Abstract Submitted
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Directed and persistent movement arises from mechanochemistry of the ParA/ParB system LONGHUA HU, National Heart, Lung, and Blood Institute, National Institutes of Health, ANTHONY G. VECCHIARELLI, KIYOSHI MIZUUCHI, National Institute of Diabetes and Digestive and Kidney Diseases, National Institutes of Health, KEIR C. NEUMAN, JIAN LIU, National Heart, Lung, and Blood Institute, National Institutes of Health — The segregation of DNA prior to cell division is essential for faithful genetic inheritance. In many bacteria, segregation of the low-copy-number plasmids involves an active partition system composed of ParA ATPase and its stimulator protein ParB. Recent experiments suggest that ParA/ParB system motility is driven by a diffusion-ratchet mechanism in which ParB-coated plasmid both creates and follows a ParA gradient on the nucleoid surface. However, the detailed mechanism of ParA/ParB-mediated directed and persistent movement remains unknown. We develop a theoretical model describing ParA/ParB-mediated motility. We show that the ParA/ParB system can work as a Brownian ratchet, which effectively couples the ATPase-dependent cycling of ParA-nucleoid affinity to the motion of the ParB bound cargo. Paradoxically, the resulting processive motion relies on quenching diffusive plasmid motion through a large number of transient ParA/ParB-mediated tethers to the nucleoid surface. Our work sheds light on a new emergent phenomenon in which non-motor proteins work collectively via mechanochemical coupling to propel cargos — an ingenious solution shaped by evolution to cope with the lack of processive motor proteins in bacteria.

Longhua Hu
National Institutes of Health

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