



The Physics of Soft and Biological Matter

P.12 Short-time dynamics E. coli chromosomal loci reveal a dependence on coordinate and indicate the presence of a sporadic but ubiquitous super-diffusive motion

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In recent years, evidence has emerged that the bacterial chromosome possesses a remarkable level of spatial and temporal organization, and its structural changes are believed to have an important role in key cellular functions, such as regulating transcription.

Particle tracking of chromosomal loci is possible by constructing strains in which GFP adheres to a particular genomic site. This has been used by several labs over the last few years both as a technique to map out the “home position” of each genomic site within the cell body, and to study the fluctuation properties. It has become a key technique in the development of a correct physical model to capture the in vivo structure and functional organization.

Our analysis of chromosomal dynamics investigated the short time (0.1s-10s) regime, published in [1], showing a decrease in motility in loci near the terminus of replication. This chromosomal trend is maintained across different growth conditions and appears to be related with the positioning of Ter in mid-cell position during chromosomal replication.

In unpublished work, we have compared the observed foci behavior with a physical model of subdiffusive dynamics, and we have found a small subset of ubiquitous “rapid movements” that exhibit near ballistic dynamics. This suggests the presence of an active driving machinery, or stress relaxation mechanisms that are non-trivially coupled with chromosomal partitioning; in either case, non-thermal fluctuations are present in the chromosome.

Finally, we have studied the effect on chromosomal dynamics induced by that chemical perturbations and in knockout mutants lacking certain nucleoid associated proteins.

[1] Javer, et al. "Short-time movement of E. coli chromosomal loci depends on coordinate and subcellular localization." Nature communications 4 (2013)