



$\nu=1$ quantum Hall state in a lateral periodic quantum anti-dot array

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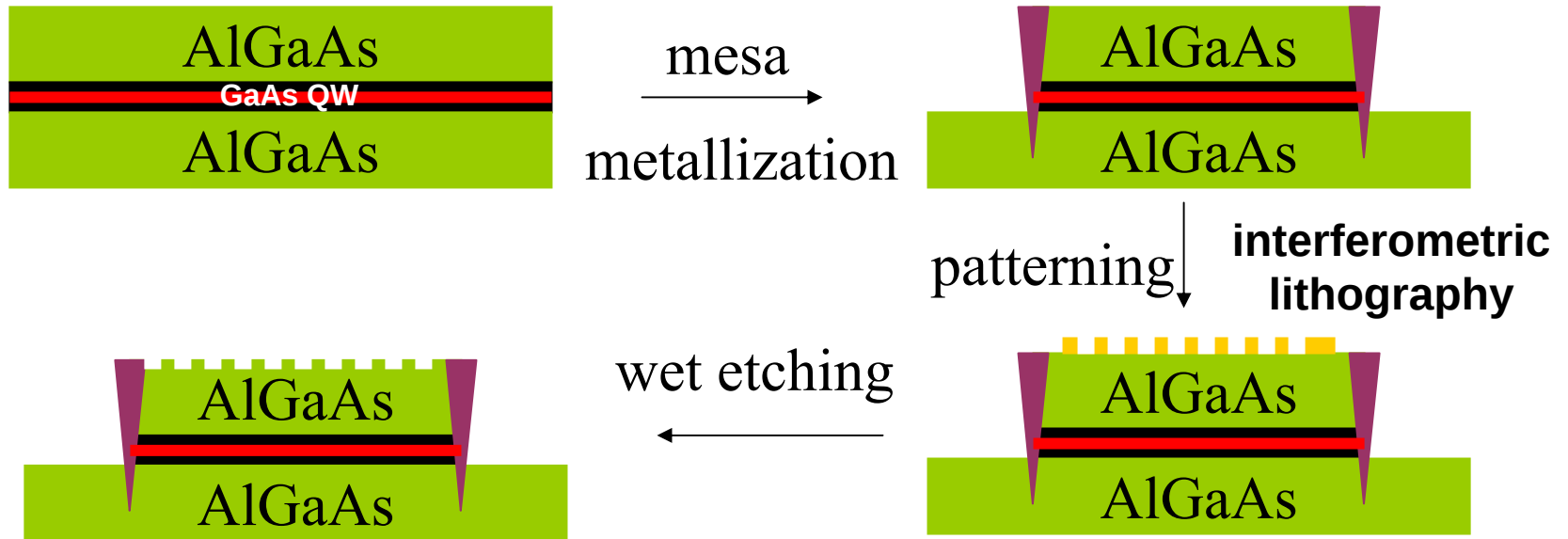
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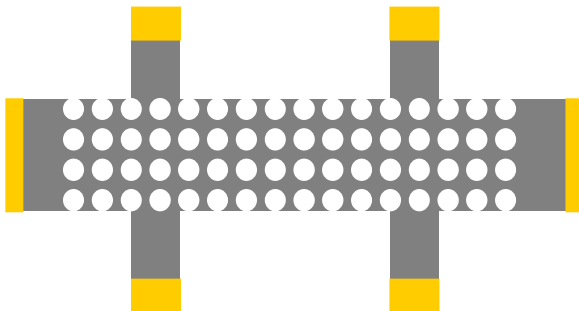
Outline

- Sample fabrication and characterization
- $\nu=1$ QH state and its disorder dependence
- Summary

