MAR05-2004-020120

Abstract for an Invited Paper
for the MAR05 Meeting of
the American Physical Society

The bosonic peak in Bi-2212: Is it caused by phonons or the 41 meV magnetic resonance?[1]

TOM TIMUSK, McMaster University

The infrared spectra of the high temperature superconductors are dominated by two features, a broad continuous background absorption extending to ≈ 1 eV and a sharp onset at $\hbar\omega \approx 8k_BT_c$. Dispersion curves of the free carriers in the same materials measured by angle resolved photo emission (ARPES) display strong curvature (termed the "kink") in the same spectral region suggesting that the IR absorption features are spectroscopic signatures of the bosonic excitations that scatter the carriers. The feature at $8k_BT$ has been attributed to the neutron scattering resonance, seen at (π, π) momentum transfer. We test this notion by tracking the IR mode as a function of doping level in $Bi_2Sr_2CaCu_2O_8$ and compare our data with ARPES dispersion. We also show new data on the temperature dependence of the mode strength in $YBa_2Cu_3O_x$ for the $x = 6.5$, the Ortho II, material where neutron data of the resonance is available for samples from the same source. The mode, as seen in the IR, weakens in a linear fashion as the temperature increases to completely vanish at ≈ 200 K in parallel with the neutron scattering mode. A phonon model for the bosonic mode would predict a temperature independent strength. Another interesting feature of the mode its frequency which scales with the superconducting transition temperature over a wide range of materials and doping levels in the optimally and over doped regions with an intercept at zero frequency. Model calculations for a *d*-wave superconductor are in accord with this behavior provided both the mode frequency and the gap scale with T_c, ruling out the phonon origin for the mode which is expected to have a doping and material independent frequency.

[1]Work done in collaboration with J. Hwang.