BDR SEMINAR (Kobe/online hybrid)

Mechanobiology Seminar Series presents

Pamela Guruciaga

Cell Biology and Biophysics Unit, European Molecular Biology Laboratory

Friday, August 4, 2023

11:00-12:00

5F Seminar Room (C501), DB Building A, Kobe / Broadcast online via Zoom

Zoom meeting URL will be announced on the event day by e-mail.

※This seminar is open only to BDR members.

Boundary curvature drives polar order in mouse epiblast morphogenesis

Summary

Many morphogenetic processes depend on the geometry of tissue-ECM or tissue-tissue boundaries, which often undergo dynamic shape changes themselves. We address this complex interaction in the context of polar ordering during epithelial development. Motivated by observations of an interplay between apico-basal polarity and boundary geometry in mouse embryo morphogenesis, we develop a theory for epithelial ordering based on the Landau-de Gennes approach to surface-induced alignment in liquid crystals. We introduce a vector order parameter to represent the polarity, and model its interaction with the boundaries by a weak anchoring energy. We calculate the corresponding alignment fields for different values of the parameters and boundary curvature, and identify two transitions where topological defects appear out of a uniform field, or change their structure in a non-trivial way. These defects represent regions where the apical sides of the cells meet; we therefore hypothesize that changes in defect position and structure are relevant to lumen formation in the biological system. Preliminary observations indeed indicate that lumen initialization sites in the mouse epiblast change with curvature as predicted. Furthermore, we determine the preferred tissue shape in terms of the parameters, study their lowest-energy field configurations, and compare our theoretical predictions with imaging data of the morphogenetic process for wild-type and genetically perturbed mouse embryos in which the surrounding structures have been altered. Our work highlights the role of extra-embryonic tissue in embryogenesis, while identifying interesting physical phenomena such as boundary-dependent transitions in the structure of topological defects.

Host: Yu-Chiun Wang

Laboratory for Epithelial Morphogenesis, BDR

Contact: yu-chiun.wang@riken.jp

BDR

RIKEN Center for Biosystems Dynamics Research (BDR)