Title: Molecular spin devices for quantum processing

General Scope:
The realization of an operational quantum computer is one of the most ambitious technological goals of today’s scientists. In this regard, the basic building block is generally composed of a two-level quantum system (a quantum bit). It must be fully controllable and measurable, which requires a connection to the macroscopic world. In this context, solid state devices, which establish electrical connections to the qubit are of high interest. Among the different solid state concepts, spin based devices are very attractive since they already exhibit long coherence times.

Electrons possessing a spin 1/2 are conventionally thought as the natural carriers of quantum information, but alternative concepts make use of the outstanding properties of molecular magnets as building blocks for nanospintronics devices and quantum computing. Their spin benefit from longer coherence times compared to purely electronic spins. In this context, our team combines the different disciplines of spintronics, molecular electronics, and quantum information processing. In particular, we fabricate, characterize and study molecular spin-transistor in order to manipulate[1] and read-out an individual spin[2] to perform quantum operations[3].

Research topic and facilities available: Nano-devices addressing single molecular spins will be designed and reliable methods for their realization and characterization will be developed. Our team has a strong experience in molecular magnetism, nanofabrication, ultra-low noise transport measurements, microwave electronics and cryogenic equipment. We propose to use molecular spins as platform to perform multiqubit algorithms. Single molecular units are embedded in scalable electronic circuits and individual spin read out is performed by molecular (or carbon-based) quantum dots. The key experiment will be the demonstration of two qubit gate to complete the set of universal gates for scalable architectures. The student will fabricate the samples using the clean room facilities of the Néel Institut. She/he will carry out the measurements of the device at very low temperature (20mK), using one of the six fully equipped dilution refrigerators of the team, in order to create, characterize and manipulate single spin using spin based molecular quantum dot.

Possible collaboration and networking: This multidisciplinary research field is based on years of collaborations with teams from different scientific and technical cultures (cleanroom, technicians, collaborations with chemists and theoreticians, ...), in the framework of European projects and different national and regional funding.

Possible extension as a PhD: Yes

Required skills: We are looking for a motivated student who is interested in experiments that are challenging from the experimental point of view.

Starting date:
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