Decoherence of an NV center coupled to a bath of ^{13}C nuclear spins

Damian Kwiatkowski[1], **Łukasz Cywiński**[1]

[1] *Institute of Physics, Polish Academy of Sciences, al. Lotników 32/46, PL 02-668 Warsaw, Poland*

The nitrogen-vacancy (NC) color center in diamond [1] is one of the most actively researched semiconductor-based spin qubits [2]. It is especially promising for applications involving using it as a sensor of magnetic field noise. This noise can either be intrinsic, i.e. caused by other spins present inside the diamond crystal (electronic spins of nearby nitrogen impurities, or nuclear spins of ^{13}C isotopes present among the carbon atoms forming the diamond lattice), or extrinsic, caused e.g. by spins of molecules present close to the surface of the diamond nanocrystal [3]. In the former case a careful analysis of decoherence signal can be used to identify NV centers having a few ^{13}C nuclear spins in close proximity [4], and such complexes of spins can be used as few-qubit quantum registers [5]. Such an identification of environment of the NV center requires a very good theoretical understanding of nuclear-induced decoherence in this system. The best available theory is the Correlated Cluster Expansion (CCE) [6], in which contributions to NV decoherence [7] coming from groups (clusters) of increasing numbers of nuclei are systematically taken into account. We will present our recent progress in implementing this method and using it for calculation of NV center decoherence.

This research is supported by funds of Polish National Science Center (NCN), grant no. DEC-2012/07/B/ST3/03616.

[1] M. W. Doherty, N. B. Manson, P. Delaney, Fedor Jelezko, Jörg Wrachtrup, L. C. L. Hollenberg, Annu. Rev. Condens. Matter Phys. **528**, 1 (2013).
[2] V. V. Dobrovitski, G. D. Fuchs, A. L. Falk, C. Santori, and D. D. Awschalom Phys. Rep. **4**, 23 (2013).
[3] T. Staudacher, F. Shi, S. Pezzagna, J. Meijer, J. Du, C. A. Meriles, F. Reinhard, J. Wrachtrup, Science **339**, 561 (2013).
[4] F. Shi, X. Kong, P. Wang, F. Kong, N. Zhao, R.-B. Liu, and J. Du, Nat. Phys. **10**, 21 (2014).
[5] M. V. Gurudev Dutt, L. Childress, L. Jiang, E. Togan, J. Maze, F. Jelezko, A. S. Zibrov, P. R. Hemmer, and M. D. Lukin, Science **316**, 1312 (2007).
[6] W. Yang and R.-B. Liu, Phys. Rev. B **78**, 085315 (2008); Phys. Rev. B **79**, 115320 (2009).
[7] N. Zhao, S.-W. Ho, and R.-B. Liu, Phys. Rev. B **85**, 115303 (2012).