INFLUENCE OF ATOMIC AND SURFACE PROPERTIES ON THE VAN DER WAALS AND CASIMIR ATOM-WALL INTERACTION WITH POSSIBLE APPLICATIONS TO BEC

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The influence of atomic and surface properties on atom-wall interaction is discussed. It is shown that accurate results can be obtained using the single-oscillator model of atomic dynamic polarizability. This is applicable at all separations in both nonretarded and retarded regimes. At separations where the thermal effects are essential, atom can be described by the static atomic polarizability. The problem on how to describe the dielectric properties of wall material is more complicated. Important information on this subject can be obtained from recent experiments on the measurement of the Casimir force between metal and semiconductor test bodies. As to metal-metal interaction, several theoretical approaches have been proposed during the last few years leading to controversial predictions. This, however, does not influence on the predicted interaction of an atom and a metal cavity wall. The interaction between an atom and dielectric or semiconductor wall is much more sensitive to different models of wall dielectric permittivity. In particular, alternative ways of accounting for the free charge carriers inevitably existing at nonzero temperature lead to qualitatively different results for the atom-wall interaction. The seemingly most evident approach to use the actual conductivity properties at nonzero temperature is shown to lead to contradictions with thermodynamics and is already excluded experimentally on measuring the interactions between macrobodies. We analyze the application region of different asymptotic potentials of atom-wall interaction used for the description of quantum reflection. The calculational procedure is presented on how to take into account free charge carriers in dielectric and semiconductor walls in agreement with thermodynamics. The tests for these procedures are suggested in experiments on quantum reflection and Bose-Einstein condensation.