**Numerical modeling of the central spin problem using the spin coherent states P-representation** V.V. DOBROVITSKI, Ames Laboratory and Iowa State University, Ames IA 50011, K.A. AL-HASSANIEH, E. DAGOTTO, Oak Ridge National Laboratory, Oak Ridge TN, and University of Tennessee, Knoxville TN 37831, B.N. HARMON, Ames Laboratory and Iowa State University, Ames IA 50011 — We analyze decoherence of a central spin coupled to a spin bath (the central spin problem). Theoretical understanding of this process is important for many experiments, such as the recent study of decoherence of the electron spin by the nuclear spins in a quantum dot. To investigate the important non-perturbative decoherence regimes, we developed an efficient mean-field-based method for modeling the spin-bath decoherence. The method is based on the P-representation for the central spin density matrix, which is very useful in quantum optics, but has not been widely applied to quantum many-spin systems. In contrast with the standard time-dependent mean field theory, our method gives excellent agreement with the exact solution. We demonstrate performance of the method for longitudinal and transversal relaxation at different external fields. In particular, by modeling the quantum systems with up to 16000 bath spins, we make controlled predictions for the slow long-time decoherence of the central spin. We thank L. Glazman, M. Lukin, A. Polkovnikov, and J. Taylor for helpful discussions. This work was supported by NSA, ARDA, ARO, and NSF.

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