Quantum Critical Transport Near the Mott Transition

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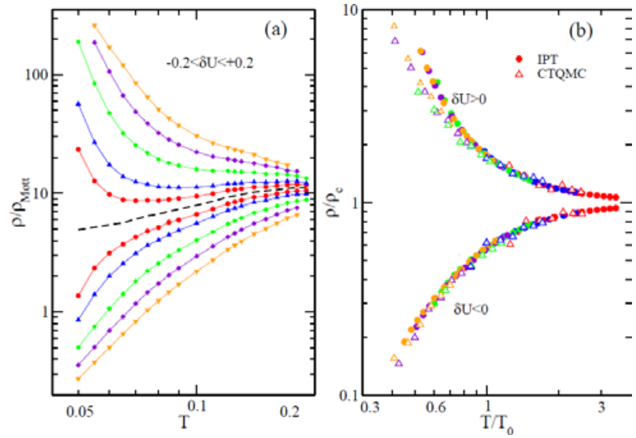
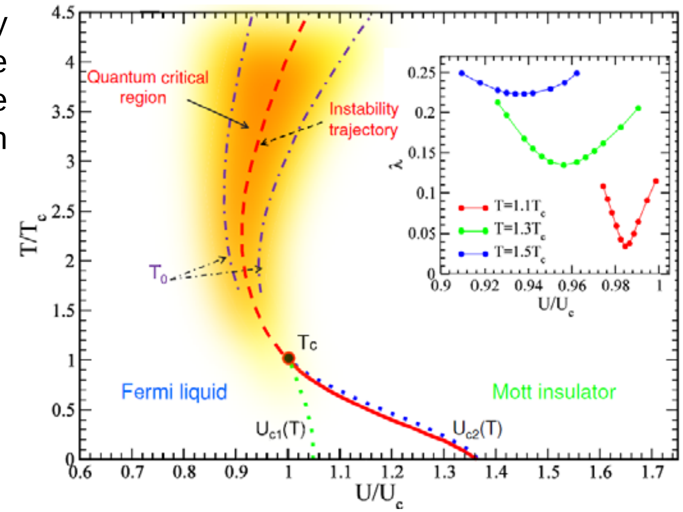
Many systems close to the metal-insulator transition (MIT) often display surprisingly similar transport features in the high temperature regime, with the entire family of curves displaying beautiful scaling behavior, with a remarkable ``mirror symmetry'' of the relevant scaling functions. But under which microscopic conditions should one expect such scaling phenomenology?

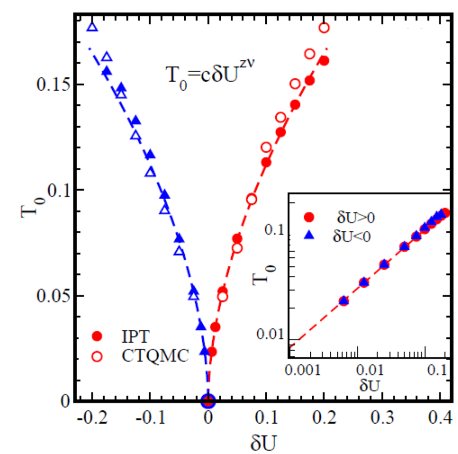


(a) DMFT resistivity curves as function of temperature along different trajectories -0.2<δU<0.2 with respect to the instability line δU=0. (b) Scaled resistivity.



DMFT phase diagram of the fully frustrated half-filled Hubbard model. The curvature of the free energy functional is minimal along the instability trajectory U*(T). Control parameter is δU=U- U*(T).

To answer this question, we perform a systematic DMFT study of incoherent transport in the high temperature crossover region of the half-filled one-band Hubbard model. We demonstrate that the family of resistivity curves displays characteristic quantum critical scaling of the form $\rho(T,\delta U) = \rho_c(T) f(T/T_o(\delta U))$ with $T_o(\delta U) \sim |\delta U|^{z\nu}$, and $\rho_c(T) \sim T$. The corresponding β-function displays a ``strong coupling'' form ,$\beta \sim \ln(\rho_c/\rho)$, reflecting the peculiar mirror symmetry of the scaling curves. This behavior indicates that Mott quantum criticality may be acting as the fundamental mechanism behind the unusual transport phenomena in many systems near the MIT.



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