Quantum Control of nano-diamond Nitrogen Vacancy spin ensembles

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Abstract

Nitrogen-Vacancy (NV) colour centre in diamond is a powerful tool as a quantum sensor that works under ambient conditions. An ensemble of such sensors in nanoparticle size with reduced coupling to its immediate intrinsic surroundings can enhance the sensitivity and offer high spatial resolution [1]. Two main challenges need to be addressed to make the full potential of NV nano-diamond sensors based on the spin ensembles. The first one is the fast decay of the quantum coherence of the NV spin ensemble system due to the coupling to its intrinsic surrounding spin bath, and the second one is the random orientation of the NV ensembles originating from the random orientation of nanodiamonds relative to the external control fields [2, 3, 4]. Here I present the latest results from our ongoing experiments in nano-diamond NV spin ensembles. To address the fast decay due to the intrinsic spin bath we use various dynamical decoupling (DD) methods along with controlled spin-bath driving. We are also exploring optimization algorithms to address the problems arising due to the random orientation of the nano-diamonds. Furthermore, we introduce additional pulse rotations in conventional DD and observe an 'unusual' sharp change in the coherence decay timescales and phase transitions in comparison with the conventional DD.

References

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