Quantum sensing with diamond spin maser at room-temperature

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The continuous-wave MASER operating at room-temperature using microwave emission from negatively charged nitrogen-vacancy (NV) spins in diamond opens a new platform for various technological applications, particularly for quantum sensing [1]. Though the NV maser has been experimentally realised [2], a quantum sensor using the NV maser has not been developed yet to the best of our knowledge. We present our progress on developing a room-temperature NV maser quantum magnetic sensor. We theoretically explore the magnetic field sensor's limitations considering a detailed photo-physics of the NV centre including the light induced charge state switching between its neutral and negative change states [3]. As a first step towards the realization of such a sensor, we experimentally explore the parameters required to optimise the interaction between the NV spins and microwave cavity for realising the maser system.

[1] Jin, Liang, et al. "Proposal for a room-temperature diamond maser." Nature Communications 6.1 (2015): 1-8.

[2] Breeze, Jonathan D., et al. "Continuous-wave room-temperature diamond maser." Nature 555.7697 (2018): 493-496..

[3] Sarath Raman Nair, et al. "Absorptive laser threshold magnetometry: combining visible diamond Raman lasers and nitrogen-vacancy centres." Materials for Quantum Technology 1.2 (2021): 025003.