Bidirectional motor-driven intracellular transport: Collective effects

Robin Jose [1] , Sarah Klein[1,2] , and Ludger Santen[1]

[1]Fachrichtung Theoretische Physik , Universität des Saarlandes, Saarbrücken, Germany, [2] LPT, Université Paris Sud, Orsay, France

Transport of e.g. vesicles and cell organelles is cell is carried out by molecular motors. The cargo is transported bidirectionally along the cytoskeleton. Recently, the dynamics of individual cargo which is driven by teams of molecular motors has been analyzed in detail [1,2]. In this work our focus is on the collective dynamics in systems of many cargo-motor complexes.
The cargo-motor complexes are transported on a network of microtubules (MT) which is embedded in a cylinder. This choice of the system's geometry is based on the MT-network structure of axons. For this system we estimate the waiting time for bypassing processes of such cargoes for different cargo densities by using stochastic simulations.
Based on the results of the three-dimensional stochastic transport model, we define and analyse a simplified lattice gas model for the different waiting time characteristics. Here, we find a phase transition between different regimes of the system's current and clustering behavior.

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[2] William O. Hancock. Bidirectional cargo transport: moving beyond tug of war. Nat Rev Mol Cell Biol, 15(9):615–628, September 2014.