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Reversal of spin dynamics in an antiferromagnetic F=1 spinor Bose-Einstein condensate ARNE SCHWETTMANN, Joint Quantum Institute, NIST and the University of Maryland, GIL SUMMY, Oklahoma State University, HYEWON PECHKIS, Bryn Mawr College, JONATHAN WRUBEL, Creighton University, RYAN BARNETT, Imperial College London, RYAN WILSON, EITE TIESINGA, PAUL LETT, Joint Quantum Institute, NIST and the University of Maryland — The antiferromagnetic F=1 sodium spinor Bose-Einstein condensate (BEC) exhibits coherent population oscillations of the magnetic sublevels that are internally driven by spin-exchange collisions. Here, we experimentally demonstrate reversals of the collisional dynamics. The reversals are controlled with microwave pulses. We observe nearly complete reversals even after a significant amount of population oscillation has already occurred. In addition, and somewhat surprisingly, we can generate partial reversals in the cold, non-condensed normal gas. We explain our results with numerical calculations based on the truncated Wigner approximation and an analytical theory based on the Bogoliubov approximation. In the future, this type of microwave control of collisional dynamics will allow us to implement matter-wave analogs of devices known from quantum optics with photons, such as a phase-sensitive matter-wave amplifier.

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