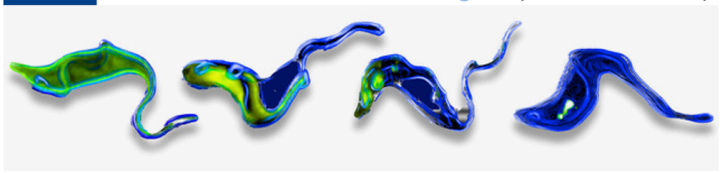

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Effects of flagellar elasticity and cell body constraints on E.coli motility

Many motile bacteria, such as Escherichia coli, swim by rotating multiple flagella. These semi- flexible helical filaments are independently actuated by flagellar motors randomly distributed on the surface of the cell body. When all the motors rotate in the same direction, within a fraction of a second, this complex elastohydrodynamic system transforms into a straight swimmer in which all the flagella form a tight bundle propelling the cell forward.
Underlying this bundling phenomenon there are several physical factors, most of which have been analysed in isolation using theoretical or macroscopic models.

Here we report a direct study of bundling dynamics [1] in bacterial cells whose flagellar motors can be switched on and off by light, while fluorescently labelled flagella are observed. Using optical tweezers and microfabrication to constrain cell body kinematics, we found that although translations are not essential for bundling, wobbling plays an important role in achieving a stable configuration of the bundle and body complex. We find that the curved shape of the hook, a flexible joint that transmits motor torque to flagella, strongly affects the vectorial nature of the exchanged torques and must be taken into account to correctly reproduce experimental observations.

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