Abstract Submitted
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Eigenvalues of the time evolution operator governing nuclear spin behavior in solids[1] STEVEN W. MORGAN, BRIAN SAAM, University of Utah Physics Department — The decay of nuclear magnetic resonance (NMR) signals in solids is an extremely difficult many-body problem with no complete solution. Utilizing frozen xenon polarized by spin-exchange optical pumping, we have observed the long-time behavior of the transverse NMR signal for both free-induction decay and spin (solid) echoes. The hyperpolarized signal can be observed for up to $\sim$10 decay constants, allowing us to characterize the long-time behavior, which is predicted to have one of two forms: $S(t) \sim e^{-\gamma t}$ or $S(t) \sim e^{-\gamma t} \cos(\omega t + \phi)$, where the constants ω and γ are the same for the FID as for the solid echo. Our data agree well with this prediction, which follows from considering the evolution of the density matrix under the action of its time evolution operator, with the corresponding eigenvalues determining the evolution of the spin system.* Not only is this decay an example of Markovian behavior on non-Markovian timescales but these eigenvalues should be a deep fundamental property of many-body quantum systems. The eigenvalues are also expected to be analogous to Pollicott-Ruelle resonances in classical chaotic systems. *B.V. Fine, Phys. Rev. Lett. 94, 247601 (2005) .

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Steven W. Morgan
University of Utah Physics Department

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