PHYSICAL MATHEMATICS SEMINAR

The origin of solidity and fluidity in cellular materials and biological tissues

DAPENG "Max" BI

Northeastern University

ABSTRACT:

Models for confluent biological tissues often describe the network formed by cells as a triple-junction network, similar to foams. However, higher order vertices or multicellular rosettes exist prevalently in developmental and in vitro processes and have been recognized as crucial in many important aspects of development, disease and physiology. In this work, we study the influence of rosettes on the mechanics of a confluent tissue. We find that the existence of rosettes in a tissue can greatly influence its rigidity. Using a generalized vertex model and effective medium theory we find a fluid-to-solid transition driven by rosette density and intracellular tensions. This phase transition exhibits several hallmarks of a second-order phase transition such as a growing correlation length and a universal critical scaling in the vicinity a critical point. Further, we elucidate the nature of rigidity transitions in dense tissues using a generalized Maxwell constraint counting to answer a long-standing puzzle of the origin of solidity in cellular materials.

TUESDAY, NOVEMBER 6, 2018
2:30 pm
Building 2, Room 136

Reception following in Building 2, Room 290
(Math Dept. Common Room)

http://math.mit.edu/seminars/pms/

Massachusetts Institute of Technology