The University *of* Western Ontario

Faculty of Science

Department of Applied Mathematics

APPLIED MATHEMATICS COLLOQUIUM

Date: Thursday, June 12, 2008

Time: 1:30 pm

Location: Physics & Astronomy Building Room 215

Strain Hardening, Avalanches and Strain Softening in Dense Cross-linked Actin Networks

Prof. Sunil P.B. Kumar

Dept. of Physics

Indian Institute of Technology Madras

Abstract:

Biological cells have an amazing capacity to change their shape and to adjust to a variety of external conditions. The dynamical structural organization needed for this is believed to be facilitated by a mesh- like structure formed of protein filaments, active and passive cross- linkers and a chemical network that is able to control the amount of cross-linking. Actin filaments are one of the major constituents of this network. Actin filament networks enable the cytoskeleton to adjust to internal and external forcing. These active networks can adapt to changes by dynamically adjusting their cross-links. Here, we model actin filaments as elastic fibers of finite dimensions. We employ a full three-dimensional model to study the elastic properties of actin networks by computer simulations. We model a dense actin network with the cross-links being approximately lÎ¼m apart. The results show compelling evidence that dense actin networks, are characterized by (a) strain hardening without entropic elasticity, (b) avalanches of cross-link slippage and destruction.

When fully dynamics cross links are introduced, to simulate motors that can move along the filaments, we find that for clamped boundaries the network undergoes a transition from a fragmented structure and aster formation to a connected structure which can maintain a static contraction strain.