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Stochastic Turing Patterns of Trichomes in Arabidopsis Leaves

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Biological patterns that emerge during the morphogenesis of multicellular organisms can display high precision at large scales, while at cellular scales cells exhibit large fluctuations stemming from cell-cell differences in molecular copy numbers also called demographic noise. We study the conflicting interplay between high precision and demographic noise in trichome patterns on the epidermis of wild-type Arabidopsis thaliana leaves, as a two-dimensional model system. We carry out a statistical characterization of these patterns and show that their power spectra display fat tails – a signature compatible with noise-driven stochastic Turing patterns – which are absent in power spectra of patterns driven by deterministic instabilities. We then present a theoretical model that includes demographic noise stemming from birth-death processes of genetic regulators which we study analytically and by stochastic simulations. The model captures the observed experimental features of trichome patterns.

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