Inequality of 2D Magnetic Conductors Electroconductivity at Contact and Non-Contact Introducing of Electrical Current

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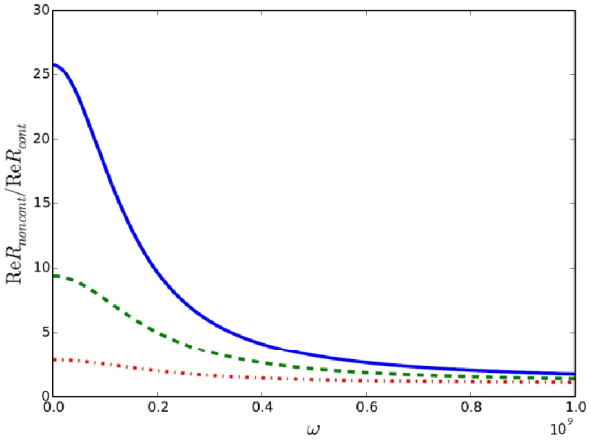
We showed that contact and non-contact methods of inserting to source of current lead to different electron kinetic processes in conductor, and therefore magnitudes of conductivity for these methods are different. The difference is especially large in hydrodynamic situation in electroconductivity [1] in which electron-electron collisions are more frequent than collisions with loss of electron momentum. We showed that at non-contact inserting electron-electron collisions give contribution to electrical resistivity in contrast with contact case. Reason is in space unhomogeneity of polarization charge induced by leads.

We obtain follow expression for electrical field E in 2D conductor by our hydrodynamic approach for "good conductors" [2] for non-contact case:

$$E = m(e\Pi\rho)^{-1}[(\Pi\uparrow\rho\downarrow - \Pi\downarrow\rho\uparrow)(i\omega + \nu_{ee} + \nu)\Delta u + (i\omega + \nu)\Pi j_p], \qquad (1)$$

here m and e are electron mass and charge correspondingly, $\Pi_{\uparrow,\downarrow}$, $\rho_{\uparrow,\downarrow}$ are 2D density of states and density of both of electron spin components, Π and ρ are full electron density of states and density, ω is frequency of applied electrical field, ν_{ee} and ν are frequencies of electron-electron and electron-impurity collisions, Δu is difference between drift velocities of "spin up" and "spin down" electrons, that was found in the work. Second addend in expression (1) corresponds to contact case. One can see from (1) that effect is large for quantum degenerated electron system, for classical system $\Pi\uparrow\rho\downarrow = \Pi\downarrow\rho\uparrow$. For electron system on surface of liquid helium quantum parameter $(\Pi\uparrow\rho\downarrow - \Pi\downarrow\rho\uparrow)/\Pi\rho \approx 10^{-3}$.



At picture dependence ratio of electroresistance of two inserting cases on frequency is described. Different colors of curves correspond different spin polarizations $\rho\downarrow/\rho\uparrow$, difference increase with polarization, $\rho = 6\cdot10^{11}$ m^{-2}, $\nu = 10^{10}$, $\nu_{ee} = 10^{11}$.

1. R.N. Gurgi, UFN, **94**, 689, (1968).
2. A.N.Kalinenko, A.I. Kopeliovich, P.V. Pyshkin, A.V. Yanovsky, Low Temp. Phys., **40**, 960 (2014).