A Casimir Effect in Quantum Mesoscopic Physics

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Fluctuation induced forces - or Casimir forces - are ubiquitous [1], and are caused by the confinement of long-range correlated fluctuations. Their most celebrated and initial version were first predicted and measured using perfectly conducting plates immersed in the QED vacuum [2].

Here, we show that fluctuation induced forces emerge when light scatters in a disordered medim. Those forces depend on the strength of disorder and on the geometry of the system. In the multiple scattering regime, the light intensity fluctuates in space due to interferences, and can be described in the out-of-equilibrium language with an effective Langevin equation which incorporates the interference effects. This leads to the identification of a fluctuating light current. Using plates to spatially confine the light, we show that both the light intensity and current fluctuations induce a normal force on the plates, which can be measured.

The Langevin description bears a similarity with corresponding fluctuation induced forces recently identified in non-equilibrium systems [4], resulting from long-ranged density fluctuations around the steady state density profile.

References

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