# Casimir effect

In quantum field theory, the Casimir effect and the Casimir-Polder force are physical forces arising from a quantized field. The typical example is of two uncharged metallic plates in a vacuum, placed a few micrometers apart, without any external electromagnetic field. In a classical description, the lack of an external field also means that there is no field between the plates, and no force would be measured between them. When this field is instead studied using quantum electrodynamics, it is seen that the plates do affect the virtual photons which constitute the field, and generate a net force—either an attraction or a repulsion depending on the specific arrangement of the two plates. Although the Casimir effect can be expressed in terms of virtual particles interacting with the objects, it is best described and more easily calculated in terms of the zero-point energy of a quantized field in the intervening space between the objects. This force has been measured, and is a striking example of an effect purely due to second quantization. However, the treatment of boundary conditions in these calculations has led to some controversy. In fact “Casimir's original goal was to compute the van der Waals force between polarizable molecules” of the metallic plates. Thus it can be interpreted without any reference to the zero-point energy (vacuum energy) or virtual particles of quantum fields.

Dutch physicists Hendrik B. G. Casimir and Dirk Polder proposed the existence of the force and formulated an experiment to detect it in 1948 while participating in research at Philips Research Labs. The classic form of the experiment, described above, successfully demonstrated the force to within 15% of the value predicted by the theory.

Because the strength of the force falls off rapidly with distance, it is only measurable when the distance between the objects is extremely small. On a submicrometre scale, this force becomes so strong that it becomes the dominant force between uncharged conductors. In fact, at separations of 10 nm—about 100 times the typical size of an atom—the Casimir effect produces the equivalent of 1 atmosphere of pressure (101.3 kPa), the precise value depending on surface geometry and other factors.

In modern theoretical physics, the Casimir effect plays an important role in the chiral bag model of the nucleon; and in applied physics, it is significant in some aspects of emerging microtechnologies and nanotechnologies.

## 참고

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