Opening Postdoctoral Position: New Paradigms in Spintronic Fluctuations

SPINTEC

Positioned at the crossroad of science and technology, **SPINTEC** (**SPINtronique et TEchnologie des Composants**, https://www.spintec.fr) is one of the leading spintronics research laboratories worldwide. SPINTEC was created in 2002 and rapidly expanded to currently exceed 120 persons, of which 54 permanent staff from CEA, CNRS and Grenoble-Alpes University. The lab aims at bridging the gap between fundamental research and applications in spin electronics. As such, the outcome of the laboratory is not only scientific publications and communications at international conferences, but also a consistent patent portfolio and implementation of relevant functional demonstrators and device nanofabrication. The lab has launched six start-up companies in the past 20 years. This synergy has placed SPINTEC at the forefront of spintronics research, having actively contributed to the emergence in industry of spintronic memories called MRAM, on which the laboratory holds key patents and develops further exploiting magnetic tunnel junctions for various technologies.

SPINTEC benefits from an idea local environment with a large spectrum of opportunities:

- SPINTEC belongs with the Interdisciplinary Research Institute of Grenoble (IRIG), gathering 10 laboratories with of total of 1000 researchers, technicians, doctoral and post-doctoral students. IRIG covers interdisciplinary skills (physics, chemistry, biology), and provides access to cutting-edge scientific and technological platforms such as PTA cleanroom, and nano-characterization PFNC.
- The Giant Campus Site (also called Scientific Presqu'Île) offers an exceptional scientific environment with partners such as CEA-LETI, Néel Institute and major European facilities (ESRF and ILL on the EPN Campus).
- The entire Campus of Grenoble Alpes University, whose excellence was recently recognized by the national IDEX award, bears a collective dynamics of research challenges in all fields of knowledge.

Grenoble is a cosmopolitan city at the heart of the French Alps. One out of five people living there works in the field of research, innovation or higher education. In addition, Grenoble offers various cultural and sportive opportunities all year round.

CONTEXT

Spintronics offers a promising alternative to current electronics by leveraging the spin of charge carriers to process information, enabling the development of fast, miniaturized, and energy-efficient components compatible with existing CMOS-based systems. A notable achievement in this field is the commercialization of STT-MRAM memories, which utilize magnetic tunnel junctions (MTJs) to control magnetization via spin-transfer torque and read it through tunnel magneto-resistance. While noise has traditionally been a challenge for data storage, recent advancements propose harnessing these stochastic fluctuations—observed in systems like superparamagnetic tunnel junctions (SMTJs) and spin-torque nano-oscillators (STNOs)—to create low-power, unconventional computing paradigms, such as probabilistic or bio-inspired computing schemes. However, the theoretical models currently used in magnetism often rely on oversimplified analytical derivations, failing to capture the full complexity of physical processes. This project aims to bridge the gap between experiment and theory by developing innovative numerical tools to model spintronic systems under electrical currents and

various noise conditions, ultimately advancing both fundamental understanding and practical applications.

The SPINTEC laboratory is pioneering the use of stochastic properties in spintronic nanodevices, such as SMTJs and STNOs, to develop energy-efficient, neuromorphic computing architectures that harness rather than suppress noises. Our research demonstrates how thermal magnetization fluctuations lead to applications like secure data encryption and low-power cognitive computing, with recent breakthroughs including nanosecond-scale stochastic operation in SMTJs. Through collaborative projects and advanced numerical modeling, SPINTEC is bridging the gap between experimental observations and theoretical understanding, positioning itself at the forefront of unconventional, noise-driven spintronic technologies.

POSITION

The project is opening a 12-month position (possible extensions) for a postdoctoral researcher to explore the integration of Kramers-type thermal activation theories—validated for equilibrium conditions in superparamagnetic systems—with a functional calculus approach. This approach extends the Fokker-Planck equation (FPE) to magnetization dynamics under colored noise, moving beyond the usual Markovian approximations. By incorporating spin-transfer torques into this formalism, the combined framework will enable the study of spintronic systems (e.g., SMTJs, STNOs) under arbitrary electric currents and complex noise environments, bridging theoretical predictions with experimental observations like mean dwell times.

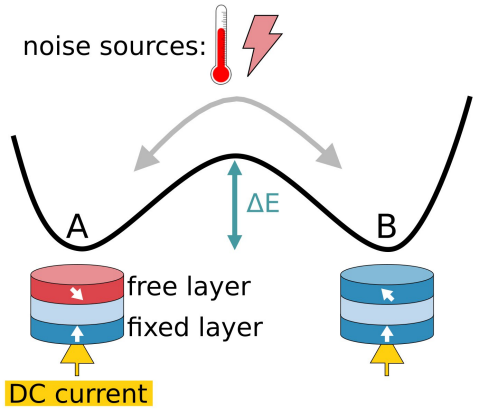

Figure 1 Illustration of the problem addressed by the project. A magnetic tunnel junction (MTJ) under electric current fluctuates between two metastable states A and B (magnetization states, oscillator phases), driven by various noise sources (thermal, electronic, etc).

The ideal candidate will hold a PhD in theoretical condensed matter physics, theoretical spintronics/nanomagnetism, or statistical physics, with demonstrated expertise in stochastic processes (including FPEs and Langevin dynamics), non-equilibrium systems, and numerical methods for non-linear differential equations. A foundation in spintronics—particularly spin-transfer torques, magnetic tunnel junctions, and noise effects—is appreciable, alongside the ability to extend analytical formalisms to non-Markovian regimes. Experience collaborating with experimental teams to interpret data (e.g., mean dwell times, nano-oscillator dynamics) is desirable, while familiarity with machine learning for stochastic systems or high-performance computing would be advantageous.

How to apply: Submit a CV with publications, including research interests and motivation (2 pages maximum), up to 2 recommendation letters (from academic supervisors/collaborators), and academic transcripts (including PhD certificate).

All application materials should be submitted in English or French via email to Dr Louise Desplat (louise.desplat@cea.fr), and Dr Pascal Thibaudeau (pascal.thibaudeau@cea.fr) with the subject line clearly marked as “Postdoctoral Application – Spintronic Fluctuations”. The selection process will involve a deadline for submissions (15/09/2026), after which shortlisted candidates will be invited for an online interview to discuss their technical expertise and alignment with the project. The successful candidate is expected to start a CEA contract position by 01/12/2026, with some flexibility.