Abstract Submitted
for the MAR06 Meeting of
The American Physical Society

Dirac-Bogoliubov-de Gennes quasiparticles in the mixed state of lattice d-wave superconductors[1] ASHOT MELIKYAN, University of Florida, ZLATKO TESANOVIC, Johns Hopkins University — In the mixed state of cuprate superconductors the low energy quasiparticles can be effectively described as Dirac fermions moving in the field of singular scalar and vector potentials. Although the effective linearized Hamiltonian operator formally does not depend on the structure of vortex cores, singular nature of the perturbation requires imposing additional boundary conditions at vortex locations. Each vortex is described by a parameter θ that effectively represents all effects beyond linearization. We identify the parameters θ of the solutions found earlier, analyze the relation between fully self-consistent formulation of the problem and the linearized model, and construct the low-field scaling form of the quasiparticle spectra incorporating the parameters θ explicitly and generalizing the conventional Simon-Lee scaling. We present a detailed numerical study of the lattice d-wave superconductor model and examine its low energy, low magnetic field behavior. The low energy limit is faithfully represented by Dirac-like fermions which are either truly massless, massless at the linearized level or massive, depending on the commensuration of magnetic length and lattice spacing.

[1]Supported in part by NSF grants DMR-0094981 and DMR-0531159. A.M. was supported by the Inst. of Fundamental Theory, Florida

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Date submitted: 30 Nov 2005 Electronic form version 1.4