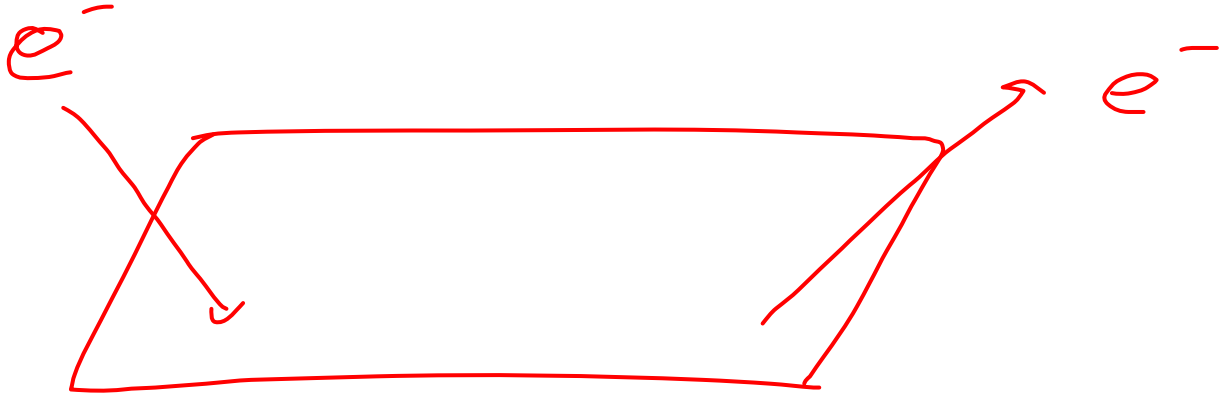
Ballistic quantization

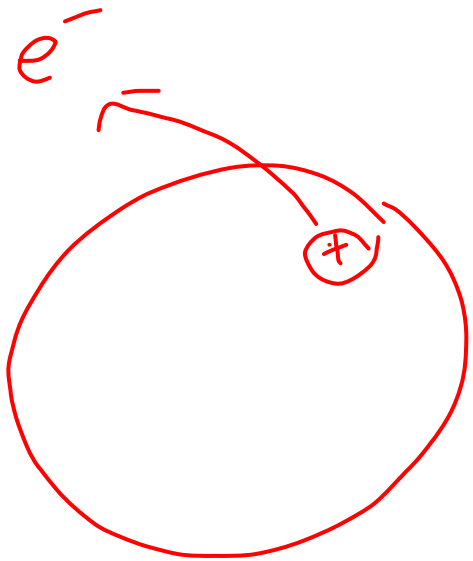
& HE

single-particle picture



electrical measurements

Add one then get one.



