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**Axis Specification in Hydra**

ALBRECHT OTT, Universitaet des Saarlandes

Hydra is an about cm sized polyp of roughly $10^5$ cells exhibiting surprising robustness: it can regenerate even from a random cell aggregate made from its own cells. During such a reorganization, hydra first forms a hollow cell sphere. We show that even a weak temperature gradient directs the axis of the regenerating animal – but only if it is applied during the symmetry-breaking moment. We observe that the spatial distribution across the cell sphere of the early expressed, head-specific gene ks1 has become scale-free and fractal at that point. We suggest that in order to break the symmetry and define an axis during the regeneration process, the cell network organizes towards a state, that is characterized by an unusually high sensitivity to external perturbation as well as spatially self-similar gene expression patterns. The observed behavior arises naturally from next-neighbor cell communication, when long-range signaling as required for axis definition is achieved through increased synchronization of expression profiles. Numerical results in progress show that our observations can be robustly reproduced with avalanches of gene expression patterns generated from gene switching above a stimulation threshold.