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Pollen Patterning as a Brazovskii Phase Transition on a Sphere MAXIM LAVRENTOVICH, ERIC HORSLEY, ASJA RADJA, ALISON SWEENEY, RANDALL KAMIEN, University of Pennsylvania — Pollen grains acquire intricate, varied surface patterns during development. The patterns are reproducible within a single plant species, and yet exhibit a wide variation among species, despite having similar developmental steps. We model this pattern formation on spherical grains as a phase transition to a spatially modulated phase, characterized by an unstable wavelength λ_0. On the infinite, flat plane, the patterned phase consists of uniform stripes, as shown by Brazovskii. We find that, by contrast, the patterns may be much more varied on a spherical surface because the topological defects which must be present in the pattern may be accommodated in a variety of ways. This variation may explain the wide range of observed pollen patterns. We also argue that the first-order character of the transition may be responsible for the robust reproducibility of the patterns in a single plant species. Finally, we compute the free energy difference between the unpatterned, smooth phase and various patterned phases on the sphere. These calculations point toward possible future experimental tests of our model.

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