STUDIES OF THE NV CENTERS ^{14}N NUCLEAR SPIN ORIENTATION AND ALIGNMENT USING THE METHOD OF ODMR

Marcis Auzinsh[1], Andris Berzins[1], Dmitry Budker[2,3], Laima Busaite[1], Ruvin Ferber[1], Florian Gahbauer[1], Reinis Lazda[1], Arne Wickenbrock[2], Huijie Zheng[2]

[1]Laser Centre, University of Latvia
[2]Helmholtz Institute Mainz, Johannes Gutenberg University
[3]Department of Physics, University of California at Berkeley, USA
reinis.lazda@lu.lv

This work probes the energy levels of the NV centers in diamond using the ODMR spectroscopy method [1] at an axial magnetic field around 102.4 mT (GSLAC). At this magnetic field region the mixing of the hyperfine levels (of the ground state $m_s = 0 \longrightarrow m_s = \pm 1$ transitions) in the magnetic field can be studied (see Fig. 1).

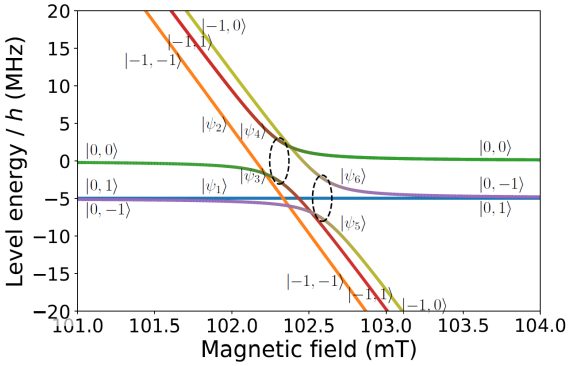

Fig. 1. Hyperfine level mixing near the GSLAC denoted by the dashed ellipses.

A theoretical model (using a Hamiltonian method [2]) that estimates the transition energies, transition probabilities between the ground-state sublevels and the hyperfine level mixing was developed. The model includes coupling to the nuclear spin of the NV center's ^{14}N nucleus and coupling to ^{13}C atoms as well.

Calculations from the model were combined with the measured results using a fitting procedure giving information about the polarization of the nuclear spin of the NV centers (see Fig. 2).

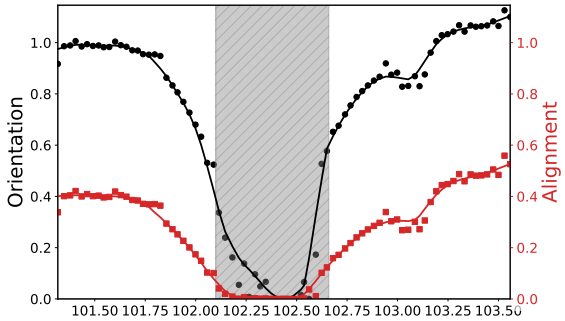

Fig. 2. Nuclear ^{14}N spin orientation (black dots) and alignment (red squares) obtained for the ground state $m_S = 0 \longrightarrow m_S = +1$ transition from the fitted transition peak amplitudes.

Acknowledgements

The Riga group gratefully acknowledges the financial support from the M-ERA.NET project Metrology at the Nanoscale with Diamonds (MyND) and from the Laserlab-Europe Project (EU-H2020 654148), and from the Base/Performance Funding Project Nr. AAP2016/B013, ZD2010/AZ27. A. Berzins acknowledges support from the PostDoc Latvia Project Nr. 1.1.1.2/VIAA/1/16/024 "Two-way research of thin-films and NV centres in diamond crystal". The Mainz group acknowledges support by the German Federal Ministry of Education and Research (BMBF) within the Quantumtechnologien program (FKZ 13N14439) and the DFG through the DIP program (FO 703/2-1). H. Zheng acknowledges support from the GRK Symmetry Breaking (DFG/GRK 1581) program.

[1] M. Negyedi, J. Palots, B. Gyre, S. Dzsaber, S. Kollarics, P. Rohringer, T. Pichler and F. Simon, Rev. Sci. Instrum. **88**, 013902 (2017).
[2] J. D. A. Wood, D. A. Broadway, L. T. Hall, A. Stacey, D. A. Simpson, J.-P. Tetienne and L. C. L. Hollenberg, Phys. Rev. B **94**, 155402 (2016).