Centre DE Nanosciences & DE Nanotechnologies

# C2N General Seminar

Friday February 7th 2020- 10h 00
Amphitheater of C2N

# "$SrTiO_3$-based 2-dimensional electron gases for ultralow power spintronics"


## Manuel Bibes

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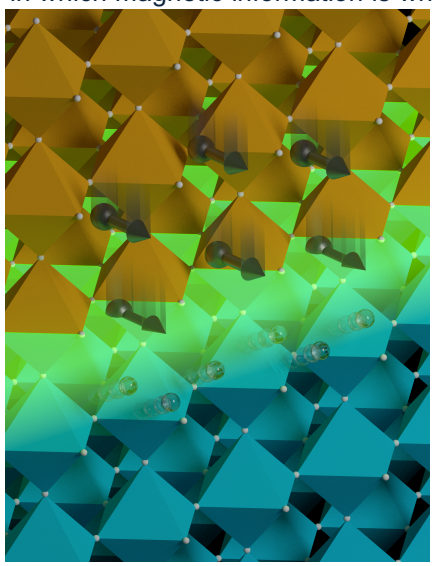
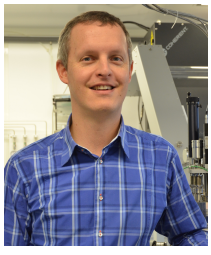
One promising approach for beyond CMOS is the so-called MESO transistor proposed by Intel (for MagnetoElectric-Spin-Orbit), a spin-based non-volatile device in which magnetic information is written by a magnetoelectric element and read out by a spin-orbit element through the inverse spin Hall effect (ISHE) or the inverse Edelstein effect (IEE). The IEE occurs in systems with broken inversion symmetry such as two-dimensional electron gases (2DEG) displaying Rashba spin-orbit coupling and results in more efficient conversion than the ISHE.



In this talk, I will show that the 2DEG that forms at the interface of SrTiO3 (STO) with LaAlO3 or reactive metals such as Al may be exploited to interconvert spin and charge currents with very high efficiencies. By applying a gate voltage, we tune the position of the Fermi level in the complex multi-orbital structure of STO, which results in a strong variation of the conversion amplitude with sign changes. This can be related to the band structure through ARPES experiment and tight-binding calculations. Importantly, a finite spin to charge conversion effect persists at room temperature. In a second part, I will present gate-controlled, all-electrical spin current generation and detection in planar nanodevices free from ferromagnets and only based on a STO 2DEG.

Finally, I will propose a new approach to achieve a non-volatile control of spin-charge interconversion with Rashba 2DEGs based on ferroelectricity rather than ferromagnetism, that may pave the way to an entirely new family of ultralow power spintronics devices.

***Figure caption :*** *Conversion of a spin current injected in the 2DEG at the $LaAlO_3/SrTiO_3$ interface into a charge current.*



**Manuel Bibes** is a CNRS Research Director at the CNRS/Thales laboratory in Palaiseau, France. After a double PhD degree in France and Spain with a thesis on manganite interfaces (ICMAB Barcelona, 2001) he became a CNRS Researcher in 2003. Manuel Bibes has pioneered research lines on multiferroics, ferroelectric tunnel junctions and explored novel routes for the electrical control of magnetism and spin transport in oxide architectures. He is the recipient of the 2013 EU40 Materials Prize of the E-MRS, the 2017 Descartes-Huygens prize, the 2017 Friedrich-Wilhelm Bessel award of the Humboldt Foundation and the laureate of two ERC grants.

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