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STM Observation of a Bosonic Mode in the Electron-Doped Superconductor $Pr_{0.88}LaCe_{0.12}CuO_{4-\delta}$

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Information on bosonic excitations in high temperature superconductors is part of a critical dataset that is necessary to decipher the puzzle of the pairing mechanism in these materials. In this talk, I will discuss our recent STM investigations of the electron-doped cuprate superconductor $Pr_{0.88}LaCe_{0.12}CuO_{4-\delta}$ (PLCCO) ($T_c = 24$ K). Our spectra reveal superconducting gaps with coherence peaks that disappear above T_c. In addition, multiple step/peak-like features are observed outside the gap. Such features in STM spectra are suggestive of bosonic excitations that couple strongly to the electrons. Analysis of the data indicates that the observed (bosonic) mode energy in PLCCO lies at 10.5±2.5 meV which is much lower than the bosonic mode observed in hole-doped BSCCO. The energy scale of our mode is the same as the magnetic resonance mode (spin-excitations) in PLCCOmeasured by inelastic neutron scattering but is also consistent with a low energy acoustic mode. Additionally, I will show that both the local mode energy and the intensity reveal correlations with the local gap energy scale. The sensitivity of the mode intensity to the energy scale of the onset of the continuum of excitations (2Δ) may indicate an electronic origin rather than phonons. This work was done in collaboration with F. C. Niestemski, S. Kunwar, S. Zhou, Shiliang Li, H. Ding, Ziqiang Wang, and Pengcheng Dai.