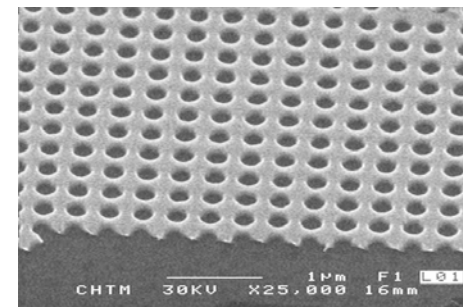
Sample fabrication



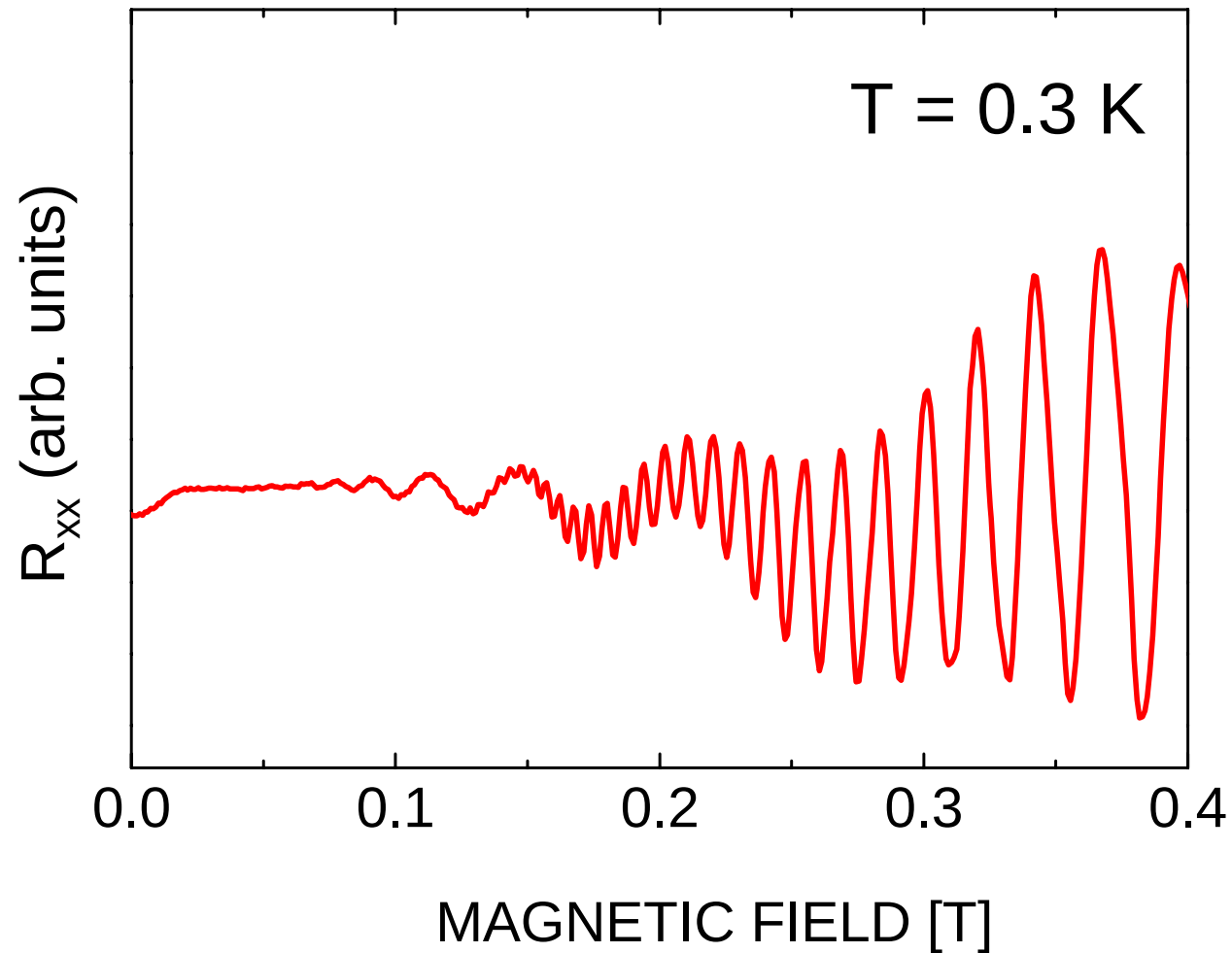
Top view



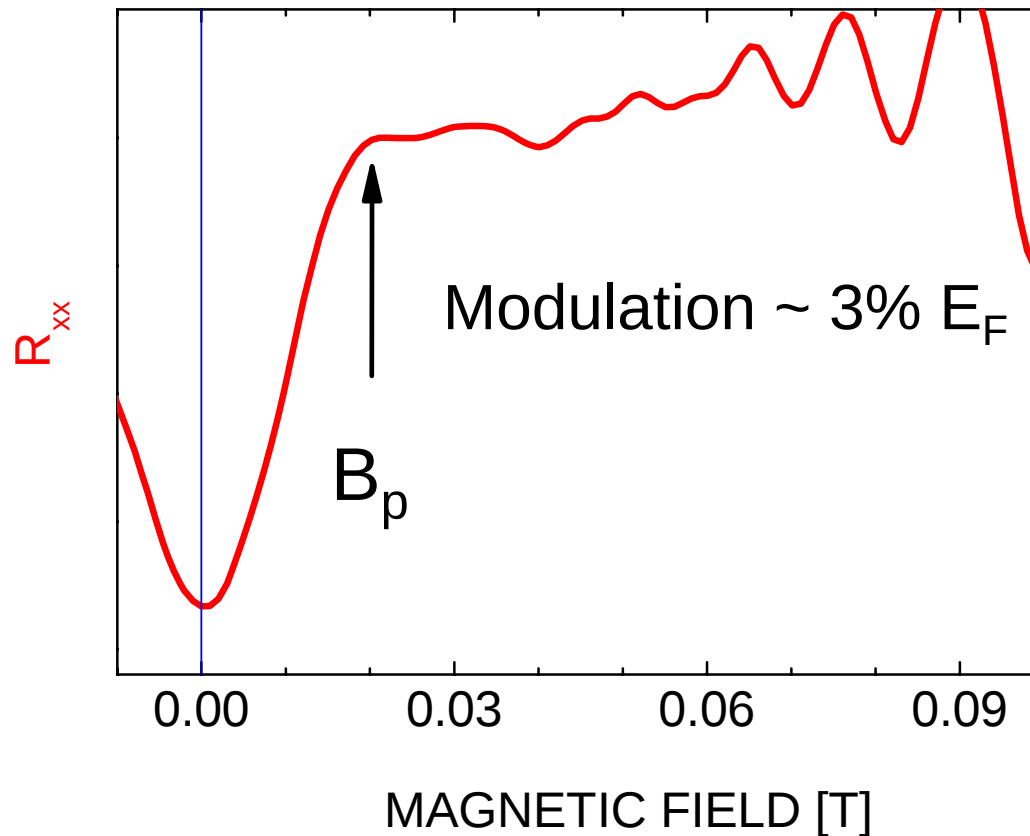
