

Abstract

Active systems consist of units which are self-driven and therefore exist out of equilibrium. They exist across several length scales. One such example is the ant system which is the focus of this thesis. Ants have evolved as one of the most successful social insects and have shown surprising efficiency in searching and homing strategies. To model such systems, active random walk models (ARW) have proved effective to reproduce signature foraging structure in ants. We first experimentally study trajectories of ants and quantify their persistent behavior in following the chemical trails left by them. Then using a simple ARW model to replicate this behavior, we show that the trajectories of ants and their chemical trails show a non-equilibrium continuous transition from a coil to a globule state on increasing the activity, which is tuned by the deposition rate of the pheromone and the decay rate. The phase diagram also shows a re-entrant transition for small decay rates of the chemical and for large deposition rates. We provide a mean field description of the problem to understand this transition.