Session QC27 - Vortices in Superconductors VI: Hall Effect and Vortex Core States.
ORAL session, Wednesday morning, March 24
Room 169W, GWCC

[QC27.01] Vortex-State Complex Hall Conductivity of Superconducting YBa$_2$Cu$_3$O$_7$ Epitaxial Films at Radio Frequencies

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The first intermediate-frequency measurements of the vortex-state complex Hall conductivity $\sigma_{xy}$ of YBa$_2$Cu$_3$O$_7$ superconducting epitaxial films are reported. A direct transport measurement technique from dc to 7 MHz was used. The results are analyzed in terms of a phenomenological model, generalized from that for the dc Hall conductivity, with the assumptions that 1) the sign reversal in the vortex-state Hall conductivity is associated with the different carrier densities within and far away from the vortex cores; 2) the Drude approximation is applicable; and 3) the anomalous sign reversal occurs in the flux-flow limit. The temperature, frequency, and magnetic field ($B$) dependencies of our $\sigma_{xy}$ data are in good agreement with the model. The $B$-dependence of $\sigma_{xy}$ reveals that both vortices ($\sigma_{xy}^v \propto B^{-1}$) and quasiparticles ($\sigma_{xy}^q \propto B$) contribute to the vortex-state Hall conduction. The magnitude of the real part of $\sigma_{xy}$, $\sigma_{xy}^\prime$, in good agreement with our model, while that of the imaginary part, $\sigma_{xy}^\prime\prime$, is significantly larger than the theoretical prediction. This may be attributed to the unconventional electronic structures in the vortex core of cuprate superconductors with d-wave or mixed pairing symmetries.

Part Q of program listing