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ENS Biophysics Seminar

Mardi 2 Décembre 2025, 11 :30
LPENS, L378
Domaines : physics.bio-ph

Titre : *Oriented flows in multi-cellular systems*

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Résumé : *A key morphogenetic process during animal development is convergent extension (CE). From a physics perspective, tissues undergoing CE can be described as oriented active materials. However, active matter physics predicts that such materials are inherently unstable, raising the question of how CE can be robust during development. We show that the presence of a signaling gradient can stabilize CE, but only if it acts to actively extend the tissue along the gradient direction. Conversely, tissues are unstable if they tend to actively contract along the gradient direction. Intriguingly, developing tissues seem to exclusively use the gradient-extensile and not the unstable gradient-contractile coupling. This suggests that the active matter instability acts as an evolutionary selection criterion. In other words, our work points to a new principle of multi-cellular development that is directly rooted in active matter physics. We further discuss oriented flows in the context of body axis formation. Most animals display one or more body axes (e.g. head-to-tail, dorsal-ventral, left- right). In our work, we demonstrate that the formation of the primary, head-to- tail, axis can be promoted by large-scale tissue flows. Specifically, we study aggregates of mouse embryonic stem cells, called gastruloids, which are initially spherically symmetric, but later form an axis defined by the polarized expression of the transcription factor T/Brachyury. We show that advection of cells with tissue flows contribute substantially to the overall polarization, and that these flows are driven by effective interface and surface tension differences.*