MAR12-2011-000976

Abstract for an Invited Paper
for the MAR12 Meeting of
the American Physical Society

**Infinite-randomness criticality in disordered metals and superconductors**[1]

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Quantum phase transitions in disordered systems often display unconventional behavior which is dominated by rare strongly coupled spatial regions. In this talk, we investigate magnetic and superconducting quantum phase transitions in disordered metallic systems. We develop a strong-disorder renormalization group method that accounts for both quenched disorder and the dissipation of the critical modes due to the Fermi sea. We find that the quantum phase transition in Heisenberg anti-ferromagnets and the pair-breaking superconductor-metal transition are both governed by non-perturbative infinite-randomness critical points. Even stronger disorder effects arise for metallic magnets with Ising spin symmetry in which the quantum phase transition is completely destroyed by smearing. We determine thermodynamic and transport properties at these transitions and in the associated quantum Griffiths phases. We also discuss the current status of experimental observations of these exotic disorder phenomena in a variety of systems including transition metal compounds, heavy-fermion systems, and superconducting nanowires.

[1]Supported by the NSF under grant No. DMR-0906566.