Phase-Slip State of Quasi-Two Dimensional Superconductors

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In the case of low dimensional superconducting microbridges, the superconducting currents induce the nonequilibrium state called Phase-Slip Center or Phase Slip-Line. Quasiparticle diffusion currents exit in both side of the phase-slip area. We found the relationship between quasiparticle currents and superconducting currents in magnetic fields. Hysteresis of critical currents in magnetic field is determined by nonequilibrium transition magnetic field \( \tau_1(H) \) calculated in the equation (1). [1] [2]

\[
\frac{1}{2\tau_s(H)} = \frac{1}{2\tau_f} + \frac{1}{\tau_1(H)}, \quad \tau_s(H) = \frac{\hbar}{1.76k_B T_c} \frac{H_{c2}^2(T)}{H^2}
\] (1)

Due to the shielding currents induced by in superconducting electrodes, a hysteresis phenomenon is observed. [3] Regarding this hysteresis phenomenon, we have investigated the relationship between the Josephson currents in nonequilibrium state and shielding current in the surface of superconductors.