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Deterministic generation of a spin-1 Dicke state with more than 10000 atoms YI-QUAN 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 report the first generation of a spin-1 Dicke state in the close vicinity of $|l = N, m = 0\rangle$ with $N \sim 11700$ ^{87}Rb atoms. A spinor Bose-Einstein condensate supports various quantum phases due to competition between spin-exchange interaction and quadratic Zeeman energy. In the zero magnetization subspace and assuming the same spatial wave function for all spin components, the ground state of a spin-1 condensate at vanishing magnetic field (or zero quadratic Zeeman shift) is a balanced (or zero magnetization) spin-1 Dicke state. We experimentally generate this spin-1 Dicke state by slowly sweeping the effective quadratic Zeeman shift through a quantum phase transition point from an initial $m_F = 0$ condensate. The prepared state is of exceptional quality. It implicates entanglement among all atoms and allows for the demonstration of quantum enhanced measurement.

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