

The retarded van der Waals potential

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Abstract

In their highly celebrated 1948 work, Casimir and Polder predicted that the potential between two hydrogen atoms at distance R decays as $-R^{-7}$, once the radiation field is quantized. We review the status of their result in the framework of nonrelativistic QED. The hamiltonian describes two infinitely heavy nuclei, charge e , separated by a distance R and two spinless electrons, charge $-e$, nonrelativistically coupled to the quantized radiation field. Casimir and Polder use the dipole approximation and small coupling to the Maxwell field. We employ the full hamiltonian and determine the asymptotic strength of the leading $-R^{-7}$ potential, which is valid for all e and includes magnetic contributions. Our computation is based on a path integral representation and expands in $1/R$, rather than in e .