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Anisotropic mechanical response of the enzyme Guanylate Kinase perturbed by the DNA molecular spring. CHIAO-YU TSENG, ANDREW WANG, GIOVANNI ZOCCHI, Department of Physics and Astronomy, University of California, Los Angeles, California — Protein molecules are semi-rigid objects with organized but fluctuating conformation. For Guanylate Kinase, which catalyzes phosphoryl transfer between ATP and GMP, a large conformational change upon substrate binding occurs which is essential for enzymatic activity. With a DNA molecular spring stretching the molecule in distinct ways, we demonstrate that the enzymatic functions of substrate binding and phosphoryl transfer can be separately controlled mechanically. Three different attachment points of the DNA spring on the surface of the protein were tested, corresponding to stretching the protein along three different directions. Using activity measurements with titration over substrate concentration, the kinetic parameters (i.e., binding affinity of substrates and catalytic rate constant) based on Michaelis-Menten kinetics were obtained in the presence and absence of the three different mechanical perturbations.

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