Nanomechanics of DNA-Protein interactions

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The interaction of DNA with proteins is essential to many fundamental processes inside cells. Understanding the underlying physical principles that drive or regulate these processes is therefore of utmost importance. Many of these processes are driven by molecular motors, extremely complex and highly evolved nanometer-sized machineries that couple the free energy liberated by a chemical reaction to provide mechanical work. Details about this so called mechano-chemical coupling will not only further our understanding of biological phenomena, but also provide clues for constructing highly efficient nano-machines.

Single-molecule methods enable us to follow these processes in real-time and with ultra high temporal and spatial resolution in highly controlled in-vitro experiments. On elegant method to investigate such molecular systems is single-molecule force spectroscopy (SMFS). We apply SMFS to various systems, such as transcription by RNA-polymerase or viral DNA packaging, by using force measuring dual beam optical tweezers.[1] By varying the force applied, as well as the chemical conditions, we are able to probe the mechano-chemistry of the motor and identify the movement step. We are furthermore conducting single-molecule fluorescence experiments that are aimed to reveal details of the motor processes, such as conformational changes or transient interactions.

[1] Y. Chemla, K. Aathavan, J. Michaelis, S. Grimes, P. Jardine, D. Anderson und C. Bustamante, “Mechanism of force generation of a viral DNA packaging motor,“ *Cell* **122**, (2005), 683-692.