

Abstract Submitted  
for the MAR07 Meeting of  
The American Physical Society

**Intermediate energy structure of cuprates using Resonant Inelastic X-ray Scattering** JASON HANCOCK, GUILLAME CHABOT COU-TURE, LI LU, MARTIN GREVEN, KENJI ISHII, JUN'ICHIRO MIZUKI, Stan-ford, THOMAS GOG, DIEGO CASA, Argonne — We present a comprehensive study of the charge-transfer excitations in the 1-8 eV range using the burgeoning technique of resonant inelastic X-ray scattering (RIXS). Surprisingly, we find that the charge-transfer gap, distinct at around 2.25 eV in Mott insulating  $\text{La}_2\text{CuO}_4$ , is also discernible in the high- $T_c$  superconductor  $\text{HgBa}_2\text{CuO}_{4+\delta}$ . In addition, we are able to identify many distinct, weakly dispersive features above the charge-transfer gap of  $\text{La}_2\text{CuO}_4$  [1-3] and the model high- $T_c$  superconductor  $\text{HgBa}_2\text{CuO}_{4+\delta}$  [1]. De-tailed extension of this work in  $\text{La}_2\text{CuO}_4$  reveals previously unresolved systematics in the vicinity of the charge-transfer gap, and a distinct dependence on scattering geometry of both the charge-transfer gap and the high-energy excitations. We in-terpret this scattering-geometry dependence as arising from the intrinsic symmetry selectivity of the RIXS/Raman process, and suggest that similar experiments can give definitive identification of excitation symmetry. [1] L. Lu et al., Phys. Rev. Lett. 95, 217003 (2005). [2] L. Lu et al. (to appear Phys. Rev. B 74; cond-mat/0607311) [3] J. N. Hancock et al. (in preparation).

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Date submitted: 19 Nov 2006

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