NEW YORK CITY COLLEGE OF TECHNOLOGY

Physics Department

Seminar in Theoretical Physics

Strong electron-phonon coupling in copper-oxide superconductors

Presented by:

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Abstract

The attempt to understand copper oxide superconductors is complicated by the presence of multiple strong interactions. While many believe that antiferromagnetism is important for the superconductivity, there has been resurgent interest in the role of electron-lattice coupling. The recently studied conventional superconductor MgB_2 has a very strong electron-lattice coupling involving a particular vibrational mode (phonon) that was predicted by standard theory and confirmed quantitatively by experiment. Our inelastic neutron scattering measurements show that there is a similarly strong anomaly in the Cu-O bond-stretching phonon in cuprate superconductors $La_{2-x}Sr_xCuO_4$ (x=0.07, 0.15); however, this behavior is completely absent in conventional calculations. Instead, the anomaly is strongest in $La_{1.875}Ba_{0.125}CuO_4$ and $La_{1.48}Nd_{0.4}Sr_{0.12}CuO_4$, compounds that exhibit spatially modulated charge and magnetic order, often called stripe order. It occurs at a wave vector corresponding to the charge order. The results suggest that this giant electron-phonon anomaly, which is absent in undoped and over-doped non-superconductors, is associated with charge inhomogeneity. It follows that electron-phonon coupling may be important to understanding the superconductivity although its contribution to the mechanism is likely indirect.