The copying fidelity of a polymerase facing an obstacle

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The connections between information and thermodynamics have been fascinating scientists ever since Maxwell envisioned his famous demon. One of the extensively studied problems in this field is the copying fidelity of molecular machines. This fidelity can be increased using an out-of-equilibrium mechanism called kinetic discrimination. Kinetic discrimination results in higher fidelity when the system is driven further away from equilibrium, while at the same time the copying velocity increases. What will happen to the copying fidelity when such a machine encounter an obstacle and slows down?

We investigate a simple model of a polymerase that copies a template and at the same time must open a single- to double-stranded junction to progress along its track. We find that the kinetics of the bond opening and closing in the junction affect the fidelity of copying. Surprisingly, the copying fidelity turns out not to depend on the form of the elastic interaction between the polymerase and the junction. Both passive and active interactions lead to the same mean rate of copying errors. Our results suggest that the copying fidelity can not be used as a tool to investigate the properties of the motor-junction interaction.