Physikalisches Institut
Fakultät für Mathematik und Physik
Albert-Ludwigs-Universität Freiburg

IRTG-Seminar

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“Molecular QED Theory and its Application to Inter-Particle Interactions”

The fundamental theory of electron-photon interactions is quantum electrodynamics (QED). In this seminar we first consider the coupling of a collection of non-relativistic charged particles to an electromagnetic field, and apply the canonical quantisation scheme to obtain the quantum electrodynamical Hamiltonian operator. This theory, known as molecular QED [1-3], has been applied successfully to treat linear and nonlinear absorption, emission and scattering of light by matter, as well as to interactions between atoms and molecules. In the latter case coupling occurs via the exchange of one or more virtual photons [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 [6-9]. Results obtained for these interactions are valid for all separation distances outside the charge overlap region, and include the effects of retardation. Asymptotically limiting forms of the general results are shown to lead to the familiar Förster rate, the London dispersion formula, the Casimir shift, and the Axilrod-Teller-Muto triple dipole dispersion potential, as appropriate special cases.

[1] D. P. Craig and T. Thirunamachandran, Molecular Quantum Electrodynamics, Dover, 1998.
[2] A. Salam, Molecular Quantum Electrodynamics, Wiley, 2010.
[3] A. Salam, WIREs Comput. Mol. Sci. 5, 178 (2015).
[4] A. Salam, Mol. Phys. 113, 3645 (2015).
[5] A. Salam, J. Chem. Phys. 136, 014509 (2012).
[6] H. B. G. Casimir and D. Polder, Phys. Rev. 73, 360 (1948).
[7] M. R. Aub and S. Zienau, Proc. Roy. Soc. London A257, 464 (1960).
[8] A. Salam, J. Chem. Phys. 139, 244105 (2013).
[9] A. Salam, J. Chem. Phys. 140, 044111 (2014).

Tuesday, April 12th, 2016, 4:00 p.m., HS II, Physik-Hochhaus, Hermann-Herder-Str. 3

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