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ENERGY RELAXATION DUE TO MAGNETIC IMPURITIES IN MESOSCOPIC WIRES: LOGARITHMIC APPROACH

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The transport in mesoscopic wires with large applied bias voltage has recently attracted great interest by measuring the energy distribution of the electrons at a given point of the wire, in Saclay. In the previous theoretical works of different authors extensive numerical calculations were presented, but the relative importance of the different effects was hidden. The main goal of the present talk is to break up the calculation and show how the final result is formed step by step. In the diffusive limit with negligible energy relaxation the energy distribution shows two sharp steps at the Fermi energies of the two contacts. Those steps are, however, broadened due to the energy relaxation which is relatively weak if only a Coulomb electron-electron interaction is assumed. In some of the experiments the broadening is more essential, reflecting an anomalous energy relaxation rate proportional to E-2 instead of E-3/2 where E is the energy transfer. Later it has been suggested that such a relaxation rate can be due to the electron-electron interaction mediated by Kondo impurities which is, as has been known for a long time, singular in E. In the present paper the magnetic-impurity-mediated interaction is systematically studied in the logarithmic approximation valid above the Kondo temperature. In the case of large applied bias voltage Kondo resonances are formed at the steps of the distribution function and they are narrowed by increasing the bias. An additional Korringa energy broadening occurs for the spins by creating electron-hole pairs in the electron gas out of equilibrium. That smears the Kondo resonances, and the renormalized coupling can be replaced by a smooth but essentially enhanced average coupling and that enhancement can reach the value 8-10. Thus the experimental data can be described by formulas without logarithmic Kondo corrections, but with enhanced coupling. In certain regions of large bias, that averaged coupling depends weakly on the bias. In those cases the distribution function depends only on the ratio of the electron energy and the bias, showing scaling behavior.

- O. Újsághy, A. Jakovác and A. Zawadowski, Phys. Rev. B 72, 205119 (2005)

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