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Production of a planar squeezed state in a cold atomic ensemble GIORGIO COLANGELO, FERRAN MARTIN CIURANA, ROBERT J. SEWELL, MORGAN W. MITCHELL, ICFO-The Institute of Photonic Sciences — Production of squeezed states is of great interest for quantum metrology and allows production of exotic highly entangled spin states, a powerful resource for quantum simulators. However, while canonical variables such as quadratures of the radiation field can be squeezed in at most one component, a planar quantum squeezed (PQS) state, where two orthogonal spin components are simultaneously squeezed can be achieved due to the angular momentum commutation relations. Such states have recently attracted attention due to their potential applications in atomic interferometry and quantum information. Here we report the generation of a PQS state by coherently rotate the collective spin of a cold atomic ensemble of more than one million atoms . We induce spin squeezing through quantum non-demolition (QND) measurements and a coherent rotation by an external magnetic field that rotates a coherent spin state on a plane. This allows us to successively measure and squeeze two components of the atomic spin, while maintaining a large spin polarization (coherence) in the plane. We observe 3dB of spin squeezing and quantum enhanced sensitivity in the estimation of the magnetic field for any angle in the rotation plane, and detect entanglement by using generalized spin squeezing inequalities.

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