MAR14-2013-005768

Abstract for an Invited Paper
for the MAR14 Meeting of
the American Physical Society

Fractionalizing the vortex lattice in multiband superconductors in the flux flow region[1]

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Because of the discovery of MgB_2 and iron-based superconductors, multiband superconductors have attracted considerable attention recently. Multiband superconductors are not always straightforward extensions of the single-band counterpart, and novel features may arise. In multiband superconductors, electrons in different bands form distinct superfluid condensates, which are coupled to the same gauge field. Each condensate thus supports vortex excitation with fractional flux quantum. However the energy of a fractional vortex diverges logarithmically in the thermodynamic limit. In the ground state vortices in different bands are bounded and their normal cores are locked together to form a composite vortex with the standard integer quantum flux. It is interesting to ask whether the vortices in different condensates can decouple under certain conditions. In this talk, I will discuss the dissociation of the composite vortex lattice in the flux flow region when the disparity of superfluid density and coherence length between different bands is large. The fractional vortex lattice in different bands move with different velocities after the dissociation transition, and the dissociation transition shows up as an increase of flux flow resistivity. In the dissociated phase, the Shapiro steps are developed when an ac current is superimposed with a dc current. We also propose to stabilize the fractional vortices by periodic pinning arrays.

[1]This work was supported by the U.S. Department of Energy, Office of Basic Energy Sciences, Division of Materials Sciences and Engineering.