17 April 2026

PhD contract offer

Subject: Femtosecond generation and propagation of spin currents in magnetic heterostructures

General information

Workplace: Nancy, France
Type of contract: PhD contract
Contract period: 36 months
Expected date of employment: October 2026
Proportion of work: Full time
Desired level of education: Master's degree in physics or material science.

Missions / Activities

When a magnetic multilayer absorbs a strong femtosecond laser pulse, it triggers both ultrafast demagnetization and the generation of hot electrons. These processes can produce a spin current capable of manipulating magnetic states—such as reversing layer magnetization or driving magnetic textures like domain walls [1,2]. While our recent experiments have successfully demonstrated magnetization reversal via such spin currents [3–5], the underlying mechanisms—including ultrafast demagnetization, spin-dependent transport, spin transfer torque (STT), and heat dissipation—remain complex and not yet fully understood.

This PhD project focuses on developing efficient methods for generating and propagating spin currents on femtosecond timescales across diverse magnetic heterostructures. This approach will allow us to develop and understand ultrafast spintronics devices, which combine the ideas and concepts of magneto-optics and opto-magnetism with spin transport phenomena, supplemented with the possibilities offered by photonics for ultrafast low-dissipative manipulation and transport of information. The project builds on a long-standing collaboration between two world leading groups in this area, the Physics of Nanostructures group at Eindhoven University of Technology (TU/e) and the Spin group at Institut Jean Lamour (UL-CNRS). The project will leverage state-of-the-art optical and growth techniques as well as the complementary expertise of both teams. This collaboration will thus allow us to tackle complex fundamental and technical challenges in the exploration and application of ultrafast spin currents. We are convinced that the novel and disruptive idea of using laser induced spin currents in an application perspective will allow us to move toward more environment friendly digital technologies.

The selected PhD student will investigate and evaluate the efficiency of the generation of the pure spin currents following laser induced ultrafast demagnetization, their propagation and their interaction with another magnetic material in a number of systems. The student will work on state-of-the-art time resolved magneto-optical setups and they will extensively learn about spintronics, magnetism and ultrafast optics.

References

[1] S. Iihama, Y. Xu, M. Deb, G. Malinowski, M. Hehn, J. Gorchon, E. E. Fullerton, and S. Mangin, Single-Shot Multi-Level All-Optical Magnetization Switching Mediated by Spin Transport, Adv. Mater. **30**, 1804004 (2018).
[2] J. Igarashi, Q. Remy, S. Iihama, G. Malinowski, M. Hehn, J. Gorchon, J. Hohlfeld, S. Fukami, H. Ohno, and S. Mangin, Engineering Single-Shot All-Optical Switching of Ferromagnetic Materials, Nano Lett. **20**, (2020).
[3] Q. Remy, J. Hohlfeld, M. Vergès, Y. Le Guen, J. Gorchon, G. Malinowski, S. Mangin, and M. Hehn, Accelerating ultrafast magnetization reversal by non-local spin transfer, Nat. Commun. **14**, 445 (2023).
[4] K. Ishibashi, J. Igarashi, A. Anadón, M. Hehn, Y. Le Guen, S. Iihama, J. Hohlfeld, J. Gorchon, S. Mangin, and G. Malinowski, Single-Shot Magnetization Reversal in Ferromagnetic Spin Valves via Heat Control, Phys. Rev. Lett. **135**, 116702 (2025).
[5] J. Igarashi, W. Zhang, Q. Remy, E. Díaz, J. Lin, J. Hohlfeld, M. Hehn, S. Mangin, J. Gorchon, and G. Malinowski, Optically induced ultrafast magnetization switching in ferromagnetic spin valves, Nat. Mater. **22**, 725 (2023).

Keywords:
Ultrafast spin current, magnetization dynamics, spintronic.

Work context

The PhD student will work under the supervision of Dr. Grégory Malinowski within the Spintronic and Nanomagnetism research group whose topics range from the development of innovative materials for implementation in spin electronics devices, to the development of magnetic sensors and the fundamental study of physical phenomena related to magnetism. The project will be carried in tight collaboration with the group of Prof. Bert Koopmans (co-advisor) from the Eindhoven University of Technology (Eindhoven, The Netherlands).

Skills

- Knowledge of Solid State Physics, including magnetism and electronic transport properties is essential.
- Knowledge of English (oral and written) is very important and knowledge of French would be an advantage but not mandatory.
- As an enthusiastic researcher you like team work, enjoy working in an international environment and have a flexible approach to collaborating between different laboratories.
- You are willing to spend several months in Eindhoven.
- You have interest in both experimental and theoretical work.

Constraints and risks

The position you are applying for is located in a sector relating to the protection of scientific and technical potential. It therefore requires, in accordance with the regulations, that your arrival be authorized by the competent authority of the Ministry of Higher Education, Research and Innovation.

About Institut Jean Lamour

The Institute Jean Lamour (IJL) is a joint research unit of CNRS and Université de Lorraine.
Focused on materials and processes science and engineering, it covers: materials, metallurgy, plasmas, surfaces, nanomaterials and electronics.
It regroups 183 researchers/lecturers, 91 engineers/technicians/administrative staff, 150 doctoral students and 25 post-doctoral fellows.
Partnerships exist with 150 companies and our research groups collaborate with more than 30 countries throughout the world.
Its exceptional instrumental platforms are spread over 4 sites; the main one is located on Artem campus in Nancy.

Application

Applicants are invited to submit:
- Curriculum Vitae
- Letter of motivation
- Academic grades for the last couple years
- Scan of passport
- Recommendation letters or contacts (if possible)

Applications will be accepted until 16th of May 2026. Interviews will be carried during the month of May. A decision should be made end of May/early June.

Applicants should have finished their master's degree before the beginning of the expected PhD start date. A diploma will be required to sign the contract.

Send the application to:
G. Malinowski (CNRS Researcher) : gregory.malinowski@univ-lorraine.fr
J. Gorchon (CNRS researcher): jon.gorchon@univ-lorraine.fr