Optical Studies of Electron-boson Interactions in Superconductors

Jiufeng Tu

Physics Department, Brookhaven National Laboratory, Upton, NY 11973-5000

Electron-phonon coupling and in general electron-boson coupling, are essential for the formation of Cooper-pairs in superconductors. Infrared spectroscopy is a direct probe to study such interactions and their influences on superconductivity. In this talk, three representative superconductors will be discussed: Nb (T_c = 9.3 K), MgB_2 (T_c = 39.6 K) and OP Bi2212 (T_c = 91.5 K). The robustness of a second derivative technique will be established first in Nb by determining $\alpha^2F(\omega)$ in this classic BCS superconductor. The electron-phonon interaction is more intriguing in MgB_2 and λ_{tr} = 0.13 is determined from our optical data. This surprising result can be understood since the electron-phonon interaction is highly anisotropic in MgB_2. An electron-boson spectral function peaked at 43 meV is found in OP Bi2212 using the second derivative technique and is shown to be involved in the pair formation. In contrary to the recent suggestion, our data indicate that the zone-boundary phonons (~ 80 meV) alone are not sufficient to explain the superconducting properties in high-T_c cuprates and our data are consistent with the spin-fluctuation models.