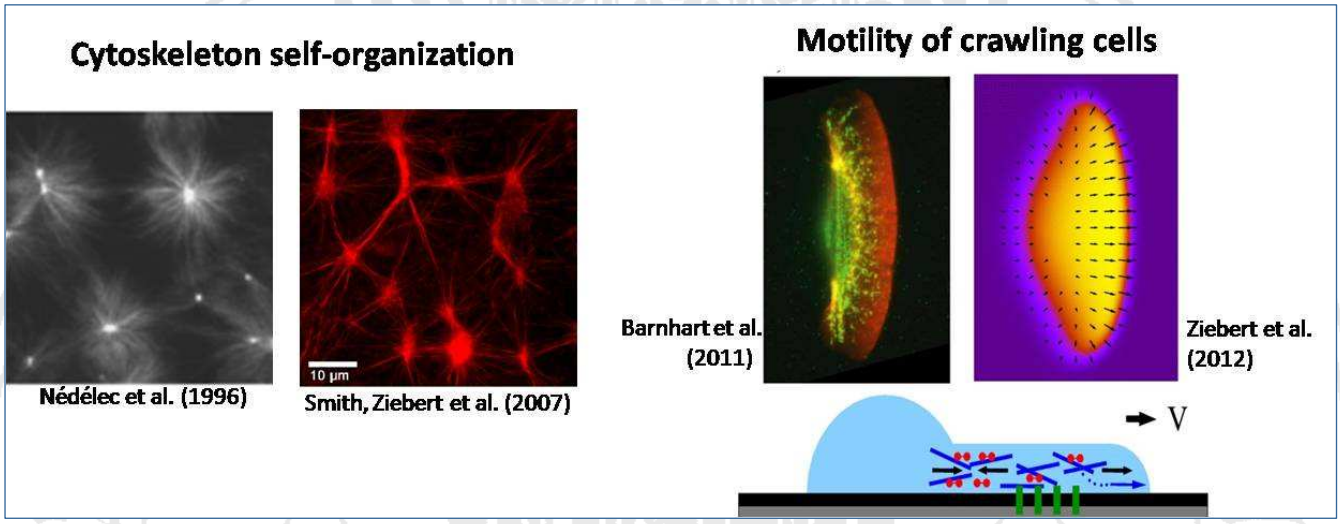
PHYSIKALISCHES KOLLOQUIUM

AM 15. APRIL 2013 UM 17 UHR C.T.

IM GROßEN HÖRSAAL



THE CYTOSKELETON AND CELLULAR MOTION – COMPLEX SYSTEMS OUT-OF-EQUILIBRIUM

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The cytoskeleton is constituted of rigid biofilaments, actin and microtubules. As a biological, living system it is maintained in an out-of-equilibrium state: both the polymerization of the filaments and the action of molecular motors - introducing filament sliding, local contractions and active reorganization - are driven by chemical energy delivered by the cell's metabolism. The out-of-equilibrium nature of the cytoskeleton is crucial for its functions in cell mechanics and response, cell division, intracellular transport and cell motility. I will discuss two main effects: self-organized structure formation and cell motility.

Concerning self-organization, experimentally it has been shown (see figure on the left) that reconstituted cytoskeleton solutions are able to self-organize into many different filament patterns like star-like asters, vortex patterns, networks and bundles. I will discuss recent modeling of this structure formation process involving filaments, active motors and passive crosslinks.

In the second part I will present a simple model describing how cells (or simpler cell fragments) can use active processes, namely actin polymerization and motor-induced contraction, to move on a substrate (see figure on the right). This model successfully reproduces the primary phenomenology of cell motility like discontinuous onset of motion and a diversity of cell shapes. In addition, if adhesion and substrate deformation is taken into account, stick-slip cell motion and motion on patterned substrates can be discussed in this framework.