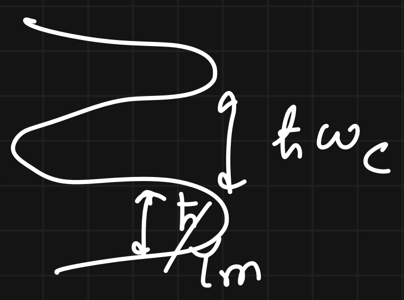
Recap

most of qHall physics still carries forward for a confining potential.

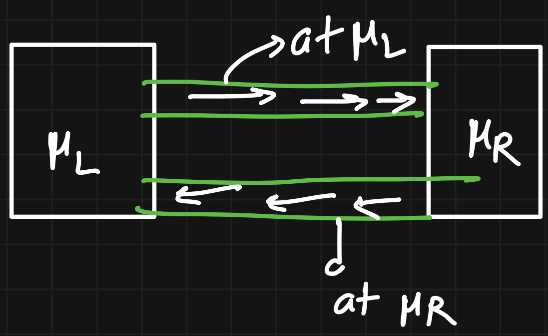
→ momentum relaxing scattering broadens lifetime



$\omega_c > \frac{1}{\tau_m}$

$\Rightarrow B > \frac{1}{\mu}$ large mobility

→



i = counts # of 1d-modes involved

$i = \frac{2e}{h} M (\mu_L - \mu_R)$ → # of modes

$= 2e \sum_n \int v(n,k)\, dk \times \left(\frac{1}{2\pi}\right)^n$

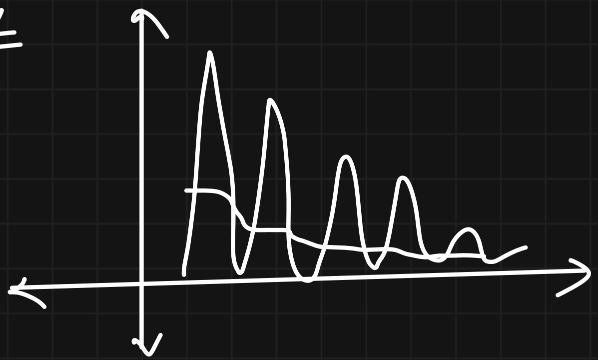
e

$R_H = \frac{h}{2e^2 M}$ → Quantized

→ # of modes is zero.

longitudinal resistance $= 0$

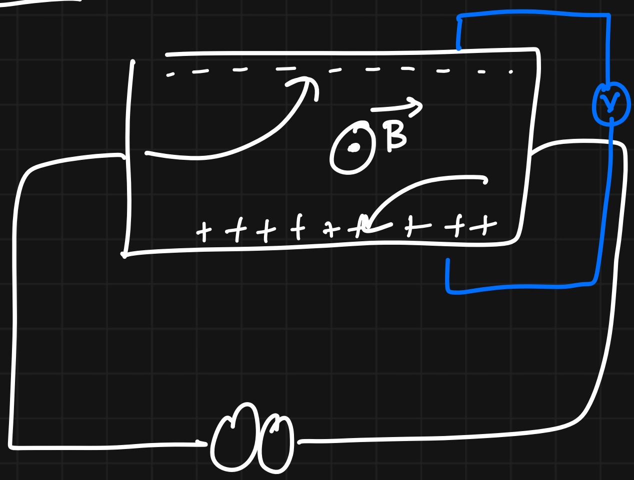
→ voltage drops at end



Q. why hall resistance?

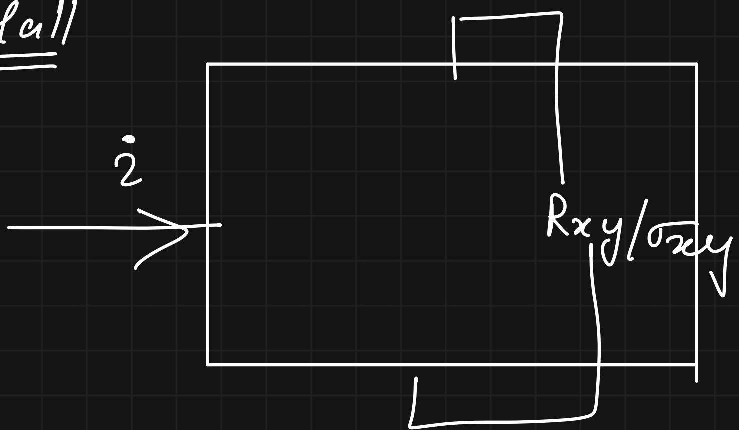
Nothing can move to opposite edge → exp suppressed

