Investigation of a Proposed QCP in Overdoped Region at $x \sim$0.23 in $La_{2-x-y}Nd_ySr_xCuO_4$

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Strong reduction of Tc is seen around $x = 1/8$ in LTT phase of La-based 214 cuprates. Recent studies of $La_{2-x}Ba_xCuO_4$ (LBCO) ($x \sim 1/8$), however, demonstrate the existence of superconducting order in a CuO_2 plane even in the static stripe phase. From this, the following picture emerges: (i) superconductivity does not compete, but coexists with stripe order in the CuO_2 plane; (ii) the superconductivity for $x \sim 1/8$ loses coherence along the is strongly suppressed[1]. By extending the doping region in LNSCO, Daou et al. suggests presence of a quantum critical point (QCP) at $x \sim 0.23$ which separates the static stripe ordered phase and the overdoped Fermi liquid phase[2]. However, for Nd-free LSCO, the superconducting and non-superconducting regions are separated by the LTO-HTT structural transition at nearly the same x (=0.22). To investigate the presence or otherwise of QCP, we performed optical and transport measurements on crystals with various Nd contents. The result of optical measurement clearly indicates that the c-axis Josephson plasma appears edge below Tc for $x = 0.20$, whereas no plasma resonance for $x = 0.24$ which shows apparent SC transition at T$\sim$10K. We conclude that both LSCO and LNSCO with $x = 0.24$ are not bulk superconductors, and that both stripe and SC orders disappear at $x \sim 0.23$.

[1]J.M.Tranquada *et al.*, Phys. Rev.B **78**, 174529(2008).
[2]Daou *et al.*, Nature Phys. **5**, 31 (2009).