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Quantum oscillations, phase fluctuations and competing orders in a d-wave vortex liquid[1] SHIZHONG ZHANG, Department of Physics, The University of Hong Kong, SUMILAN BANERJEE, MOHIT RANDERIA, Department of Physics, The Ohio State University — The observation of quantum oscillations in underdoped cuprates has generated intense debate about the nature of the field-induced resistive state and its relation to the "normal" state of high T_c superconductors. Quantum oscillations suggest a Fermi liquid state at high magnetic fields H and low temperatures, in contrast to the high-temperature, zero-field pseudogap state. Motivated by recent high-field heat capacity measurements, we present a theoretical analysis [1] of the electronic excitations in a vortex-liquid state, with pairing correlations that are short-ranged in both space and time. We show that this permits us to reconcile the various seemingly contradictory experimental observations. We show that phase fluctuations that give insight into the pseudogap in the high temperature classical regime also lead to a large and singular (square root of H) density of states (DOS) suppression at low temperatures. In addition, the DOS shows quantum oscillations with a period determined by a Fermi surface reconstructed by a possible competing order parameter in the vortex liquid. We also comment on possible implications of our results for thermal conductivity and c-axis optical conductivity in such a state. [1] S. Banerjee, S. Zhang, and M. Randeria, arXiv:1210.2466.

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