Mechanism and Control of Bacterial Motors

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Abstract:

Bacteria have developed surprisingly diverse cellular appendages for motility. Type IV pili are among the most ubiquitous extracellular organelles and they are generated by various bacterial species. Pili are multifunctional polymers supporting a multitude of functions including motility, adhesion and host cell interaction, biofilm formation, and horizontal gene transfer.
We have shown that individual type IV pili generate force exceeding 100pN and that high force generation is a conserved property of the type IV pilus system. We are currently trying to unravel the molecular mechanism of high force generation during pilus retraction and DNA import, using a combination of laser tweezers and genetic tools. Furthermore, we are addressing the question how multiple pili cooperate to generate directed movement. So far, we found that the directional correlation of bacterial movement increases with the average number of pili per cell and suggest a tug-of-war model for movement. Apart from trying to understand mechanistic questions, we can only speculate about the biological function of high force generation by pili. Using a laser tweezers based assay, we found that the force generated by multiple pili leads to rapid reorganization of the actin cytoskeleton in epithelial host cells. This finding adds mechanical force to the many strategies by which bacteria reprogram their host cells.

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