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**Multi-body effects in Charged Colloids - Polyelectrolyte systems**

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— Multibody effects upon the electrostatic interaction between particles, polyelectrolyte molecules and monovalent ions were analyzed within Poisson-Boltzmann approximation. The numerical self-consistent field (SCF) theory for a polymer - nanoparticles systems was developed for a mixture of quenched polyelectrolytes and charged and uncharged particles and the pseudo-spectral method was used to solve polymer SCF equations in three dimensions within the Grand Canonical Ensemble for polymer and ions. A calculation of the free energies of a single particle and of two particles in polyelectrolyte solutions allowed us to calculate respectively the particle insertion free energy and particle-particle interactions as a function of the properties of solution, polymer-particle interaction and particle size. By explicitly calculating the free energy of three particles after subtraction of the contributions from two-body interaction allowed us to calculate effective contribution of 3-body particle-particle interactions in polyelectrolyte -particles systems. We have found that the polyelectrolyte mediated two body interactions are repulsive for the larger particle-particle distances and lower polymer concentrations. Interestingly, such an electrostatic repulsion exists even if particles have

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