Thermal Effects in General Diffusion: An Energetic Variational Approach

Professor Chun LIU
Illinois Institute of Technology

Abstract: (with Francesco De Anna , Pei Liu and Hao Wu) Almost all biological activities involve transport and distribution of ions and charged particles in complicated biological environments. The complicated coupling and competition between different ionic solutions in various biological environments give the intricate specificity and selectivity in these systems. These systems are often associated with complicated, but specific biological relevant special biological and chemical conditions, such as the high concentration of specific species in solutions, which make most of the "ideal" assumptions in classical and conventional approaches irrelevant or unsuitable in the studies of biological problems. In the talk, I will explore the underlying mechanism governing various diffusion processes [4]. We will employ a general framework of energetic variational approaches, consisting of in particular, Onsager's Maximum Dissipation Principles [1, 2, 3], and their specific applications in biology and physiology [5]. I will discuss several extended general diffusion systems motivated by the study of ion channels and ionic solutions in biological cells. In particular, I will focus on our recent results in studying the interactions between different species, the boundary effects[8] and in some cases, the thermal effects [6, 7].

References

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[4] (with Arkadz Kirshtein and Mi-Ho Giga) *Variational Modeling And Complex Fluids*, Handbook of Mathematical Analysis in Mechanics of Viscous Fluids, edited by Anton Novotny and Yoshikazu Giga, Springer (2018).

[5] (with Shixin Xu and Ping Sheng) *An Energetic Variational Approach for Ion Transport.* Communications on Mathematical Sciences, textbf12,(4) (2014) 779-789.

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[8] (with Hao Wu) *An Energetic Variational Approach for the Cahn-Hilliard Equation with Dynamic Boundary Conditions: Derivation and Analysis* to appear in Archive of Rational Mechanics and Analysis (2018).