Contribution ID : **11** Type : **Postdoc talk**

Patterning the vertebrate retina: How random cell behavior gives rise to an orderly structure

Tuesday, 12 June 2018 09:35 (10)

In the retina, like in most other brain regions, different neuron types are precisely arranged into distinct layers giving the tissue its stratified pattern. Such spatial patterning needs to be highly controlled and orchestrated, as its disorganization leads to impaired retinal function. Yet, how retinal neuron pattern formation emerges remains largely unknown. To understand this, we use the zebrafish retina as a model and study emergence of Horizontal Cell (HC) patterning. Using light-sheet microscopy imaging, we extracted single cell behavior of HCs in the developing retina and found that HC migration patterns, cell-cycle and division kinetics are not stereotypic. Moreover, our preliminary data showed that HCs send dynamic apical protrusions before migrating apically. This argues that HCs might actively sense and respond to environmental cues and do not exclusively follow intrinsically imprinted migration patterns. To examine this possibility, using a combination of genetic interference and enzymatic digestion assays, we are currently examining how changes in the overall retinal architecture could influence emergence of HC patterning. Together, this work will contribute to our understanding of how well-defined forms and patterns within tissues emerge from cell-tissue interactions during development.

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Session Classification : Session IV