S N BOSE NATIONAL CENTRE
FOR BASIC SCIENCES
Block JD, Sector III, Salt Lake, Kolkata 700 106

DEPARTMENTAL SEMINAR

Physics of Complex Systems

15th January, 2024 **4.00 PM** **ONLINE / FERMION**

SPEAKER

Dr. Pranay Mandal,
Postdoc, Max-Planck Institute of Molecular Cell Biology and Genetics

TITLE OF THE TALK

Dynamics of Helix at Nanoscale: From Active Matter to DNA Protection

ABSTRACT

There has been a surge of interest in recent years to design and fabricate various types of motile micro/nanoparticles that can be maneuvered using chemical, optical, thermal, electrical or magnetic energy sources. A collection of such motile particles can be used as a model system to study various active matter phenomena, which can answer fundamental questions related to non-equilibrium statistical physics. Of all types of actuation techniques, magnetic actuation deserves special mention owing to its non-invasive and non-chemical nature. However, designing magnetically actuated active matter system is not a trivial task. In the first half of my talk, I will discuss how to design a helical structured, magnetically actuated, active matter system.

In the second half of my talk, I will discuss how protein components of the nuclear envelope organise DNA to increase its mechanical stability to withstand forces that would otherwise damage double-stranded DNA. We use a bottom-up reconstitution approach coupled with optical tweezer experiments, theoretical physics and cell biology to investigate how the chromatin cross-bridging factor BAF, the inner nuclear membrane protein LEM2 and DNA self-organize. Our data point to a mechanism where BAF-LEM2 organize DNA into regular loops and further jointly compact into large fluid-like dna-protein co-condensates. As a result, DNA is mechanically protected in couple of ways: Firstly, DNA respond to increasing external forces with increased compaction forces, suggesting that the protein-bound DNA molecule is mechanically stabilized. Secondly, forces with the potential to damage DNA percolate through the co-condensate, reducing the mechanical stress on individual DNA strands. Our study quantitatively describes a conserved and previously unknown molecular mechanism by which cells use the nuclear envelope proteins as a self-assembling buffer against spontaneously occurring mechanical stress to protect DNA from damage, suggesting a first preventive mechanism that adds to the cell's ability to repair DNA damage or responsively change chromatin properties.

HOST FACULTY

Prof. Punyabrata Pradhan,
Professor, Dept. of Physics of Complex Systems

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