2DEG resistance asymmetry caused by an effective spin injection in a parallel magnetic field

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Longitudinal resistivity in strong parallel magnetic fields up to B = 14 Tesla was measured in Si-MOSFET with a narrow slot (90nm) in the upper metallic gate that allows to apply different gate voltage across the slot and, therefore, to control the electron density n_1 and n_2 in the two parts of the sample independently. The experimental scheme allows to pass through the source-drain channel relatively large DC current ($I_{\rm DC}$), while the measuring the dynamic resistance. It is found that the sample resistance is asymmetric with respect to the direction of DC current. The asymmetry increases with increase of magnetic field (Fig. 1), DC current, and difference between n_1 and n_2.

These observations can be understood in terms of spin drift-diffusion picture: the degree of spin polarisation is different in the two parts of the sample, implying different magnitudes of spin current away from the slot. The carriers therefore must leave the excess spin (of the appropriate sign) in the region around the slot, leading to *s*pin accumulation (or depletion). The rate of this novel effective spin injection is proportional to I_{DC} and changes sign at $I_{DC} = 0$. Due to the positive parallel-field magnetoresistance of 2DEG, the ensuing magnetisation change around the slot gives rise to an asymmetric correction, $\Delta R = R(I_{DC}, H) - R(0, H)$, in the measured resistance.

We further observe that the value of $R(I_{\rm DC})$ saturates at large $I_{\rm DC}$; possible origins of this effect are discussed. Preliminary results were reported in Ref. [1].

[1] I. Shlimak *et al.*, Solid State Phenomena **190**, 129 (2012).

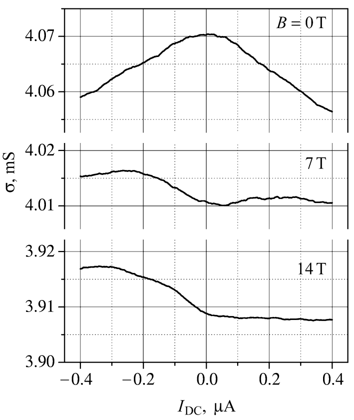

Figure 1: Sample conductance as a function of DC current at $B = 0$, 7, and 14 T. Electron densities in the two parts of the sample are $n_1 = 0.9 \cdot 10^{12}\mathrm{cm}^{-2}$ and $n_2 = 2.5 \cdot 10^{12}\mathrm{cm}^{-2}$, and temperature $T = 0.3$K