Poisson-Boltzmann equations with steric effects

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Abstract

When ions are crowded, the effect of steric repulsion between ions becomes significant and the conventional Poisson-Boltzmann (PB) equation (without steric effect) should be modified. Several modified PB equations had been developed before. In this lecture, a general model of PB equations called Poisson-Boltzmann equations with steric effects (PB-steric equations) will be introduced. The concentrations of ions and solvent molecules are determined by the Lambert type functions under the assumptions of steric effects and chemical potentials. Theorems of the asymptotic limit of PB-steric equations with the Robin boundary condition may show the approach of previous modified PB equations. Moreover, we find the oscillatory total charge density function (which cannot be obtained in the conventional and modified PB equations) under the assumptions of steric effects and chemical potentials.