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JOHANNES GUTENBERG UNIVERSITÄT MAINZ

Seminar über Theorie der kondensierten Materie / TRR146 Seminar

June 12, 2024 at 3:30 p.m.
Lorentz-Raum, 05-119, Staudingerweg 7

Apratim Chatterji
Prof

Entropic Organization of topologically modified ring-polymers in confinement

Under high cylindrical confinement, segments of ring polymers with internal loops can be made to
get localized along the long axis of the cylinder. The emergent organization of the polymer
segments occurs because of the entropic repulsion between internal loops which mutually exclude
each other position along the long axis of the cylinder [Phys.Rev.E, 106, 054502 (2022)].
We used these localization properties of segments in such topologically modified bead-spring
models of ring polymers to identify the underlying mechanism of the evolution of bacterial
chromosome organization as the cell goes through its life cycle [Soft Matter 18, 5615-5631 (2022)].
Here, we show how to modify ring polymer topology by creating internal loops of two different
sizes within the polymer, and thereby create an asymmetry in the two halves of the modified ring-
polymer. This allows us to strategically manipulate and harness entropic interactions between
adjacent polymers confined in a cylinder, such that a polymer prefers to orient itself in a specific

way with respect to its neighbours. Thus, we can induce entropy driven effective interactions
reminiscent of Ising-spin like interactions between adjacent topologically modified polymers. We
consider a completely flexible bead-spring model of polymers with only excluded volume
interactions between the monomers.
We extend the work to investigate the entropic organization of topologically modified ring-
polymers confined within a sphere. We observe that for a single topologically modified polymer
within a sphere, the monomers of the bigger loop are statistically probable to be found closer to the
periphery. However, the situation is reversed when we have multiple such topologically modified
polymers in a sphere. The monomers of the small loops are found closer to the walls of the sphere.
We can increase this effect by introducing a large number of small loops in each ring polymers.

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