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Quasiparticle scattering from vortices in d-wave superconductors: Superflow and Berry phase contributions ADAM C. DURST, SRIRAM GANESHAN, MANAS KULKARNI, Stony Brook University — In the vortex state of a d-wave superconductor, massless Dirac quasiparticles are scattered from magnetic vortices via a combination of two basic mechanisms: effective potential scattering due to the superflow swirling about the vortices and Aharonov-Bohm scattering due to the Berry phase acquired by a quasiparticle upon circling a vortex. First, we consider the superflow contribution by calculating the differential cross section for a quasiparticle scattering from the effective non-central potential of a single vortex. Next, we consider the Berry phase contribution, which results in branch cuts between neighboring vortices across which the quasiparticle wave function changes sign. Here, the simplest problem that captures the physics is that of scattering from a single finite branch cut that stretches between two vortices. Elliptical coordinates are natural for this two-center problem and we proceed by separating the massless Dirac equation in elliptical coordinates. The separated equations take the form of the Whittaker-Hill equations, which we solve to obtain radial and angular eigenfunctions. With these eigenfunctions in hand, we construct the scattering cross section via partial wave analysis. We discuss the scattering effect of each mechanism, superflow and Berry phase, leaving the important issue of interference between the two mechanisms to future work.

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