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A spectroscopic fingerprint of electron correlation in high temperature superconductors GEY-HONG GWEON, KAZUE MATSUYAMA, Univ of California-Santa Cruz, G.-D. GU, J. SCHNEELOCH, R.D. ZHONG, T.S. LIU, BNL — The so-called "strange metal phase" of high temperature (high Tc) superconductors remains at the heart of the high Tc mystery. Better experimental data and insightful theoretical work would improve our understanding of this enigmatic phase. In particular, the recent advance in angle resolved photoelectron spectroscopy (ARPES), incorporating low photon energies ($\approx$ 7 eV), has given a much more refined view of the many body interaction in these materials. Here, we report a new ARPES feature of $Bi_2Sr_2CaCu_2O_{8+\delta}$ that we demonstrate to have the key ability to distinguish between different classes of theories of the normal state. This feature–the anomaly in the nodal many body density of states (nMBDOS)–is clearly observed in the low energy ARPES data, but also observed in more conventional high energy ARPES data, when a sufficient temperature range is covered. We show that key characteristics of this anomaly are explained by a strong electron correlation model; the electron-hole asymmetry and the momentum dependent self energy emerge as key required ingredients. In particular, we find that, among many theories available for comparison, the phenomenological extremely correlated Fermi liquid (ECFL) model scores the best in terms of explaining the new anomaly feature.

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