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Pattern formation in superheated cylindrical superconductors[1]
ALDEN PACK[2], None — A hallmark of superconductivity is the Meissner effect: the expulsion of an externally applied magnetic field. For large magnetic fields, the superconductor transitions to either a normal metal (type I) or mixed state (type II). However, the Meissner state may persist as a meta-stable state up to a critical "super heating field". For type II superconductors, the Meissner state first becomes unstable to fluctuations that break the transverse symmetry of the system. This instability leads to interesting pattern formation dynamics connecting the Meissner state to the final mixed state of vortex arrays. We explore this transition by numerically solving the time-dependent Ginzburg-Landau equation in a cylindrical superconductor. We illustrate the Meissner effect, convergence to a steady state, quenching, and nontrivial dynamics characterizing vortex formation.

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