Thermal Enhancement of Interference Effects in Quantum Point Contacts

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We study (Abbout et al., 2010) an electron interferometer (Jura et al., 2009) formed with a quantum point contact and a charged scanning probe tip (Scanning Gate Microscope (Topinka et al., 2000)) in a two-dimensional electron gas. The images giving the conductance as a function of the tip position exhibit fringes spaced by half the Fermi wavelength $\lambda_F$. For a contact opened at the edges of a quantized conductance plateau, the fringes are enhanced as the temperature $T$ increases and can persist beyond the thermal length $l_T$. This unusual effect is explained assuming a simplified model: The fringes are mainly given by a contribution which vanishes when $T \to 0$ and has a decay characterized by a $T$-independent scale.

Figure 1 The correction of the conductance $\delta g(T) = g(T) - g_0(T)$ ($g_0(T)$ is the conductance of the unperturbed system at temperature $T$) as a function of the charged tip position (in units of $\lambda_F/2$). The figures (a) and (c) correspond to $T = 0$, while $T \neq 0$ for the figures (b) and (d). $g_0$ is biased as indicated by the arrow in the insets (giving $g_0(T = 0)$ as a function of $E_F$). Figs. (a) and (b): QPC opened at the beginning of the first plateau with $k_B T / E_F = 0.01$ for Fig. (b) ($2l_T/\lambda_F \approx 14.6$). Figs. (c) and (d): QPC opened at the beginning of the second plateau with $k_B T / E_F = 0.035$ for Fig. (c) ($2l_T/\lambda_F \approx 4$).

References