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Droplet phase in a nonlocal isoperimetric problem under confinement

We begin with a variational model for the self-assembly of diblock copolymers under confinement, which takes the form of an isoperimetric problem which is both nonlocal and nonhomogeneous. That is, we seek minimizers in the form of characteristic functions of fixed volume. The energy consists of three competing terms, and minimizers should reduce their perimeter (as in the classical isoperimetric problem,) but also prefer spatial separation into disjoint components, which are confined by an attractive potential. We consider periodic configurations in the small volume fraction limit, in which one phase forms vanishingly small droplets in a sea of the complementary phase. Introducing a small parameter $\eta > 0$, which represents the radii of the droplets, we show that the minority phase splits into several droplets which converge to the maximum value of the confining potential, at an intermediate scale $\eta^{1/3}$. Isolating the droplets at the scale $\eta^{1/3}$ requires a fine analysis of the blown-up problem, using concentration-compactness and the regularity properties of minimizers of the nonlocal isoperimetric problem on $\mathbb{R}^3$. This is joint work with Stan Alama, Rustum Choksi and Ihsan Topaloglu.