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Vortex dynamics in Superconducting Corbino Disks: Molucular Dynamics and Heat Transport Simulations[1]

MASARU KATO, DAVID FUJIBAYASHI, Department of Mathematical Sciences, Osaka Prefecture University — Understanding vortex dynamics is important for application of superconductivity, because vortex motion causes resistive state of superconductors and controlling vortex motion is useful for superconducting devices. Also vortex dynamics shows much variety of phenomena. In a corbino disk geometry, where electric current is injected at the center of the disk and flows toward the perimeter of the disk, vortex moves circular by the Lorentz force from this current. But the Lorentz force depend on the distance from the center as $1/r$, and therefore the vortex velocity faster in the center region than those in the perimeter region. Then vortex motion generates heat and causes non-uniform temperature distribution. Non-uniform temperature distribution causes further vortex motion. Therefore in the superconducting corbino disk, vortex dynamics is not a simple problem. In order to investigate this vortex dynamics, we combine the molecular dynamics and the heat transport simulations. Our simulation results show that dynamical structure of vortices depends on the heat resistance between the superconductor and a substrate as well as the heat capacity and heat conductance of superconductors. Especially there is a transition from laminar flow to the spiral or non-uniform flow.

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Masaru Kato
Department of Mathematical Sciences, Osaka Prefecture University

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