Resonant Inelastic X-ray Scattering study of electron-exciton Coupling in high-T_c cuprates

F. Barantani[1,2], M. K. Tran[1], I. Madan[2], I. Kapon[1], N. Bachar[1], T. C. Asmara[3], E. Paris[3], Y. Tseng[3], W. Zhang[3], Y. Hu[4,5], E. Giannini[1], G. Gu[6], T. P. Devereaux[5,7,8], C. Berthod[1], F. Carbone[2], T. Schmitt[3], and D. van der Marel[1].

[1] *Department of Quantum Matter Physics, University of Geneva, 1211 Geneva, Switzerland*
[2] *Institute of Physics, École Polytechnique Fédérale de Lausanne, Lausanne, 1015, Switzerland*
[3] *Photon Science Division, Paul Scherrer Institut, 5232 Villigen PSI, Switzerland*
[4] *Department of Applied Physics, Stanford University, CA 94305, USA*
[5] *Stanford Institute for Materials and Energy Sciences, SLAC, CA 94025, USA*
[6] *Brookhaven National Laboratory, Upton, NY 11973 5000, USA*
[7] *Department of Materials Science and Engineering, Stanford University, Stanford, CA 94305, USA*
[8] *Geballe Laboratory for Advanced Materials, Stanford University, CA 94305, USA*

Studying the interactions which cause electrons to form Cooper pairs is the first step towards the understanding of the superconductivity mechanism in the high-T_c cuprates. Pairing can be mediated by phonons, the screened Coulomb force, spin or charge fluctuations, excitons, or by a combination of these [1,2,3,4]. An exciton-mediated pairing mechanism has been postulated [4,5], but experimental evidence for coupling between conduction electrons and excitons in the cuprates is sporadic [6].
In this work, we use resonant inelastic x-ray scattering (RIXS) to follow the temperature dependence of the *dd* exciton spectra of $Bi_2Sr_2CaCu_2O_{8-x}$ (Bi-2212) crystals with different charge carrier concentrations. We observe a signature of the superconducting transition on the *dd* exciton spectra: in the proximity of T_c the *dd* exciton peak first moment shows a change of slope in its temperature dependence, which reverses sign as function of doping. We attribute the superconductivity-induced effect and its sign-reversal from underdoped to overdoped to the exchange coupling of the site of the $\underline{d}d$ exciton to the surrounding copper spins.

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