Poster-1-4

Strong pinning transition with arbitrary defect potentials

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The onset of strong pinning exhibits a striking correspondence to the physics of a critical point terminating a thermodynamic first-order transition, with the Labusch parameter κ that quantifies the pinning strength replacing the scaled temperature T/T_c. So far, this transition has been studied for isotropic defect potentials, resulting in a (mean-field type) critical exponent $\mu = 2$ for the onset of the strong pinning force density $F_{\text{pin}} \sim n_p f_p (\xi/a_0)^2 (\kappa - 1)^\mu$, with n_p and f_p denoting the density and pinning force of the defects and ξ and a_0 the coherence length of the superconductor and the intervortex distance. This result is owed to the special rotational symmetry of the defect producing a *finite* trapping area $S_{\text{trap}} \sim \xi^2$ near the strong-pinning onset at $\kappa = 1$. The behavior changes dramatically when studying anisotropic defects with no special symmetries: the pinning originates from isolated points with length scales growing as $\xi(\kappa - 1)^{1/2}$, resulting in a different (mean-field type) exponent $\mu = 5/2$. Our analysis uncovers interesting geometrical structures in the strong pinning transition, with the appearance of *unstable* areas of elliptical shape marking the locations of vortex jumps, that grow and join in hyperbolic geometries. Correspondingly, we find the *bistable* areas of asymptotic vortex positions characteristic of strong pinning; they assume banana-shaped geometries growing with $\kappa > 1$ that join up into the ring-shaped structures previously encountered for isotropic defects. Making heavy use of the Hessian matrix associated with the pinning landscape, we study the geometrical evolution of these unstable and bistable areas with increasing pinning strength $\kappa > 1$ and present an interesting relation between a random 2D pinning landscape and the Euler characteristic of a planar graph.