Single Large Nuclear Spin Coherent Manipulation

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Advances in experimental techniques offer physicists the opportunity to implement simple systems worth of the "gedanken-experiments" imagined by the founders of quantum theory. During the presentation, I propose to study one of these toy model systems, namely a single 3/2 nuclear spin.
The presentation will start by investigating the read-out process and the coherent manipulation of the 4 nuclear spin states using a single molecular magnet transistor [1,2]. These preliminary results demonstrate that we have a fully controlled 4-level quantum system, a qudit, on which we recently implemented a quantum algorithm.
With their state space of large dimension, qudits open fascinating experimental prospects. Protocols based on a generalization of the Ramsey interferometry to a multi-level system enable to measure, among others, the accumulation of geometric phases and of quantum gate phase [3].
As an outlook, I will display how, using a larger single nuclear spin, we could apply quantum error correction protocol [4], to obtain a self-corrected qubit.

1 Thiele S. et al. Science 344, 1135 (2014)
2 Godfrin C. et al. Phys. Rev. Lett. 119, 187702 (2017)
3 Godfrin C. et al. submitted
4 Pirandola S. et al. Phys. Rev. A 77, 032309 (2008)

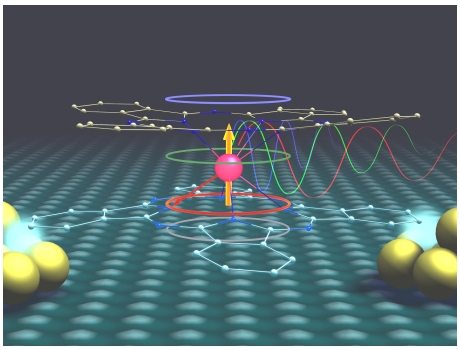

Figure 1: Artistic view of the $TbPc_2$ molecular spin transistor