Investigations of radiation pressure : optical side-band cooling of a trampoline resonator and the effect of superconductivity on the Casimir force

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Propositions

to be defended along with the dissertation

Investigations of Radiation Pressure

Optical side-band cooling of a trampoline resonator and the effect of superconductivity on the Casimir force

I

Surrounding a trampoline resonator with an extra resonator isolates it from high-frequency mechanical vibrations at the cost of increased sensitivity to low-frequency vibrations.

chapter 4 of this thesis

II

Using superconducting materials to probe the effect of a static magnetic field on the Casimir force is limited by the requirement to perform these measurements at low temperatures, which necessitates the inclusion of many higher-order Matsubara frequencies.

chapter 5 of this thesis

III

In contrast to measurement schemes with separate calibration and measurement runs, a measurement scheme with simultaneous calibration and measurement greatly improves the reliability of the interpretation of measurements in challenging environments.

chapter 7 of this thesis

IV

The Casimir force between materials of high resistivity shows a significant difference between the Drude and plasma models due to higher-order Matsubara frequencies. This difference can be both calculated and experimentally demonstrated.

chapter 8 of this thesis

V

Feedback cooling and lowering the bath temperature, as mentioned by *Milatz et al. (1953)*, have the same effect on only a single mechanical mode. It is therefore incorrect to say that the resonator is cooled to a certain temperature.

J. M. W. Milatz and J. J. van Zolingen, Physica ***19****, 181 (1953).*

VI

To fully understand the Casimir effect, one should not forget that it can also be described as the van der Waals interaction between the atoms taking retardation into account, based on the potential deduced by *Casimir et al. (1948)*.

H. B. G. Casimir and D. Polder, Phys. Rev. ***73****, 360 (1948).*

VII

Due to the broadband nature of the Casimir effect, influencing the force with metamaterials as mentioned by *Rodriguez et al. (2011)* is not realistic if the metamaterials depend on a narrow-width resonance.

A. W. Rodriguez, F. Capasso and S. G. Johnson, Nature Photonics ***5****, 211 (2011).*

VIII

Compensation of the contact potential difference based on a single measurement does not account for the apparent distance dependence in the contact potential difference found by *Hadjadj et al. (2002)*.

A. Hadjadj, B. Equer, A. Beorchia and P. Roca Cabarrocas, Phil. Mag. B ***82****, 1257 (2002).*

IX

Using the Casimir effect to prove the existence of the gravitational quantum vacuum field, as calculated by *Quach (2015)*, is strongly limited by the availability of appropriate mirrors.

J. Q. Quach, Phys. Rev. Lett. ***114****, 081104 (2015).*

X

While teaching or supervising students it is important to comprehend the student's level of understanding and only give the information that they are ready to receive.

XI

Although perseverance will bring you closer to your goal, it is no guarantee that you will actually reach it.

XII

Success must be celebrated.

Hedwig Julia Eerkens

Leiden, 21 December 2017