multiple mounting configurations in normal gravity. While FEA computations are used to analyze particular candidate sets of mount configurations, these principles allow model-free insight into new configurations that are likely to be useful. Additional information and extensions of the particular mounting schemes presented here, including one that offers dramatically improved zero-gravity map fidelity without the need for bonding, are discussed in Bloemhof, Lam, Feria, and Chang, Appl. Opt. Vol. 46, No. 31, p. 7670 (2007).

This work was done by Eric E. Bloemhof of Caltech for NASA's Jet Propulsion Laboratory. For more information, contact iaoffice@jpl.nasa.gov. NPO-45685

Optical Modification of Casimir Forces for Improved Function of Micro- and Nano-Scale Devices

Manipulating these forces could result in improved MEMS devices.

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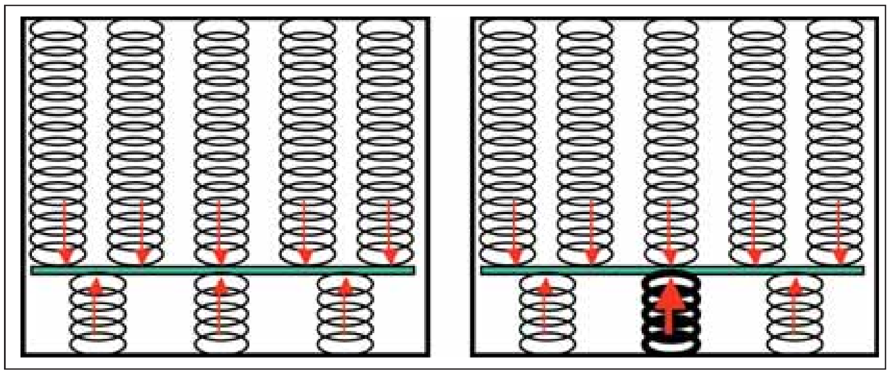
Recently, there has been a considerable effort to study the Casimir and van der Waals forces, enabled by the improved ability to measure small forces near surfaces. Because of the continuously growing role of micro- and nanomechanical devices, the focus of this activity has shifted towards the ability to control these forces. Possible approaches to manipulating the Casimir force include development of composite materials, engineered nanostructures, mixed-phase materials, or active elements. So far, practical success has been limited. The role of geometrical factors in the Casimir force is significant. It is known, for example, that the Casimir force between two spherical shells enclosed one into the other is repulsive instead of normal attractive. Unfortunately, nanosurfaces with this topology are very difficult to make.

A more direct approach to manipulating and neutralizing the Casimir force is using external mechanical or electromagnetic forces. Unfortunately, the technological overhead of such an approach is quite large. Using electromagnetic compensation instead of mechanical will considerably reduce this overhead and at the same time provide the degree of control over the Casimir force that mechanical springs cannot provide. A mechanical analog behind Casimir forces is shown in the figure.



A **Mechanical Analog of the Casimir Force:** On the left, a net force arises from the difference in the number of compressed springs (the optical modes) attached to two sides of a partition. On the right, the Casimir force can be compensated, or even reversed, by making a certain spring "tougher" (i.e., eternally pumping the optical mode).

WGM (whispering gallery mode) resonators play an important role in modem optics and photonics because of their high quality factor and strong field localization. The optical field in such resonators is localized near the surface, resulting in a strong evanescent field. A new method takes advantage of the evanescent field of optical WGMs and utilizes them to control the Casimir force at a metal-dielectric interface. The main novelty of the approach lies in combination of state-of-the-art techniques for measuring the Casimir force with the optical WGM microresonators. The WGM resonators shaped as microspheres will be used. The evanescent field emerging from the microresonator surface will enable the desired capability of manipulating, neutralizing, and reversing the Casimir force.

In real MEMS (microelectromechanical system) applications, it may or may not be possible to utilize the optical evanescent field technique. The proposed approach relies on modification of the electromagnetic energy density in a vacuum gap, rather than on modification of material properties or of the microdevice shape. The advantage of this approach is that the new knowledge and techniques developed in its framework will be applicable to a much broader class of MEMS affected by Casimir force, in particular to those of practical importance. The optical evanescent field is just one example of various surface excitations that can modify the energy density in small gaps, therefore changing the Casimir forces. As another example, forces can be mediated by exciting surface plasmons instead of the evanescent field photons. Therefore, it will be possible to directly apply these theoretical results and experimental techniques to realistic metallic or silicon MEMS.

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