SEM picture



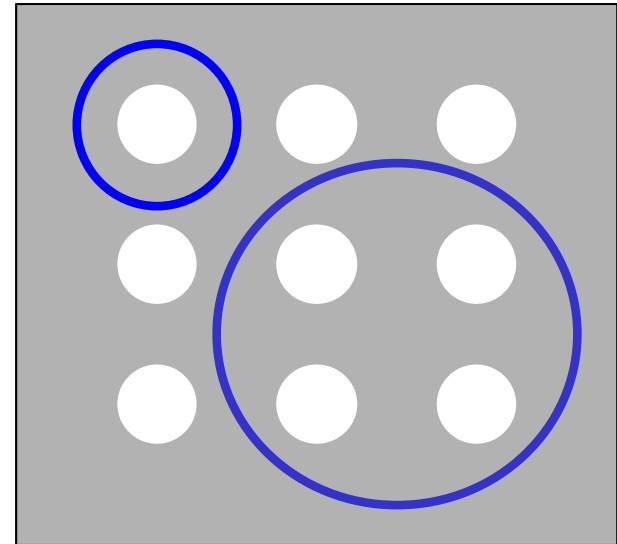
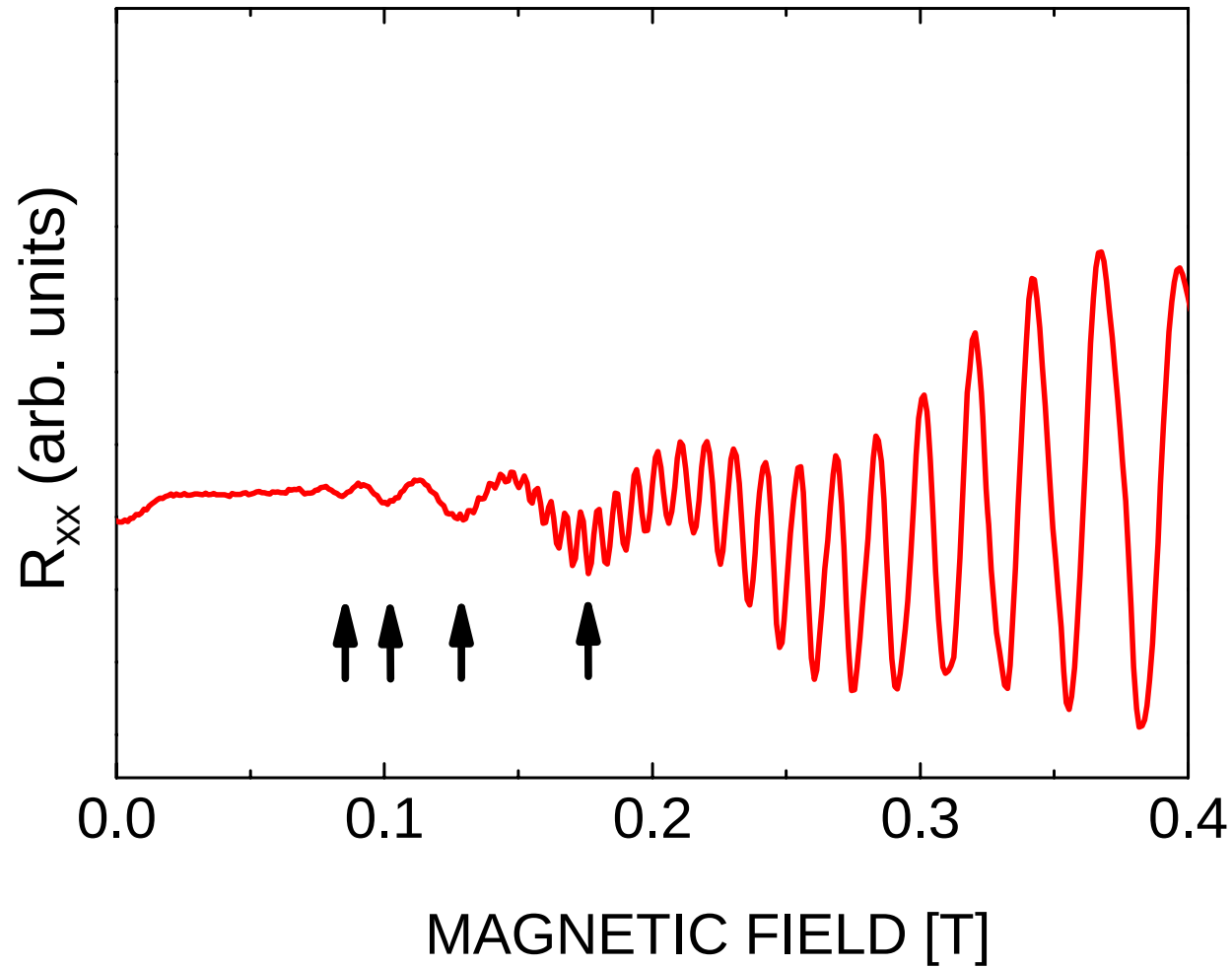
Sample characterization – magneto-transport

