PHYSICS COLLOQUIUM

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REFRESHMENTS AT 3:45PM

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ACTIVE CONTRACTION OR EXPANSION OF DISORDERED CYTOSKELETAL NETWORKS

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The cytoskeleton drives many essential processes in vivo, but for this, the system of filaments will arrange itself into different overall spatial organizations, e.g., random, branched networks, parallel bundles, antiparallel arrays, etc. A general objective of our research is to understand what makes these architectures adapted to their tasks. In this talk, I will first focus on 2D disorganized actin networks in which the filaments are oriented randomly and connected both by active molecular motors and passive crosslinkers. Systems with these properties have been reconstituted *in vitro*, and serve as a model of the cortical actomyosin networks that drive morphogenesis in animal tissues, or cytokinesis during cell division. Although the network components and their properties are known, the requirements for contractility are still poorly understood. I will describe a theory that predicts whether an isotropic network would contract, expand, or conserve its dimensions, depending on the properties of the filaments and the elements that connect them. This simple theory encompasses mechanisms of contractions previously proposed and predicts how the contraction rate depends for example on the ratio of motors to crosslinkers.

François Nedelec *was trained in physics and applied math and obtained his PhD in 1998 from Paris University. He led a group at the European Molecular Biology Laboratory studying the role of the cytoskeleton in Cell and Developmental Biology. To analyze cytoskeletal systems following synthetic and systems biology approaches his group has developed bio-physical and quantitative analysis methods, with a strong theory component. It established cytosim, an Open Source computer simulation platform (http://www.github.com/nedelec/cytosim) that can simulate the interactions of thousands of filaments with millions of associated proteins such as molecular motors according to the laws of mechanics and stochastic reaction-kinetics. Cytosim was applied to various problems involving actin or microtubules networks, and was also used to guide the development of analytical theory.*