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Loops determine the mechanical properties of mitotic chromosomes[1] YANG ZHANG, DIETER W. HEERMANN, Institute for Theoretical Physics, Heidelberg University, Germany — In mitosis, chromosomes undergo a condensation into highly compacted, rod-like objects. Many models have been put forward for the higher-order organization of mitotic chromosomes including radial loop and hierarchical folding models. Additionally, mechanical properties of mitotic chromosomes under different conditions were measured. However, the internal organization of mitotic chromosomes still remains unclear. Here we present a polymer model for mitotic chromosomes and show how chromatin loops play a major role for their mechanical properties. The key assumption of the model is the ability of the chromatin fibre to dynamically form loops with the help of binding proteins. Our results show that looping leads to a tight compaction and significantly increases the bending rigidity of chromosomes. Moreover, our qualitative prediction of the force elongation behaviour is close to experimental findings. This indicates that the internal structure of mitotic chromosomes is based on self-organization of the chromatin fibre. We also demonstrate how number and size of loops have a strong influence on the mechanical properties. We suggest that changes in the mechanical characteristics of chromosomes can be explained by an altered internal loop structure.

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