Title: Controlling the Casimir force with light and shape

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The optical modification of the Casimir force, measured between a gold sphere and silicon plate, will be discussed. When light is incident on the silicon surface, it changes the dielectric properties leading to an altered Casimir force. Our experiments of this optical modulation of the Casimir force agree with theoretical results which neglect the DC conductivity of silicon as shown in Figure 1 below. The inclusion of the DC conductivity leads to deviations.

Figure 1: The change in the Casimir force due to the incidence of 8.5mW of 514 nm light on the silicon surface is plotted as a function of the separation distance between the Au sphere and Si plate as squares. The different theoretical predictions including and neglecting the DC conductivity of the silicon with the incident light is shown by the dashed and solid lines respectively. The dotted line is theory at zero temperature.

Experiments exploiting the geometry dependence of the lateral Casimir force will also be presented. Two sinusoidally corrugated surfaces lead to a lateral component to the Casimir force. The measurement shows agreement with theories that take complete account of the geometry of the surfaces. Approximate theories such as the proximity force approximation are shown to significantly deviate from the observations. This is shown in Figure 2.

Figure 2: The lateral Casimir force between a sinusoidally corrugated sphere and plate plotted as a function of the separation is shown. The complete theory is shown by the solid line and the proximity force approximation by the dashed line.

References: