

MAR11-2010-001143

Abstract for an Invited Paper
for the MAR11 Meeting of
the American Physical Society

Finite doping signatures of the Mott transition in the two-dimensional Hubbard model

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The evolution from the conventional metal at high doping to the Mott insulator at zero doping remains a central problem in physics of copper-oxide superconductors. Here we solve the cellular dynamical mean-field equations [1,2] for the two-dimensional Hubbard model on a plaquette with continuous-time quantum Monte Carlo [3,4]. The normal-state phase diagram as a function of temperature T , interaction strength U , and filling n reveals that, upon increasing n towards the Mott insulator, there is a surface of first-order transition between two metals at nonzero doping. That surface ends at a finite temperature critical line originating at the half-filled Mott critical point [5,6]. There is a maximum in scattering rate associated with this transition. These findings suggest a new scenario for the normal-state phase diagram of the high temperature superconductors. The criticality surmised in these systems can originate not from a $T=0$ quantum critical point, nor from the proximity of a long-range ordered phase, but from a very low temperature transition between two types of normal state metals at finite doping. The influence of Mott physics extends well beyond half-filling.

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