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Weak Anchoring for a Two-Dimensional Liquid Crystal

We study the weak anchoring condition for nematic liquid crystals in the context of the Landau-De Gennes model. We restrict our attention to two dimensional samples and to nematic director fields lying in the plane, for which the Landau-De Gennes energy reduces to the Ginzburg–Landau functional, and the weak anchoring condition is realized via a penalized boundary term in the energy. We study the singular limit as the length scale parameter $\epsilon \to 0$, assuming the weak anchoring parameter $\lambda = \lambda(\epsilon) \to \infty$ at a prescribed rate. We also consider a specific example of a bulk nematic liquid crystal with an included oil droplet and derive a precise description of the defect locations for this situation, for $\lambda(\epsilon) = K\epsilon^{-\alpha}$ with $\alpha \in (0, 1]$. We show that defects lie on the weak anchoring boundary for $\alpha \in (0, \frac{1}{2})$, or for $\alpha = \frac{1}{2}$ and K small, but they occur inside the bulk domain Ω for $\alpha > \frac{1}{2}$ or $\alpha = \frac{1}{2}$ with K large. This represents joint work with S. Alama and B. Galvão-Sousa.