Novel Microwave Resonance around Integer Landau Level Fillings in Unidirectional Lateral Superlattices

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ThB3-7

1. Motivation

Electron-Crystal-like states in Quantum Hall Systems



Electron-Crystal-like states in Quantum Hall Systems



Electron-Crystal-like states in Quantum Hall Systems



Pinning mode resonance



Microwave conductivity of the ULSL has not investigated yet . Will there be any resonance?

2. Experimental

Measurement of microwave conductivity



Measurement of microwave conductivity



Measurement of microwave conductivity



1D periodic modulation



3. Results

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400 500 600 <i>f</i> (MHz)	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$\frac{1}{300} \frac{400}{f} \frac{500}{MHz}$			









4. Discussion

What is the origin of the resonance?

 \rightarrow Pinning Mode resonance of a Crystal-like state

Crystal-like state is corroborated by 1D periodic modulation.

Quality factor:
$$Q = f_{pk} / \Delta f \sim 25$$

cf.
 $Q \sim 10$: Wigner Crystal at high B
[C. C. Li *et al*, PRL 79, 1353 (1997)]
for frequency

 \rightarrow electrons in large regions oscillate coherently (in phase) [M. M. Fogler and D. A. Huse, PRB 62, 7553 (2000)]

Tok

Peak frequency vs. filling factor



Weak pinning: [H. Fukuyama and P. A. Lee, PRB 18, 6245 (1978)]

reducing effective carrier density in topmost LL ($\nu \rightarrow 2$)

- \Rightarrow weaker e-e interaction (more easily-deformable)
- \Rightarrow electrons fall deeper into disorder potential (more pinned)
- $\Rightarrow f_{pk}$ increases

Ground state phase diagram calculated by DMRG method (for plain 2DES) [N. Shibata and D. Yoshioka, JPSJ 72, 664 (2003)]



Stripe II (predicted in theory):

Wigner Crystal melt by quantum fluctuations anisotropically



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5. Summary

We investigated microwave conductivity $Re\{\sigma_{xx}\}$ of ULSLs.

In the vicinity of v = 2, the resonant peak is ...



The resonance is reminiscent of the pinning mode resonance of crystal-like states.

Stripe II phase predicted in theory may be related to the observed resonance. However, further studies are required to clarify the origin of the resonance.