

Charged membranes and their influence on supercoiled DNA conformations

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Abstract

We have adsorbed plasmid pUc19 DNA on a supported bilayer. By varying the fraction of cationic lipids in the membrane, we have tuned the surface charge. Plasmid conformations were imaged by Atomic Force Microscopy (AFM). We performed two sets of experiments: deposition from salt free solution on charged bilayers and deposition from salty solutions on neutral bilayers. Both sets show similar trends: at low surface charge density or low bulk salt concentration, internal electrostatic repulsion forces plasmids to adopt completely opened structures, while at high surface charge density or higher bulk salt concentration, usual supercoiled plectonemes are observed. We experimentally demonstrate the equivalence of surface screening by mobile interfacial charges and bulk screening from salt ions. At low to medium screening, the electrostatic repulsion at plasmid crossings is predominant, leading to a number of crossovers decreasing linearly with the characteristic screening length. We compare our data with an analytical 2D-equilibrated model developed recently for the system and extract the DNA effective charge density when strands are adsorbed at the surface.

