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Adiabaticity in state preparation for spin squeezing of 10^{11} Atoms SHENCHAO JIN, HAN BAO, JUNLEI DUAN, XINGDA LU, Department of Physics, Fudan University, HENG SHEN, Clarendon Laboratory, University of Oxford, YANHONG XIAO, Department of Physics, Fudan University — Spin squeezed state (SSS) is a many-body entangled state of great interest to precision measurements and quantum information science. Here we report the realization of quantum-nondemolition-measurement based spin squeezing of 10^{11} atoms in a ^{87}Rb vapor cell in free space. The greatest challenge to obtain quantum squeezing in our experiment is to overcome classical noises whose power can dominate over atom projection noise power by a factor equal to the number of atoms. In order to solve this problem, we have developed the technique of adiabatic pulse control to prepare a coherent spin state that is strictly along the magnetic field and orthogonal to the probe fields wave vector. This has removed the adverse effects of unwanted classical spin component in the quantum noise detection, and thus forms a key element in the success of squeezing an ensemble with both large particle number and large volume. We present experiment results and a theoretical model to demonstrate the efficacy of the adiabatic pulse control.

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