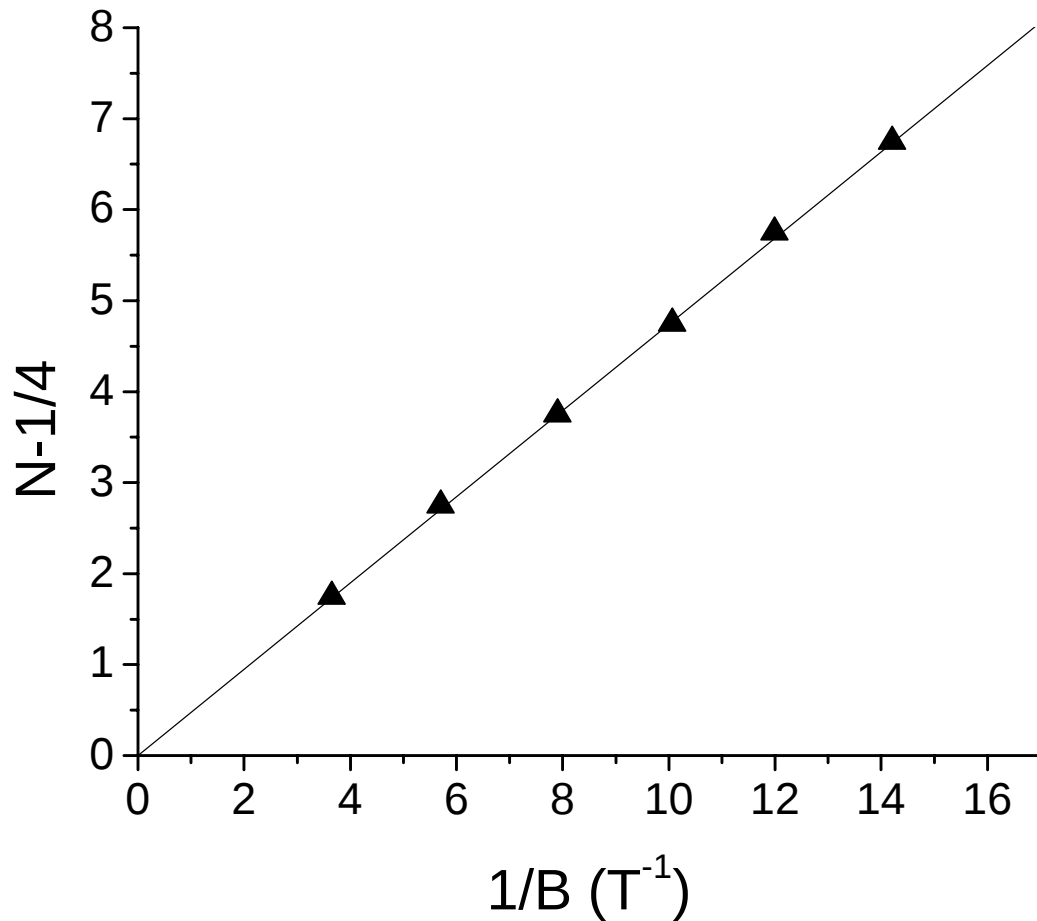


Positive magneto-resistance around $B = 0$



Commensurability oscillation





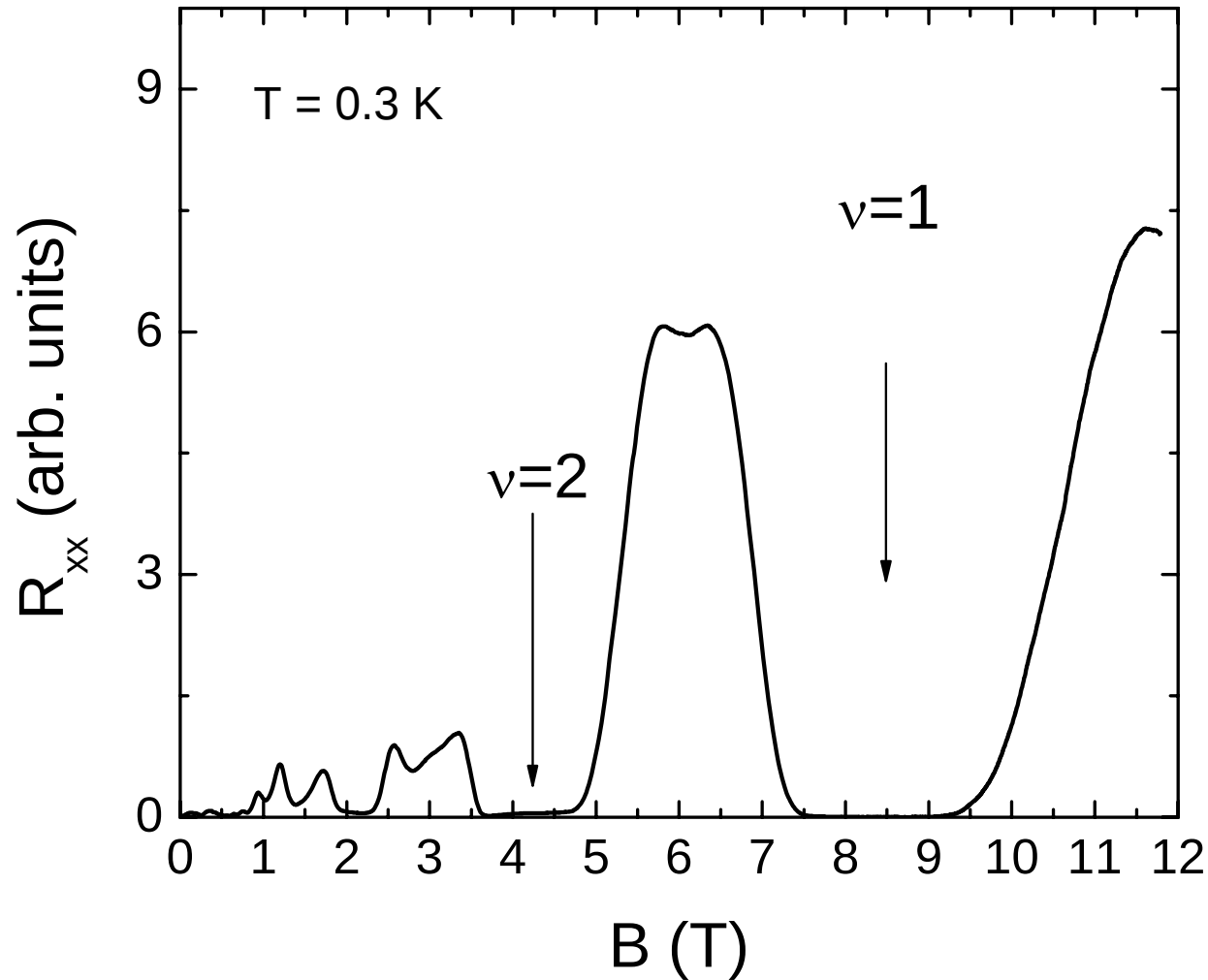
$$2R_c/d = N-1/4$$

or

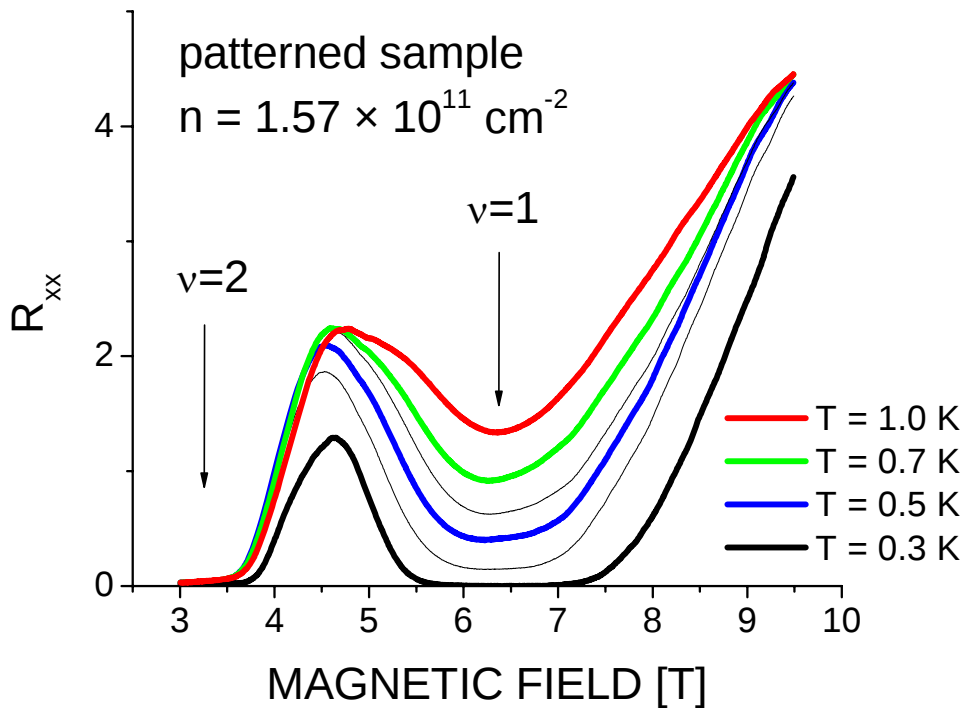
$$N-1/4 = (2\hbar k_F/ed) \times 1/B$$

From slope,
 $d \sim 340 \text{ nm}$

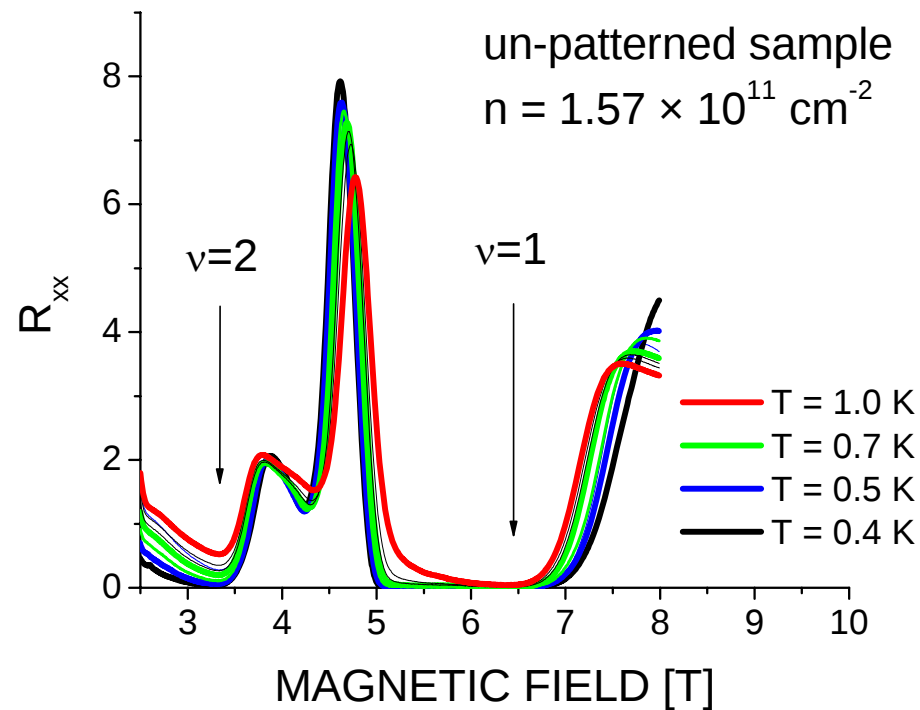
Well developed integer quantum Hall states



Weakened $\nu=1$ quantum Hall state



Energy gap at $\nu=1$ is $\sim 3\text{K}$



Energy gap at $\nu=1$ is $\sim 20\text{K}$

Disorder effect

PHYSICAL REVIEW B

VOLUME 62, NUMBER 20

15 NOVEMBER 2000-II

