PhD in three dimensional spintronic circuits

Job description:

We offer a PhD position *in three dimensional spintronic circuits*, a joint project between the University of Zaragoza (Spain) and the University of Vienna (Austria).

Spintronics is an emerging area of nanoelectronics that exploits the spin of electrons to store and process information. The development of spin-based hardware components and devices is one of the most promising approaches to realize disruptive green computing technologies, going beyond Moore approaches.

Our groups are carrying out pioneering work on three-dimensional spintronics, where we study new physical phenomena in 3D magnetic devices which go beyond the standard approach in nanoelectronics, currently based on planar geometries. Moving to 3D has a great potential to create ultra-high density low-power devices and to exploit new physical effects which emerge as a consequence of the change in dimensionality. Figure 1 shows some examples of spintronic devices with 3D geometries recently investigated by the host groups.

In this project, the candidate will carry out computational and experimental work devoted to the design, fabrication and characterization of three-dimensional spintronic circuits. For this, he/she will use state of the art equipment to fabricate and characterize complex 3D nanoelectronic circuits based on magnetic materials, in combination with advanced computational techniques for the design and simulation of the devices.

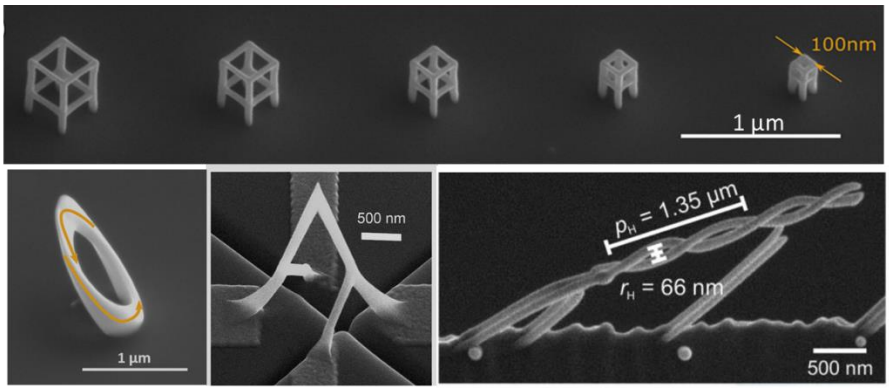

Figure 1. Recent examples of three-dimensional nanomagnetic structures created by the host group for applications in spintronics, including nano-cubes, Möbius strips, nano-bridges and double helices.

The PhD project is designed in a holistic way, with the candidate based in Zaragoza and spending long periods of time in Vienna, and working in all phases of the research: On the computational part, designing the circuits using micromagnetic and multiphysics simulations, developing numercial models for the printing processes and implementing state-of-the art algorithms from the field of machine learning to optimize the fabrication process. On the experimental part, 3D printing the devices using nanolithography methods based on focused electron beams and depositing thin film heterostructures, and characterizing them via magneto-optical, magneto-electrical, X-ray and electron microscopy techniques. Contact with high-tech industry and technology transfer activities are also foreseen.

The complementary expertise of the two host groups, the international environment and the wide range of technical skills that will be acquired, constitutes a great opportunity for the candidate to

become a highly-qualified individual with a broad skill set. We are therefore looking for a highly motivated candidate eager to accept the challenge and develop the next generation of nanoelectronic green devices based on magnetic materials.

The project is funded via the ERC Consolidator project "3DNANOMAG: Three-dimensional nanoscale magnetic structures". The two supervisors are: Dr Amalio Fernández-Pacheco (Zaragoza) and Dr Claas Abert (Vienna).

More information: Key publications & videos

Donnelly et al, *Nature Nanotechnology* **17**, 136–142 (2022)
Meng et al, *ACS Nano* **15**, 6765 (2021).
Fernández-Pacheco et al, *Nature Materials* **18**, 679–684 (2019).
Fernández-Pacheco et al, *Nature Communications* **8**, 15756 (2017).
3D spintronics research talk: https://www.youtube.com/watch?v=9qjpU0Wk9cM
TedX talk: https://youtu.be/bMWMFcDBUu4

Profile of the candidates:

Applicants should have a MSc, MSci or MRes in physics, maths, materials science, or a discipline relevant to the project, and hold or be on track for a First Class degree result (or equivalent).

Previous experience in either computational or experimental research work including nanofabrication, characterization and modelling of nano-devices , as well as solid computing skills, are very desirable.

The successful candidate should have good interpersonal skills, be able to carry out inter-dependent research activities within a team, enjoy challenging work, and be willing to spend part of the time in two countries, as well as travel internationally to visit collaborations, attend conferences and perform synchrotron experiments.

Details of the job:

Starting date and duration: Start between July 2022 and January 2023. 3 years of funding (extended up to 4).

Gross Salary: 1,500€/month approximately (14 payments). Complemented with additional funding to spend periods in both Universities.

Additional benefits: Coverage of health insurance and pension contribution.

How to apply:

Applications should be sent to nanomag.applications@gmail.com , with the subject "3DNANOMAG PhD application", and a single .pdf file as an attachment with three sections: (1) a cover letter (max length of 2 pages) describing your previous research experience and what motivates you to work in this project; (2) a full CV; (3) contact details of two referees.