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# Van der Waals interaction at finite temperature in the presence of macroscopic bodies

Abstract: Dispersion forces such as van der Waals forces originate from electromagnetic field fluctuations that also exist in the ground state of the quantized field. At finite temperature, additional noise sources due to thermal fluctuations can contribute. In the presence of macroscopic bodies, boundary conditions are imposed on the electromagnetic field that alter the dispersion interactions. Van der Waals interactions become a dominant force for highly excited (Rydberg) atoms, as they typically scale as n^11 with the principal quantum number n. These giant interactions lead, for example, to the phenomenon of Rydberg blockade. Of particular interest to us are situations in which guided modes in waveguide structures can alter the interaction range of the atoms. A typical example consists of (Rydberg) atoms confined in cylindrical hollow-core waveguides. Here, we first derive a general formula for the van der Waals interaction of excited atoms at finite temperature in the presence of macroscopic bodies within the framework of macroscopic quantum electrodynamics. In the limiting case of very high temperature, we recover the previously derived result that high temperature can compensate the effect of retardation. Finally, we apply the formalism to cylindrical hollow-core fibers and present some first results.