Controlling Biological Motors in Living Cells

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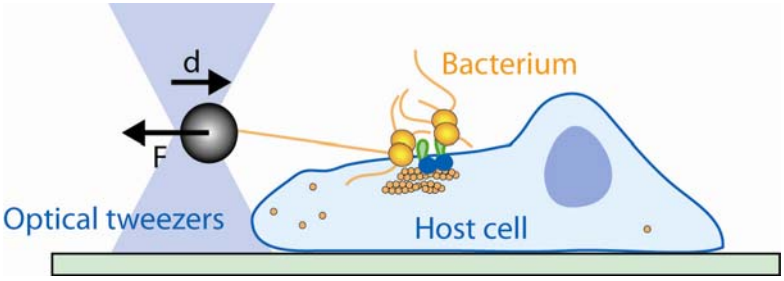
Biological molecular motors are the basic elements that generate directed movement in living cells. Nanotechnological tools enable the characterization of the physical output of individual molecular motors such as force generation, energy transduction, and directional switching. However, the application of these tools to characterize the physical output and the regulation of molecular motors in the context of their natural environment has been limited.



Our research group is interested in regulation and function of force generation by type IV pili and in the related DNA import machine *in vivo*. Type IV pili are major bacterial virulence factors supporting adhesion, surface motility and gene transfer. The polymeric pilus fiber is a highly dynamic molecular machine that switches between elongation and retraction.

We used laser tweezers to investigate the dynamics and force generation of individual pili of *Neisseria gonorrhoeae*. In particular, we have shown that the type IV pilus motor can switch between different modes in both speed and direction and that force tunes the probability of assuming the individual states. High force generation exceeding 100pN was a conserved property of pilus systems. Even during infection of epithelial host cells, high forces were detected. The type IV pilus is therefore an ideal model system for understanding generation of high molecular forces and their regulation *in vivo*.