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Pushing single molecule techniques to microsecond resolution proves that T4 Lysozyme is a Brownian ratchet MAXIM V. AKHTEROV, Dept. of Physics and Astronomy, Univ of California Irvine, YONGKI CHOI, Dept. of Physics and Astronomy, Univ of California Irvine; Dept. of Physics, North Dakota State Univ, TIVOLI J. OLSEN, Dept. of Chemistry, Univ of California Irvine, PATRICK C. SIMS, Dept. of Physics and Astronomy, Univ of California Irvine, MARIAM IFTIKHAR, Dept. of Chemistry, Univ of California Irvine, O. TOLGA GUL, BRAD L. CORSO, Dept. of Physics and Astronomy, Univ of California Irvine, GREGORY A. WEISS, Dept. of Chemistry, Univ of California Irvine, PHILIP G. COLLINS, Dept. of Physics and Astronomy, Univ of California Irvine — Single-molecule techniques can monitor conformational dynamics of proteins, but such methods usually lack the resolution to directly observe conformational pathways or intermediate conformational states. We have recently described a single-molecule electronic technique that breaks this barrier. Using a 1 MHz-bandwidth carbon nanotube transistor, the transition pathways between open and closed conformations of T4 lysozyme have been recorded with a microsecond resolution. We directly resolve a smooth, continuous transition with an average duration of 37 microseconds. Unexpectedly, the mechanical closing and re-opening of the enzyme have identical distributions of transition durations, and the motion is independent of the enzyme catalyzing the substrate. These results illustrate the principle of microscopic reversibility applied to a Brownian ratchet, with lysozyme tracing a single pathway for closing and the reverse pathway for enzyme opening, regardless of its instantaneous catalytic productivity.

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