Disorder and interactions in quantum Hall ferromagnets near $\nu=1$

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(Received 19 April 2000)

PHYSICAL REVIEW B, VOLUME 64, 241309(R)

Effects of disorder on the $\nu=1$ quantum Hall state

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(Received 10 October 2001; published 10 December 2001)

Dirty quantum Hall ferromagnets and quantum Hall spin glasses

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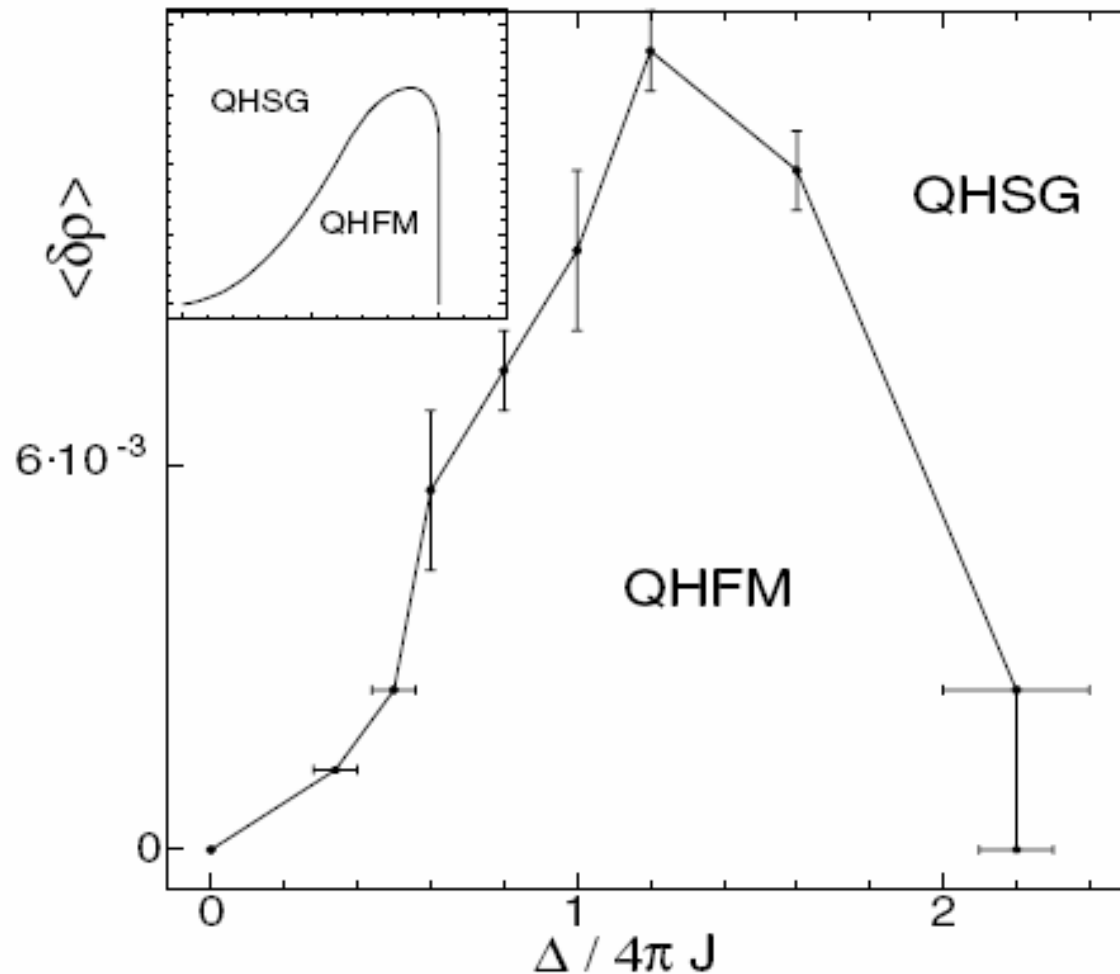
Blackett Laboratory, Imperial College London, London SW7 2AZ, United Kingdom

