy (BNCT) to improve their spatial accuracy.

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

The research will merge with other ongoing activities developing detectors, gamma cameras, algorithms and integrated circuits (ASICs) for analog readout of arrays of SiPMs. It will focus on the design of multiple electronic boards and developing firmware (in VHDL) for FPGA data acquisition, timing (with digital TDCs) and energy extraction, for both spectroscopy and imaging, i.e. the reconstruction of the scintillation coordinated by mean of machine learning algorithms running in the FPGA in real time.

### Educational objectives

The education objectives are twofold: on the side to



	strengthen the expertise in FPGA programming, in particular to run machine learning algorithms in real time and complex electronics systems (detectors, ASIC, HV power supply, ADC, TDC). On the other side, cross-disciplinary knowledge in the areas of medical physics and algorithms will be deepened as well. PhD courses and conferences will be the main learning opportunities, along with collaboration with other national and international research groups.
<b>Job opportunities</b>	PhD candidates with expertise in electronics, sensors and FPGA platforms for embedded processing are highly requested by companies developing electronic systems and instrumentation, in multiple application areas spanning from industry, to medical, to robotics and vehicles.
<b>Composition of the research group</b>	1 Full Professors 1 Associated Professors 1 Assistant Professors 10 PhD Students
<b>Name of the research directors</b>	Marco Carminati

<b>Contacts</b>
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<b>Additional support - Financial aid per PhD student per year (gross amount)</b>	
<b>Housing - Foreign Students</b>	--
<b>Housing - Out-of-town residents (more than 80Km out of Milano)</b>	--

<b>Scholarship Increase for a period abroad</b>	
<b>Amount monthly</b>	700.0 €
<b>By number of months</b>	6

<b>Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information</b>
The student will carry out his activity in a dynamic and stimulating team composed by several PhD students and Master students coming from different degrees (Electronics, Biomedical, Physics,...) and acting in different topics of the research, from detector physics, to electronics, to machine learning, to applications in space, physics and medical imaging.



LIST OF UNIVERSITIES, COMPANIES, AGENCIES AND/OR NATIONAL OR INTERNATIONAL INSTITUTIONS THAT ARE COOPERATING IN THE RESEARCH: INFN; CNAO; University of Pavia

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

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: individual use

DESK AVAILABILITY: individual use