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Force spectroscopy of biomolecular folding and binding: theory meets experiment

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Conformational transitions in biological macromolecules usually serve as the mechanism that brings biomolecules into their working shape and enables their biological function. Single-molecule force spectroscopy probes conformational transitions by applying force to individual macromolecules and recording their response, or "mechanical fingerprints," in the form of force-extension curves. However, how can we decode these fingerprints so that they reveal the kinetic barriers and the associated timescales of a biological process? I will present an analytical theory of the mechanical fingerprints of macromolecules. The theory is suitable for decoding such fingerprints to extract the barriers and timescales. The application of the theory will be illustrated through recent studies on protein-DNA interactions and the receptor-ligand complexes involved in blood clot formation.