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Spin cooling via incoherent feedback in an ensemble of cold ^{87}Rb atoms MORGAN W. MITCHELL, NAEIMEH BEHBOOD, GIORGIO COLANGELO, FERRAN MARTIN CIURANA, MARIO NAPOLITANO, ROBERT J. SEWELL, ICFO-Institut de Ciencies Fotoniques, MORGAN W. MITCHELL TEAM — We report an experimental study of a new technique for spin cooling an ensemble of ultracold atoms via quantum non-demolition (QND) measurement and incoherent feedback [Phys. Rev. Lett., 111,103601 (2013)]. We observe 12dB of spin noise reduction, or a factor- of-63 reduction in phase-space volume, after two rounds of cooling. This technique has direct application in generating highly entangled macroscopic singlet states via measurement-induced spin squeezing [New J. Phys. 12 053007(2010)]. We report the generation of such macroscopic singlet states with up to 3dB of squeezing relative to the standard quantum limit, and a violation of the generalised spin squeezing inequality [Phys. Rev. Lett. 99, 250405 (2007)] an entanglement witness for the collective spin state, by more than 3 standard deviations.

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