Spin Correlations and Free Magnetic Moments in Disordered Mesoscopic Metals

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A local magnetic impurity is known to change the whole ground state of a Fermi liquid due to correlations created by the exchange interaction between its spin and the delocalised electrons in a metal. As a result, the electron scattering and thereby the resistance is enhanced, and the magnetic impurity spin is screened at low temperatures, the Kondo effect.

On the other hand, the exponential increase of the low temperature resistance of disordered metals, the Anderson localisation is the macroscpic manifestation of quantum coherent scattering of the electrons from impurities.

One is thus lead to the question how in low dimensional disordered metals with magnetic impurities both effects, the Kondo effect and the Anderson localisation, do compete with each other.

We present recent results, showing how the Kondo effect is quenched by Anderson localisation, but Anderson localisation is enhanced by the Kondo effect. The resulting quantum phase diagram of disordered, correlated low dimensional electron systems is discussed [1]. Furthermore, the Kondo temperature itself is found to be distributed with a width that exceeds the expectations from the analogue of the Anderson Theorem [2,3].

Possible consequences at finite temperature, like non-Fermi liquid behaviour and anomalous temperature dependence of the dephasing rate are discussed and compared with experiments.

[1] S. K., Proceedings of the V. Rencontre de Moriond (2004)
[2] S. K. and M.E. Raikh, Phys. Rev. Lett. 90, 146601 (2003)
[3] S.K. And E. Mucciolo, arXiv:cond-mat/0509251 (2005)