Waltzing defects in cholesteric liquid crystal shells

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Confining rod-like molecules, such as the nematogens of liquid crystals, on a curved surface inevitably yields topological defects, which are singular points where the alignment between molecules can no longer be fulfilled. Remarkably, in the specific case of a nematic sphere, Poincaré stated that the sum of the topological charges of the defects must always be +2. Recent studies, led both at experimental and theoretical levels [1,2], have shown that in the case of nematic shells, three kinds of configuration are possible. Each of these configurations corresponds to different arrangements of defects that satisfy Poincaré's theorem. But much richer scenarios appear when playing with the shell thickness, since bulk effects start competing with surface effects. In particular, we show that inducing chirality in the liquid crystal can have a dramatic effect in the defect structure of the shell, where the ratio c between the cholesteric pitch p and the shell thickness h becomes an additional control parameter.

We present evidence of new defect structures, such as +3/2 charge defects, and then focus on the specific configurations displaying two disclination lines of charge +1 and one disclination line of charge +2. We study in more details their intricate structures and show that the +2 configuration, commonly known as the Frank-Pryce structure, actually consists of two non-singular +1 lines that are winded around each other (see Fig. 1). These results match recent numerical simulations by Sec *et al.* [3] on cholesteric droplets. Moreover, we perform a detailed study of the transition between the 2(+1) and the +2 configurations and provide a theoretical explanation unveiling its governing mechanisms [4].

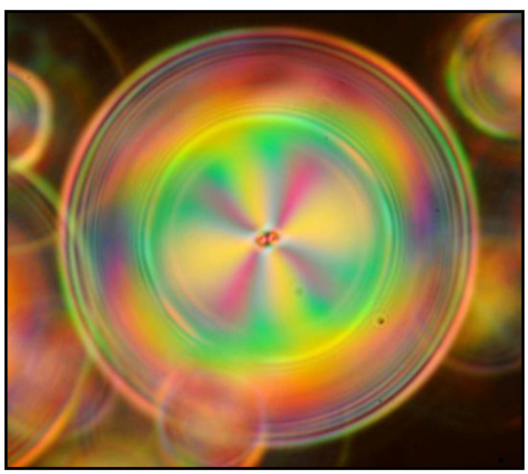

Figure 1: Cholesteric shell observed between crossed polarizers. At the center two +1 disclination lines twisted around each other can be observed.

[1] Lopez-Leon, T., Koning, V., Devaiah, K. B. S., Vitelli, V., & Fernandez-Nieves, A., Nature Phys. **7** (2011).
[2] Vitelli, V. & Nelson D. R., Phys Rev. E **74** (2006).
[3] Sec, D., Porenta, T., Ravnik, M. & Zumer, S., Soft Matter **8** (2012).
[4] Darmon, A., Benzaquen, M., Dauchot, O. & Lopez-Leon, T., (in preparation)