Abstract

Analytical solutions to diffusion- limited reactions in biology

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Chemical reactions make cells work only if the participating chemicals are delivered to desired locations in a timely and precise fashion. Most research to date has focused on active-transport mechanisms, although passive diffusion is often equally rapid and energetically less costly [1]. Capitalizing on these advantages, living systems have developed sophisticated reaction-diffusion (RD) systems that control a wide range of cellular functions. Understanding the operation of these complex (bio) chemical systems requires the analysis of pertinent transport kinetic equations [2] or, at least on a qualitative level, the characteristic rates of the constituent subprocesses. The talk would be concerned with providing a modern account of the rates of diffusion-controlled reactions in solution. I would delve into some of the rate theories that are most useful for modeling biological processes. Few examples would be presented to illustrate how rate theories can be used to generate insight at the microscopic level into biomolecular behaviours [3]. Along with reviewing the manifestations of Reaction-Diffusion, I would also describe the analytical theories available so far that uses the lens of classical statistical physics like random walk etc., to model such a phenomenon [4]. We as a theory group interested in chemical physics are involved in proposing general methods for finding an exact analytical solution to phenomenon such as electron relaxation, end-to-end looping kinetics, polymer translocation, Bicoid morphogen gradient formation etc. and have proposed a general method for solving them analytically.

References

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