

Special Program in Applied Mathematics and Applied Mechanics

An electrostatic model with size effects and the asymptotic behavior of its solutions

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15:30 - 18:00

308, Mathematics Research Center Building (ori. New Math. Bldg.)

Recently, a wide variety of Poisson-Boltzmann (PB) type equations have been established to approach the phenomena of ion transport in various electrolyte solutions. Due to the finite size effect on the electric double layer at the charged surface, Andelman et. al. [PRL, 1997] have investigated a modified Poisson-Boltzmann (MPB) equation for electrolyte solutions with two types of ions having the same size. The MPB equation is a good model for describing the effect of ions' size on the behavior of the electric double layer. However, in the case when different size ion species occupy electrolyte solutions, the MPB equation seems unavailable. The main purpose of this talk is to introduce a new PB equation with finite size effects --- the PB_{ns} equation. To briefly study this model, we are going to focus on the case of one cation and one anion species and formally derive a limiting form of the PB_{ns} equation which is more general than the MPB equation. In particular, when the size of all ions are the same, we show that solutions of the PB_{ns} equation and the MPB equation have the same asymptotic behavior in the limit of zero Debye length. On the other hand, under a suitable setting on parameters in PB_{ns} equation, we can show that the solution also approaches to that of Bo Li's electrostatic model. This is a joint work with Tai-Chia Lin and Chun Liu.

