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Field-Induced Quantum Critical Route to a Fermi Liquid in Overdoped $Tl_2Ba_2CuO_{6+x}$

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In high temperature superconductivity, charge doping is a natural tuning parameter that takes copper oxides from the antiferromagnet through the superconducting 'dome'-shaped region. In the metallic state above T_c the standard Landau's Fermi-liquid theory of metals, as typified by the temperature squared (AT^2) dependence of resistivity, appears to break down. The expected recovery of the usual Fermi-liquid metal on the high doping side is fundamental but ill understood. Here we uncover a new transformation in an overdoped superconducting copper oxide $Tl_2Ba_2CuO_{6+x}$ from the non-Fermi to a Fermi-liquid state driven by magnetic field [1]. From the c-axis resistivity measured up to 45 T, we show that the Fermi-liquid AT^2 features, accompanied by a field-linear magnetoresistance, appear above a field H_{FL}. This crossover field H_{FL} decreases linearly with decreasing temperature T and lands at a quantum critical point (QCP) near the upper critical field $H_{c2}(0)$. The Fermi-liquid coefficient $A(H)$ shows a power-law diverging behavior on the approach to the QCP, indicating the second-order quantum phase transition at this field. The connection between the field-induced QCP and the pseudogap observed in the underdoped regime will be discussed.

[1] T. Shibauchi *et al.*, Proc. Natl. Acad. Sci. USA **105**, 7120 (2008).