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High resolution photoemission studies of strongly correlated electron systems

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Strongly correlated materials present us with some of the biggest challenges in materials science today. Among these challenges is an understanding of the elementary or low energy excitations. Can we still consider the excitations as Landau quasiparticles or do we need to think in terms of fractionalization. By comparing observations from both elementary metallic systems and strongly correlated materials, modern high resolution photoemission is beginning to offer some answers to these questions. Here we discuss two systems, both materials that become superconductors as the temperature is lowered. The first an optimally doped high Tc cuprate, makes the transition from a non Fermi liquid at high temperatures directly into the superconducting state at 90K. The second system, a ruthenate, goes from a non-Fermi liquid into Fermi liquid before becoming a superconductor at the much lower temperature of 1K. We use photoemission to examine the nature of the excitations in these systems. In the case of the cuprate we show that the scattering rates display a cubic dependence on binding energy and temperature in the superconducting state. In the case of the ruthenate we show that there is a marked symmetry dependence in the scattering rates and that this symmetry dependence correlates at a microscopic level with transport measurements at a macroscopic level.

Keywords : photoemission, strongly correlated electrons