oe⁻

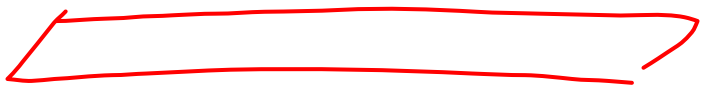
electrically neutral

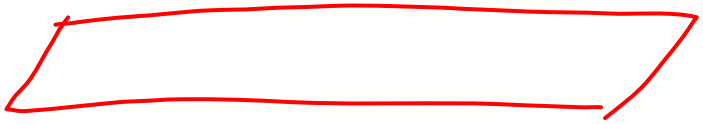
Fermi gas → Fermi liquid

interaction strength

1 - 1 correspondence

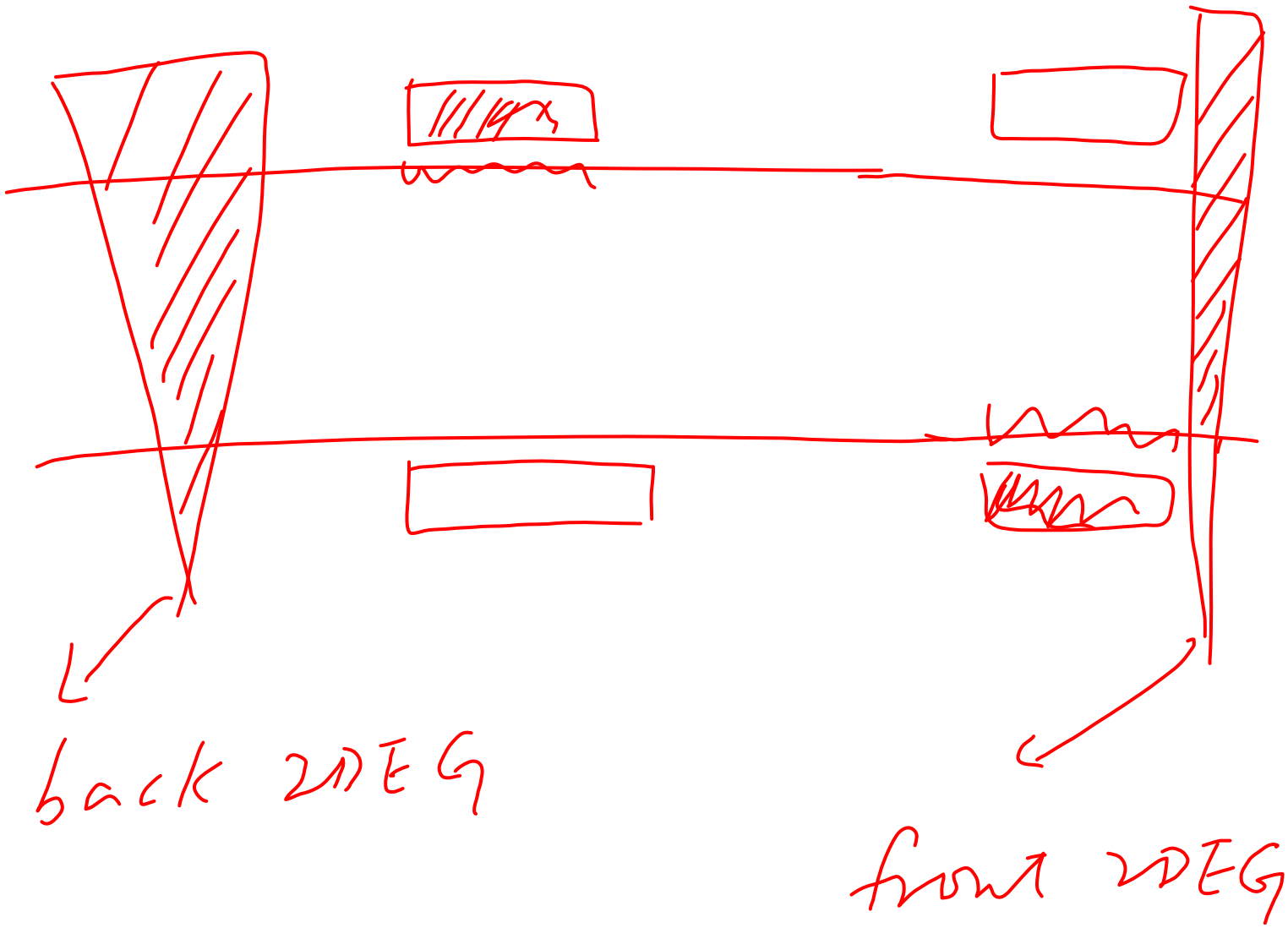
2 2DEGs





no inter layer tunnelling ✗

Layer Interchange should give the same result Oh super relation


back 2DEG
front 2DEG

