

Seminar

Beyond Cell Shape: Dissipation and Collective Dynamics in Epithelial Tissues

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How do interactions among individual cells determine the fluidity of a cell collective or tissue? This fundamental question lies at the intersection of statistical physics, soft matter, and cell biology and is relevant to dynamic processes such as embryonic development, wound healing, and cancer invasion.

In this seminar, I will discuss our recent *in vitro* experiments investigating the physical origin of tissue fluidity. Vertex models provide a widely used theoretical description in which the solid-fluid behaviour of confluent tissues is closely associated with cell geometry, particularly the cell shape index. We experimentally perturb cell-cell adhesion and find that epithelial monolayers become substantially more fluid even though their average cell shape index remains nearly unchanged. Remarkably, this fluidisation also occurs without significant changes in cell number density, cell-substrate traction, or junctional line tension. These observations indicate that cell geometry alone is insufficient to describe the mechanical state of the tissue.

Motivated by these results, we introduce an extended vertex-model framework in which cell-cell adhesion influences tissue dynamics through both interfacial energy and dissipative resistance associated with junctional remodelling during relative motion between neighbouring cells. The model quantitatively reproduces the experimentally observed shape-independent fluidisation and identifies junctional dissipation as an additional control parameter for tissue mobility. These results suggest a broader picture in which tissue fluidity emerges from the interplay between geometry and dissipation, providing a new route for understanding collective dynamics in living active matter.

Tuesday, Sep 22nd 2026

16:00 Hrs (Tea / Coffee 15:45 Hrs)

Seminar Hall, TIFRH