Quantitative Biology > Subcellular Processes

Microtubules Interacting with a Boundary: Mean Length and Mean First-Passage Times

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We formulate a dynamical model for microtubules interacting with a catastrophe-inducing boundary. In this model microtubules are either waiting to be nucleated, actively growing or shrinking, or stalled at the boundary. We first determine the steady-state occupation of these various states and the resultant length distribution. Next, we formulate the problem of the Mean First-Passage Time to reach the boundary in terms of an appropriate set of splitting probabilities and conditional Mean First-Passage Times, and solve explicitly for these quantities using a differential equation approach. As an application, we revisit a recently proposed search-and-capture model for the interaction between microtubules and target chromosomes [Gopalakrishnan & Govindan, Bull. Math. Biol. 73:2483--506 (2011)]. We show how our approach leads to a direct and compact solution of this problem.

Subjects: **Subcellular Processes (q-bio.SC)**; Mathematical Physics (math-ph)

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