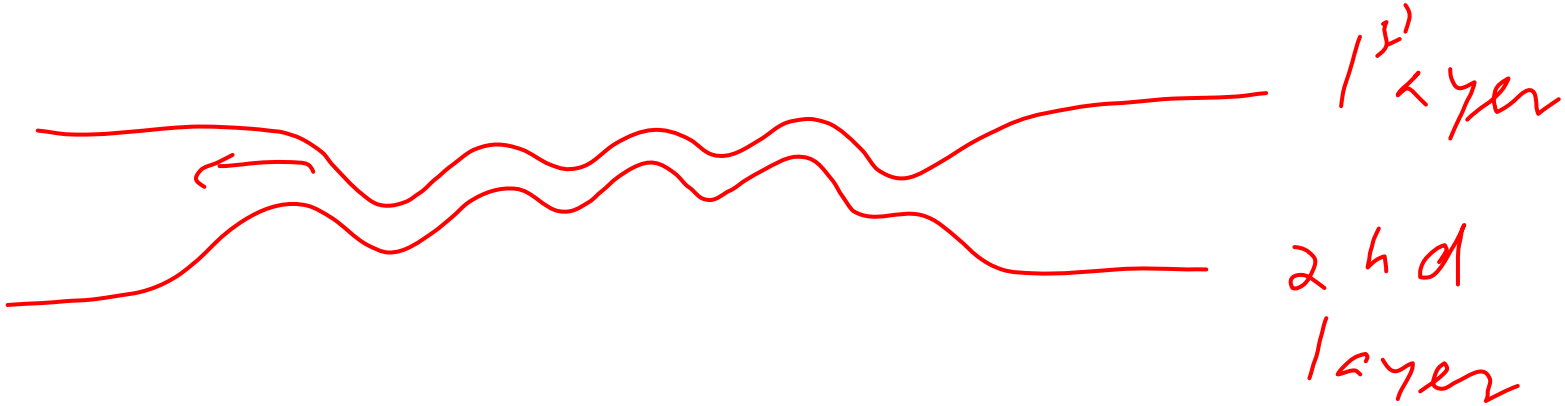
2 electron $f_2^0(\epsilon)$

1' into a hole
an empty state

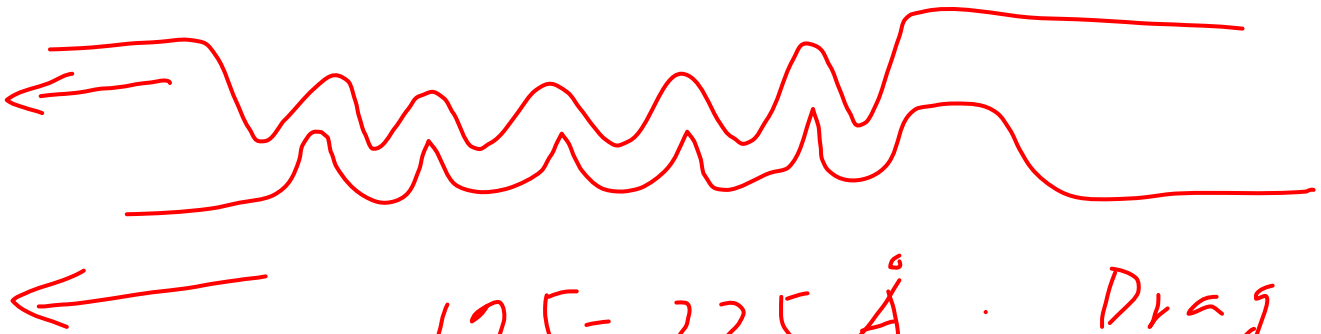
$1 - f_1^0(\epsilon)$

2' ||

$1 - f_2^0(\epsilon)$

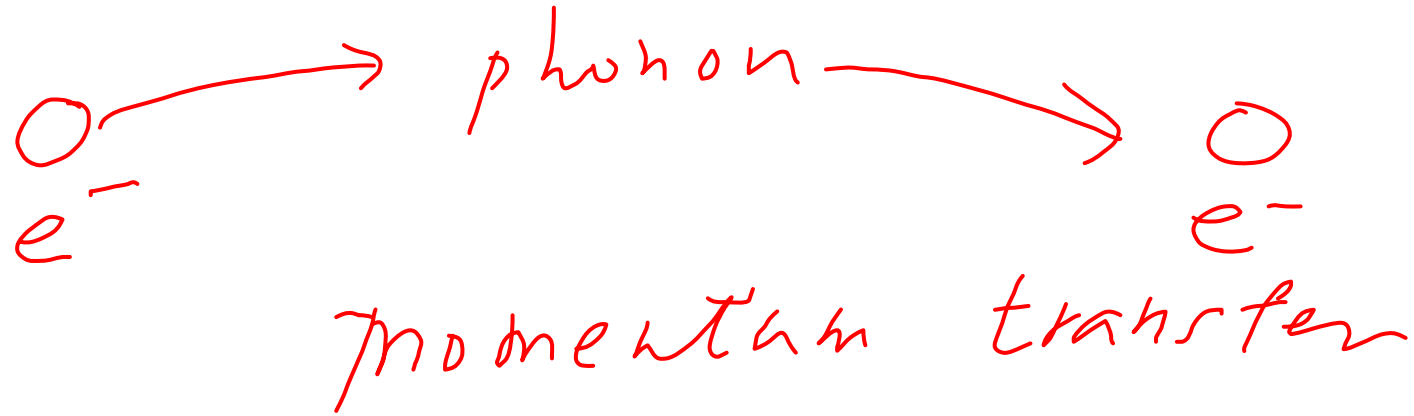


frictional drag

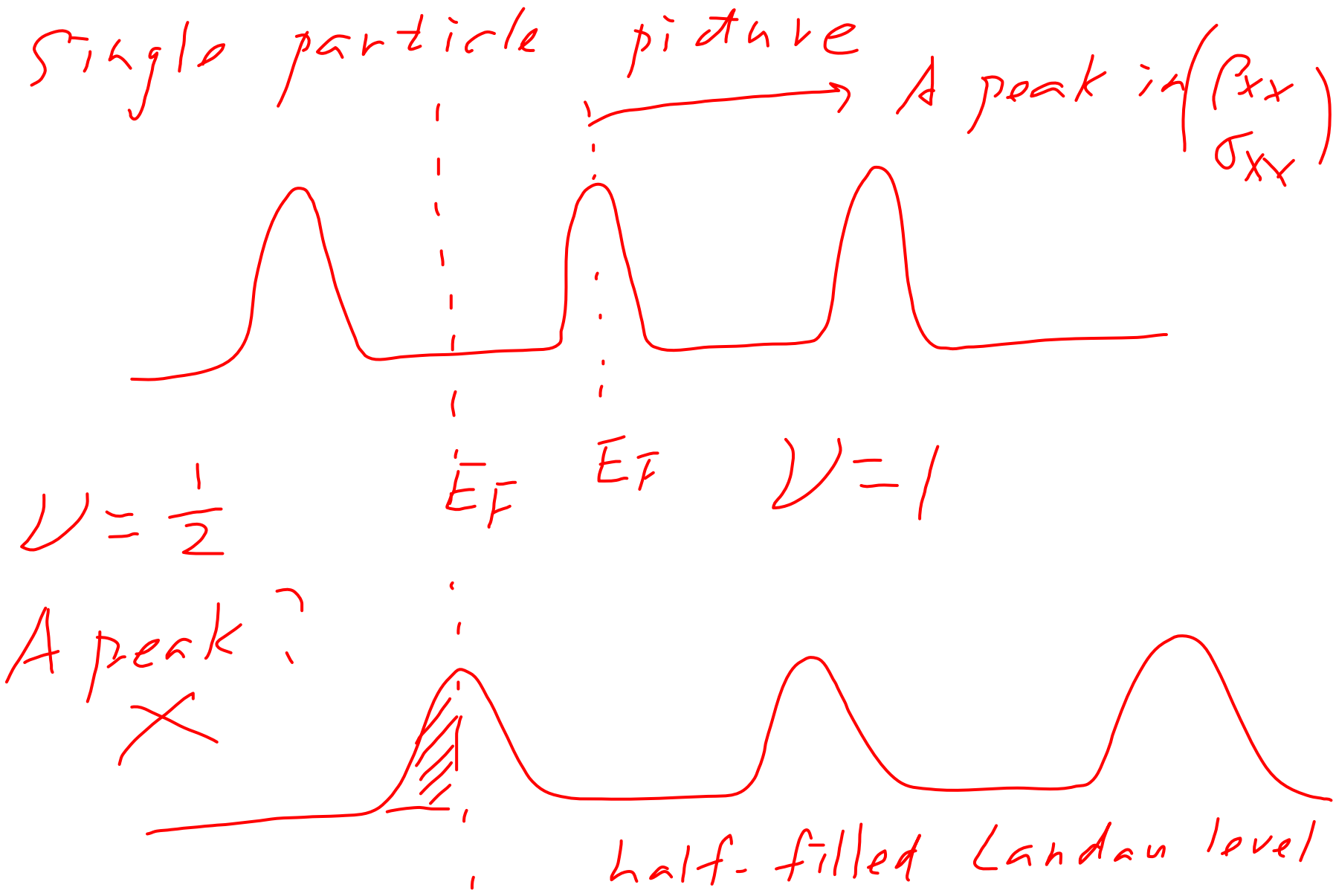


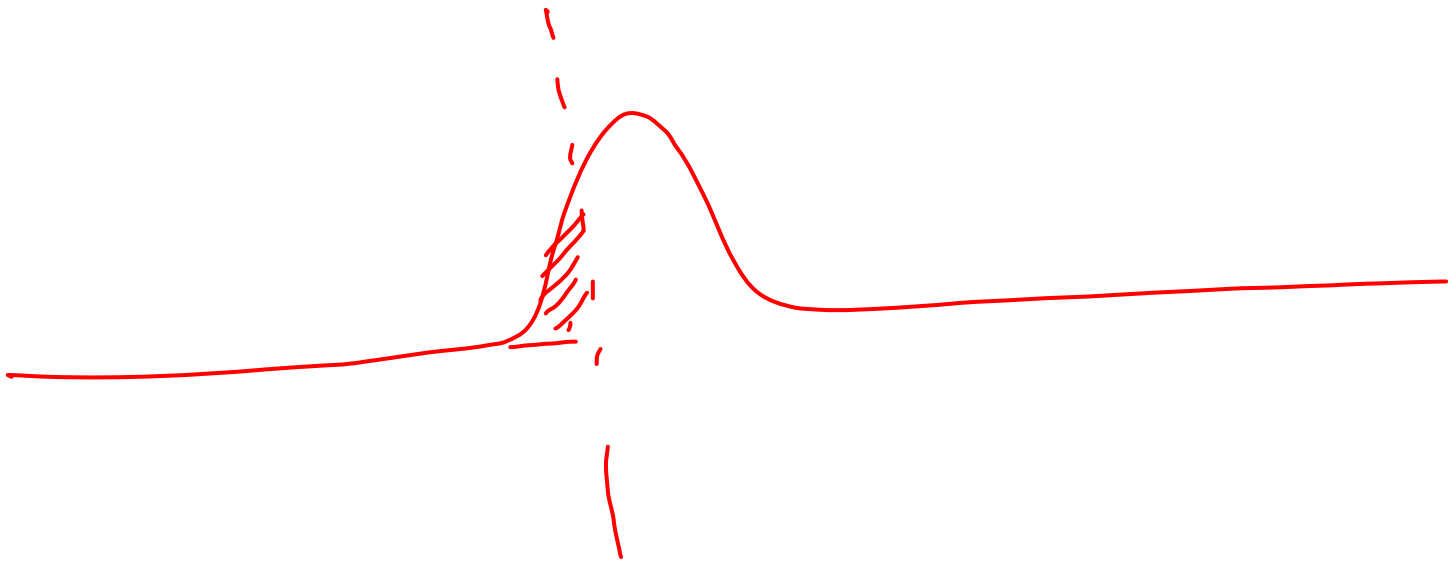
175 - 225 Å : Drag
25 Å : tunneling

Virtual phonon process



momentum transfer


Single particle picture
A peak in (ρ_{xx} σ_{xx})
E_F
E_F
$\nu = 1$
$\nu = \frac{1}{2}$
A peak ?
×
half-filled Landau level



$\nu = \frac{1}{3}$

Within a single-particle picture

$\rho_{xx} \neq 0$

e-e interactions!

$$\nu = \frac{p}{2p+1} \quad \Longrightarrow \quad \nu_{eff}$$

$p = 1$	$(\frac{1}{3})$	$p = -1$	(1)
$p = 2$	$(\frac{2}{5})$	$p = -2$	$(\frac{2}{3})$
$p = 3$	$(\frac{3}{7})$	$p = -3$	$(\frac{3}{5})$

Composite fermion

$\lim_{p \to \pm\infty} \frac{p}{2p+1} = \frac{1}{2}$

Lots of states condense into this $p = 1, 11, -$

Broad minimum ($\nu = \frac{1}{2}$) persists up to
17 K. At that T, no FQH
states are observable!

