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Mathematical models of molecular motors and other cellular processes

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Transport of material inside long cells (e.g. up to meters in the case of neuronal cells) requires active processes other than simple diffusion. Molecular motors (such as kinesin and dynein) that “walk” along microtubules (long structural biopolymers) are important in such transport. In this talk I will describe some recent work on the dynamics of these proteins in simple cells: the filamentous hyphae of a fungus (Ustilago maydis). We find that quasi-steady state (QSS) reduction of the model to a Fokker-Plank equation (by methods of Bressloff and Newby), as well as simulations of the original model provide insight into the behavior of the system for various parameter regimes. I will conclude with a brief survey of other recent work on cellular and multi-cellular dynamics in my group.