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Tilt magnetic field studies of quantum Hall effect in a high quality Si/SiGe quantum well

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Introduction

High quality Si/SiGe quantum well samples have provided an ideal platform to study the electron-electron (e-e) interactions in two-dimensional electron systems (2DES). Currently, the sample mobility has surpassed 10^6 cm^2/Vs and very low carrier densities are realized, which are crucial to reveal strong e-e interactions.

Experimental

In this study, a high quality Si/SiGe quantum well sample was measured under tilt magnetic fields. The electron peak mobility reaches 2 x 10^6 cm^2/Vs and the density is varied from 0.8 to 2.1 x 10^{11} cm^{-2}. The magnetoresistance measurements were performed in a dilution fridge with rotator probe at 20 mK (SCM1). Magnetic field was scanned at fixed tilt angles.

Results and Discussion

Fig. 1 shows a set of typical magneto-transport measurement results of two-dimensional electrons in the high quality Si/SiGe quantum well as a function of tilt angles (or 1/cos(θ)). Under tilt magnetic fields, two Landau levels with opposite spins are brought into energetic coincidence [1], which gives rise to the red peaks in the graph. From the coincidence angles we determine the effective spin susceptibility g*m*. At n =2.1 x 10^{11} cm^{-2}, g*m* ~ 4 (in units of $m_b g_b$), consistent with previous work [2]. Our results further show that the spin susceptibility is enhanced by 20% at 0.8 x 10^{11} cm^{-2} from its high density value. In addition, a resistance peak is also observed at nu=3 when the coincidence occurs in our undoped Si/SiGe field-effect transistor sample, different from previous results in modulation doped Si/SiGe quantum wells [2].

Conclusions

The enhancement of the effective spin susceptibility g*m* as the charge carrier density decreases indicates that either g* or m* is strongly modified by the e-e interactions.

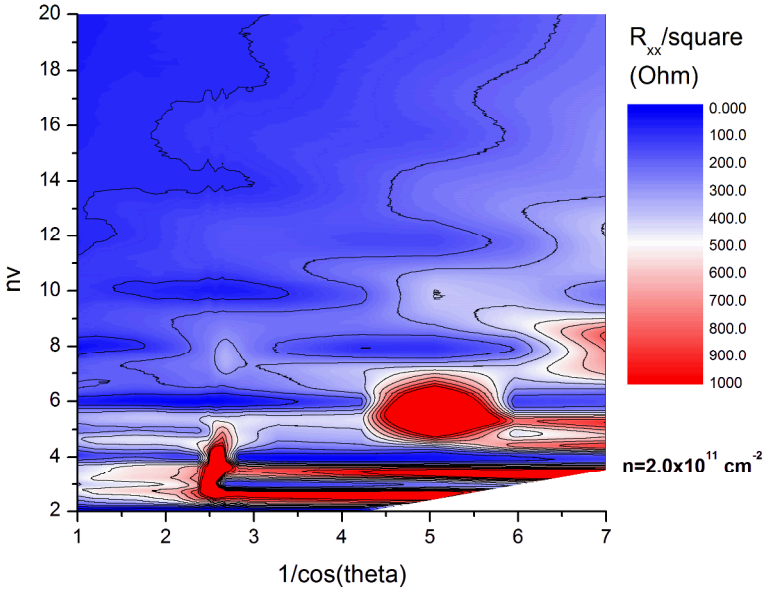

Fig. 1 Contour plot of Rxx as a function of filling factor nv and tilt angle parameter 1/cos(theta), where theta is the angle between B field and the sample norm.

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References

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