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Electron itinerancy, orbital symmetry and itinerant spin fluctuations in Fe-based superconductors as revealed by soft x-ray spectroscopies[1]

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The discovery of superconductivity with critical temperature exceeding 55 K in the iron-pnictides (FeSC) compounds has offered the community a new set of materials hosting high temperature superconductivity [1]. In this talk, I will discuss some of our most important results obtained with complementary soft x-ray spectroscopies such as core level and Angle Resolved Photoemission (ARPES) and x-ray absorption (XAS) on different families of FeSC compounds. Results concerning two main aspects particularly important for the physics of the FeSC materials will be discussed, namely 1) the bonding topology/orbital symmetry, and 2) the presence of spin fluctuations. The symmetry of the orbitals and their hybridization play a central role in the interplay between magnetism and superconductivity, and in the nature of the superconducting pairing. I will discuss the symmetry and topology of the occupied and unoccupied orbitals by presenting results of polarization-dependent ARPES and element-specific XAS measurements of the electronic structure in the normal state of $BaFe_2As_2$ and $BaFe_{1.8}Co_{0.2}As_2$ single crystals. I will then focus on discussing how the presence of exchange multiplets in the Fe $3s$ photoemission spectra in different FeSC materials are indicative of the presence of fluctuating spin moments on the Fe sites. Due to extremely fast time scales involved, the detection of magnetic fluctuations by means of magnetic probes has so far remained elusive. Our experiment provides a strong test case for the occurring of itinerant magnetic fluctuations, whose detection has been made possible by the extremely fast time scales proper of the photoemission process. The Fermi surface topology revealed by ARPES experiments in different FeSC compounds and its possible relation to the presence of magnetic fluctuation will also be discussed.

[1] Y. Kamihara, et al., *J. Am. Chem. Soc.* **130**, 3296 (2008).

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