Manipulation of a single spin in diamond at room temperature

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During this practical, the basics of quantum two level systems manipulation and control will be introduced. The observation of quantum effects at room temperature is enabled by the exceptional properties of coloured centre in diamond. We will use nano-diamonds hosting a single Nitrogen Vacancy (NV) defect that is able to trap and isolate a single electronic spin. This single spin triplet, which has long coherence and lifetime, can be manipulated and readout using a combination of light and microwave pulses [1].

1. *Optical characterisation*

After having spread a droplet of the nano-diamond solution on a surface the first step will consists in finding and optically characterising a single NV defect. This coloured centre is a single photon source and emits red fluorescence when excited with a green laser. Dedicated optics and photon counting modules will be used as well as mean to quantify the number of NV quantum emitters under study using statistics.

2. *Single spin manipulation*

Having isolated a single NV centre, its electronic spin will be coherently manipulated. The spin quantum state can be initialised and readout using light pulses and manipulated with microwave fields. Using microwave pulses the electronic spin resonance will be measured. Finally, the quantum coherence of the spin will be investigated by measuring Rabi oscillations, i.e. by creating quantum superposition of spin states at room temperature!

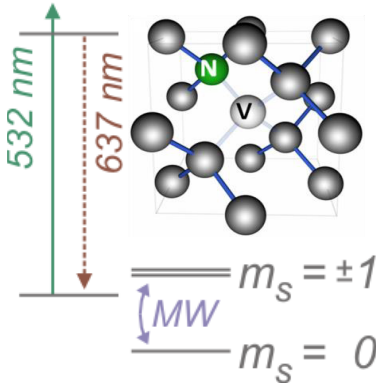

Figure 1: Electronic, spin and crystalline structure of a NV defect in diamond

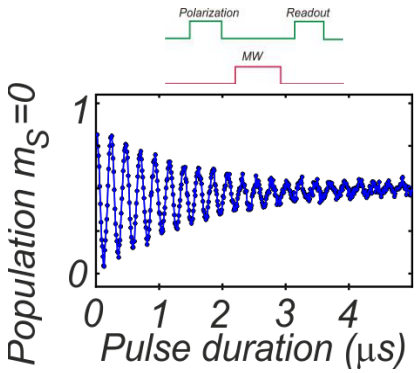

Figure 2: Rabi oscillation of a single spin at room temperature

References:

[1] Jelezko, F. *et al*. Observation of coherent oscillations in a single electron spin. *Phys. Rev. Lett.* **92**, 076401 (2004)