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Cell polarity is fundamental to the development of multi-cellular organisms, playing a central role in proliferation, cell fate diversification and tissue homeostasis or morphogenesis. The mechanisms controlling cell polarization are conserved, and the *Drosophila* fruit fly model has played a leading role in helping our understanding of the mechanisms controlling cell polarization during development.

Our interdisciplinary research group, composed of biologists and physicists, studies the development of epithelial tissue and the specification of distinct cell fates upon asymmetric cell division in *Drosophila*. Our work on asymmetric cell division has unravelled mechanisms regulating cortical cell polarity and mitotic spindle orientation. This work has also provided an experimental and conceptual foundation with which to study epithelial tissue development. In the next five years, we aim to extend our study of epithelial tissue, using the following approaches:

1. *Modulating cell polarization at the subcellular level.* To complement the panoply of Drosophila genetic tools, we aim to manipulate cell polarity at the sub-cellular level and in a temporally control manner. To this end we will implement optogenetic control of polarization to finely modify cell polarization and therefore decipher its role in cell shape and organization.

2. *Dissecting the molecular pathways controlling epithelial polarization*. We are coupling genetic tools to state of the art time-lapse microscopy to dissect the mechanisms of cortical cell polarization and mitotic spindle orientation. Our expertise allows us to tackle two central questions in the field of epithelial tissue: how is the mitotic spindle oriented in epithelial tissue? And how is cell polarity maintained and transmitted through cell division?

3. *Linking the cellular scale to the tissue scale.* To integrate our knowledge of the role of cell

polarization and mitotic spindle orientation from the cell level to the tissue level, we are implementing physical methodologies to provide a quantitative readout of how the regulation of cell shape, of cell division orientation and of cell movement impact on the morphogenesis and homeostasis of an epithelial tissue.

Using both conventional and innovative methodologies, our goals over the next years are to better understand how molecules and protein complexes are moved and activated at different locations within the cell and how cell polarization impacts on epithelial tissue growth and morphogenesis. The work will rely to a great extent on the interdisciplinary nature of the team. Furthermore this interdisciplinarity underlies our long-term perspective to integrate gene regulation and cell mechanics in order to understand tissue development. Since the mechanisms underlying cell polarization are conserved throughout evolution, the findings should improve our understanding of these processes not only in *Drosophila*, but in all animals**.**

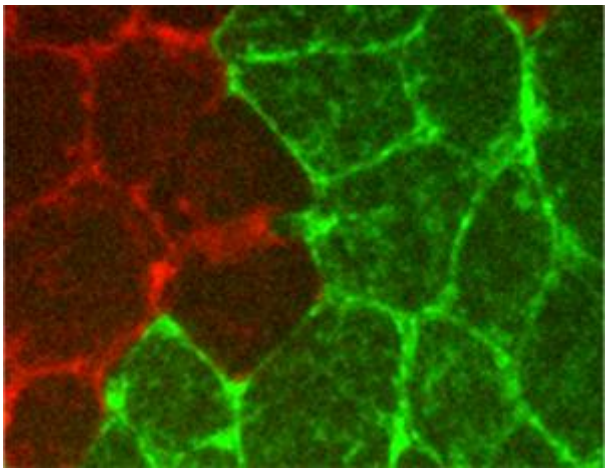

figure 1 : Cytokinesis of an epithelial cell (Herszterg et al., Dev Cell 2013)

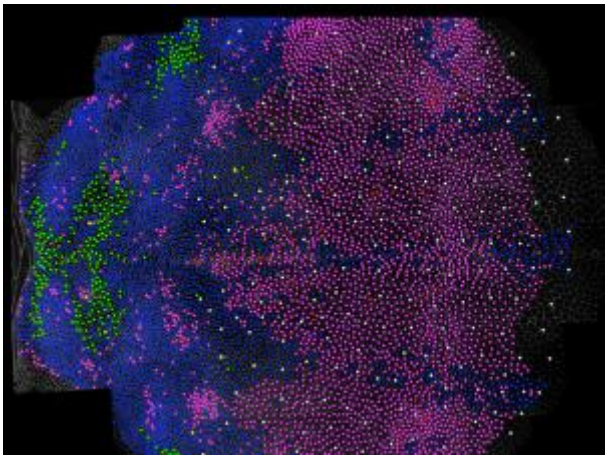

figure 2 : Proliferation in the epithelium of the dorsal thorax (Bosveled et al., Science 2012).

Key publications

Year of publication 2017

Diana Pinheiro, Edouard Hannezo, Sophie Herszterg, Floris Bosveld, Isabelle Gaugue, Maria Balakireva, Zhimin Wang, Inês Cristo, Stéphane U Rigaud, Olga Markova, Yohanns Bellaïche (2017 Mar 16)
Transmission of cytokinesis forces via E-cadherin dilution and actomyosin flows.
Nature : DOI : 10.1038/nature22041

Year of publication 2016

Floris Bosveld, Olga Markova, Boris Guirao, Charlotte Martin, Zhimin Wang, Anaëlle Pierre, Maria Balakireva, Isabelle Gaugue, Anna Ainslie, Nicolas Christophorou, David K Lubensky, Nicolas Minc, Yohanns Bellaïche (2016 Feb 18)
Epithelial tricellular junctions act as interphase cell shape sensors to orient mitosis.
Nature : 495-8 : DOI : 10.1038/nature16970

Year of publication 2015

Boris Guirao, Stéphane U Rigaud, Floris Bosveld, Anaïs Bailles, Jesús López-Gay, Shuji Ishihara, Kaoru Sugimura, François Graner, Yohanns Bellaïche (2015 Dec 15)
Unified quantitative characterization of epithelial tissue development.
eLife : DOI : 10.7554/eLife.08519

Floris Bosveld, Boris Guirao, Zhimin Wang, Mathieu Rivière, Isabelle Bonnet, François Graner, Yohanns Bellaïche (2015 Jul 5)
Modulation of junction tension by tumor suppressors and proto-oncogenes regulates cell-cell contacts.
Development (Cambridge, England) : 623-34 : DOI : 10.1242/dev.127993

Year of publication 2013

Pierre-Luc Bardet, Boris Guirao, Camille Paoletti, Fanny Serman, Valentine Léopold, Floris Bosveld, Yûki Goya, Vincent Mirouse, François Graner, Yohanns Bellaïche (2013 May 28)
PTEN controls junction lengthening and stability during cell rearrangement in epithelial tissue.
Developmental cell : 534-46 : DOI : 10.1016/j.devcel.2013.04.020

Sophie Herszterg, Andrea Leibfried, Floris Bosveld, Charlotte Martin, Yohanns Bellaiche (2013 Feb 16)
Interplay between the dividing cell and its neighbors regulates adherens junction formation during cytokinesis in epithelial tissue.
Developmental cell : 256-70 : DOI : 10.1016/j.devcel.2012.11.019