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Structural Organization and Properties of DNA in the Cell

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The dynamical architecture of the cell nucleus can be regarded as one of the “grand challenges” of modern molecular and structural biophysics. The genomic DNA and the histone proteins compacting it into chromatin account for the major part of the contents of the nucleus. In my talk I will discuss the structural properties of the DNA from the 30nm fiber up the entire chromosome. For the 30nm range I present a model for the compactification and discuss the resulting phase diagram. I am going to reveal the fine-structure of the excluded-volume borderline. Furthermore, the effect of the Coulomb repulsion of the DNA linkers will be presented. Moving up further in the range (300-800nm), we will look at the entanglements of the polymer chain. On the level of the entire chromosome I will present a model for the chain that can successfully describe experimentally measured distance distributions on chromosome 1 in human cells using the notion of “ridge” regions (cluster of strongly expressed genes) and the “antiridge” regions.