Sebastian Rapsch and J. T. Chalker

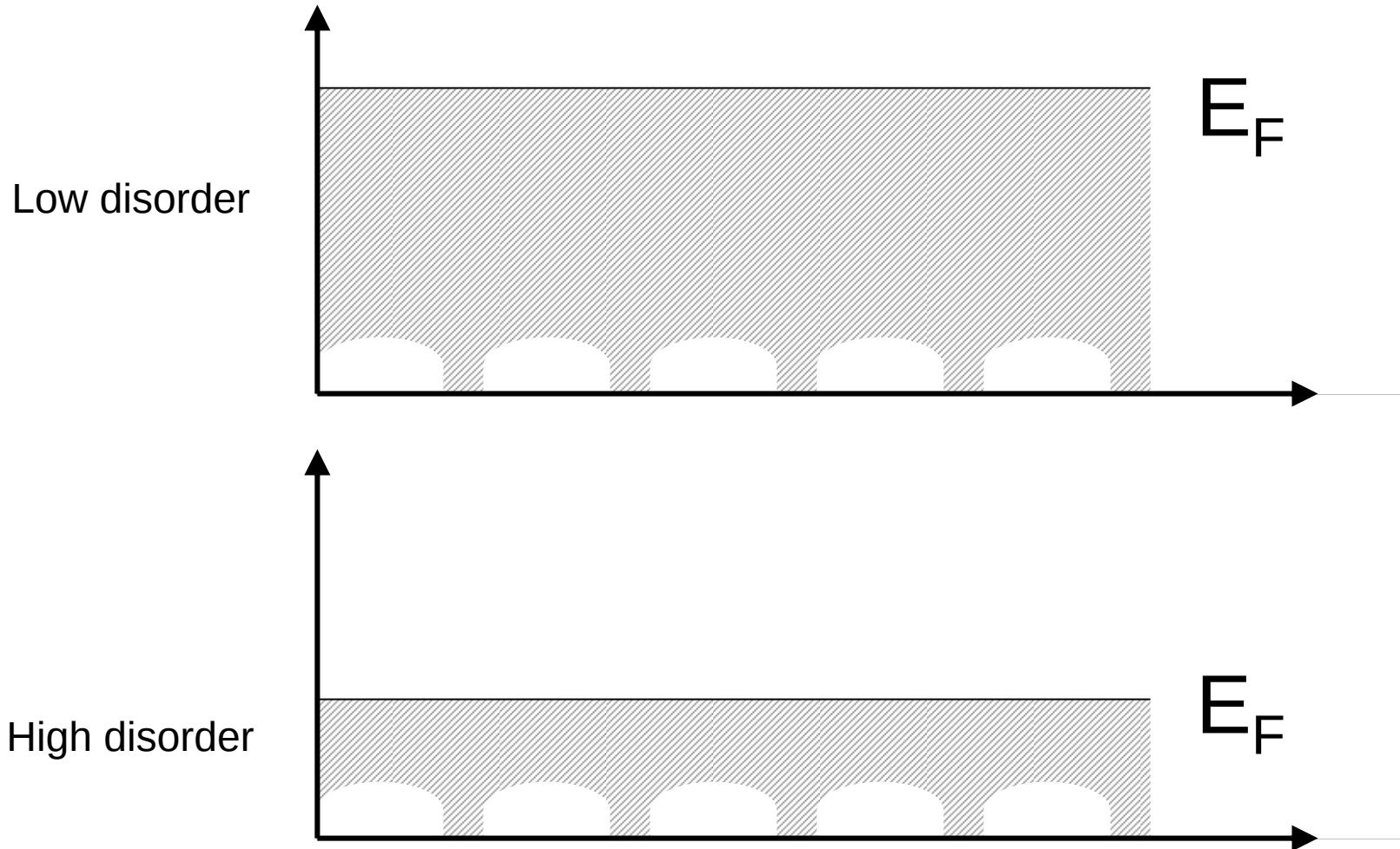
Theoretical Physics, University of Oxford, 1 Keble Rd, Oxford OX1 3NP, United Kingdom

(Received 18 October 2002; published 20 May 2003)

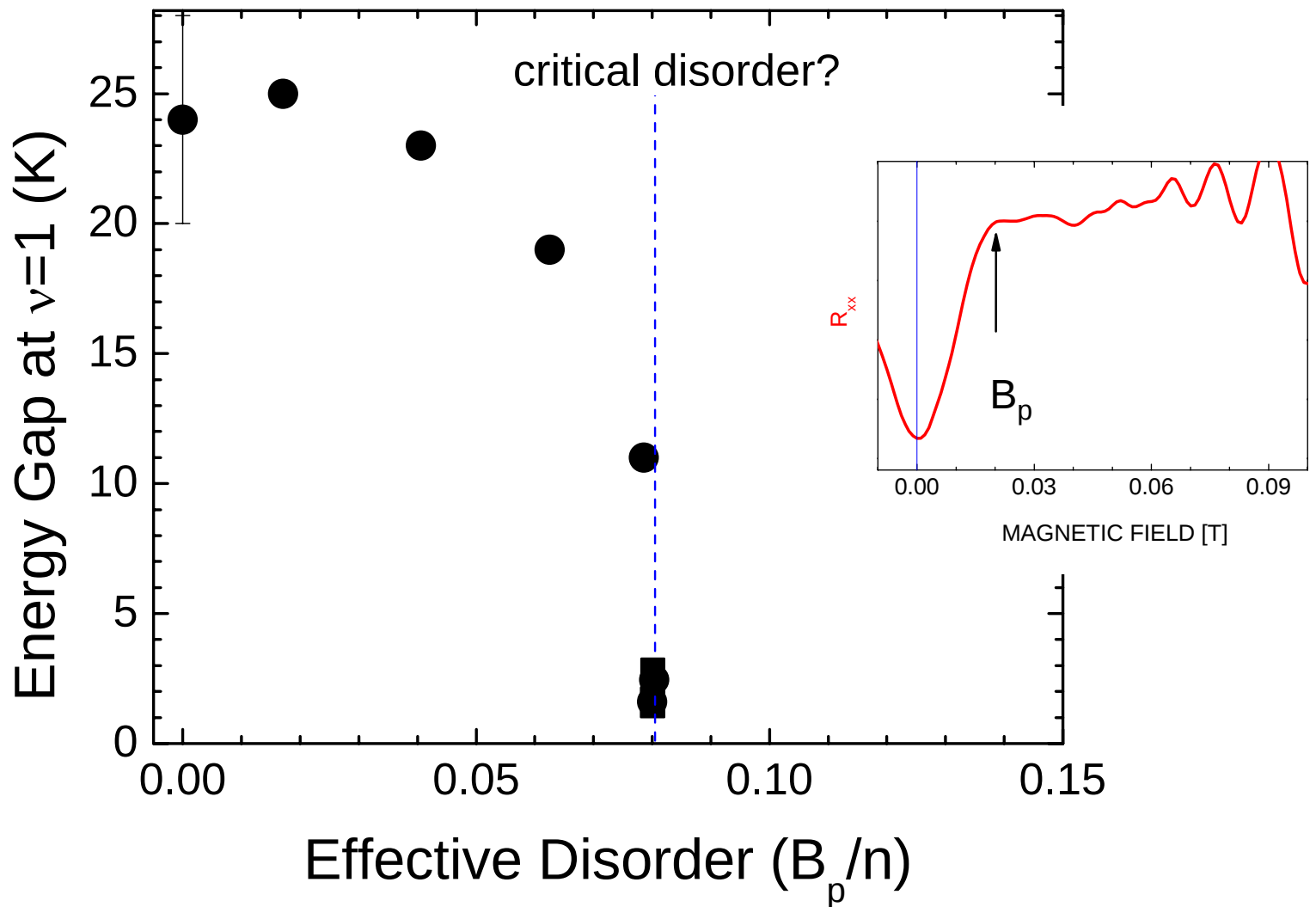
Transition from quantum Hall ferromagnetic state to quantum Hall spin glass state



