SFB TRR 102

Polymers under Multiple Constraints

Kolloquium

Thursday,

7th May 2015

at: **5.00 pm**

Hörsaal für Theoretische Physik
Linnéstr. 5
04103 Leipzig

Coffee will be served from 4.30 pm!

Prof. Dr. Sanjay Kumar

(Department of Physics, Banaras Hindu University
Varanasi 221 005, India)

DNA under force: New insights from simulations

Separation of a double stranded DNA (dsDNA) is prerequisite for the essential cellular processes, such as, replication and transcription. It is now well known that DNA is stabilized by inter- and intra- molecular interactions. Single Molecular Force Spectroscopy (SMFS) techniques, e.g. optical tweezers, magnetic tweezers and atomic force microscopy, have emerged as powerful tools to investigate these interactions. These experiments have provided various insights and understanding of biological processes at the molecular level. Moreover, experiments which explored the functioning of these interactions revealed that not only the magnitude of the force is important, but the nature of force, how and where force is applied, is also important in the understanding of the biological processes. In the first half of the talk, I will develop a simple model of DNA and use Langevin Dynamics simulations to describe the equilibrium aspect of DNA separation. Later, I will discuss non-equilibrium aspects of DNA separation and propose dynamical transition, where without changing the physiological condition, it is possible to bring DNA from the zipped or unzipped state to a new dynamic (hysteretic) state by varying the frequency of the applied force. Our studies reveal that the area of the hysteresis loop grows with the same exponents as of the isotropic spin systems. These exponents are amenable to verification in the force spectroscopic experiments.

Ref.:

1. Dynamical phase transition of a periodically driven DNA, G. Mishra, P. Sadhukhan, S. M. Bhattacharjee, and S. Kumar, Phys. Rev. E 87, 022718 (2013)
2. Statistical Mechanics of DNA Unzipping under Periodic Force: Scaling Behavior of Hysteresis Loops, S. Kumar and G. Mishra, Phys. Rev. Lett. 110, 258102 (2013)
3. Scaling of hysteresis loop of interacting polymers under a periodic force, R. K. Mishra, G. Mishra, D. Giri, and S. Kumar, J. Chem. Phys. 138, 244905 (2013)