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Frustrated orientational order on extrinsic geometries[1]

BADEL L. MBANGA, GREGORY M. GRASON, Department of Polymer Science and Engineering, University of Massachusetts, Amherst, CHRISTIAN D. SANTANGELO, Department of Physics, University of Massachusetts, Amherst — The ground state of an anisotropic liquid on a curved surface has topological defects due to the surface's Gaussian curvature. The extrinsic geometry of the surface, however, frustrates the ground state arising from Gaussian curvature alone, changing the defect configurations in the ground state or expelling them from the surface altogether. We study nematic order on unduloids - a family of undulated cylinders with constant mean curvature spanning from the cylinder to a chain of spherical droplets - arising in systems ranging from liquid bridges to fluid membranes. We identify structural transitions in which pairs of disclinations of opposite signs are nucleated as the unduloid progresses from cylinder to spheres, explicitly separating the role of intrinsic geometry, which nucleates disclinations to screen Gaussian curvature, and extrinsic geometry, which expels defects from the neck. We describe some implications for the pinching off of a cylinder.

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Badel L. Mbanga
Department of Polymer Science and Engineering,
University of Massachusetts, Amherst

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