Casimir interaction between two spheres with perfect electromagnetic boundary conditions

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Vacuum fluctuations of the electromagnetic field in the presence of two scatterers give rise to a force between the objects known as Casimir force or retarded van der Waals force. For finite temperatures, thermal fluctuations contribute to the force as well. Specifically, we consider the Casimir interaction between two bi-isotropic spheres where polarization mixing upon reflection at each sphere occurs. An asymptotic expansion of the Casimir force for large spheres shows that the leading term corresponds to the result obtained when the Casimir force between two plates is integrated over the local distances between the spherical surfaces [1]. This approximation is commonly known as proximity force approximation (PFA).

A special case of bi-isotropic spheres are perfect electromagnetic conductors interpolating between spheres with infinite permittivity and infinite permeability for which we present results for vanishing [2] as well as non-zero temperatures. Apart from the PFA results, we also determine the leading PFA corrections and the results for large distances which reveal that the transition from an attractive force to a repulsive force depends on the temperature and the distance between the spheres.

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[2] S. Rode, R. Bennett, S. Y. Buhmann, New J. Phys. 20 (2018) 043024.