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Strong Spin-Orbit Coupling Effects on the Fermi Surface of Sr_2RuO_4[1]

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The Fermi surface of Sr_2RuO_4 was studied by a wide variety of probes, establishing this material as the first complex oxide for which the de Haas-van Alphen bulk transport technique [1] and surface- sensitive angle-resolved photoemission spectroscopy (ARPES) [2] have arrived at a precise quantitative agreement. This result was obtained by exploiting temperature as an empirical cleaving parameter in suppressing the photoemission intensity associated with the reconstructed surface of the material [2]. On the basis of STM experiments [3], we have been able to show that this is a consequence of a temperature-dependent increase in the surface density of defects at the mesoscopic scale, and might be used as an effective mean to gain bulk-representative information by ARPES on unstable oxide surfaces. By comparing these bulk ARPES results to first-principle calculations, we provide evidence for the importance of spin-orbit coupling effects [4]. Subtle Fermi surface modifications are observed whenever the bands are nearly degenerate; most importantly, however, spin-orbit coupling induces a strong momentum dependence, normal to the RuO_2 planes, for both orbital and spin character. These findings have profound implications for the understanding of unconventional superconductivity in Sr_2RuO_4.

[1] Bergemann *et al.*, PRL **84**, 2662 (2000).
[2] A. Damascelli *et al.*, PRL **85**, 5194 (2000).
[3] Y. Pennec *et al.*, PRL **101**, 216103 (2008).
[4] M.W. Haverkort *et al.*, PRL **101**, 026406 (2008).

[1]In collaboration with M.W. Haverkort, I.S. Elfimov, L.H. Tjeng, and G.A. Sawatzky.