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Many-body Quantum Control of a Spin-1 BEC THAI HOANG, MARTIN ANQUEZ, BRYCE ROBBINS, XIAOYUN YANG, BENJAMIN LAND, CHRISTOPHER HAMLEY, MICHAEL CHAPMAN, Georgia Inst of Tech — Spin-1 condensates provide a useful platform for investigations of atom squeezing,[1] generation of non-Gaussian states,[2] and dynamical control.[3] We demonstrate dynamic control of a quantum many-body spin-1 system that is enabled by strong collisional interactions. In contrast to the usual single-particle quantum control techniques, the method demonstrated here is intrinsically many-body, exploiting the strong collisional interactions. The experiment uses a spin-1 ^{87}Rb condensate initialized in the $|F = 1, m_F = 0\rangle$ polar state at a high magnetic field above the quantum phase transition, and then prepared in a coherent state using a rf rotation. The many-body control is implemented by time-varying the relative strength of the Zeeman and spin interaction energies of the condensate at multiples of the natural coherent oscillation frequency of the system. This is a parametric excitation method relying on time varying changes to the Hamiltonian. We will present our experimental results, which compare well to theory, and will discuss future directions and applications.

[1]C.D. Hamley, *et al.*, Nat. Phys. 8, 305 (2012)
[2]C.S. Gerving, *et al.*, Nat. Commun. 3, 1169 (2012)
[3]T.M. Hoang, *et al.*, Phys. Rev. Lett. 111, 090403 (2013)

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