



The Vienna Doctoral Programme on Complex Quantum Systems  
invites you to a

## Seminar Talk

by

**Eugene S. Polzik**

*Niels Bohr Institute, University of Copenhagen*

### ***Tracking motion beyond the uncertainty limits***

Quantum mechanics dictates that a continuous measurement of the position of an object imposes a random quantum back action (QBA) perturbation on its momentum. This randomness translates with time into position uncertainty, thus leading to the well known uncertainty on the measurement of motion. As a consequence, and in accordance with the Heisenberg uncertainty principle, the QBA puts a limitation—the so-called standard quantum limit—on the precision of sensing of position, velocity and acceleration. In this talk I will present the ideas [1] and experimental results [2] for measurement of motion of a mechanical oscillator with the precision not restricted by the QBA. This is achieved by measuring the motion in a special reference frame linked to an atomic spin system with an effective negative mass. Applications to force sensing [3], clock synchronization [4] and gravitational wave detection [5] will be discussed.

**Monday, 23 April, 2018**

**16:30h get-together with coffee and snacks!**

Hlawka Hörsaal (HS 9), Gußhausstraße 27-29, 1040 Vienna

The seminar talk will be preceded by a CoQuS Student talk at 17:00h  
by

**Moritz Wenclawiak**

*TU Wien*

***"Strong coupling experiments in the THz regime"***

Hosted by: Arno Rauschenbeutel

[1] E.S. Polzik and K.Hammerer. Annalen der Physik. 527, No. 1–2, A15–A20 (2015). K. Hammerer et al, PRL. 102, 020501 (2009).

[2] C. Møller et al. Nature, 547, 191 (2017).

[3] X. Huang, et al. arXiv:1801.02569.

[4] E. S. Polzik and J. Ye. PRA, 93, 021404 (2016).

[5] F. Khalili and E. S. Polzik, [arXiv:1710.10405](https://arxiv.org/abs/1710.10405)