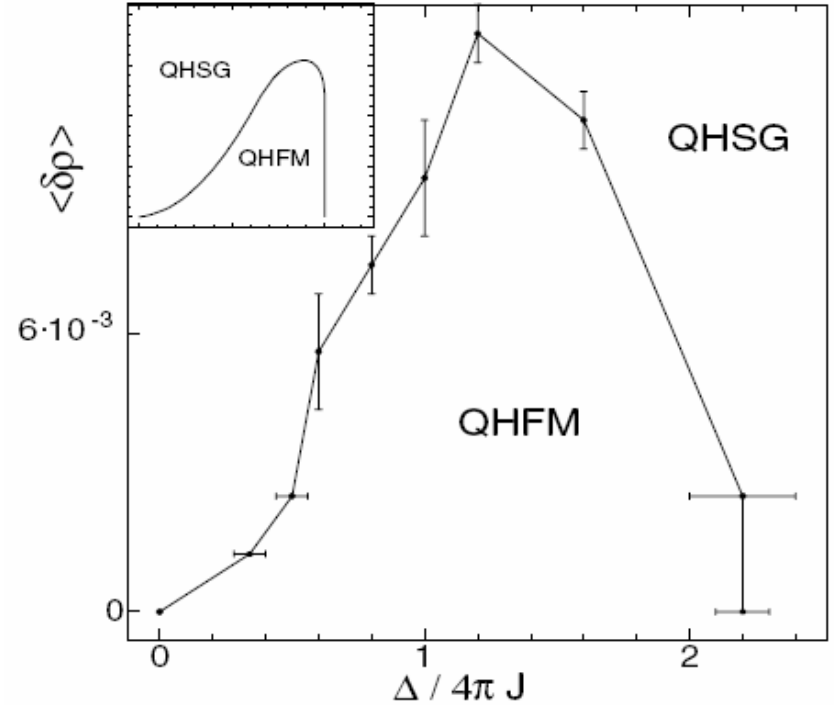
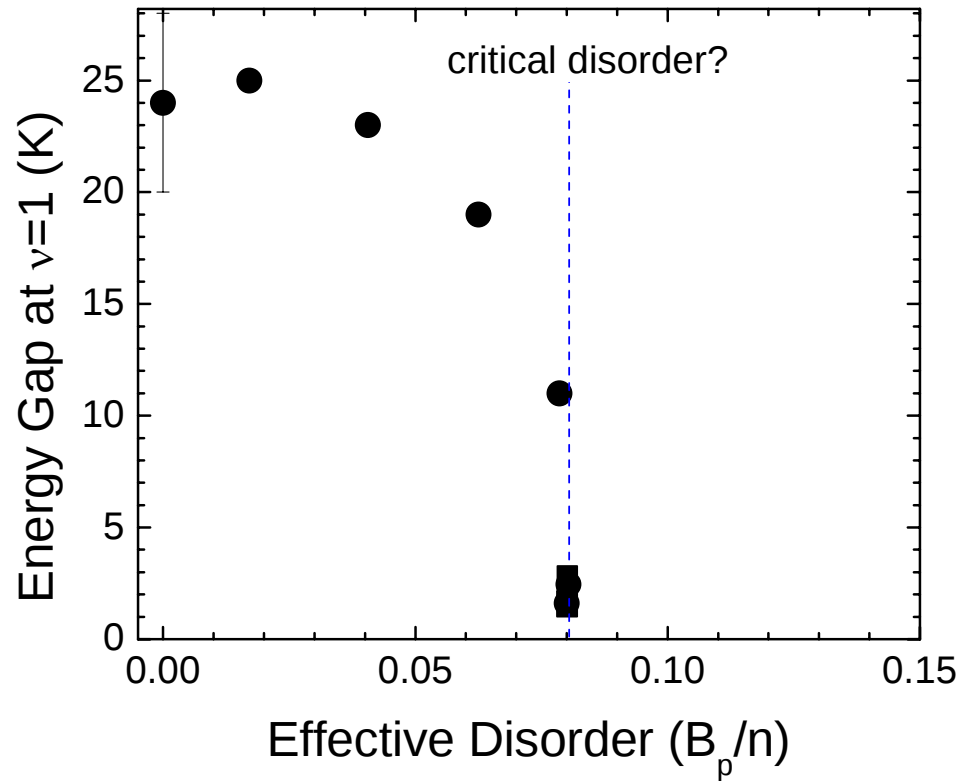
Effective disorder



