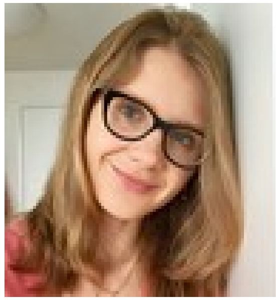
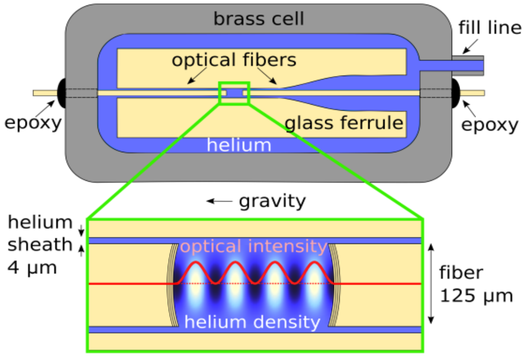
SFB 767 Colloquium

June 13, 2019
Coffee and tea 15:15
Talk 15:30
P 603



Dr. Anna Kashkanova

MPI for the Science of Light, Erlangen



Quantum Optomechanics with Superfluid Helium

In cavity optomechanics the state of a mechanical system can be manipulated by interfacing it with light via radiation pressure. The majority of mechanical systems to date are solid objects (membranes, nanowires, mirrors, etc); however fluids can also be used as a mechanical element. Compared to solids, fluids have an advantage: they don't require careful alignment between the optical cavity and the mechanical element. The fluid can conformally fill or coat the optical cavity. We have developed an optomechanical system in which the mechanical mode is a standing density wave in superfluid helium in a 70 µm long Fabry-Perot cavity. The optical mode is also a mode of the same cavity. Thus, the system is completely self-aligned.
In this system, we drive the mechanical mode with light by modulating the optical intensity. We also observed the mode’s undriven thermal motion and from that extracted the phonon number. We measured phonon number as low as n_m=5. The optomechanical effects of optical spring and optical damping were observed, as were signatures of the mechanical mode’s quantum motion. These quantum signatures were the asymmetry and the correlations between the Stokes and anti-Stokes sidebands, which arise from a combination of the mode’s zero point motion and the quantum backaction of the optical readout. We found agreement between these measurements and theoretical predictions (to within 20%) over a large range of mode temperatures.

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