Correlation between spin fluctuations and pairing in electron-doped cuprates

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The origin of the electron pairing in high-T_c cuprate superconductors is still unresolved in spite of over 20 years of research on these materials. Most research has focused on hole-doped cuprates, which have a "pseudogap" phase of unknown origin in the under doped region of the phase diagram. In contrast, electron-doped cuprates have a "pseudogap" whose origin is known to come from antiferromagnetic spin density wave (SDW) fluctuations [1]. Here we report a detailed analysis of very low temperature transport measurements (30mK < T< 2K) on electron-doped $La_{2-x}Ce_xCuO_4$ (0.10 < x < 0.21) films in the normal state (H >Hc2). Most significantly, we find a direct correlation between the strength of the linear-in-temperature resistivity and the superconducting transition temperature (T_c). This strongly suggests that pairing and normal state scattering are both caused by the same coupling, most likely to SDW fluctuations since no other excitations are known to exist at low temperatures in the n-doped cuprates. A correlation between T-linear resistivity and Tc has also been found in hole-doped cuprates [2], however, in this case the scattering responsible for the T linear term is unknown and the measurements have not been done at low enough temperatures to access the ground state. Since the superconductivity originates in the CuO_2 planes for both electron- and hole-doped cuprates, our work suggests that the spin fluctuations must play the dominant role in the pairing for all (both hole- and electron-doped) cuprate high-T_c superconductors!

[1] P. Armitage, P. Fournier, and R. L. Greene, arXiv: 0906.2931, accepted RMP
[2] For a summary and other references see; L. Taillefer, arXiv:1003.2972

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