

Abstract Submitted
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Generation of long-range entanglement in a macroscopic spin singlet ROBERT J. SEWELL, FERRAN MARTIN CIURANA, GIORGIO COLANGELO, NAEIMEH BEHBOOD, ICFO-Institut de Ciències Fòniques, Mediterranean Technology Park, 08860 Castelldefels (Barcelona), Spain, GEZA TOTH¹, Department of Theoretical Physics, University of the Basque Country UPV/EHU, P.O. Box 644, E-48080 Bilbao, Spain, MORGAN W. MITCHELL², ICFO-Institut de Ciències Fòniques, Mediterranean Technology Park, 08860 Castelldefels (Barcelona), Spain — We report the generation of long-range entanglement in a macroscopic spin singlet (MSS) [1,2] via collective quantum non-demolition (QND) measurement [3] a global entanglement method predicted [4] to produce entanglement at all length scales. In a cold ⁸⁷Rb spin ensemble of up to 2×10^6 atoms, we generate a MSS, entangling at least half of the atoms. Using a gradient field to convert singlets to triplets, we detect the decay of entanglement in the MSS via spin noise spectroscopy [4] consistent with a mean entanglement length comparable to the size of the atom cloud (~ 4 mm), three orders of magnitude larger than previously detected in atomic spin systems [5]. [1] N. Behbood *et al.*, Phys. Rev. Lett. **113**, 093601 (2014). [2] G. Tóth and M.W. Mitchell, New J. Phys. **12**, 053007 (2010). [3] R. J. Sewell *et al.*, Nat. Photon. **7**, 517 (2013). [4] I. Urizar-Lanz *et al.*, Phys. Rev. A **88**, 013626 (2013). [5] D. Greif *et al.*, Science **340**, 1307 (2013).

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