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## Link between spin fluctuations and Cooper pairing in copper oxide superconductors[1]

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Although it is generally accepted that superconductivity is unconventional in the high-$T_c$ cuprates, the relative importance of phenomena such as spin and charge (strip) order, superconductivity fluctuations, proximity to Mott insulator, a pseudogap phase and quantum criticality are still a matter of debate. In electron-doped cuprates, the absence of "anomalous" pseudogap phase in the underdoped region of the phase diagram and weaker electron correlations suggest that Mott physics and other unidentified competing orders are less relevant and that antiferromagnetic (AFM) spin fluctuations are the dominant feature. In this talk, I will report results of low temperature magnetotransport experiments in optimal to overdoped (non-superconducting) thin films of the electron-doped cuprate $La_{2-x}Ce_xCuO_4$ (LCCO). We find that a linear-in-$T$ scattering rate is correlated with the superconductivity ($T_c$). Our results show that an envelope of such scattering surrounds the superconducting phase, surviving to 20 mK (the limit of our experiments) when superconductivity is suppressed by magnetic fields [1]. Comparison with similar behavior found in organic superconductors [2] strongly suggests that the linear-in-$T$ resistivity in the electron-doped cuprates is caused by spin-fluctuation scattering. Because linear-in-T scattering has also been linked to $T_c$ in some hole-doped cuprates [2], our results suggest a fundamental connection between AFM spin fluctuations and the pairing mechanism of high temperature superconductivity in all cuprates. In addition, I will discuss how quantum criticality plays a significant role in shaping the anomalous properties of the electron-doped cuprate phase diagram. We identify quantum critical scaling in LCCO with a line of quantum critical points that surrounds the superconducting phase as a function of magnetic field and charge doping [3].

[1] K. Jin, N.P. Butch, K. Kirshenbaum, J. Paglione, and R.L. Greene, Nature 476, 73 (2011).
[2] L. Taillefer, Annu. Rev. Cond. Matter Phys. 1, 51 (2010).
[3] N.P. Butch, K. Jin, K. Kirshenbaum, R.L. Greene, and J. Paglione, submitted.

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