

Resonant inelastic scattering and absorption spectroscopies for the study of fast magnetic dynamics in solids

Giacomo Ghiringhelli^{1,2}

¹ *Dipartimento di Fisica, Politecnico di Milano, piazza Leonardo da Vinci 32, 20133 Milano, Italy*

² *CNR/INFM Coherencia and Soft, Italy*

email: giacomo.ghiringhelli@fisi.polimi.it

The study of magnetic properties by x-ray spectroscopy relies much on the spin-orbit interaction. Working at the L edges of 3d transition metals is thus ideal, as demonstrated by the success of x-ray magnetic circular dichroism (XMCD) for ferromagnetic systems. More recently also the resonant inelastic x-ray scattering (RIXS) has been used to probe the magnetic properties of antiferromagnetic materials, such as cuprates. With RIXS it is possible to determine the dispersion of spin waves in analogy to what is commonly done using inelastic neutron scattering [1,2,3]. Moreover inelastic scattering has been used to directly probe the magnetic dynamics by means of the core-hole lifetime as a stopwatch [4].

The advent of FELs offers an opportunity to use XMCD and RIXS with short pulses in a pump-probe experimental scheme. What experiments can we imagine for FELs in the domain of resonant spectroscopies? For what scientific purposes in the field of magnetism? I will try to bring some contributions to the discussion starting from my personal experience with XMCD and RIXS.

[1] L. Braicovich, L. J. P. 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] G. Ghiringhelli, A. Piazzalunga, C. Dallera, T. Schmitt, V. N. Strocov, J. Schlappa, L. Patthey,

X. Wang, H. Berger, and M. Grioni, *Phys. Rev. Lett.* **102**, 027401 (2009)

[3] 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V. Bisogni, M. Moretti Sala, L.J.P.Ament, N.B. Brookes, G.M. De Luca, M. Salluzzo, T. Schmitt, and G. Ghiringhelli, unpublished

[4] L. Braicovich, G. Ghiringhelli, A. Tagliaferri, G. van der Laan, E. Annese, and N. B. Brookes, *Phys.Rev. Lett.* **95**, 267402 (2005); L. Braicovich and G. van der Laan, *Phys. Rev. B* **78**, 174421 (2008)