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Zeroth Order Limiting Behaviour of the Ginzburg-Landau Functional

For $\Omega \subseteq \mathbb{R}^2$ there is an extensive literature concerning the limiting behaviour of the Ginzburg-Landau energy,

$$E_\varepsilon(u) = \int_\Omega \Big\{ \frac{1}{2}|\nabla u|^2 + \frac{1}{4\varepsilon^2}(|u|^2 - 1)^2 \Big\},$$

as $\varepsilon \to 0^+$. In such works, it is shown that if a sequence of functions has vorticity concentrate, as $\varepsilon \to 0^+$, about a finite collection of interior points of Ω then the Ginzburg-Landau energy converges, after renormalizing, to the total variation of a measure supported over the same interior points. However, much less is known when the vorticity of solutions is permitted to concentrate about points along the boundary.

We consider this question for a connected open set $\Omega \subseteq \mathbb{R}^2$ with $C^{2,1}$ boundary and we prove that similar conclusions to the interior case remain true up to the boundary provided the functions we consider satisfy suitable boundary restrictions. In addition, we also show that there are necessary topological restrictions on the vorticity.