

Modeling supercoiled DNA interacting with an anchored cluster of proteins: towards a quantitative estimation of chromosomal DNA supercoiling

DNA supercoiling, under or overwinding of DNA, is a key physical mechanism both participating to compaction of bacterial DNA and to the coordination of gene expression. Methods developed so far can only measure it in small plasmids. Thus the distribution of supercoiling along chromosomes remains poorly understood. Here we aim at solving this problem by confronting (i) the folding physical properties of a polymer model of supercoiled DNA at base pairs resolution with (ii) the ChIP-seq DNA binding profile of the protein ParB around its specific binding parS, which has been shown to be sensitive to DNA folding properties. Adjusting the supercoiling in the polymer simulations in order to reproduce quantitatively the experimental profile of ParB leads us to obtain an estimation of supercoiling on any DNA molecule.

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