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Efficient generation of many-body singlet state in an antiferromagnetic spinor Bose-Einstein condensate with 1000 atoms[1] PENG XU, WENXIAN ZHANG, Wuhan University, China, S. YI, Institute of Theoretical Physics, Chinese Academy of Sciences, China — We propose a fast method utilizing multilevel oscillations to generate high-fidelity massively entangled states in an antiferromagnetic spin-1 Bose-Einstein condensate (BEC). Combining the multilevel oscillations with additional adiabatic drives, we greatly shorten the necessary evolution time and relax the requirement on the control accuracy of quadratic Zeeman splitting, from micro-Gauss to milli-Gauss, for a ^{23}Na spinor BEC with 1000 atoms. The achieved high fidelities over 96% show that two kinds of massively entangled states, the many-body singlet state and the twin-Fock state, are almost perfectly generated. The generalized spin squeezing parameter drops to a value far below the standard quantum limit even with the presence of atom number fluctuations and stray magnetic fields, illustrating the robustness of our protocol under real experimental conditions. The generated many-body entangled states can be employed to achieve the Heisenberg-limit quantum precision measurement and to attack nonclassical problems in quantum information science.

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