Enhancement of Spin Susceptibility of Low-Density Two-Dimensional Electrons in a High Quality Si/Sige Quantum Well

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Introduction

High quality Si/SiGe quantum well samples provide an ideal platform to study the electron-electron (e-e) interaction in 2D. Currently, the sample mobility could reach 10^6 cm^2/Vs and very low carrier density, which are crucial to reveal the strong e-e interaction.

Experimental

In this study, a high quality Si/SiGe quantum well sample was measured under tilted 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 tilting angle.

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 under tilted magnetic fields. Under tilted magnetic fields, two Landau levels with opposite spins are brought into energetic coincidence [1], which corresponding 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. Surprisingly, unlike previous results in modulation doped Si/SiGe quantum wells, a resistance peak is observed at nu=3 when Landau level coincidence occurs in our undoped Si/SiGe field-effect transistor sample.

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.

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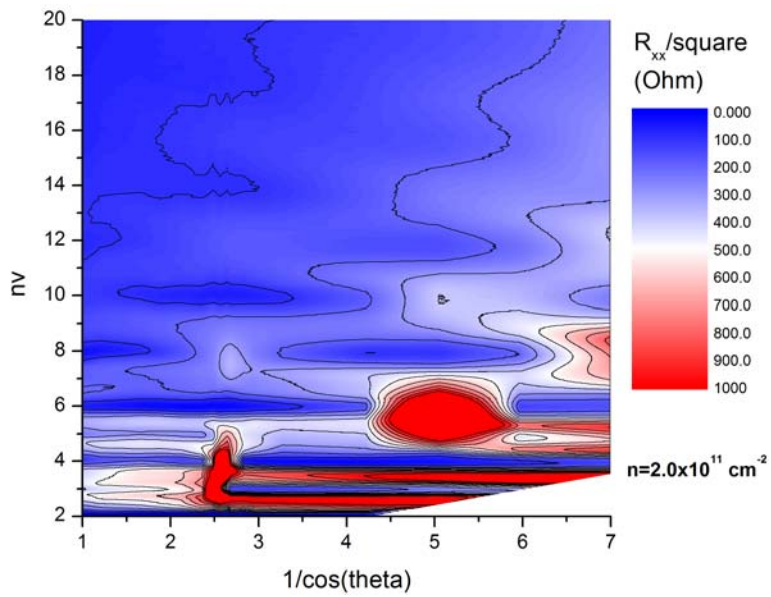

Fig. 1 Contour plot of Rxx as a function of filling factor nv and tilt angle parameter 1/cos(theta), where theta is the angle between B field and the sample norm.

References

[1] Fang and Stiles, Phys. Rev. **174**, 823 (1968).
[2] Lai et al, Phys. Rev. Letts. **96**, 076805 (2006).