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Classification of symmetric vortices for the Ginzburg-Landau equation. (English)

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Summary: This work proposes a description of the set of symmetric vortices, defined as specific solutions of the Ginzburg-Landau equations for a superconducting cylinder with applied magnetic field. It is conducted through a two parameters shooting procedure which relates the behaviour of a symmetric vortex at the center to its behaviour at the boundary. The main result is that, for a given degree d, the set of parameters for which such a "shooting" leads to a "response" - i.e. admissible values for the radius $\bar{r}$ of the cylinder and the intensity h of the magnetic field is a bounded subset in $\mathbb{R}^2$. This shows in particular that, for large intensities of the applied magnetic field, normal states do not appear as a limit of superconducting vortices of given degree, and that symmetric vortices are not equilibrium states of the system for too large or too low intensities of the applied magnetic field. Moreover, a simpler proof for the existence of bifurcations (a model for phase transitions) from the normal state to superconducting states, as studied in (*P. Bauman, D. Phillips, Q. Tang* [Arch. Ration. Mech. Anal. 142, No. 1, 1-43 (1998; Zbl 0922.35157)]), is provided.

MSC:

35J60 Nonlinear elliptic equations
35H30 Quasielliptic equations
82D55 Statistical mechanics of superconductors

Keywords:

Ginzburg-Landau equation; superconducting cylinder with applied magnetic field; two parameters shooting procedure; superconducting vortices