Dephasing effect in the presence of spin dependent scattering

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Phase coherence of electron motion leads to quantum interference effects observable in the conductance. It is well known that the measurement of a voltage at some point in a sample destroys the phase coherence of the whole sample [1, 2]. The mechanism by which the measurement of a voltage destroys phase coherence is that an electron which enters the voltage probe loses its phase memory. The Schottky barrier between the voltage probe and the sample, therefore, enables us to control the dephasing rate. It has been shown that the addition of a voltage probe results in a sharper conductance distribution[2].

Recently, we have pointed out that spin scatterers as well as Zeeman splitting in the leads attached to the sample, cause a reduction of the variance of the conductance distribution [3]. This suggests that, if there is Zeeman splitting in the voltage probe, new features might be observable in spin dependent transport coefficients.

In this report, we present a theoretical study of the dephasing effect on spin dependent transport. We consider magnetic impurities as spin scatterers in the sample region. The behavior of the conductance distribution in different universality classes has been studied. We calculate the conductance of systems using a transfer matrix method that enables us to calculate the spin dependent transmission coefficients. We extend this method to calculate the conductance in a multi-probe geometry. We consider two dimensional systems connected to narrow source and drain and attach an additional voltage probe. The voltage probe is assumed to have an asymmetric spin population. We analyze how the spin-dependent transport coefficients are influenced by this additional voltage probe.

References

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