

Post-doc position: Novel states of matter at oxide interfaces studied by magnetotransport

At the interface between two oxide materials, structural and electronic reconstruction may produce exotic, two-dimensional electronic states. This is the case when combining SrTiO₃ (STO) and LaAlO₃ (LAO) that are both wide bandgap semiconductor while their interface harbors a 2-dimensional electron gas (2DEG) that is superconducting at low temperature¹ and possesses a highly tunable Rashba spin-orbit coupling². The 2DEG at the LAO/STO interface was discovered in 2004 and since then our group has harnessed its properties for electronics and spintronics – for instance using its Rashba character to perform efficient spin-charge interconversion³⁻⁵ – but also expanded its functionalities by endowing it with ferroic orders (ferroelectricity⁶ and/or magnetism⁷) and explored 2DEGs in other systems such as KTaO₃ (KTO)^{8,9}.

The project we propose aims to further engineer oxide interfaces to reveal novel states of matter including (i) a ferromagnetic Rashba state formed in ferromagnetic STO 2DEGs, displaying spontaneous nonreciprocal transport; (ii) 2D hole gases in STO and KTO, in which we will assess spin-orbit physics and search for hole-based superconductivity; (iii) high-mobility 2DEGs at room temperature based on BaSnO₃.

This experimental physics project will be performed at the Laboratoire Albert Fert CNRS, Thales, Université Paris-Saclay in Palaiseau (France), in strong collaboration with the Paul Drude Institute in Berlin (Germany) who will provide most of the samples, and with the LPEM laboratory of the ESPCI in Paris (France). The candidate's main mission will be to characterize the electronic properties of the samples using advanced magnetotransport experiments (Hall measurements, harmonic transport, angular dependent transport, etc).

1. Ohtomo, A. *et al.* **Nature** 427, 423 (2004) ; 2. Caviglia, A. D. *et al.* **Phys. Rev. Lett.** 104, 126803 (2010); 3. Lesne, E. *et al.* **Nature Mater.** 15, 1261 (2016) ; 4. Vaz, D. C. *et al.* **Nature Mater.** 18, 1187 (2019) ; 5. Vaz, D. C. *et al.* **Phys. Rev. Mater.** 4, 071001 (2020); 6. Noël, P. *et al.* **Nature** 580, 483 (2020) ; 7. Bréhin, J. *et al.* **Nature Phys.** 19, 823 (2023) ; 8. Vicente-Arche, L. M. *et al.* **Adv. Mater.** 33, 2102102 (2021) ; 9. Varotto, S. *et al.* **Nature Commun.** 13, 6165 (2022).

Salary: 2 476,45 € net per month + benefits.

Start date: July 1, 2025

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