Two lane coupled exclusion process with extended Langmuir Kinetics

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In nature, most of the essential activities are performed employing various kinds of stochastic transportation processes. Understanding the behavior of such a system is more complicated owing to its random nature. In physics, this kind of system belongs to the category of a non-equilibrium system. Comprehending the stationary characteristics of a system is also intricate because of the continuous movement of particles. Since we do not have any fundamental theories to study the behavior of these systems. So, the scientists modeled the problem with various scenarios, gaining knowledge from there; they tried to understand the nature of the system. A Totally Asymmetric Simple Exclusion Process (TASEP) is a pragmatic model commonly used to elucidate the features of the stochastic transport process. Inspired by the crowded multi-lane transportation phenomena, where the particle movement, adsorption, and desorption rely on the occupation state of the surroundings, we construct the asymmetrically coupled multi-lane TASEP model with the incorporation of modified hopping and extended Langmuir kinetics dynamical rules. The influence of the implemented dynamics on system properties has been scrutinized through phase diagrams, density profiles, phase transitions, and finite-size effects. The obtained theoretical results from the mean-field theory have been validated through Monte Carlo simulations outcomes.