Dichotomy in the $T$-linear resistivity in hole-doped cuprates - extended criticality and quasiparticle decoherence

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From analysis of the in-plane resistivity $\rho_{ab}(T)$ of La$_{2-x}$Sr$_x$CuO$_4$, we show that normal state transport in overdoped cuprates can be delineated into two regimes in which the electrical resistivity varies approximately linearly with temperature. In the low temperature limit, the $T$-linear resistivity extends over a very wide doping range, in marked contrast to expectations from conventional quantum critical scenarios. The coefficient of this $T$-linear resistivity scales with the superconducting transition temperature $T_c$, implying that the interaction causing this anomalous scattering is also associated with the superconducting pairing mechanism. At high temperatures, the coefficient of the $T$-linear resistivity is essentially doping independent beyond a critical doping $p_{\text{crit}} = 0.19$ at which the ratio of the two coefficients is maximal. Taking our cue from earlier thermodynamic and photoemission measurements, we conclude that the opening of the normal state pseudogap at $p_{\text{crit}}$ is driven by the loss of coherence of anti-nodal quasiparticles at low temperatures.