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Helfrich walls in toroidal nematics in the presence of magnetic fields

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We observe the formation of stable, magnetic field induced, alignment inversion walls, also called Helfrich walls, in nematic liquid crystals (NLCs) confined to a toroidal droplet with tangential anchoring at the boundaries [1]. Walls are rare in NLCs due to their high energy compared to lower-dimensional defect structures. However, Helfrich walls naturally form, transform and migrate in this novel toroidal setting, generating intricate director-field configurations due to the interplay of confining geometry and external fields. Interestingly, the presence and number of point defects in the zero-field nematic configuration of the toroid [2] influences the types of walls that arise. In the absence of point defects, splay-bend walls emerge. By contrast, when a point defect pair exists on the toroidal surface [2], walls with twist form and transform. Our experiments and numerical simulations enable quantifying and elucidating the physics behind the formation and transformation of these wall structures in unprecedented ways.

References

[1] J. Rojo-Gonzalez, C.G. Slaughter, P.J. Collings, J.M. Kikkawa, A. Yodh, and A. Fernandez-Nieves (submitted).
[2] J. Rojo-González, L. Nicola Carenza, A. de la Cotte, L.A. Hoffmann, L. Giomi, and A. Fernandez-Nieves, *Phys Rev Research* **6**, L012065 (2024).