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Squeezing and entanglement in a Bose-Einstein condensate

CHRISTIAN GROSS, JEROME ESTEVE, STEFANO GIOVANAZZI, ANDREAS WELLER, MARKUS OBERTHALER — We report on the observation of spin squeezing and entanglement in a Bose-Einstein condensate trapped in double well and periodic potential [1]. The measurement of two conjugate variables - atom number difference and relative phase between adjacent sites - allows a direct connection to the presence of entanglement. The observations indeed confirm that entanglement is present even at finite temperature. The observed coherent spin squeezing of 3.8 dB implies that a usable quantum resource has been generated which is directly applicable to overcome the standard quantum limit of atom interferometry. The limitations due to experimental imperfections, finite temperature and three body loss will be discussed in detail. Latest results on spin squeezing using hamiltonian dynamics of internal states are presented. [1] J. Esteve, C. Gross, A. Weller, S. Giovanazzi and M. K. Oberthaler: Nature 455, 1216-1219

Markus Oberthaler
University of Heidelberg

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