CERN Colloquium

SPEAKER: Markus Aspelmeyer

TITLE: **Schroedinger's Mirrors - exploring mechanical motion in the quantum regime**

DATE: 8 Jun 2017, 16:30

PLACE: 500-1-001 - Main Auditorium

ABSTRACT

The quantum optical control of solid-state mechanical devices, quantum optomechanics, has emerged as a new frontier of light-matter interactions. Devices currently under investigation cover a mass range of more than 17 orders of magnitude - from nanomechanical waveguides of some picograms to macroscopic, kilogram-weight mirrors of gravitational wave detectors. This development has been enabled by the insight that quantum optics provides a powerful toolbox to generate, manipulate and detect quantum states of mechanical motion, in particular by coupling the mechanics to an optical or microwave cavity field. Originally, such cavity optomechanical systems have been studied from the early 1970s on in the context of gravitational wave antennas. Advancements in micro-fabrication and micro-cavities, however, have resulted in the development of a completely new generation of nano- and micro-optomechanical devices. Today, 10 years after the first demonstrations of laser cooling of micromechanical resonators, the quantum regime of nano- and micromechanical motion is firmly established. Recent experimental achievements include the generation of genuinely non-classical states of micromechanical motion such as quantum squeezing and entanglement. This level of control over solid-state mechanical degrees of freedom is now also being utilized in diverse application domains ranging from classical sensing, to low-noise optical coatings for precision interferometry, and also to photon-phonon quantum interfaces.

From the fundamental physics point of view, one of the fascinating prospects of quantum optomechanics is to coherently control the motional degree of freedom of a massive object in an unprecedented parameter regime of large mass and long coherence time, hence opening up a new avenue for macroscopic quantum experiments. The availability of quantum superposition states involving increasingly massive objects could enable a completely new class of experiments, in which the source mass character of the quantum system starts to play a role. This addresses directly one of the outstanding questions at the interface between quantum physics and gravity, namely "how does a quantum system gravitate?".

Organised by: W. Lerche/TH-SP........** Tea and coffee will be served at 16h00**