Manipulation of the NV Center Nuclear Spin Using Invisible Transition

A V Akimov[1]

[1] *Quantum simulators and Integrated Photonics group, Russian Quantum Center, Building 30, Block 1, Bolshoi Boulevard, Skolkovo Innovation Center, 121205, Moscow, Russia. Contact Phone: +79163473597*
Contact Email: a.akimov@rqc.ru

NV center in diamond are popular defects for sensing applications. In particular our group developed rotation sensor utilizing the nuclear spins of nitrogen-vacancy color centers in diamond have been demonstrated. However, such a device consumes significant power which is mainly due to use of RF antenna, controlling nuclear spins of NV centers. Similar problems appear in other sensors, utilizing nuclear spin in NV centers – either rather strong RF field or strong magnetic field is required. To address this issue, the coherent manipulation of nuclear spins via coherent population trapping at moderate magnetic fields using microwave fields has been successfully demonstrated in isotopically pure diamond.

In this work, we demonstrate that a similar technique can be applied to a diamond plate with a natural abundance of carbon-13, which holds significant potential for practical sensing applications. Although the forbidden resonances required for coherent control were only partially observed, coherent population trapping was successfully demonstrated at both visible and invisible transitions, with an apparent contrast of up to 98±11% and a true contrast of approximately 35±7%. This finding confirms the feasibility of coherent nuclear spin control even in diamond plates with naturally occurring carbon-13.