DYNAMICS OF CELL STATE TRANSITIONS – THEORY & SINGLE-CELL TRANSCRIPTOMICS

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The ‘cell state’ can be operationally defined by the configuration of activities of all gene loci in the genome and is approximately measured by the transcriptome. Since gene loci interact, transcriptomes change in a highly constraint manner (only certain configurations are possible), generating the characteristic dynamics of cell states: existence of stable attractors (which map to ‘cell types’) and instabilities. The ensuing phenotype plasticity is essential in development. But it is also at the core of tumor progression, where new phenotypes are still explained by genetic mutations while non-genetic plasticity is ignored [1]. Enters single-cell transcriptomics which affords the capacity to measure the state of individual cells in a population traditionally thought to be uniform, and to explore cell states dynamics predicted by theory: attractor dynamics and critical transitions with macroscopic consequences [2]. This talk deviates from the conference topic ‘CELL PHYSICS’, where ‘physics’ refers to the material aspect of cells, but suits the Collaborative Research Center’s focus around “non-equilibrium processes in biological systems”. After an introduction to theoretical principles of cell state dynamics that shall be of general utility, I will present experimental data on critical transitions in development and cancer and associated counterintuitive phenomena.

[1] Brock, A. & Huang, S. *Cancer Res* 77, 6473-647 (2017)
[2] Mojtahedi,M., et. al. (2016). *PLoS Biol* 14, e2000640 (2016)