Morphology and Responsivity in Cholesteric Droplets

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Liquid crystals are orientational ordered fluids that have large response functions to a wide variety of confining boundary conditions and external applied fields. This responsivity underpins their practical utility in flat panel displays, optical devices and sensors. In many situations, particularly strong response can be obtained by harnessing the topological defects that arise naturally in liquid crystals. For instance, such defects necessarily occur in droplets of liquid crystal where the orientation is pinned to be in the normal direction on the spherical boundary. The textures that form are sensitive to the boundary conditions so that changes in them, for instance induced by trace amounts of an endotoxin, can induce substantial transformations in the liquid crystal morphology [1, 2], providing potential for highly sensitive sensors.

This project will study morphology in cholesteric droplets, with a focus on configurations exhibiting only point defects. Recent experimental work from the Ljubljana group has shown that point defects of high topological charge can be created, and are metastable, in small cholesteric droplets [3]. We will develop a theoretical framework for describing the cholesteric geometry of such high strength defects and use it to provide robust numerical simulation of these novel states. Subsequently we will determine how the textures can be manipulated and controlled through modification of the boundary conditions or application of external fields. Understanding their responsivity will lay the foundations for potential applications in devices and sensors.

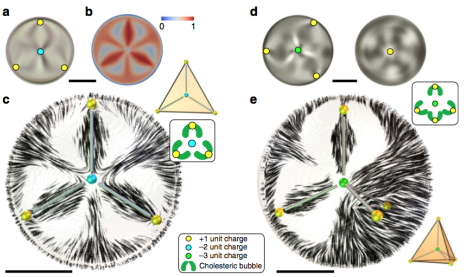

Figure 1: Configurations of multiple point defects in a cholesteric droplet [3].

It is hoped that this project will lead to a PhD in the same area of morphology and responsivity of novel liquid crystal based devices and I am currently pursuing several possibilities for external partners.

References

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[2] V. Tomar, S.I. Hernández, N.L. Abbott, J.P. Hernández-Ortiz, and J.J. de Pablo, Morphological transitions in liquid crystalline nanodroplets, Soft Matter **8**, 8679 (2012).

[3] G. Posnjak, S. Čopar, and I. Muševič, Hidden topological constellations and polyvalent charges in chiral nematic droplets, Nat. Commun. **8**, 14594 (2017).