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Nonequilibrium Fluctuations and Mechanochemical Couplings of a Molecular Motor[1] ANDY LAU, Florida Atlantic University, DAVID LACOSTE, ESPCI, KIRONE MALLICK, CEA Saclay — We investigate theoretically the non-equilibrium features of a single processive motor operating far from equilibrium using an externsion of the two-state model introduced by Kafri *et al* [Biophys. J. **86**, 3373 (2004)]. By including an important variable, namely, the number of ATP consumed, we construct a thermodynamic framework, which allows us to characterize the ATP consumption rate of a motor, its run length, and its thermodynamic efficiency. Additionally, with the aid of the Fluctuation Theorem, we analyze the violations of Einstein and Onsager relations as functions of generalized forces. Our main results are (i) one of the Einstein relations holds near stalling, (ii) the degree by which the Onsager symmetry is broken is largely determined by the underlying asymmetry of the substrate, (iii) kinesin's maximum efficiency and its maximum violation of Onsager symmetry occur roughly at the same energy scale, corresponding to that of an ATP hydrolysis ($\sim 20\, k_B T$).

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