Aggregation and Traveling Wave In A Kinetic Transport Equation with Non-Instantaneous Interaction

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Abstract

The self-organized pattern formation of run-and-tumble chemotactic bacteria is numerically investigated based on a kinetic transport equation considering internal adaptation dynamics and a finite tumbling duration. It is confirmed that the volcano-like aggregation profile is generated due to the coupling of diffusion and internal adaptation dynamics occurring at a large adaptation-time scaling. Moreover, an extended Keller-Segel model, derived by the asymptotic analysis of the kinetic model at the large adaptation-time scale, can describe the volcano effect well. It is also found that when the mean run length of the bacteria becomes large, the volcano effect is more enhanced and unexpectedly, different types of pattern formation (i.e., standing and traveling bands) arise at very large adaptation times.