MOLECULAR NANOMAGNETS FOR INFORMATION TECHNOLOGIES: CHALLENGES, ACHIEVENTS AND PERSPECTIVES.

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In ten years the size of a magnetic register (bit) and that of a processor will attain ≤10nm, thus comparable to that of nanoparticles and molecules. At this length scale, quantum effects become relevant and bottom-up approaches for the production of nano-devices become competitive with respect to top-down fabrication processes. Nanomagnets will play a role for the storage and processing of information in the next future. So it is straightforward to wonder to which extent, *molecular nanomagnets* will contribute to this game. I'll briefly review basic requirements for the information technologies and some of the recent achievements in the field as well as some ideas that can be further pursued[i].
The main part of my talk will be devoted to the use of molecular spin clusters for quantum computation. Molecular magnets are indeed quantum objects, with well-defined spin states at low temperature[ii]. The challenge is to obtain scalable quantum hardware with long coherence time. I'll consider the paradigmatic case of molecular antiferromagnetic (AF) spin systems to show that they can effectively encode quantum bits. The case of AF spin triangles already contains the main features of quantum hardware. A more sophisticate case is that of AF rings in which an extra spin was introduced to have a S=1/2 as ground state[iii] and use excited states as a resource for implementing two-qubit gates[iv]. The mechanism of decoherence can be studied in details by considering hyperfine interactions with finite number of nuclear spins[v]. Molecular nanoMagnets can be functionalized to be grafted on surface[vi]. Positioning and visualizing molecular nanomagnets is another issue and I'll briefly mention our efforts and achievement in this direction[vii]. Molecular building blocks can also be linked each other by forming supramolecular complexes[viii,ix] with tuneable entanglement of spin states. This provides a unique opportunity to observe conditional quantum dynamics of spins in molecular systems and eventually to exchange information between magnetic molecules. Finally, I'll briefly mention our efforts in the development of graphene-based devices for molecular spintronics.

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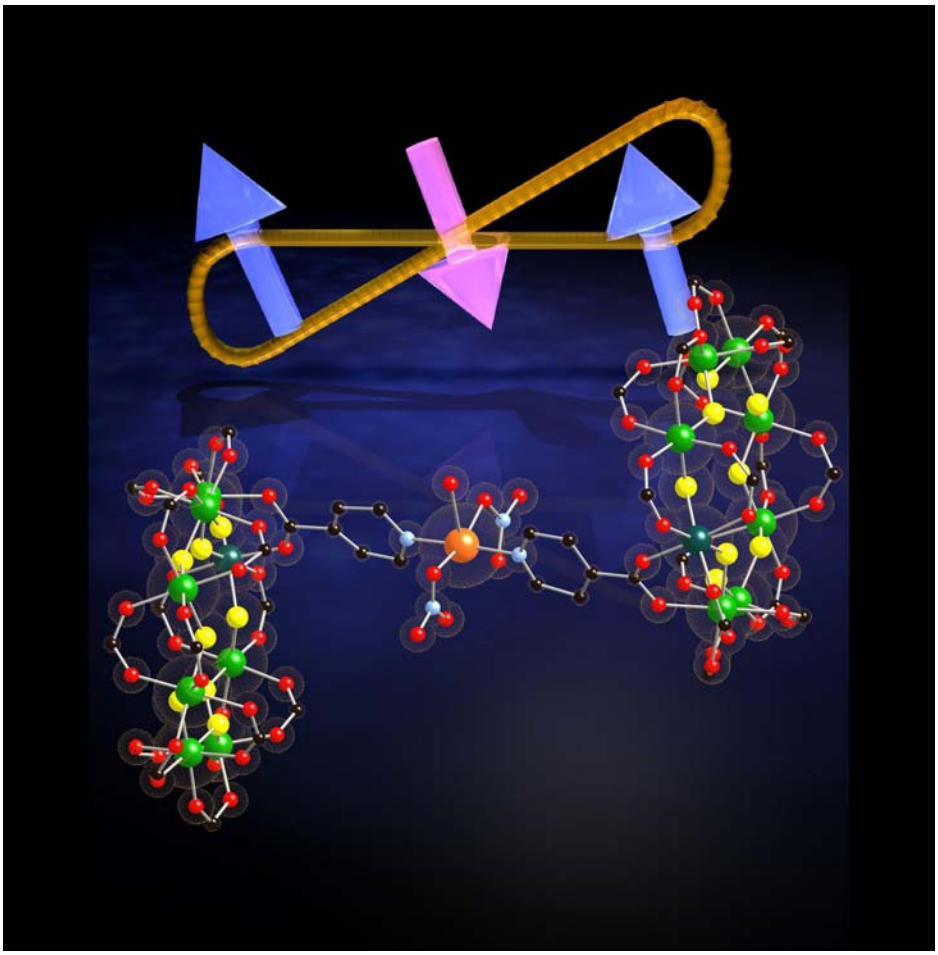

Figure: Entanglement of spins in supramolecular architectures. Ref.9