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Quantum memory enhanced nuclear magnetic resonance of nanometer-scale samples with a single spin in diamond NABEEL ASLAM, MATTHIAS PFENDER, SEBASTIAN ZAISER, FELIPE FAVARO DE OLIVEIRA, S. ALI MOMENZADEH, ANDREJ DENISENKO, 3 rd Physics Institute, University of Stuttgart, JUNICHI ISOYA, Research Center for Knowledge Communities, University of Tsukuba, PHILIPP NEUMANN, JOERG WRACHTRUP, 3 rd Physics Institute, University of Stuttgart — Recently nuclear magnetic resonance (NMR) of nanoscale samples at ambient conditions has been achieved with nitrogen-vacancy (NV) centers in diamond. So far the spectral resolution in the NV NMR experiments was limited by the sensor's coherence time, which in turn prohibited revealing the chemical composition and dynamics of the system under investigation. By entangling the NV electron spin sensor with a long-lived memory spin qubit we increase the spectral resolution of NMR measurement sequences for the detection of external nuclear spins. Applying the latter sensor-memory-couple it is particularly easy to track diffusion processes, to identify the molecules under study and to deduce the actual NV center depth inside the diamond. We performed nanoscale NMR on several liquid and solid samples exhibiting unique NMR response. Our method paves the way for nanoscale identification of molecule and protein structures and dynamics of conformational changes.

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