ParisTech ESPCI PARIS PSL

**RESEARCH TOPIC FOR THE PARISTECH/CSC PHD PROGRAM**

***Field:*** Physics, Optics
***Subfield***: Condensed Matter

***Title***: Local electronic properties of a remarkable ionic conductor

***ParisTech School***: ESPCI Paris | PSL
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The 2D oxide $Rb_2Ti_2O_5$ has a **colossal low-frequency dielectric constant** ($\simeq 10^9$) and an **exceptional electric polarization** (0.1 C/cm$^2$). This is related to the very large ionic conductivity of this electronic insulator and to the accumulation of charges at its boundaries. While $Rb_2Ti_2O_5$ is promising for super-capacitors and memory applications, the transport properties of the diffusing ionic species and the spatial variations of the electronic properties are not well understood.

In the context of a joint study (LPEM Paris, ICCMO Orsay), we rely on Nuclear Magnetic Resonance (NMR), **an excellent probe of the spin and charge properties at the atomic scale**. It allows here to show that, contrary to expectations in an electronic insulator, the nanoscale charge and magnetic fluctuations are quantitatively similar as well as correlated with one another. A tentative scenario is that of the ionic diffusion inducing electronic changes in the Ti/O layers.

**Using NMR and cryogenics, the Ph.D. student will focus on studying:**

- Ionic diffusion and its connection to the local electronic properties.
- The *macro-scale* variation of the *nano-scale* electronic properties in samples having undergone macroscopic electrical polarization.
- How the observations hold in related compounds, to help develop an optimization strategy with an eye towards applications.

***Required background***: Education in condensed matter (or solid-state) physics. Interest in experimental physics. Knowledge of NMR is NOT needed.

***Representative publications of the group:***

1 R. Rani *et al.*, Materials Letters 258, 126784 (2020)
2 G. Lang *et al.*, Phys. Rev. B 94, 014514 (2016)
3 S. de Sousa Coutinho *et al.*, Solid State Ionics 333, 72 (2019)
4 R. Federicci *et al.*, Journal of Applied Physics 124, 152104 (2018)
5 R. Federicci *et al.*, Phys. Rev. Materials 1, 032001 (2017)