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Exploring collective spin dynamics in a weakly interacting gas of fermions SCOTT SMALE, Department of Physics, University of Toronto, ANDREW KOLLER, JILA, NIST and Physics Department, University of Colorado, Boulder, BEN A. OLSEN, HAILLE SHARUM, CHRIS LUCIUK, STEFAN TROTZKY, Department of Physics, University of Toronto, ANA MARIA REY, JILA, NIST and Physics Department, University of Colorado, Boulder, JOSEPH H. THYWISSEN, Department of Physics, University of Toronto — Strongly correlated states are often associated with strongly interacting regimes. However, weak interactions can also lead to strong correlations, given sufficiently long coherent interaction times. Ultracold atomic Fermi gases, with precisely controllable parameters, offer a versatile platform to investigate the emergence of collective behavior in out-of-equilibrium settings. Here we present observations of non-trivial collective behavior that emerges in the spin dynamics of a gas of ^{40}K atoms in the weakly interacting regime. Starting with a spin-polarized gas, we study collective spin dynamics in a Ramsey sequence, both with and without a spin-reversal pulse. We observe large oscillations with life times up to 100 milliseconds. In contrast to demagnetization in the strongly interacting regime, there are multiple revivals. Experimental results are compared to a fully quantum model that maps motional trap states with s-wave scattering onto a spin chain with long-range interactions. The broader impact of this study is an improved understanding of magnetic correlations driven by the exchange interactions between itinerant spins.

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