Low energy electronic structure in strontium ruthenates: from surface distortions to magnetic-field control of the electronic structure

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The phenomenology and radical changes seen in materials properties traversing a quantum phase transition has captivated condensed matter research over the past decades. Strong electronic correlations lead to novel ground states, including magnetic order, nematicity and unconventional superconductivity. To provide a microscopic model for these requires knowledge of the electronic structure in the vicinity of the Fermi energy. The strontium ruthenates provide a family of ideal model systems to explore this physics using spectroscopic techniques: they exhibit an anisotropic, quasi-two-dimensional electronic structure and occur as single-, double- and triple-layer compounds with similar crystal structure but disparate ground states ranging from unconventional superconductivity via metamagnetism to itinerant ferromagnetism. In the metamagnetic compounds, spectroscopic information about the low energy electronic structure would allow verification of different scenarios that have been proposed to explain their exotic properties. I will present spectroscopic imaging of the electronic structure performed at temperatures down to 100mK[1] and in vector-magnetic fields, and discuss the implications for the low energy electronic structure. Notably, for several of the strontium ruthenates the surface provides a platform to study the properties of the electronic structure under conditions not accessible in the bulk.[2,3] Combination of quasi-particle interference imaging with tight-binding models derived from density functional theory enables an in-depth understanding of these emergent electronic states.[4]

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