



PhD in FISICA / PHYSICS - 39th cycle

THEMATIC Research Field: INTEGRATION OF MAGNETIC MATERIALS IN MICROSYSTEMS

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

Despite the great potential of magnetic materials for storage, computing, sensing and actuation, their integration in electronic microsystems is still at its infancy. Beyond non-volatile MRAMS based on tunneling junctions and magnetoresistive sensors for recording and navigation, there's plenty of room for the exploitation of magnetic phenomena in microsystems. Recently we started a research activity, in collaboration with STMicroelectronics, for the integration of soft and hard magnetic materials in MEMS devices, exploiting the possibility of exchanging large forces without friction for energy harvesting and actuation. Hard micromagnets integrated in microchips are also envisaged for providing a low-power solution for the bias field. The interaction between mechanical and magnetic moments in hybrid MEMS with magnetic components is under investigation, both for fundamental investigations and for the implementation of novel device architectures for sensing. In this framework, the goal of this PhD is to make a step forwards, by developing devices combining conventional electronics and magnetic materials. Novel architectures for energy harvesting via magnetic plucking will be explored in the framework of the project MetaVEH (<https://www.metaveh.com>). Ultrasensitive magnetic sensors (both magnetoresistive and MEMS-based) will be considered for large current detection with galvanic isolation. Microelectromechanical resonators with ferromagnetic elements will be eventually investigated to study the interplay between mechanical and magnetic resonances.



Methods and techniques that will be developed and used to carry out the research	The PhD student will be involved in the design, fabrication and characterization of microsystems integrating magnetic elements. The activity of materials growth and microfabrication of test devices will be carried out at Polifab, the micro and nano-fabrication facility of Politecnico di Milano. Some steps of fabrication and characterizations could be also carried out in the premises of STMicroelectronics, in the framework of the Joint Research Center "STEAM".
Educational objectives	Development of interdisciplinary knowledge at the boundary between physics, microfabrication technology, micromechanics and electronics.
Job opportunities	This activity will be carried out within the Joint Research Center of STM and Politecnico di Milano (STEAM), in strong connection with the world of MEMS. This PhD will represent a solid basis for careers both in academia and in microelectronic industry.
Composition of the research group	1 Full Professors 3 Associated Professors 3 Assistant Professors 4 PhD Students
Name of the research directors	Riccardo Bertacco

Contacts
http://nabis.fisi.polimi.it In collaboration with the staff of Polifab: www.polifab.polimi.it riccardo.bertacco@polimi.it tel. 0039 02 2399 9663; https://www.fisi.polimi.it/en/people/bertacco

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	700.0 €
By number of months	6

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

Educational activities per year (purchase of study books and material, funding for participation in courses, summer schools, workshops and conferences): financial aid for the PhD student for 3 years: max euros 5.707,20.

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.

Computer and desk availability: *individual use computer and desk*