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Evidence for Quantum Criticality in Electron-doped Cuprates[1]

YORAM DAGAN, School of Physics and Astronomy Tel Aviv University

The electron-doped cuprates have attracted a lot of scientific interest recently. The antiferromagnetic (AFM) phase in these cuprates may persist well into the superconducting dome and vanish in a quantum critical point. We describe experimental evidence for a quantum phase transition near optimum doping in the electron-doped material $Pr_{2-x}Ce_xCuO_{4-\delta}$: The normal state Hall coefficient, at 350mK, exhibits a remarkable change at this doping. This singular behavior is accompanied by significant changes in the temperature dependence of the resistivity below 20K [1]. In addition, at low temperatures, a spin scattering magnetoresistance appears in the underdoped region, increases in magnitude at optimum doping and suddenly vanishes at the critical doping where also the upturn in resistivity ($d\rho/dT<0$) disappears. [2] Supporting evidence for the quantum critical scenario from neutron scattering and infrared measurements and the nature of the ordered phase will be discussed. Our tunneling experiments show that the normal state tunneling gap is not directly related to the AFM order. T^*, the temperature at which the normal state tunneling gap disappears, is greater than T_c for the underdoped region and it follows T_c on the overdoped side. [3] This behavior suggests finite pairing amplitude above T_c on the underdoped side. [1] Y. Dagan *et al.*, PRL., **92**, 167001 (2004). [2] Y. Dagan *et al.*, PRL., **94**, 057005 (2005). [3] Y. Dagan *et al.*, PRL., **94**, 187003 (2005).

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