Loop Closure Dynamics of Flexible and Semi-flexible Polymer

JEN-FANG CHANG, YENG-LONG CHEN, Academia Sinica, INST. OF PHYS., ACADEMIA SINICA TEAM, RCAS, ACADEMIA SINICA TEAM — It is widely believed that DNA looping due to multi-site DNA-binding proteins is important for DNA transcription, replication, and recombination. The chain closure problem has been studied in several Monte Carlo simulations to determine the chain closure probabilities and the chain conformation to infer dynamic properties. In this work, we investigate how the loop closure dynamics of flexible and semi-flexible polymers depend on the polymer length and the reactive site position using Brownian dynamics simulation, accounting for hydrodynamic interactions. Our study examines the probability of closing for two reactive sites along the chain and the shape of the loop formed by closing. In addition, intrachain hydrodynamic interactions are found to affect the diffusivity of circular chains compared to linear chains, in accord with experimental observations. We also consider the dynamics of chain closing under strong slit-like confinement as a function of slit height.