Electronic Structure of Quantum Materials by Angle-Resolved PhotoEmission Spectroscopy

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Quantum materials represent the new generation of functional materials such as 2D materials, high temperature superconductor and topological material showing exotic electronic properties. Angle Resolved PhotoEmission Spectroscopy (ARPES) is a very powerful tool to explore and understand the underlining electronic structure of such materials. In this presentation, I will give an overview of the Diamond I05-ARPES beamline offering a high-resolution ARPES endstation and the spatially resolved ARPES endstation to the international user community. The recent discovery of 3D Dirac Fermion [1] and the Weyl Fermion [2] highlight the power of such technique.

In the high-Tc superconductor $YBa_2Cu_4O_8$, the cleaved surface present a termination of CuO chain and CuO_2 plan domains. Using spatially resolved ARPES (nano-ARPES) we are able to resolve both domains and characterised the band dispersion. We observe the first quasiparticle dispersions and Fermi surfaces of the double CuO chains buried underneath the CuO_2-plane block. The metallic behaviour of the double CuO chains are consistent with the bulk transport properties [3] while quite different from those in the CuO-terminated surface as reported by previous micro-ARPES studies [4]. We find a relatively reduce electron correlation suggesting the increase of the electron dimensionality in the CuO chains due to charge transfer between the CuO chains and CuO_2 planes.

REFERENCES

[1] Liu, Z.K. et al., Nature Materials 13, 677 (2014), [2] Xu, S.-Y. et al., Science 349, 613 (2015), [3] Hussey, N. E. et al., Phys. Rev. B 56, R11423 (1997), [4] Kondo, Takeshi et al., Phys. Rev. Lett. 105, 267003 (2010)

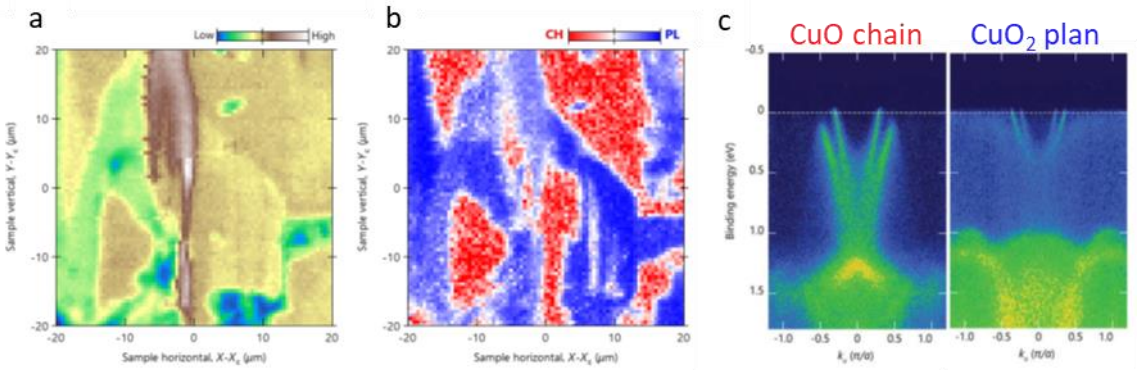

Fig. 1. Spatially resolved electronic structure of Y124. a) Total intensity mapping. b) Spatial resolved domains of the CuO-chain (red) and BaO terminated (blue) surfaces. c) Band dispersion measured along Y-Γ-Y high-symmetry for chain-terminated surface (left panel) and for CuO_2 plan region (right panel).