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Measuring Many-body Coherence in Weakly Interacting Fermi Gases[1] SAEED PEGAHAN, ILYA ARAKELYAN, JOHN E. THOMAS, North Carolina State University, JET LAB TEAM — We study a coherently prepared, weakly interacting Fermi gas of 6×10^4 ^{6}Li atoms, which offers a new foundation for understanding complex spin dynamics induced by the interplay between spin interactions and motion in many-body systems. Using phase-controlled radio-frequency (rf) pulses, we prepare an x-polarized collective spin state and implement a many-body echo: After an evolution time τ, we apply a rotation by an angle ϕ about the x-axis. This is followed immediately by a π rotation about the y-axis and inversion of the s-wave scattering length, which reverses the sign of the Hamiltonian. The rf detuning is sufficiently stable to measure the final collective spin vector as a function of ϕ for 2τ up to 1 second. This system provides a powerful tool to study many-body coherence and entanglement spreading in quantum many-body systems.

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