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Filament depolymerization can pull a chromosome during bacterial mitosis EDWARD BANIGAN, University of Pennsylvania, MICHAEL GELBART, Harvard University, ZEMER GITAI, Princeton University, ANDREA LIU, NED WINGREEN, Princeton University — Chromosome segregation is fundamental to all cells, but the force-generating mechanisms underlying chromosome translocation in bacteria remain mysterious. *Caulobacter crescentus* utilizes a depolymerization-driven process in which a ParA protein structure elongates from the new cell pole and binds to a ParB-decorated chromosome, and then retracts via disassembly, thus pulling the chromosome across the cell. This poses the question of how a depolymerizing structure can robustly pull the chromosome that is disassembling it. We perform Brownian dynamics simulations with a simple and physically consistent model of the ParABS system. The simulations suggest that the mechanism of translocation is "self-diffusiophoretic": by disassembling ParA, ParB generates a ParA concentration gradient so that the concentration of ParA is higher in front of the chromosome than behind it. Since the chromosome is attracted to ParA via ParB, it moves up the ParA gradient and across the cell. We find that translocation is controlled by the product of an effective relaxation time for the chromosome and the rate of ParA disassembly. Our results provide a physical explanation of the mechanism of depolymerization-driven translocation and suggest physical explanations for recent experimental observations.

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