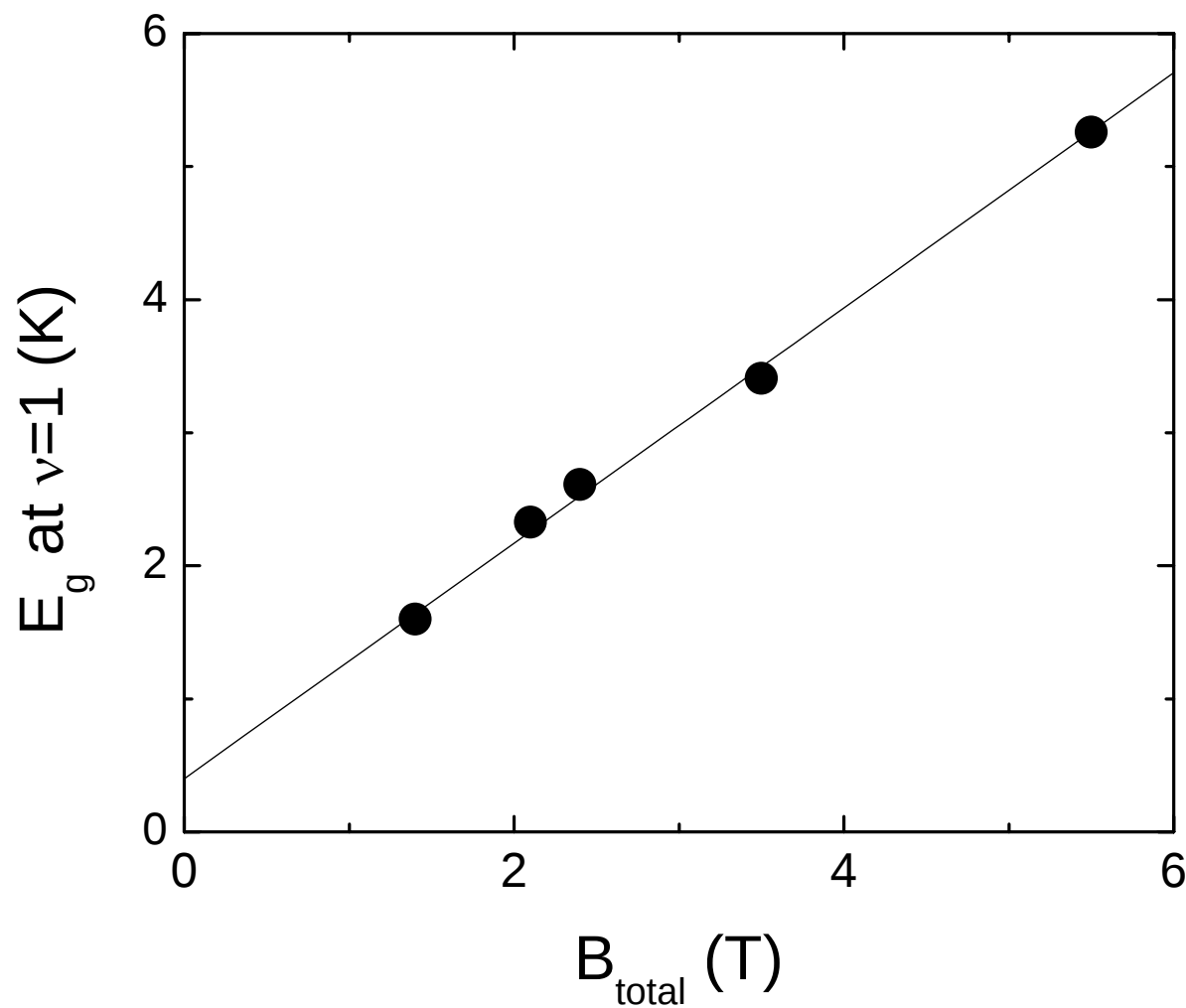
Disorder dependence



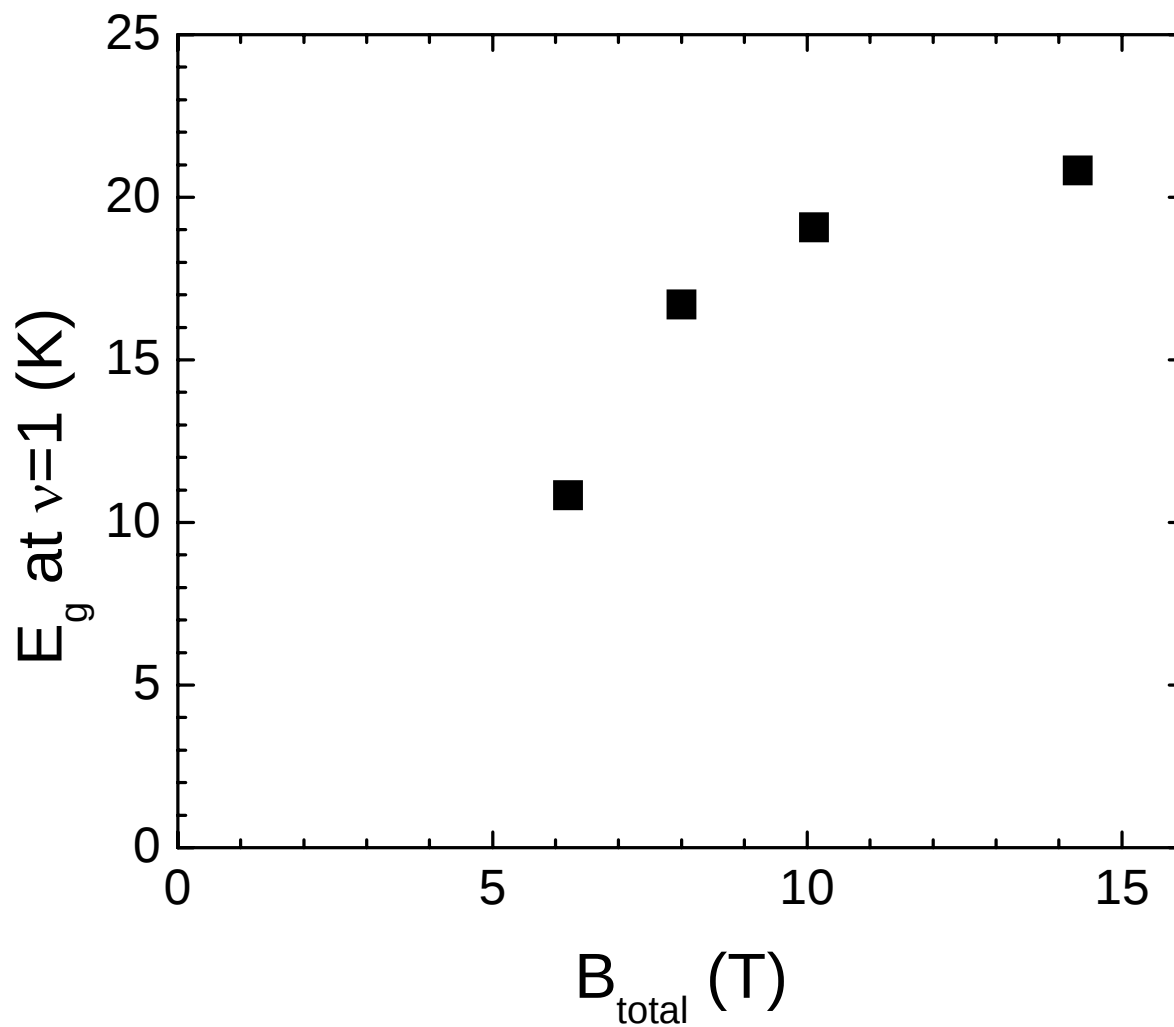
Disorder dependence



Angular dependence – strong modulation



Angular dependence – weak modulation



Summary

A sharp transition-like behavior at $\nu=1$ as a function of effective disorder.

