Molecular Spin Qubits and Chiral-Induced Spin Selectivity: Two Promising Ingredients for Quantum Technologies

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We are now experiencing the so-called Second Quantum Revolution and Quantum Technologies promise to open new possibilities in many fields ranging from computing to secure communications. Molecular Nanomagnets (MNMs) [1] provide an interesting tool for quantum technologies. In fact, they are characterized by a sizeable number of low-energy states that can be coherently manipulated, thus opening the possibility to use them to encode qudits. This in turn offers the possibility of integrating multiple quantum resources into single objects and to reduce the computational costs of some applications.

In my presentation, I will review some recent results on molecular spin qudits/qubits. For instance, I will show that using the many-level structure of MNMs it is possible to encode a qubit with embedded Quantum Error Correction in a single molecule [2], thus circumventing the typically large overhead in the number of physical units. I will also present the first working prototype of a quantum simulator based on molecular qudits [3]. In addition, I will demonstrate that the chiral-induced spin selectivity phenomenon exists at the molecular level [4,5] and could be harnessed to significantly raise the operating temperature of molecular spin qubits/qudits [6].

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