PHYSICS COLLOQUIUM:
Physics of living matter: from molecule to embryo

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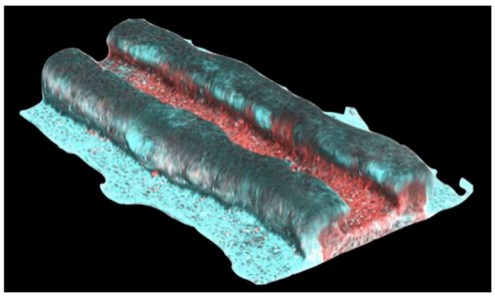
Date:
2/10/2023

Time:
10:30 AM - 11:50 AM

Location:
Granite Pass 135

About The Speaker:

I did my PhD with Lars Hufnagel at EMBL - working on "Biophysical aspects of growth and dynamics in epithelial tissues". Mainly growth control by mechanics in MDCK, and some theoretical predictive models of lateral line migration in zebrafish. For my postdoc I worked at the Kavli Institute for Theoretical Physics at UCSB, where I established methods for quantitative analysis of morphogenesis. This was done in collaboration with Eric Wieschaus' lab in Princeton, who kindly provided us with flies, expertise, and patience. We have an eLife article, in which we claim that flow during germband extension can be quantitatively described rom patterning and anisotropy of myosin motors only. As of late 2017, I changed buildings in UCSB, moved to the physics department, and started addressing questions about how DNA encodes 3d shape shifting form, drawing on inspiration in animals (mainly Drosophila, but also some projects on Parhyale), and aiming to see how far one can take cell culture in mimicking some aspects of morphogenesis. All of this happens in a tight interplay with theory and experiment, incubating biologists, with physicists in the same environment.



Abstract:

Organ architecture is often composed of multiple concentric tissue layers. Morphogenesis folds these organs into a specific shape that is required for proper function. Genetic signals that determine cell fate have been uncovered - yet the dynamic interplay of tissue layers giving rise to specific form remains elusive. We combine multi-layer analysis of cellular dynamics on evolving surfaces with physical modeling to obtain testable quantitative descriptions of how genetic patterning controls physics giving rise to shape. I will discuss two examples: (I) Quantitative analysis of visceral organogenesis in D. melanogaster reveals how a hox code in the mesoderm triggers a dynamic molecular mechanism to control physical processes in the adjacent endoderm layer. (II) A chip-based culture system enables self-organization of micro patterned stem cells into precise three-dimensional cell-fate patterns and form. This system recreates aspects of neural tube folding, and indic ates basal interactions between non-neural and neural ectoderm are required for tube closure.

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