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Trajectories of a Brownian Motor

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Many bio-molecular motors are dimers that move by a "hand-over-hand" mechanism along polar bio-polymeric tracks. Examples include kinesin, that "walks" on microtubule and myosin V that "walks" on actin. These molecular motors share two important symmetries. Typically the motor dimers have approximate mirror symmetry, and their tracks have translational, but not mirror, symmetry. Here we use a trajectory approach to analyze a minimal model for a generic dimeric motor that moves on a polymer track incorporating these two symmetry features. The analysis focuses of the relative probabilities of forward, reverse, backward, backward reverse trajectories and provides an experimentally accessible measure of the relative importance of a "Brownian motor" vs. "Power stroke" mechanism. Reciprocal relations, similar to those derived for the linear regime by Onsager for the fluxes (generalized velocities), hold for arbitrary magnitude forces (i.e.,far from the linear regime) for the net probabilities for stepping and for chemical reaction.