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Coherence Perserving Quantum Nondemolition Measurements JUSTIN BOHNET, ZILONG CHEN, University of Colorado at Boulder, SHANNON SANKAR, Massachutes Institute of Technology, JIAYAN DAI, JAMES K. THOMPSON, University of Colorado at Boulder — We demonstrate that the collective vacuum Rabi splitting can be used to perform quantum nondemolition measurements on the clock states of 10^6 ^{87}Rb atoms in an optical cavity. We observe a 13(1) dB increase in sensitivity over sampled measurements and a precision 8.6(2.6) dB below the projection noise level. We infer the preparation of spin squeezed states with sensitivities 3.4(6) dB below the standard quantum limit and directly observe a 1.1(4) dB spectroscopic improvement. The measurement is enhanced using a large ensemble and may lead to more precise atomic sensors.

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