Special Colloquium

Dr. Edward Banigan

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Emergent length scales of the cell nucleus

Monday, February 20, 2017

4:00 pm—5:15 pm

145 Goodwin Hall

The interiors of living cells are highly organized, and this internal order is critical to robust cell biological function. However, it is not well understood how few-nanometer-sized proteins dynamically generate spatiotemporal order over length scales spanning several nanometers to tens of microns. The cell nucleus and the genome contained within exemplify this problem: the same ~1 meter of DNA is packed into each ~10 micron cell nucleus, and yet, different cells differ dramatically in function and activity. Thus, biological function is largely governed by genome organization, and it is critical to establish biophysical mechanisms for measuring length in the nucleus. I will discuss several models for DNA on different length scales that reveal different physical mechanisms underlying intracellular organization. Specifically, I will discuss experimentally motivated models for non-equilibrium DNA twist dynamics, spatial partitioning of catalytic macromolecules, and whole nuclear deformation. These models show how DNA mechanics, biomolecule diffusion and catalytic activity, and nuclear geometry and architecture each determine distinct lengths for cellular phenomena on multiple scales. Together, these models illustrate how mechanical and biochemical effects at small scales may be integrated to lead to emergent phenomena that control cell nuclear and genome organization.