Anomalous Pinning Mode in Wide Quantum Wells Near Landau Filling ν=1

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Introduction

At Landau fillings (ν) near 1, recent transport studies of wide quantum wells (QWs) [1] have revealed quantum Hall effect states that are quantized like the ν =1 integer quantum Hall effect (IQHE), but which are separated from the ν =1 IQHE by small ranges of filling. These states are called reentrant quantum Hall effects (RIQHE), and are a manifestation of an insulating phase of quasiparticles or holes in the presence of the filled lowest Landau level. In the wide QW samples, their strength and location are highly sensitive to the carrier density, n.

We have long ago observed microwave resonances in the ν region of the IQHE [2]. We understand the resonances as pinning modes of an insulating Wigner solid of quasiparticles or –holes. We now present studies of the same wafers that have shown the RIQHE near ν=1.

Experimental

We measured loss of transmission lines patterned on top of 42 and 54 nm QW samples, to obtain microwave conductivity spectra, Re σ_{xx} vs frequency, f. SCM1 was used mainly for the 42 nm QW.

Results and Discussion

Figure 1a is an image plot of spectra from the 52 nm QW, for many ν and n = 2.41×10^{11} cm^{-2} The resonance frequency f_{pk} has a peak around ν=0.88. **Figure 1b** shows f_{pk} vs ν for many n. For the lowest n (1.95×10^{11} cm^{-2}) f_{pk} decreases monotonically as n moves away from 1. For larger n, a ν region with f_{pk} enhanced from its value in the n=1.95×10^{11} cm^{-2} curve is present. The ν of transition to the enhanced f_{pk} is n dependent, and moves closer to 1 as n increases.

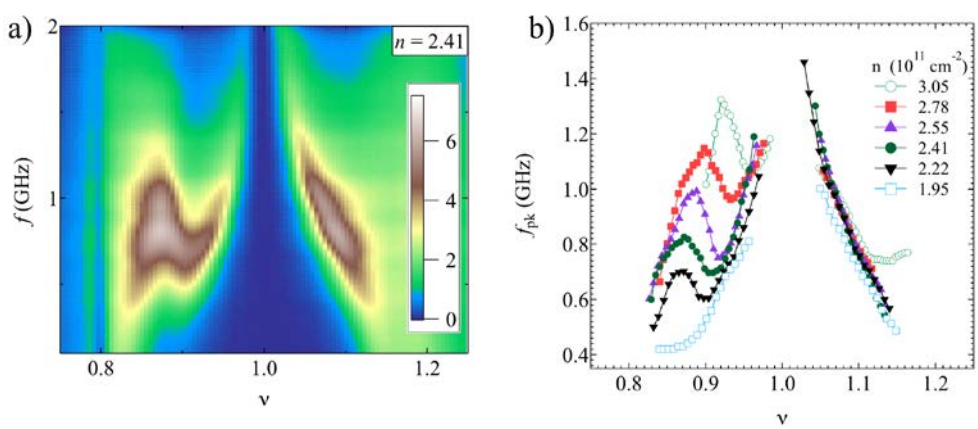

Figure 1 a) Image plot, color scale as Re σ_{xx} (μS) in frequency (f)-Landau filling (ν) plane, density n = 2.41×10^{11} cm^{-2} and temperature ~ 30 mK. b) Resonance peak frequency f_{pk} vs ν, from plots like those in a), at many densities n, with quantum well biased from both sides [1] to keep well approximately symmetric.

Conclusions

The data appear to show a transition between different quasihole solid phases, of which the enhanced-f_{pk} phase is related to the RIQHE of ref [1]. The phase transition can approach ν=1 remarkably closely at larger n, for the 54 nm QW, but does not appear to do so for the 42 nm well. The nature of the new solid phase is not clear.

Acknowledgements

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References

1 Yang Liu, *et al.*, Phys. Rev. Lett. **109**, 036801.
2 Yong P. Chen *et al.*, Phys. Rev. Lett. 91, 016801 (2003).