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Reversible quantum phase dispersion in two-component quantum gases A. WIDERA, S. TROTZKY, P. CHEINET, S. FÖLLING, F. GERBIER, I. BLOCH, Physics Department, University of Mainz, 55099 Mainz, Germany — Controlling fundamental interactions on an atomic scale has offered the unique possibility to engineer strongly correlated quantum states in ultracold atomic samples during recent years. In particular, controlling the interactions of an ensemble of particles implies the possibility of pushing into the intriguing regime of coherent many-body physics. Here we report on the controlled manipulation of a quantum many-body state in a 2D-array of mesoscopic spinor gases. Starting from a coherent spin-state, controllable interatomic interactions close to a Feshbach resonance are used to induce a dynamics which changes the distribution of intrinsic spin fluctuations. The resulting phase dispersion is detected by monitoring the decay of coherence through Ramsey spectroscopy. We demonstrate the coherent nature of this interaction effect by time-reversal of the dynamics, observing a substantial revival of coherence in the system. These results have implications not only on our understanding of decoherence in ultracold atomic systems but also point towards the possibility of dynamically creating correlated spin states or even maximally entangled mesoscopic Schrödinger cats.

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