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Nernst effect and diamagnetism in phase fluctuating superconductors

ASHVIN VISHWANATH, UC Berkeley

We investigate the characteristic signatures that arise when superconductivity is destroyed by thermal phase fluctuations induced by a dilute liquid of mobile vortices. We find that the Nernst effect and diamagnetic response differ significantly from Gaussian fluctuations – in particular, a much sharper decay with temperature is obtained. We predict a rapid onset of Nernst signal at a temperature that tracks the transition temperature Tc, rather than the pairing temperature. We also predict a close quantitative connection with diamagnetism – the ratio of magnetization to transverse thermoelectric conductivity α_{xy} is proportional to the temperature over a wide range of fields. We interpret Nernst effect measurements on the underdoped cuprates in terms of a dilute vortex liquid over a broad temperature range above Tc [1]. We also introduce a new formalism to study fluctuating superconductivity that deals directly with the vortex variables. This is applied to analyze the effect of vortex properties such as core energy on Nernst effect and diamagnetism. [1] D. Podolsky, S. Raghu and A. Vishwanath, 'Nernst Effect and Diamagnetism in Phase Fluctuating Superconductors', Phys. Rev. Lett. 99, 117004 (2007)