Dr. Wrinkle and Mr. Hyde: directing pattern formation in anisotropic elastic films

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Non-Euclidean geometry has been shown to be one of the most robust mechanisms used to prescribe the configuration of defects in crystalline or striped phases. Gaussian curvature can also stabilize more exotic defects, including scars, fractionalized defect charges, and pleats. Likewise, if a two-dimensional crystal is allowed to buckle out of the plane, the elastic energy associated with isolated disclinations can be strongly reduced by screening their strain fields through curvature, trading off stretching for bending energy. Depending on the sign of the topological charge, isolated defects can deform the membrane into cone- or saddle-shape configurations, acting as sources of Gaussian curvature. Here we demonstrate experimentally, theoretically and through simulations that the molecular splay distortions associated with disclinations in a free-standing smectic membrane act as sources of Gaussian curvature, resulting in a pattern of wrinkles in the membrane which form perpendicular to the underlying smectic layers. Dramatically, wrinkling changes the very nature of the curvature-defect coupling, making positive disclinations sources of *negative* curvature in contrast to intuition gained from geodesic domes and soccer balls. By dictating the distribution of topological defects, it should be possible to control the specific non-Euclidean geometry of the membrane.