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Evolution of the electronic excitation spectrum with strongly diminishing hole-density in superconducting $Bi_2Sr_2CaCu_2O_{8+\delta}$ J.W. ALLDREDGE, JINHO LEE, Cornell University, K. MCELROY, University of Colorado, M. WANG, K. FUJITA, Cornell University, Y. KOHSAKA, Magnetic Materials Laboratory, RIKEN, C. TAYLOR, Cornell University, H. EISAKI, NI-AIST, S. UCHIDA, University of Tokyo, P.J. HIRSCHFELD, University of Florida, J.C. DAVIS, Cornell Univeristy — We use tunneling spectroscopy to measure the T>0 spectrum of electronic excitations N(E) over a wide range of hole-density in superconducting Bi2212. We introduce a parameterization for N(E) based an anisotropic d-wave energy-gap plus an effective scattering rate which varies linearly with energy. We demonstrate that this form of N(E) allows successful fitting of differential tunnelling conductance spectra throughout much of the Bi2212 phase diagram. A single, particle-hole symmetric, anisotropic energy-gap, in combination with a strongly energy dependent effective scattering rate, can describe the excitations without recourse to an additional energy gap of another ordered state. However we also observe two distinct and diverging energy scales in the system: the energy-gap maximum Δ_1 and a lower energy scale Δ_0 separating the spatially homogeneous and heterogeneous electronic structures.

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