MAR12-2011-000220

Abstract for an Invited Paper
for the MAR12 Meeting of
the American Physical Society

Territorial Polymers and Large Scale Genome Organization

ALEXANDER GROSBERG, New York University, Center for Soft Matter Research and Department of Physics

Chromatin fiber in interphase nucleus represents effectively a very long polymer packed in a restricted volume. Although polymer models of chromatin organization were considered, most of them disregard the fact that DNA has to stay not too entangled in order to function properly. One polymer model with no entanglements is the melt of unknotted unconcatenated rings. Extensive simulations indicate that rings in the melt at large length (monomer numbers) N approach the compact state, with gyration radius scaling as $N^{1/3}$, suggesting every ring being compact and segregated from the surrounding rings. The segregation is consistent with the known phenomenon of chromosome territories. Surface exponent β (describing the number of contacts between neighboring rings scaling as N^{β}) appears only slightly below unity, $\beta \approx 0.95$. This suggests that the loop factor (probability to meet for two monomers linear distance s apart) should decay as $s^{-\gamma}$, where $\gamma = 2 - \beta$ is slightly above one. The later result is consistent with HiC data on real human interphase chromosomes, and does not contradict to the older FISH data. The dynamics of rings in the melt indicates that the motion of one ring remains subdiffusive on the time scale well above the stress relaxation time.