

Abstract Submitted
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Precise rotation angle measurement 8.44 dB beyond the standard quantum limit YIQUAN ZOU, LING-NA WU, QI LIU, XIN-YU LUO, SHUAI-FENG GUO, JIA-HAO CAO, State Key Laboratory of Low Dimensional Quantum Physics, Department of Physics, Tsinghua University, MENG KHOON TEY, LI YOU, State Key Laboratory of Low Dimensional Quantum Physics, Department of Physics, Tsinghua University; Collaborative Innovation Center of Quantum Matter — We demonstrate an interferometric measurement precision beyond the standard quantum limit (SQL) using a spin-1 Dicke state containing more than 10000 entangled atoms. The high quality Dicke state is deterministically generated through controlled quantum phase transition in a Bose-Einstein condensate of ground state $F = 1$ ^{87}Rb atoms. Compared to the twin-Fock state (spin-1/2 Dicke state) we reported earlier[1], the spin-1 Dicke state allows for a higher precision using SU(2) three-mode interferometry, which couples the three Zeeman states $|F = 1, m_F = 0, \pm 1\rangle$ symmetrically using a resonant radio-frequency field. We achieve a rotation angle measurement sensitivity 8.44dB below the two-mode SQL of $1/\sqrt{N}$ and 2.42dB below the three-mode SQL of $1/(2\sqrt{N})$.

[1] Luo, X. Y., Zou, Y. Q., Wu, L. N., Liu, Q., Han, M. F., Tey, M. K., You, L. Science, **355**, 620 (2017).

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