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Acceleration of molecular complex dissociation by occlusion of rapid rebinding THAYAPARAN PARAMANATHAN, Department of Biochemistry and MRSEC, Brandeis University, Waltham, MA 02454; Department of Natural Sciences, Assumption College, Worcester, MA 01609, DANIEL REEVES, Department of Physics, Brandeis University, Waltham, MA 02454; Rowland Institute, Harvard University Cambridge, MA 02138, LARRY FRIEDMAN, Department of Biochemistry, Brandeis University, Waltham, MA 02454, JANE KONDEV, Department of Physics and MRSEC, Brandeis University, Waltham, MA 02454, JEFF GELLES, Department of Biochemistry and MRSEC, Brandeis University, Waltham, MA 02454 — Molecular complexes in biology are held together by non-covalent interactions. Explicit consideration of molecular diffusion suggests that the dissociation kinetics of these systems are not adequately explained by simple distinctions between “bound” and “free” states of its molecular components. We formulated physical models that describe the effect of competitor molecules on the dissociation of a complex. The models show that competitor acceleration of complex dissociation by occluding rapid re-association is a natural feature of a molecular competition that could play a significant role in a wide variety of biological regulatory processes. We use single-molecule fluorescence colocalization experiments on a model complex to test this prediction and show that the effect is observed in biologically relevant ranges of competitor concentration. The results also demonstrate that single-molecule colocalization experiments can accurately measure dissociation rates despite their limited spatiotemporal resolution.

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