Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Schemes of detecting nuclear spin correlations by dynamical decoupling based quantum sensing

WEN-LONG MA MA, REN-BAO LIU, Department of Physics and Centre for Quantum Coherence, The Chinese University of Hong Kong, Shatin, New Territories, Hong Kong, China

— Single-molecule sensitivity of nuclear magnetic resonance (NMR) and angstrom resolution of magnetic resonance imaging (MRI) are the highest challenges in magnetic microscopy. Recent development in dynamical decoupling (DD) enhanced diamond quantum sensing has enabled NMR of single nuclear spins and nanoscale NMR. Similar to conventional NMR and MRI, current DD-based quantum sensing utilizes the frequency fingerprints of target nuclear spins. Such schemes, however, cannot resolve different nuclear spins that have the same noise frequency or differentiate different types of correlations in nuclear spin clusters. Here we show that the first limitation can be overcome by using wavefunction fingerprints of target nuclear spins [1], which is much more sensitive than the "frequency fingerprints" to weak hyperfine interaction between the targets and a sensor, while the second one can be overcome by a new design of two-dimensional DD sequences composed of two sets of periodic DD sequences with different periods [2], which can be independently set to match two different transition frequencies. Our schemes not only offer an approach to breaking the resolution limit set by "frequency gradients" in conventional MRI, but also provide a standard approach to correlation spectroscopy for single-molecule NMR.

References: [1] W. -L. Ma and R. -B. Liu, Phys. Rev. Appl. 6, 024019 (2016). [2] W. -L. Ma and R. -B. Liu, Phys. Rev. Appl. (in press), preprint arXiv:1512. 03548 (2015).

Wen-Long Ma
Chinese Univ of Hong Kong

Date submitted: 02 Nov 2016 Electronic form version 1.4