PHYSICAL MATH SEMINAR

Mechanical canalization of chiral morphogenesis

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ABSTRACT:

A developing embryo reliably builds the same intricate body plan, time after time, from thousands of noisy, heterogeneous cells driven by stochastic molecular signals and mechanical forces. How internal organs such as the gut break left-right symmetry with a reproducible handedness remains unclear. I will present results of a theory-experiment collaboration to understand the mechanisms of the reproducible coiling of the fruit fly midgut, in which mechanics and geometry play a starring role. We find that an initial constriction phase bias the initial symmetry breaking, with handedness determined by an inter-organ relay of molecular cues. Organ elongation under anatomical confinement then drives a controlled buckling instability, both amplifying and stabilizing coiling geometry. These results point to a 'mechanical Waddington landscape', in which molecular inputs bias the organ towards one of two chiral outcomes that are then canalized by mechanical constraints. More broadly, these findings suggest that tissue-scale mechanics can serve as a source of developmental robustness and thus help make anatomy reproducible.

Tuesday, October 13, 2026

2:30 PM – 3:30 PM

Building 2, Room 449

MIT MATHEMATICS

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