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Van der Waals interaction between an atom and a spherical plasma shell

Khusnutdinov N.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

The van der Waals interaction energy of an atom with an infinitely thin sphere with finite conductivity is investigated in the framework of the hydrodynamic approach. Thin sphere models the fullerene. We put the sphere into a spherical cavity inside the infinite dielectric media then calculate the energy of vacuum fluctuations in the context of the ζ-function approach. The interaction energy for a single atom is obtained from this expression in the limit of the rare media. The Casimir-Polder expression for an atom and plate is recovered in the limit of the infinite radius of the sphere. Assuming a finite radius of the sphere, the interaction energy of an atom falls down to a third power of distance between the atom and sphere for short distances and to a seventh power for large distances from the sphere. Numerically the interaction energy is 3.8eV for the hydrogen atom placed on the surface of the sphere with parameters of fullerene C60. We also show that the polarizability of fullerene is merely a cube of its radius.

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