Stuttgarter Physikalisches Kolloquium

Fachbereich Physik, Universität Stuttgart
Max-Planck-Institut für Festkörperforschung
Max-Planck-Institut für Intelligente Systeme*

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Dienstag, 24. April 2012	17:15 Uhr	Hörsaal V 57.01

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Sensing beyond quantum limits

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Abstract

Quantum limits of measurement stemming from the Heisenberg uncertainty relations put a limit on the sensitivity to fields and forces. In particular, the standard quantum limit of precision is associated with the best precision which can be obtained for simultaneous measurements of the position and momentum of a particle or for two projections of an atomic spin. This limit is due to the quantum back action of the measurement. In the talk I will review the recent experiments in which the back action free measurement on atomic spins has been demonstrated [1] and the standard quantum limit has been shown to be not as hard a limit as it was thought before. Applications in magnetometry and position measurements of mechanical oscillators will be discussed [2].

1. Quantum noise limited and entanglement-assisted magnetometry. W. Wasilewski, K. Jensen, H. Krauter, J. Renema, M. Balabas, and E.S. Polzik. **Phys. Rev. Lett.**, 104, 133601 (2010).Quantum interface between light and atomic ensembles. K. Hammerer, A. Sørensen, and E.S. Polzik. **Reviews of Modern Physics**. 82, 1041–1093 (2010).
2. Establishing Einstein-Podolsky-Rosen channels between nanomechanics and atomic ensembles. K. Hammerer, M. Aspelmeyer, E.S. Polzik, P. Zoller. **Phys. Rev. Lett.** 102, 020501 (2009).

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