

# Nematics on spherical surfaces: Control of defect configurations by temperature, density, and rod shape

Subas Dhakal, Francisco J. Solis, and Monica Olvera de la Cruz  
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Liquid crystals confined to curved geometries exhibit, quite generally, topological defects [1]. The defect sites can be functionalized to dictate the organization of multi-particle aggregates[2]. Herein, we present a comprehensive description of the defect structure in spherical morphologies with surface crystalline order using two different approaches, Monte Carlo simulations and a variational calculation. The highlights of our results are:

- We show a continuous evolution of the defect structure from a tetrahedral configuration to pair coalescence to a great circle arrangement on increasing the ratio of bend to splay elastic constants of nematic, and agree well with the recent experiments[3].
- Our results have demonstrated different ways to control defects location in spherical nematic. We show that the temperature, rod length, colloid size and surface density might change the defect locations. These predictions could be tested in the future experiments.
- We introduce a reduced set of co-ordinates to define the position and orientation of defects on a spherical surface.
- We introduce a variational approach to find the defect configuration in spherical nematic for unequal Frank's constant that had not been previously considered.
- The analytical expression for the nematic texture developed here can also be useful in the study of dynamical processes involving textures in diverse geometries such as the faceted tetrahedra induced by the defects in the tetrahedral configuration in deformable membranes with surface liquid crystalline order.

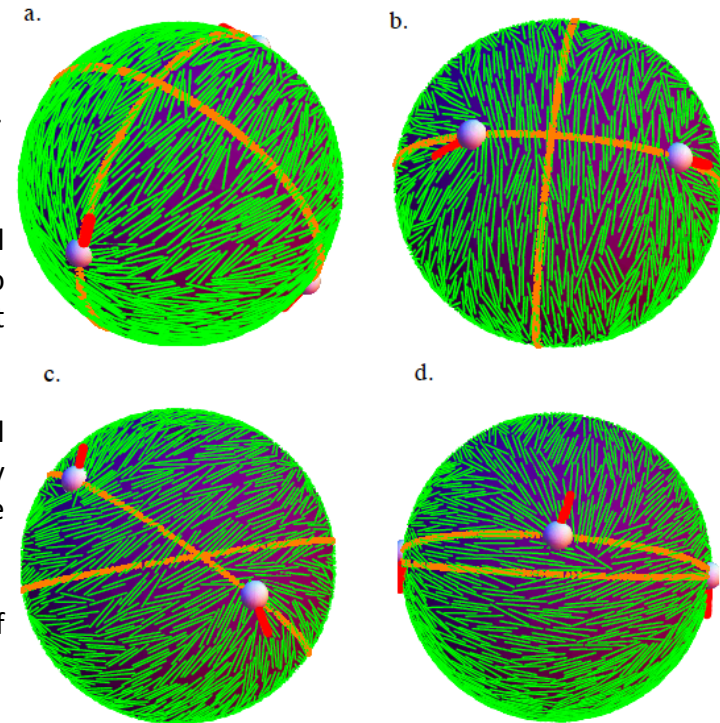


Figure: Evolution with temperature of defect configurations in a spherical nematic. Results corresponds to simulations at  $u/k_B T = 1.37, 2.22, 4.0$  and  $40.0$  (a, b, c and d). The small spheres represent a defect location, and defect orientations are shown as red-vectors.

[1] T. C. Lubensky and J. Prost, *J. Phys. II (France)* **2**, 371 (1992).

[2] G. A. DeVries *et al.*, *Science* **315**, 358 (2007).

[3] T. Lopez-Leon *et al.*, *Nat. Phys.* **7**, 391 (2011).