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Interference of two co-directional exclusion processes: stochastic kinetics of unconventional gene translation DEBASHISH CHOWDHURY, BHAVYA MISHRA, Department of Physics, Indian Institute of Technology, Kanpur 208016, India — A molecular machine called ribosome carries out gene translation. During translation, the template mRNA also serves as a track for the noisy, but directed, motor-like movement of a ribosome that is powered by chemical energy. Many ribosomes can simultaneously move along the same mRNA, each synthesizing a distinct copy of the same protein. The concept of Totally Asymmetric Simple Exclusion Process (TASEP) provides a natural theoretical framework for modeling the stochastic ribosome traffic on an mRNA. Here we develop a model of two interfering co-directional TASEP on the same one-dimensional lattice, but with their respective distinct entry sites which correspond to the sites of initiation of gene translation. The model is motivated by an unconventional mode of gene translation called Internal Ribosome Entry Site (IRES). We solve the master equations under mean-field approximation and demonstrate the accuracy of the mean-field predictions by carrying out computer simulations of the model. Our results show the effects of interference of the flow of the two species of particles on their respective flux and density profiles. We present the rich phase diagram of the model.

Debashish Chowdhury
Department of Physics, Indian Institute of Technology, Kanpur 208016, India

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