Circuit-QED experiments for Quantum Sensing with Molecular Spins

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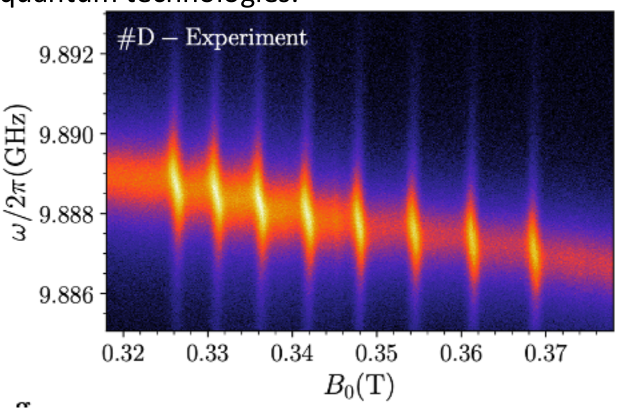
Coherent manipulation of molecular spin qubits is the prerequisite for applications such as quantum computing [1] or sensing [2] and for advanced Quantum ElectroDynamics (QED) experiments. One route to these goals is to embed molecular spins in superconducting circuits thus allowing to exploit the complementary advantages offered by each system in scalable architectures. To this end, we developed a multifrequency platform based on high-Tc YBCO superconducting planar resonators [3] and home-made heterodyne systems for advanced microwave spectroscopy and arbitrary pulse generation [4, 5].
We developed and tested protocols for quantum sensing of magnetic fields and showed that the resulting magnetic field sensitivity can reach values as high as $nT/\sqrt{Hz}$ [6]. We have recently extended these protocols to reconstruct tiny magnetic field signals with different time evolution [7].
Finally, I shall report on QED experiments we performed at single photon regime at mK temperature. In a first case, I shall discuss some features of molecular spins that allowed us to control both the spin-photon coupling and the dissipation thus achieving conditions for *perfect absorption* (see figure) [8]. Secondly, we recently implement our setup to separately address electron and nuclear spins in molecular qubits by sequences of alternating RF and MW pulses. Preliminary results depict a viable route to fully exploit both electron and nuclear spins in molecules for quantum technologies.



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