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Quantifying gliding forces of filamentous cyanobacteria

Filamentous cyanobacteria are one of the oldest and today still most abundant lifeforms on earth, with manifold implications in ecology and economics. Their flexible filaments, often several hundred cells long, exhibit gliding motility in contact with solid surfaces. The underlying force generating mechanism is not yet understood. Here, we demonstrate that propulsion forces and friction coefficients are strongly coupled in the gliding motility of filamentous cyanobacteria. We directly measure their bending moduli using micropipette force sensors, and quantify propulsion and friction forces by analyzing their self-buckling behavior, complemented with analytical theory and simulations. The results indicate that slime extrusion unlikely generates the gliding forces, but support adhesion-based hypotheses, similar to the better-studied single-celled myxobacteria. The critical self-buckling lengths align well with the peaks of natural length distributions, indicating the importance of self-buckling for the organization of their collective in natural and artificial settings.

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