Abstract Submitted
for the MAR06 Meeting of
The American Physical Society

Effective Action for Vortex Dynamics in Clean d-wave Superconductors PREDRAG NIKOLIC, SUBIR SACHDEV, Harvard University — We describe influence of gapless nodal quasiparticles on vortex dynamics in clean two-dimensional d-wave superconductors. At zero temperature, the guasiparticles give rise to a finite renormalization of vortex mass, as well as a universal sub-Ohmic damping of vortex motion. Slow vortex motion is dissipated only at finite temperatures, or when some perturbation, such as disorder, creates a finite quasiparticle density of states at the gap nodes. These results are obtained by a non-perturbative derivation of the effective vortex action, where the quasiparticles are integrated out exactly in a continuum functional formalism. Fortunately, an uncontrolled perturbative analysis reaches the same conclusions, and all findings are reflected in a simple scaling argument where the gapless Dirac quasiparticles are regarded as a quantum-critical system. Our results appear to differ from those of the semiclassical theory, which obtains singular corrections to a vortex mass appearing in transport equations.

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Date submitted: 23 Nov 2005 Electronic form version 1.4