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Morphogenesis at criticality? DMITRY KROTOV, Joseph Henry Laboratories of Physics, Lewis-Sigler Institute for Integrative Genomics, Princeton University, JULIEN DUBUIS, Joseph Henry Laboratories of Physics, Lewis-Sigler Institute for Integrative Genomics, Howard Hughes Medical Institute, Princeton University, THOMAS GREGOR, WILLIAM BIALEK, Joseph Henry Laboratories of Physics, Lewis-Sigler Institute for Integrative Genomics, Princeton University — Spatial patterns in the early fruit fly embryo emerge from a network of interactions among transcription factors, the gap genes, driven by maternal inputs. Such networks can exhibit many qualitatively different behaviors, separated by critical surfaces. At criticality, we should observe strong correlations in the fluctuations of different genes around their mean expression levels, a slowing of the dynamics along some but not all directions in the space of possible expression levels, correlations of expression fluctuations over long distances in the embryo, and departures from a Gaussian distribution of these fluctuations. Analysis of recent experiments on the gap genes shows that all these signatures are observed, and that the different signatures are related in ways predicted by theory. While there might be other explanations for these individual phenomena, the confluence of evidence suggests that this genetic network is tuned to criticality.

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