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Resonant Inelastic X-ray Scattering in Correlated Electron Systems[1]

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Extremely bright photons generated at the new generation of synchrotron light sources have made a huge impact on various scientific disciplines ranging from biology to materials science. One of the exciting new developments is the use of x-rays in the field of solid-state spectroscopy. Inelastic x-ray scattering, analogous to the well-known inelastic neutron scattering, is a powerful tool for studying momentum-dependent electronic excitations and phonons. In particular, resonant inelastic x-ray scattering in the hard x-ray regime has been widely utilized to study the momentum dependence of various electronic excitations in strongly correlated electron systems. For example, by tuning the incident photon energy to the Cu K-edge, one can gain a large intensity enhancement as well as element specific knowledge of the electronic excitations in various copper oxide compounds. Most of the work to date has been focused on the charge-transfer excitation between the bonding and antibonding molecular orbitals, the excitation across the Mott gap, and crystal field excitations between the d-orbitals. Recent improvements in instrumentation have allowed us to observe a new mode in the mid-infrared frequency region. We will discuss the momentum dependence of these excitations in prototypical cuprate superconductors, $La_{2-x}Sr_xCuO_4$, and also examine the evolution of such excitations as charge carriers are doped into the system.

[1]Work done in collaboration with D. S. Ellis, S. Wakimoto, R. J. Birgeneau (Univ of Toronto), J. P. Hill (Brookhaven Natl Lab), G. Blumberg (Lucent), S. Komiya, Y. Ando (CRIEPI, Japan), D. Casa, and T. Gog (Argonne Natl Lab)