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Electromagnetic Energy, Absorption, and Casimir Forces[1] FELIPE DA ROSA, DIEGO DALVIT, PETER MILONNI, Los Alamos National Laboratory — The derivation of Casimir forces between dielectrics can be simplified by ignoring absorption, calculating energy changes due to displacements of the dielectrics, and only then admitting absorption by allowing permittivities to be complex. As a first step towards a better understanding of this situation we consider in this paper the model of a dielectric as a collection of oscillators, each of which is coupled to a reservoir giving rise to damping and Langevin forces on the oscillators and a noise polarization acting as a source of a fluctuating electromagnetic (EM) field in the dielectric. The model leads naturally to expressions for the quantized EM fields that are consistent with those obtained by different approaches, and also results in a fluctuation-dissipation relation between the noise polarization and the imaginary part of the permittivity. Our main result is the derivation of an expression for the QED energy density of a uniform dispersive, absorbing media in thermal equilibrium. We also show how the fluctuation-dissipation theorem ensures a detailed balance of energy exchange between the (absorbing) medium, the reservoir and the EM field in thermal equilibrium.

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