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Momentum scaling of the marginal Fermi liquid continuum in $\mathbf{Bi_2Sr_2CaCu_2O_{8+x}}$[1] MATTEO MITRANO, ALI HUSAIN, SEAN VIG, MELINDA RAK, Univ of Illinois - Urbana, ANSHUL KOGAR, MIT, GENDA GU, Brookhaven National Laboratory, CHANDRA VARMA, Univ of California- Riverside, PETER ABBAMONTE, Univ of Illinois - Urbana — High-temperature superconductivity in cuprates emerges from a metal whose temperature-dependent resistivity and NMR relaxation rate cannot be described in terms of a simple Fermi liquid. One of the main theoretical proposals to account for these normal state properties is the so-called marginal Fermi liquid (MFL) theory. A fundamental hypothesis of the MFL theory is the existence of a universal, momentum-independent form for the density fluctuation spectrum, $\chi(q,\omega)$. The most direct evidence supporting a MFL scenario is the observation of an energy-independent continuum at $q = 0$ in Raman scattering experiments, but whether this exhibits the correct scaling form at $q \neq 0$ has never been established. Here we present a meV-resolution electron energy-loss spectroscopy measurement of the MFL momentum-dependence in the cuprate superconductor $Bi_2Sr_2CaCu_2O_{8+x}$ at optimal doping. We show that this continuum is present not only at q = 0, but rather extends throughout the entire Brillouin zone. Our study suggests that optimally-doped cuprates may be close to quantum criticality with strong, local normal-state fluctuations.

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