European XFEL Science Seminar

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Video Conference, via Zoom

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RIXS, phonons and charge density fluctuations

Having reached the 30 meV experimental resolution range, we are eventually in the position of fully exploiting the ability of resonant inelastic soft x-ray scattering (RIXS) of probing all relevant degrees of freedom in solids. In fact, RIXS spectra can be used to map the dispersion of spin excitations [1], to determine ligand field energies [2,3], to measure the electron-phonon coupling of optical modes [4,5], to spot out charge density spatial modulations and associated fluctuations [6]. I will review some of our recent results, mostly on superconducting cuprates and on SrTiO3, highlighting how useful it can be to have in the same spectra orbital, spin, charge and phonon excitations when it comes to understanding the intertwining among them [5,7]. To conclude, a couple of questions. How can we envisage the combination of RIXS with optical pumps at XFEL? Are there other ways of exploiting the special properties of the XFEL pulses in RIXS spectroscopy? The user community is working on some possible answer.

[1] Y. Y. Peng, E. W. Huang, R. Fumagalli, M. Minola, Y. Wang, X. Sun, Y. Ding, K. Kummer, X. J. Zhou, N. B. Brookes, B. Moritz, L. Braicovich, T. P. Devereaux, and G. Ghiringhelli, Dispersion, damping, and intensity of spin excitations in the monolayer (Bi,Pb)2(Sr,La)2CuO6+δ cuprate superconductor family, Phys. Rev. B 98, 144507 (2018)
[2] Roberto Fumagalli, Abhishek Nag, Stefano Agrestini, Mirian Garcia-Fernandez, Andrew C. Walters, Davide Betto, Nicholas B. Brookes, Lucio Braicovich, Ke-Jin Zhou, Giacomo Ghiringhelli, and Marco Moretti Sala, Crystalline and magnetic structure of Ba2CuO3+δ investigated by x-ray absorption spectroscopy and resonant inelastic x-ray scattering arXiv:2004.11651 (2020)
[3] Roberto Fumagalli, Jonas Heverhagen, Davide Betto, Riccardo Arpaia, Matteo Rossi, Daniele Di Castro, Nicholas B. Brookes, Marco Moretti Sala, Maria Daghofer, Lucio Braicovich, Krzysztof Wohlfeld, Giacomo Ghiringhelli, Mobile orbitons in Ca2CuO3: crucial role of the Hund's exchange, arXiv:2003.06401 (2020)
[4] Matteo Rossi, Riccardo Arpaia, Roberto Fumagalli, Marco Moretti Sala, Davide Betto, Kurt Kummer, Gabriella M. De Luca, Jeroen van den Brink, Marco Salluzzo, Nicholas B. Brookes, Lucio Braicovich, and Giacomo Ghiringhelli, Experimental Determination of Momentum-Resolved Electron-Phonon Coupling, Phys. Rev. Lett. 123, 027001 (2019)
[5] Lucio Braicovich, Matteo Rossi, Roberto Fumagalli, Yingying Peng, Yan Wang, Riccardo Arpaia, Davide Betto, Gabriella M. De Luca, Daniele Di Castro, Kurt Kummer, Marco Moretti Sala, Mattia Pagetti, Giuseppe Balestrino, Nicholas B. Brookes, Marco Salluzzo, Steven Johnston, Jeroen van den Brink, Giacomo Ghiringhelli, Determining the Electron-Phonon Coupling in Superconducting Cuprates by Resonant Inelastic X-ray Scattering: Methods and Results on Nd1+xBa2−xCu3O7−δ Phys. Rev. Research in press (arXiv:1906.01270) (2020)
[6] R. Arpaia1, S. Caprara, R. Fumagalli, G. De Vecchi, Y. Y. Peng, E. Andersson, D. Betto, G. M. De Luca, N. B. Brookes, F. Lombardi, M. Salluzzo, L. Braicovich, C. Di Castro, M. Grilli, G. Ghiringhelli, Dynamical charge density fluctuations pervading the phase diagram of a Cu-based high-Tc superconductor, Science 365, 906 (2019)
[7] Andrey Geondzhian, Alessia Sambri, Gabriella M. De Luca, Roberto Di Capua, EmilianoDi Gennaro, Davide Betto, Matteo Rossi, Ying Ying Peng, Roberto Fumagalli, Nicholas B. Brookes, Lucio Braicovich, Keith Gilmore, Giacomo Ghiringhelli, and Marco Salluzzo, Large polarons as key quasiparticles in SrTiO3 and SrTiO3-based heterostructures, unpublished.

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