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Long-Range Inter-Particle Interactions: Recent Results from Molecular QED Theory

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The theory of molecular QED [1-3] has been applied successfully to a variety of linear and nonlinear optical processes, as well as to couplings between atoms and molecules. In this seminar a brief outline of molecular QED will be given first. Applications then follow to a few fundamental inter-particle interactions, which are mediated by virtual photon exchange [4]. Specific examples to be presented include resonance energy transfer (RET) [1,2], and its mediation by a third molecule [5], and the van der Waals dispersion potential between two and three particles [6,7]. Results obtained for these interactions are valid for all separation distances outside the charge overlap region, and include the effects of retardation. Interesting results are found when electric octupole coupling is included [8]. The octupole weight-1 term is a higher–order correction to the electric dipole dependent transfer rate [9] and dispersion energy shifts [8,10,11]. For isotropic three-body dispersion potentials involving mixed dipole-octupole polarisability, the weight-3 contribution vanishes in all of the cases considered, leaving a retarded potential dependent solely upon the octupole weight-1 term [12].

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