Friedrich-Alexander-Universität
Erlangen-Nürnberg

Department für Physik

Physikalisches Kolloquium

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Controlling biological motors in living cells

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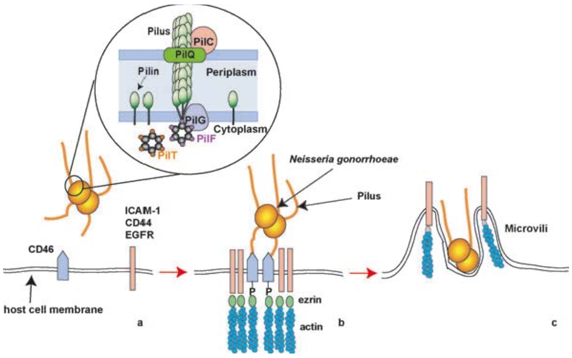

Biological molecular motors are the basic elements that generate directed movement in living cells. Nanotechnological tools enable the characterization of the physical output of individual molecular motors such as force generation, energy transduction, and directional switching. However, the application 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 *in vivo*. Type IV pili are major bacterial virulence factors supporting adhesion, surface motility and gene transfer. Using laser tweezers, we found that the polymeric pilus fiber of *Neisseria gonorrhoeae* is a highly dynamic molecular machine that switches between depolymerization and polymerization. The switching probability was controlled by mechanical force and genetic modifications of the pilus system. We studied the biological function of pilus control through external forces by investigating the translation of pilus dynamics into bacterial movement. We found that multiple pili were required for persistent movement. The unbinding force of individual pili from the surface (F < 30pN) was considerably lower than the stalling force (F > 100pN), suggesting that density, force, and adhesive properties of the pilus motor have evolved to enable a tug-of-war mechanism for bacterial movement. The type IV pilus is therefore an ideal model system for investigating the generation of high molecular forces and its function *in vivo*.

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