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On Some New Properties of the Totally Asymmetric Simple Exclusion Process

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Abstract. The asymmetric simple exclusion process (TASEP) plays the role of a paradigmatic model in the exploration and understanding the rich behavior of low-dimensional non-equilibrium phenomena. First introduced to model kinetics of protein synthesis [1], it has a number of diverse applications ranging from vehicular traffic flow, biological transport, one-dimensional surface growth, forced motion of colloids in narrow channels, spintronics, transport of 'data packets' on the Internet, to current through chains of quantum dots, to mention some.

Here, we first shortly review some known properties of a TASEP on long open chains. Then we report on some interesting new features, found recently through numerical simulations and analytical studies, of the stationary states of TASEP with open boundary conditions on long chains with a shortcut in the bulk, which model the motion of molecular motors along twisted protofilaments. Along these protofilaments the molecular motors can jump with some probability between sites, which are distant along the backbone, but close in the real space (i.e., shortcuts). We show that crowding phenomena (shock phases) occur under certain conditions in the presence of both zero-length [2] and finite-length [3] shortcuts, which as suggested in [4] may be responsible for some human diseases. The theoretical study of the system states is based on the application of the Effective Rates Approximation [5,6].

References

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