Magnetic molecules for quantum technologies

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Magnetic molecules showing magnetic bistability have been attracting a great interest in the last three decades as the ideal platforms to investigate quantum effects in magnetism. Technological applications have been up to now hampered by the low operation temperature, which only recently - thanks to a rational chemical design - has boosted to above liquid nitrogen temperature.[1] At the same time the interest has shifted to application of magnetic molecules as logic units in quantum computing[2] or for quantum sensing applications.[3] From the chemical point of view the molecular approach opens interestingly perspectives for the superior tuneability and processability[4] of molecules compared to spin impurities in solid matrices. Supramolecular chemistry is in fact a promising avenue to overcome the scalability issue. However, the molecular approach also poses key challenges, requiring for instance a more efficient control of decoherence, the possibility to switch spin-spin interactions, and the access to single molecule properties.

In this presentation I will highlight the possible contribution of molecular and coordination chemistry to this emerging field, as well as the open questions that the chemistry community need to tackle.

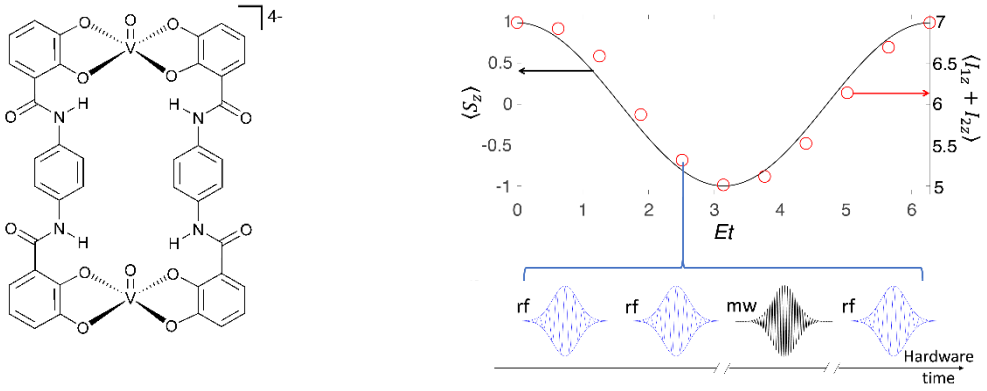

Figure 1 left) Molecular structure of a vanadyl-based two-qubit molecular architecture; right) Proposed use as a quantum simulator, where the nuclear magnetic moment projection of the vanadium atoms simulate the tunnelling of the magnetization of a S=1 system in a rhombic environment. Each calculated point is obtained with a four pulses sequence.

[1] a) C. A. P. Goodwin, F. Ortu, D. Reta, N. F. Chilton, D. P. Mills, *Nature* **2017**, *548*, 439; b) F.-S. Guo, B. M. Day, Y.-C. Chen, M.-L. Tong, A. Mansikkamäki, R. A. Layfield, *Science* **2018**, *362*, 1400-1403.
[2] M. Atzori, A. Chiesa, E. Morra, M. Chiesa, L. Sorace, S. Carretta, R. Sessoli, *Chem. Sci.* **2018**, *9*, 6183-6192.
[3] T. Yamabayashi, M. Atzori, L. Tesi, G. Cosquer, F. Santanni, M.-E. Boulon, E. Morra, S. Benci, R. Torre, M. Chiesa, L. Sorace, R. Sessoli, M. Yamashita, *J. Am. Chem. Soc.* **2018**, *140*, 12090-12101.
[4] L. Malavolti, M. Briganti, M. Hänze, G. Serrano, I. Cimatti, G. McMurtrie, E. Otero, P. Ohresser, F. Totti, M. Mannini, R. Sessoli, S. Loth, *Nano Lett.* **2018**, *18*, 7955-7961.