# Distorted nematic ordering: splay, twist, bend [psl16]

Orientational ordering in nematic phase characterized by director $\mathbf{n}$.

Nematic liquid crystal responds to shear stress with viscous flow. Director field remains largely uniform.

Deformations $\mathbf{n}(\mathbf{r})$ from uniformity can be imposed by boundary conditions.

Depending on the forces between liquid crystal molecules and container surfaces we have a

- homeotropic boundary condition ($\mathbf{n}$ perpendicular to the surface),
- homogeneous boundary conditions ($\mathbf{n}$ parallel to the surface).

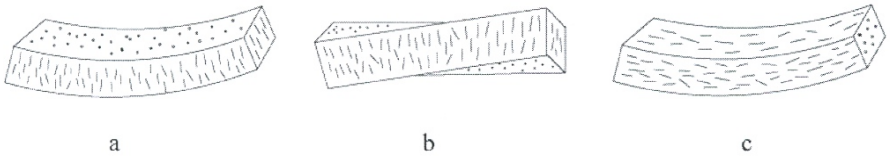
Boundary induced deformations $\mathbf{n}(\mathbf{r})$ represent elastic response.

Three fundamental types of deformations produce different contributions to the distortion Helmholtz free energy:

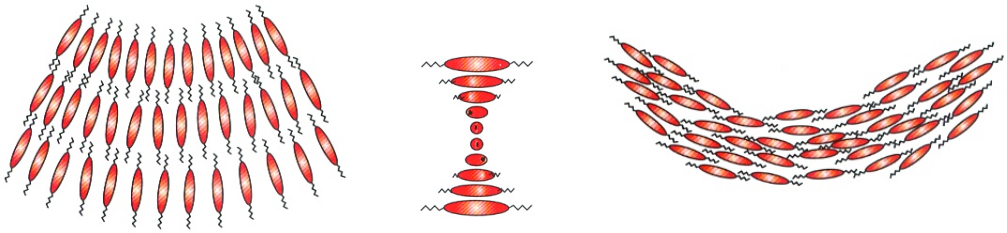
(a) splay: $\nabla \cdot \mathbf{n} \neq 0, \quad \Delta A_1 = \frac{1}{2} K_1 (\nabla \cdot \mathbf{n})^2,$

(b) twist: $\nabla \times \mathbf{n} \parallel \mathbf{n}, \quad \Delta A_2 = \frac{1}{2} K_2 (\mathbf{n} \cdot \nabla \times \mathbf{n})^2,$

(c) bend: $\nabla \times \mathbf{n} \perp \mathbf{n}, \quad \Delta A_3 = \frac{1}{2} K_3 [\mathbf{n} \times (\nabla \times \mathbf{n})]^2.$




[image from Andrienko 2006]



[image from Hirst 2013]