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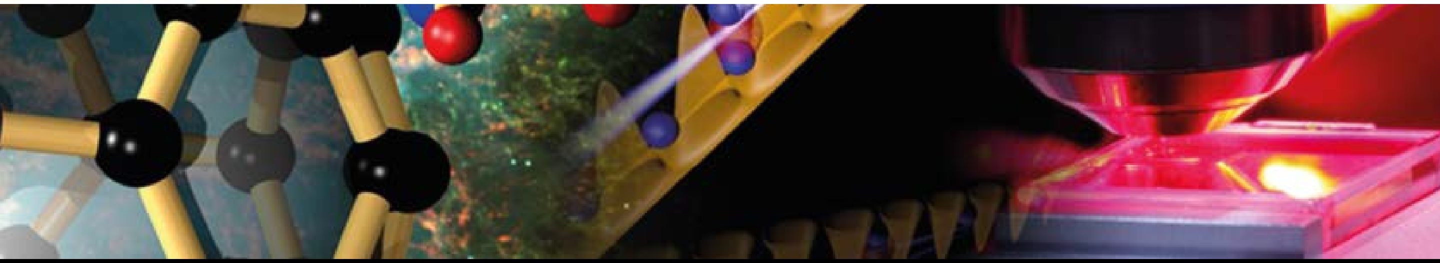

Innsbruck Physics Colloquium

Phonic quantum sensors and transducers

Albert Schliesser

University of Copenhagen, Niels Bohr Institute, Denmark

In the last decade, we have made dramatic progress in our ability to control motional degrees of freedom of nano- and microscale solid-state objects. Phonons, their elementary excitations, now reach coherence times approaching one second. At the same time, they can be tailored to couple to physical quantities that range from magnetic and electric fields to acceleration and gravity. This opens a host of opportunities for sensing and transducing signals, all the way to the quantum regime. In this talk, I will discuss how quantum mechanics constrains the sensitivity of such measurements with a “standard” quantum limit (SQL), and how we can implement a mechanical sensor that can reach the SQL in practice. I will also demonstrate that we can overcome the SQL when we exploit quantum correlations. Interestingly, such precise measurements enable us, in turn, to control the quantum state of mechanical systems. We plan to use these sensors to measure small forces, such as those exerted by a single spin on a nanomagnet.

I will furthermore discuss the prospects of hybrid quantum systems, in which phonons mediate tailored interactions which convert quantum information from one carrier to another. In recent work, for example, we have entangled two optical fields via their interaction with a common phononic mode. In a separate experiment, we could couple the supercurrents in a microwave resonator strongly to a similar phononic mode, as required for coherent microwave-to-optical transducers.

Colloquium, Tuesday, 10.01.2023
17:15 h, lecture hall C, Technikerstr. 25

DK-ALM Pre-Talk: 16:30 h, new: lecture hall C

Lukas Deeg, Nonlinear Magnetomechanics

Snacks will be provided in between the pre-talk and the colloquium.

LAND TIROL

Innsbruck Physics Colloquium, Organisation: M. Beyer, K. Erath-Dulitz, H.-C. Nägerl, A. Reimer, T. Schrabback