H. W. Jiang

$\nu = \frac{1}{2}$ is not a FQH state
no plateau as well!

$T \rightarrow 0.1\ K$

$T \rightarrow 0.3\ K$ 0 K

$T \sim 1.5\ K$ Dan Tsui
Horst Stormer

↓

$\frac{1}{3}$

higher mobility
lower n

$$\frac{\nu e B}{h} = n_{2D}$$

$\frac{h}{e}$: magnetic flux quantum

$$\frac{\nu B A e}{h} = n_{2D} A = \#$$

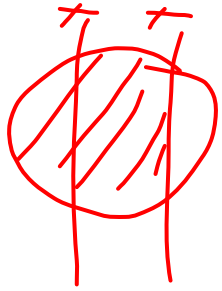
$$\nu \left(\frac{BA}{\frac{h}{e}} \right) = \# \qquad \frac{\left(\frac{BA}{\frac{h}{e}} \right)}{\#} = \frac{1}{\nu}$$

number of flux

$\nu = \frac{1}{2}$ one electron with 2 flux

$\nu = \frac{1}{3}$ one e^- with 3 flux

$\nu = 1$ one e^- with 1 flux

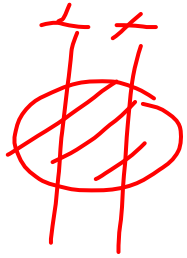


CF-1

one e^- with 2 flux

$B_{eff} = 0$ $\nu = \frac{1}{2}$

$=$

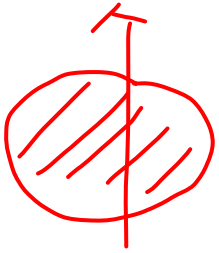


$+$

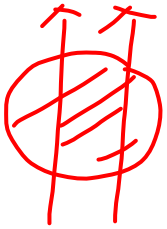
$\nu = \frac{1}{3}$

CF $B_{eff} = B - B_{\nu=\frac{1}{2}}$

> 0



$=$



$+$

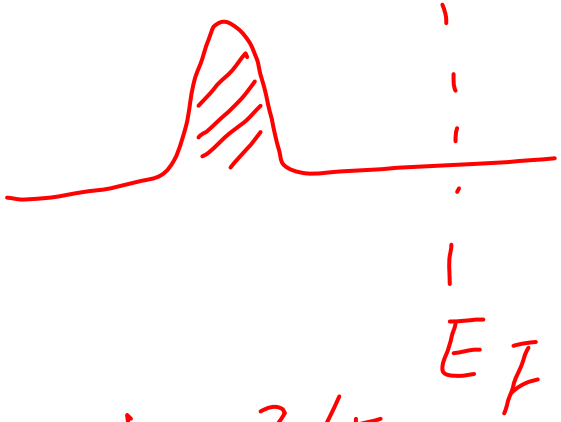
$\nu = 1$

$B_{eff} < 0$

Mean-field 平均場

$\nu = \frac{1}{3} \Rightarrow \nu_{eff} = 1$

cf LLs



$\nu = 2/5 \Rightarrow$

$\nu_{eff} = 2$

$n_{2D} = 10^{11}\,cm^{-2}$

$\nu = \frac{1}{2}$ 8 T

$\nu = 1$ 4 T

$\nu = \frac{1}{3}$ 12 T

$B_{eff} = 0$

$B_{eff} = -4\,T$

$B_{eff} = 4\,T$

IQHE of CFs

$12 - 8 = 4$

$4 - 8 = -4$

m^*.