Observation of quantum fluctuations via position to polarization converter

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Synopsis Hybrid quantum system is used to observe the quantum effects like quantum fluctuations. It consists of an optomechanical system where a micromechanical membrane is strongly coupled to a high finesse cavity using position to polarization converter and couple it into Rb atoms.

Hybrid quantum systems are a hot topic, especially transducers that allow us to interface the quantum noise properties of an object of one type to quantum noise properties of an object of another type. A micromechanical membrane coupled to an electromagnetic optical cavity is considered as a new frontier in quantum optics. This coupling gives an opportunity for connecting different quantum resources, manipulating the quantum state of light[1], studying quantum measurement back-action in the optical detection of macroscopic objects[2], and ultra sensitive force detectors [3]. The optomechanical system that is used is composed of a high-stress silicon nitride membrane that placed in the middle of a high finesse cavity. The membrane will have an effect on the behaviour of the cavity which is the focus of our measurements. One way to achieve this would be to measure the phase of the reflected beam from the optical cavity as function of the membrane position by interfering it with a reference beam which has a constant phase relation with the cavity beam. Thus, we can map the position onto polarization and couple the reflected beam to rubidium 87 atoms.

This hybrid quantum system can be used to generate entanglement between atoms and mechanical systems. Such a set-up could be used to facilitate long distance quantum communication, as well as inertial sensing schemes and many other possibilities.

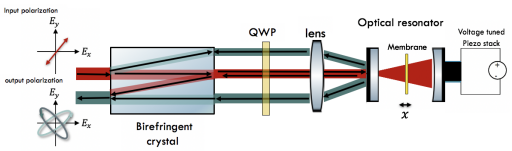

Figure 1. A design of position to polarization converter.

References

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[2] Møller, C.B., Thomas*et al* 2017 *Nature.* **547** 7662
[3] Yu, P.L. 2016 *University of Colorado.*

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