Ultra-low temperature ARPES on strontium ruthenates

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Strontium ruthenates are well known for their unconventional p-type superconductivity, metamagnetism, proximity to a quantum critical point along with the notable effects of spin–orbit coupling. In particular, understanding the superconductivity in single-layered Sr_2RuO_4 requires a detailed knowledge of its electronic structure. As the early photoemission and scanning tunnelling microscopy experiments were confronted with a problem of surface reconstruction, surface ageing was proposed as a solution to access the bulk states. We demonstrate that, in the case of Sr_2RuO_4, circularly polarized light can be used to distinguish between signals from the bulk and surface layers, thus opening a possibility to investigate many-body interactions both in bulk and surface bands [1, 2]. The proposed procedure enabled us to detect an unexpected splitting of the surface β band and a notable difference in the renormalization of the bulk and surface α band. We argue that Rashba effect at the surface might be responsible for the splitting of the surface β band, while enhanced electron-phonon coupling at the surface may explain stronger renormalization of the surface α band.

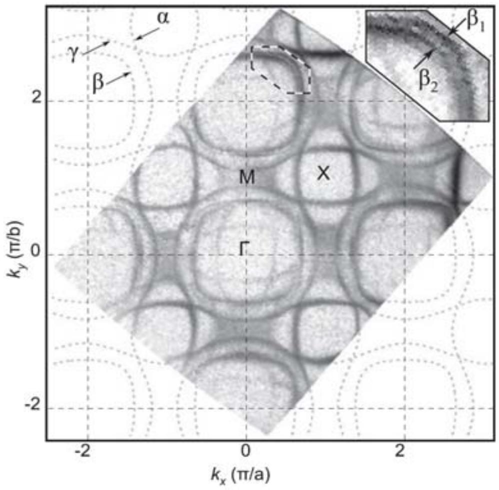

Fig. 1. Experimental Fermi surface of Sr_2RuO_4, demonstrating splitting of the surface β band. (For details see ref. [1])

Further, combining our experimental data with tight-binding (TB) approach, we produce a maximally precise description of low energy band structure of Sr_2RuO_4 [3]. The resulting model can be used to obtain band velocity and orbital character for any arbitrary momentum point. In particular, the density of states, and hence Sommerfeld coefficient γ~40mJ/molRuK^2, is in perfect agreement with direct bulk sensitive measurements. The developed model is meant to be used as more realistic input for various calculations aimed at understanding of unconventional superconductivity in Sr_2RuO_4.

[1] Zabolotnyy V. B. *et al.* New J. Phys. 14 063039 (2012)
[2] Zabolotnyy V. B. *et al.* Phys. Rev. B 76, 024502 (2007)
[3] Zabolotnyy V. B. *et al.* ArXiv:1212.3994 (2012)