Coulomb and van der Waals interactions of nanoparticles in plasma

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The electrostatic interaction of nanoparticles caused by the overlap of double electric layers and the van der Waals interaction caused by quantum and thermodynamic fluctuations of electromagnetic fields are considered in electrolytes [1, 2] and dusty plasmas [3]. An exact solution to the problem is obtained for both identical particles and particles of very different sizes. For the van der Waals interaction, screening of static fluctuations and the retardation of electromagnetic fields for the dispersion part of the interaction are taken into account. The predominance of the van der Waals force over the force of screened electrostatic repulsion was found at high electrolyte concentrations in the range from 10^{-2} to 10^{-3} mol/l for both small and large interparticle distances. In dusty plasmas, no predominance of the van der Waals force over the screened electrostatic force was found at large interparticle distances [3].
This work is devoted to a more thorough study of the interaction forces in dusty plasmas and electrolytes using a numerically stable method for calculating the geometric factor, taking into account the retardation of the electromagnetic field. The studies were conducted in electrolytes with different dielectric permittivity of the solution and in dusty plasma with vacuum dielectric permittivity while varying the Debye screening constant, charge (surface potential) and radius of nanoparticles over a wide range.

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[3] Filippov A V and Starov V M 2024 *J. Exp. Theor. Phys.* **164**(2) 131–157