Equilibrium and non-equilibrium transport in quantum dots and nano-constrictions

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Recent advances in nanotechnology have made it possible to fabricate tunable quantum dots in the Kondo regime. This has raised the necessity to explore structure and transport in such correlated systems in more complex situations as well as in nonequilibrium. It is shown that the presence of several correlated local orbitals in a Kondo defect gives rise to multiple Kondo peaks. A generalized Friedel sum rule leads to an approximate conductance quantization in such systems, relevant for transport through multi-level nano-constrictions. Multiple Kondo resonances have recently been identified experimentally in Ce-based heavy fermion systems by high-resolution photoemission spectroscopy. Furthermore, the Kondo effect is analyzed at large transport bias voltage, using a novel, perturbative renormalization group technique valid in nonequilibrium. The results for the nonlinear differential conductance through Kondo quantum dots in a magnetic field are discussed in comparison with experiments,