

Multifractal Quantum Spin Phases at Kondo-Anderson Transitions

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Dilute magnetic impurities in a disordered Fermi liquid are considered close to the Anderson metal-insulator transition (AMIT). The multifractal correlations in the critical state are shown to result in a wide distribution of indirect exchange couplings and of the Kondo temperature. The competition between Kondo screening and the exchange coupling of magnetic moments yields coupled spin clusters surrounded by wide regions where the magnetic impurities are Kondo-screened, and rare sites where the quantum spins of the magnetic impurities remain free. We find a phase diagram with finite temperature transitions between insulator, critical semimetal,¹ and metal phases. These new types of phase transitions, Kondo-Anderson transitions (KATs), are caused by the interplay between the Kondo screening and the Anderson localization transition, which is shifted by the temperature dependent spin flip scattering rate.

¹S. Kettemann, E. R. Mucciolo, I. Varga, Phys. Rev. Lett. **103**, 126401, (2009)