3D vortex approximation construction and applications to the study of global minimizers for the Ginzburg-Landau functional below and near the first critical field

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The Ginzburg-Landau model is a phenomenological description of superconductivity. An essential feature of type-II superconductors is the presence of vortices (similar to those in fluid mechanics, but quantized), which appear above a certain value of the applied magnetic field called the *first critical field*. We are interested in the regime of small ε, where $\varepsilon > 0$ is the inverse of the *Ginzburg-Landau parameter* (a material constant). In this regime, the vortices are at main order codimension 2 topological singularities.

This talk will provide a polyhedral approximation of the vorticity in 3D, which allows one to obtain a Jacobian (or vorticity) estimate and a lower bound for the Ginzburg-Landau free energy. These estimates are optimal, analogous to the 2D ones, and work at the ε-level. We then apply these results, together with arguments from the calculus of variations and geometric measure theory, to describe the behavior of global minimizers for the 3D Ginzburg-Landau functional below and near the first critical field.