The study of magnetic excitations of cuprates with Resonant Inelastic X-Ray Scattering: results and perspectives

Lucio Braicovich

INFM-CNR, Dipartimento di Fisica del Politecnico di Milano, Italy

We have recently found (1,2) that Resonant Inelastic X-ray Scattering (RIXS) at the L_3-edge of Copper can be used to measure the dispersion of spin excitations in cuprates both undoped and doped (see also (3,4)). Up to now this was possible only with neutron scattering. Indeed the x-rays (used in the RIXS mode) extend dramatically the possibilities of experimental work since it becomes possible to study very tiny objects not accessible to neutrons as thin films and, in perspective, nano-objects having both fundamental and technological interest. The cases of La_2CuO_4 and $L_{(2-x)}Sr_xCO$ will be used as a benchmark and in particular we will show that single magnons are seen with RIXS in La_2CuO_4 in perfect agreement with neutrons. Moreover the x-rays have already shown new features in doped systems not seen with neutrons so that the cross fertilization between the two approaches is expected to be particularly promising. In particular in $L_{(2-x)}Sr_xCO$ we have seen spin excitations up to high energies (around 300 meV) surviving to doping in the under-doped regime (8% holes) a fact not known up to now. We show also that the sensitivity and selectivity of RIXS allow the study of the strain effects on very thin films of $CaCuO_2$; this new approach gives the simultaneous measurement of the "pressure" effect on super-exchange and on crystal field. Finally the perspectives of RIXS at the ESRF are discussed.

1. L. Braicovich, L. J. Ament, V. Bisogni, F. Forte, C. Aruta, G. Balestrino, N. B. Brookes, G. M. De Luca, P. G. Medaglia, F. Miletto Granozio, M. Radovic, M. Salluzzo, J. van den Brink, and G. Ghiringhelli, Phys. Rev. Lett. **102**, 167401 (2009).

2 L. J. P. Ament, Giacomo Ghiringhelli, Marco Moretti Sala, Lucio Braicovich, and J van den Brink, Phys. Rev. Lett. **103**, 117003 (2009).

3. J. Schlappa, T. Schmitt, F. Vernay, V. N. Strocov, V. Ilakovac, B. Thielemann, H. M. Ronnow, S. Vanishri, Andrea Piazzalunga, X. Wang, Lucio Braicovich, Giacomo Ghiringhelli, C. Marin, J. Mesot, B. Delley, and L. Patthey, Phys. Rev. Lett. **103**, 047401 (2009).

4. L. Braicovich, J. van den Brink, V. Bisogni, M. Moretti Sala, L.J.P. Ament, N.B. Brookes, G.M. De Luca, M. Salluzzo, T. Schmitt,V. Strocov, G. Ghiringhelli, arXiv:0911.0621