GSI - FAIR Colloquium

Main Lecture Hall (SB1 1.120), 64291 Darmstadt, Planckstraße 1

Tuesday, January 24, 2017,
16:15 Uhr (Tee ab 15:45)

Pre-colloquium for students at 15:30

Markus Oberthaler - Universitaet Heidelberg

Quantum metrology with Bose Einstein Condensates

Quantum metrology is about the exploration of how quantum mechanics allows surpassing the classical statistical limit in parameter estimation [1]. Since the gain in precision is intimately connected to quantum entanglement these investigations are also interesting from the fundamental point of view for many particle systems.
In this colloquium I will give an introduction to quantum metrology and connect it to experimental observations building on the results we have obtained with Bose Einstein condensates. The simplest form of useful many particle quantum states are spin squeezed states which can be classified as Gaussian states [2] [3]. Very recently we also explored the regime of non-gaussian entangled states [4]. The experimental extraction of a bound of the quantum Fisher information implies that these states also surpass the classical limits of the phase estimation precision and thus contain quantum entanglement.

[1] Quantum Metrology, V. Giovannetti, S. Llyod, and L. Maccone, Phys. Rev. Lett. 96, 010401 (2006)
[2] Nonlinear atom interferometer surpasses classical precision limit, C. Gross, T. Zibold, E. Nicklas, J. Esteve and M. K. Oberthaler Nature 464, 1165-1169 (2010)
[3] Atomic homodyne detection of continuous variable entangled twin-atom states, C. Gross, H. Strobel, E. Nicklas, T. Zibold, N. Bar-Gill, G. Kurizki and M.K. Oberthaler, Nature 480, 219–223 (2011)
[4] Fisher information and entanglement of non-Gaussian spin states
H. Strobel, W. Muessel, D. Linnemann, T. Zibold, D. B. Hume, L. Pezzé, A. Smerzi, and M. K. Oberthaler, Science, 345, 424-427, (2014)

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