Testing Fermi Liquid Theory in Cuprate Superconductors: ARPES and Neutron Scattering Studies

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Abstract

Interacting electron systems encompass some of the most challenging problems in condensed matter physics. In one limit, where the electrons are completely delocalized, we have the metallic state. Here Landau’s Fermi-liquid theory (FLT) has formed the cornerstone of our understanding of normal metals since its inception in the 1950’s. In the opposite limit, the electrons are localized on lattice sites, and the system is an insulator. Interactions between electrons then may give rise to an ordered magnetic state. It turns out that the Cu-based perovskites, which were shown, more than 20 years ago, to become superconducting can be tuned between these two limits. Using state-of-the-art momentum resolved spectroscopy techniques of both electrons (photoemission) and spins (neutron scattering) in cuprates, it is possible to experimentally test the validity of FLT and, more important, its breakdown as one approaches the insulating state.