Abstract Submitted
for the MAR10 Meeting of
The American Physical Society

Proposed Physical Mechanism of Chromosome Segregation in Caulobacter crescentus EDWARD BANIGAN, Dept. of Physics and Astronomy, University of Pennsylvania, MICHAEL GELBART, Dept. of Physics, Princeton University, ZEMER GITAI, Dept. of Molecular Biology, Princeton University, ANDREA LIU, Dept. of Physics and Astronomy, University of Pennsylvania, NED WINGREEN, Dept. of Molecular Biology, Princeton University — Chromosome segregation is a fundamental process for all cells, but the force-generating mechanisms that drive chromosome movements in bacteria are especially unclear. In Caulobacter crescentus, recent work has demonstrated that a structure made up of the ParA protein elongates from one cell pole and interacts with ParB, a protein binding to the chromosome near the origin of replication (ori). ParB disassembles ParA, causing ParA to pull ParB, and thus, the ori to the opposite end of the cell. We performed Brownian dynamics simulations of this system in order to uncover the physical mechanism of this motion. We find that motion of the ori is robust to several variations of the model as long as a steady-state concentration gradient of ParA is established in the moving frame of the ParB-decorated chromosome. We suggest that the mechanism is "self-diffusiophoretic": by disassembling ParA, ParB creates a concentration gradient of ParA so that the ParA concentration is higher in front of the chromosome than behind it. Since the chromosome is attracted to ParA via ParB, it moves up the gradient in the desired direction.

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Date submitted: 18 Dec 2009 Electronic form version 1.4