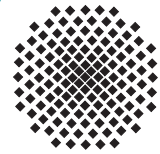


# Stuttgarter Physikalisches Kolloquium

Max-Planck-Institut für Intelligente Systeme  
Max-Planck-Institut für Festkörperforschung  
Fachbereich Physik, Universität Stuttgart

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17.15 Uhr

Hörsaal 2 D5

Stuttgarter Max-Planck-Institute, Heisenbergstraße 1, 70569 Stuttgart-Büsnau

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## Strongly interacting electrons: from Kondo effect to quantum criticality

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### Abstract

About 50 years ago, Jun Kondo explained a phenomenon in solid-state physics that at that time had been around already for three decades and had defied an explanation: the low-temperature resistance minimum in metals containing dilute magnetic impurities. His calculation showed that the minimum arises from a temperature dependent interaction of conduction electrons with those impurities, leading to an increase of the electron scattering rate towards low temperature. Today, the term *Kondo effect* entails many phenomena associated with this interaction. Around each impurity, a "local" Fermi liquid is formed.

Starting in the 70's, intermetallic compounds with a stoichiometric array of rare-earth "impurities" were investigated. In many cases, these compounds exhibit features of the Kondo effect in the dilute case. The lattice-coherent superposition of the Kondo "impurities" leads to a Fermi liquid with electronic quasiparticles of very large effective masses (up to several hundreds of the free-electron mass). These *heavy-fermion systems* can exhibit most unusual properties such as superconductivity arising from the heavy quasiparticles, or unusual types of magnetic order.

Subsequently, it was found that the transition between a magnetic and nonmagnetic ground state can be easily achieved by a non-thermal parameter such as pressure, magnetic field, or composition. These phase transitions, if of second order, reveal unusual critical properties nicknamed "non-Fermi-liquid behavior" due to the fact that the quantum energy of fluctuations becomes a relevant energy scale as the temperature is lowered toward absolute zero. Several different types of *quantum phase transitions* have been identified, as will be discussed in this talk. Examples of these quantum phase transitions will be introduced and different routes to quantum criticality will be discussed.