Internship Proposal

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Project Title:
How do epithelial cells balance internal forces – a super-resolution approach

Level:

Master Student

Project Summary:

During development, epithelia are subjected to mechanical forces, which contribute to elongate and fold them into their final shape [1, 2]. However, mechanical forces can also challenge epithelia, deform them and even disrupt their normal organization – a hallmark of disease. This project aims to understand how epithelia protect their shape and integrity by preventing or responding to disruptive forces.

In our recent work, we uncovered that proliferative epithelia have to balance mechanical forces in order to ensure tissue cohesion. By applying new optogenetic tools in Drosophila, we increased contractility and directly observed that this causes the tissue to rupture within minutes [3]. These findings reveal that while contractile forces are important to shape epithelia, excessive contractility can be detrimental. During this internship, we will address how epithelia balance apical contractility to maintain cohesion and epithelial architecture.

Work to be developed by the student:

To address this question, we aim to implement genetic and optogenetic tools to manipulate contractility in the adult Drosophila follicular epithelium. We will use these tools to address how epithelial cells respond to changes in contractility in their neighbours. Furthermore, we will characterize the contractile behavior of epithelial cells with live imaging and study the apical actomyosin network with unprecedented spatial detail using super-resolution STED microscopy. Alltogether, the proposed work will contribute to understand how epithelial cells regulate apical contractility to preserve the integrity and architecture of proliferative tissues.

References:

[1] Heisenberg, C.-P., & Bellaiche, Y. (2013). Forces in tissue morphogenesis and patterning. Cell, 153(5), 948–962. http://doi.org/10.1016/j.cell.2013.05.008

[2] Paci, G., & Mao, Y. (2021). Forced into shape: Mechanical forces in Drosophila

development and homeostasis. Seminars in Cell & Developmental Biology, 120, 160–170. http://doi.org/10.1016/j.semcdb.2021.05.026

[3] Osswald, M., Barros-Carvalho, A., Carmo, A. M., Loyer, N., Gracio, P. C., Sunkel, C. E., et al. (2022). aPKC regulates apical constriction to prevent tissue rupture in the Drosophila follicular epithelium. Current Biology, 32(20), 4411–4427.e8. http://doi.org/10.1016/j.cub.2022.08.063

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