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Planar Anchoring of Achiral Nematic Liquid Crystals in Capillaries — with a Twist[1] ZOEY S. DAVIDSON, JOONWOO JEONG, LOUIS KANG, Department of Physics & Astronomy, University of Pennsylvania, Philadelphia, Pennsylvania 19104, USA, PETER J. COLLINGS, Department of Physics & Astronomy, Swarthmore, Department of Physics & Astronomy, University of Pennsylvania, Philadelphia, Pennsylvania 19104, USA, TOM C. LUBENSKY, A. G. YODH, University of Pennsylvania, Philadelphia, Pennsylvania 19104, USA — In the common three-term Frank free energy of a nematic liquid crystal, the ground state configuration will have no deformations and all nematic directors will be parallel. However, certain confining geometries can impose significant deformations on the ground state, even if a zero-deformation configuration can be drawn that satisfies all boundary conditions. By solving the Euler-Lagrange problem of the Frank free energy equation, including the saddle-splay term, with cylindrical confinement and degenerate planar anchoring, we find conditions for a highly deformed ground state configuration that has a double twist like structure. We explore these effects experimentally with both thermotropic and lyotropic liquid crystal materials, finding good agreement with the theoretically predicted configuration. We also observe a rich phenomenology of defect structures in the liquid crystal samples.

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