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Turing Patterns on Curved Surfaces[1] JOHN FRANK, MIT, JEMAL GUVEN, Instituto de Ciencias Nucleares, Universidad Nacional Autonoma de Mexico, MEHRAN KARDAR, MIT — Surface curvature modifies the emergence of Turing patterns in reaction-diffusion systems on two-dimensional interfaces. We adapt operator perturbation theory, familiar in quantum mechanics, to determine how curvature affects diffusion. When these modifications are taken into account in Turing's stability analysis, we observe new phenomena that may be relevant to patterning on cell membranes, neuron synapses, and fluid interfaces with reactive surfactants. A cylinder with longitudinal ripples illustrates how Turing patterns can lock into phase with the ripples when the most unstable mode is nearly commensurate with the ripples. The framework we introduce also sheds light on diffusion constrained to a rippled sphere, a Gaussian bump, and other shapes. More generally, it is relevant to any model that involves the Laplacian on a curved manifold.

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