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MECHANOCHEMICAL PATTERNING: A NEW STRAIN-MORPHOGEN PDE MODELING FRAMEWORK

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ABSTRACT

In this talk, I present a new mechanochemical framework for morphogenesis in regenerating epithelia, providing mechanistic insight into how physical forces and biochemical signalling interact to control pattern formation in living tissues. Focusing on Hydra morphogenesis, the model couples morphogen dynamics with tissue mechanics through a positive feedback loop: mechanical stretching promotes morphogen production, while morphogen concentration regulates tissue elasticity. Through bifurcation and stability analysis, we explain symmetry breaking and the emergence of single-peaked patterns without invoking a second diffusible inhibitor. This mechanochemical model is further contrasted with classical pattern formation theory, demonstrating how mechanical feedback offers an alternative mechanism for long-range inhibition. Theoretical predictions are supported by experimental validation.