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Metalloporphyrin frameworks for a hybrid quantum computation arquitecture

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Integration of quantum information hardware into scalable and robust solid-state architectures will be key to allow performing quantum computation. The approach that uses magnetic molecules to embody the quantum bit of information, or qubit, has the advantage of facilitating scalability. However, the proposed hybrid technology to build a scalable computation architecture based on these molecular qubits requires positioning them at specific localizations of solid-state devices, while keeping a control over their orientation. We argue that such a control can be enforced by the periodicity of 2D networks in which the molecular qubit would act as node.

The seminar will first briefly describe the proposed hybrid arquitecture and the associated requirements for the qubits, as well as recent relevant studies of molecular qubits. I will then present our first attempts using M(II) porphyrin molecules with four coordinating carboxylic acid groups, [MTCPP] (M=Cu, VO), showing that these present reasonable quantum coherence in frozen solution, and that it is maintained in 2D Metal-Organic Frameworks formed by reaction with diamagnetic ions. In a second part, I will show how nanodomains of the same 2D MOF can be implemented on a variety of substrates, with an homogeneous orientation.

Olivier Roubeau is a CSIC tenured researcher at the Aragón Institute of Materials Science (ICMA) in Zaragoza, Spain. After a final undergraduate work on vanadium framework materials at Université Versailles-Saint-Quentin-en-Yvelines with Prof. G. Férey, he obtained his Ph.D. in 2002 from Leiden University with Prof. J. Reedijk, working on Fe(II) triazole-based materials. He was then associate professor in Physical Chemistry at University of Bordeaux, working on molecular magnetic materials and covalent functionalization of carbon nanotubes.

His current research activities mainly deal with magnetic molecular-based coordination compounds and their surface structuration, while also collaborating to a research line focused on magnetic nanoparticles for magnetic hyperthermia.

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