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**Visualizing pair formation in  $Bi_2Sr_2CaCu_2O_{8+x}$** <sup>1</sup>

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Unlike traditional superconductors, the density of states (DOS) of the high- $T_c$  superconductor  $Bi_2Sr_2CaCu_2O_{8+x}$  shows large nanoscale variations that have been detected using scanning tunneling microscopy (STM) [1,2]. Such variations are seen in the low temperature superconducting gap [1] and in features associated with the coupling of pairs to boson modes [2]. In order to understand these variations in the spectra, we perform atomic resolution STM measurements of  $Bi_2Sr_2CaCu_2O_{8+x}$  as a function of temperature [3]. Using newly developed experimental techniques, we measure the evolution of the DOS from low temperature ( $T \ll T_c$ ) to temperatures where all gaps in the spectrum have disappeared ( $T > T^*$ ). Such measurements show that the pairing gap nucleates in nanoscale regions at temperatures between  $T_c$  and  $T^*$ . By normalizing the low temperature DOS ( $T \ll T_c$ ) to the DOS at high temperature, we are able to fit the superconducting DOS to the d-wave BCS form. We find that the experimental spectrum deviates from a simple d-wave fit indicating a strong coupling between electrons and bosonic modes. We will discuss the temperature evolution of these as well as other features in the DOS, and correlate such measurements with the inhomogeneity seen in the gap magnitude at low temperature.

1. C. Howald et. al. Phys Rev B **64**, 100504(R) (2001).
2. J. Lee et. al. Nature **442**, 546 (2006).
3. K. Gomes et. al. Nature **447**, 569 (2007).

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