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Inelastic Tunneling, Electronic Nanoscale Inhomogeneities and Local Pairing in Superconductor with Inhomogeneous Bosonic Modes[1]

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There is a growing experimental evidence that nanoscale electronic inhomogeneity plays defining role in a growing classes of materials. Recently scanning tunneling spectroscopy has reached the stage where electronic properties of materials can be imaged on a nanometer scale. Local tunneling data that indicate strong nanoscale inhomogeneity of superconducting gap in high temperature superconductors[1,2]. Strong local nanoscale inhomogeneity in the bosonic scattering mode has also been observed in the same samples. We argue that these two inhomogeneities are directly related to each other. To address local boson scattering effects, we would need to develop a local strong coupling model of pairing in a coarse grained superconducting state. I will present a simple strong coupling model that yields features that are broadly consistent with the doping and isotope substitution trends observed experimentally. Oxygen isotope substitution O16 ->O18 reveals nontrivial changes in boson mode energy. These changes and changes in electron-boson coupling will also be discussed. [1] A. V. Balatsky and J.-X. Zhu, Local Strong Coupling Pairing in d-wave superconductors, Phys. Rev. B **74**, 094517 (2006). A.V. Balatsky, Ar. Abanov and J.X. Zhu, Inelastic Tunneling Spectroscopy in d-wave Superconductor, Phys. Rev. B 68, 214506 (2003). J. X. Zhu et al, Effects of Collective Spin Resonance Mode on STM spectra in d-wave Superconductor, Phys. Rev. Lett. v 92, 017002, (2004). [2] J. Lee et al, Interplay of electron–lattice interactions and superconductivity in Bi2Sr2CaCu2O8 , Nature, v **442**, p 546, (2006).

[1]http://theory.lanl.gov, email: avb@lanl.gov. Work done in collaboration with A. Abanov, J.X. Zhu, J. C. Davis, S. Uchida, J. Lee, K. Fujita, K. McElroy. Supported by US DOE through BES and LDRD at Los Alamos.