From weak to strong correlation: a new renormalization group approach to strongly correlated Fermi liquids

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Abstract:

Strong renormalization effects in heavy fermion Fermi liquids are due to the enhanced spin fluctuations, which in turn are caused by the strong local Coulomb interactions. These fluctuations can however be suppressed by the application of an external magnetic field so the degree of renormalization can be controlled. We can start from a system in an extremely strong magnetic field, such that the renormalization effects are very weak, and then continuously reduce the field to zero to enter the strong correlation regime. The Fermi liquid parameters, which determine the low energy behaviour, then evolve continuously as a function of the magnetic field value. We illustrate this quantitatively for an impurity Anderson model, using the numerical renormalization group (NRG) to determine the Fermi liquid parameters, and then show how we can reproduce these results using a renormalized perturbation theory, starting from mean field theory in the high field regime. The application to a wider class of strong correlation models will be discussed.

We will also consider an alternative strategy for moving from the weak to the strong correlation regime as a function of the chemical potential, and discuss some recent results on the convergence of energy scales at some local quantum critical points. These lead to some conjectures regarding Kondo collapse and omega/T scaling in some heavy fermion materials.