Abstract Submitted
for the MAR11 Meeting of
The American Physical Society

Non-Equilibrium Dynamics of the Metaphase Spindle DANIEL NEEDLEMAN, JAN BRUGUES, Harvard University — A wide variety of cellular structures exist in a nonequilibrium steady-state with a constant flux of molecules and energy continuously modifying and maintaining their architecture. Understanding such self-organizing structures is not only crucial for cell biology, but also poses a fundamental challenge for physics, since these systems are materials that behave drastically differently from those that have been traditionally studied in condensed matter physics. Physical theories of active materials have been used to describe the cytoskeleton, but it is still unclear how applicable these theories are to complex biological systems *in vivo*. We are experimentally testing if such phenomenological theories of cytoskeletal behavior can be profitably used to model the metaphase spindle. Our approach is to use polarized light microscopy, spinning disk fluorescence microscopy, single molecule imaging, and magnetic tweezers to quantitatively measure spatial-temporal correlation functions of spontaneous fluctuations in the director, concentration, and internal stress in spindles. We are comparing these measurements with predictions from various continuum theories to determine how best to describe the non-equilibrium dynamics of these structures.

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Date submitted: 18 Nov 2010 Electronic form version 1.4