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A Superradiant Raman Laser as a Hybrid Active/Passive Atomic Sensor JUSTIN G. BOHNET, JOSHUA M. WEINER, KEVIN C. COX, ZILONG CHEN, University of Colorado at Boulder, JILA, JAMES K. THOMPSON, University of Colorado at Boulder, JILA, NIST — We have realized an atomic sensor that combines active, wideband sensing with passive measurement periods using dynamic control of a cold-atom, superradiant Raman laser. In a superradiant laser, collective emission of the atomic ensemble maps the quantum phase stored in the atoms onto the detected cavity field. We discuss the fundamental precision of the superradiant mapping and show theoretically that the precision of the non-demolition measurement is only a factor of two worse than the standard quantum limit on phase estimation for a coherent spin state. Using the superradiant readout, we experimentally demonstrate a repeated, non-demolition conditional Ramsey sequence that has the potential to combine the benefit of a high-bandwidth active frequency reference with a high-accuracy passive device. We also present an experimental realization of a superradiant Raman laser operated as a hybrid active/passive atomic magnetometer.

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