Classical hall



In eqm there's no net current through the edges
↓
as if open circuit voltage

Q. Hall



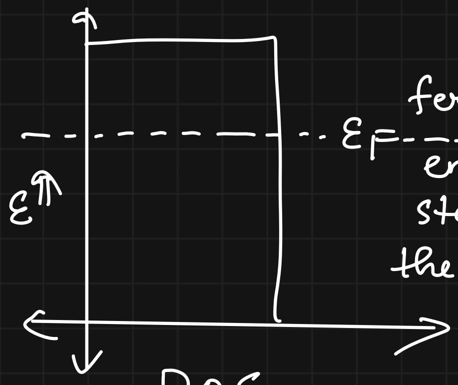
so $R_{xy} = \frac{V}{i_{long}}$

not i transverse

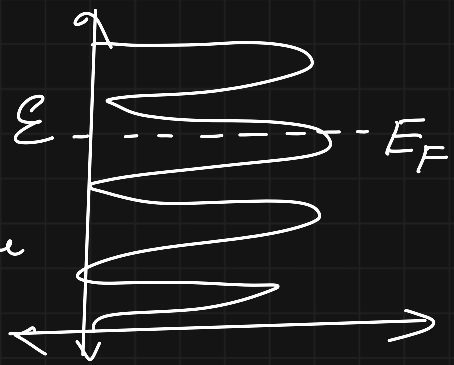
So we're looking at an "open" circuit voltage

MD: what matters in $\frac{B}{\rho}$. why?

Now we think about degen. of QH system



fermi en. stays the same



DOS $B=0$ DOS $B \neq 0$

2DEG   LL

$$\eta = \frac{N}{S} = \frac{m}{\pi^2\hbar^2} = \frac{dn}{dE}$$

# of Landau levels filled.

$$N = \frac{mS}{\pi^2\hbar^2} \times \underline{\nu\,\hbar\omega_c} \Rightarrow \eta = \frac{eB}{\pi\hbar}\nu$$

total # of electrons

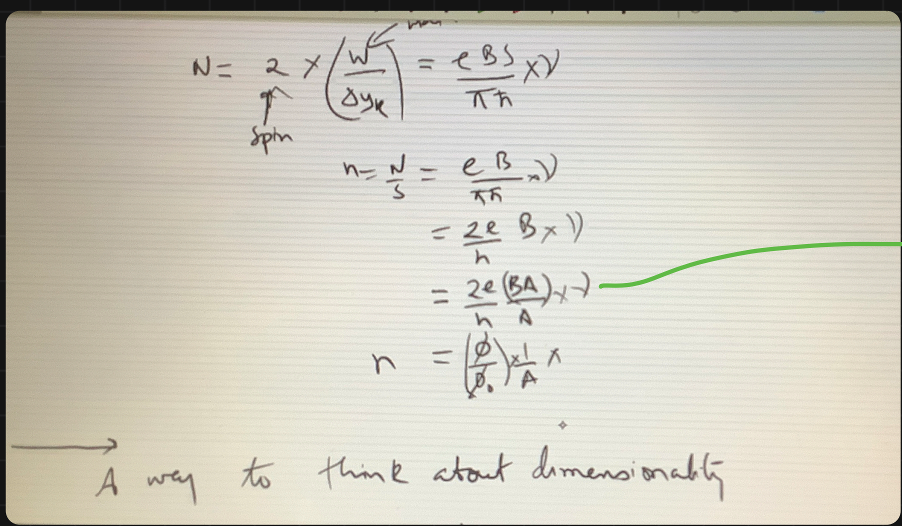
# of L.L. filled.

$$= \left(\frac{2e}{h}\right)\frac{BA}{A}\nu$$

$$\eta = \frac{1}{\phi_0}\left(\phi/A\right)\nu$$

$$\Rightarrow \frac{\eta}{\left(\frac{\phi}{\phi_0}\right)\frac{1}{A}} = \nu = \text{filling factor}$$

M-2 of ~~I~~ state counting



$$N = 2 \times \left(\frac{W}{\Delta y_k}\right) = \frac{eBS}{\pi\hbar}\times\nu$$

spin

$$n = \frac{N}{S} = \frac{eB}{\pi\hbar}\times\nu$$

$$= \frac{2e}{h}B\times\nu$$

$$= \frac{2e}{h}\frac{(BA)}{A}\times\nu$$

$$n = \left(\frac{\phi}{\phi_0}\right)\times\frac{1}{A}\times$$

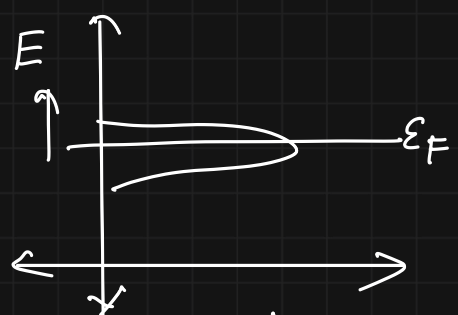
→ A way to think about dimensionality

filling factor

$\nu = 1, 2, 3 \cdots$

IQHE

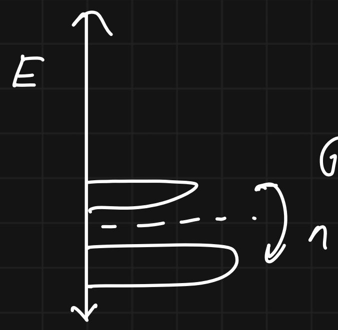
FQHE



since band is flat, so only interaction plays an important role.

at $\nu = 1/2$

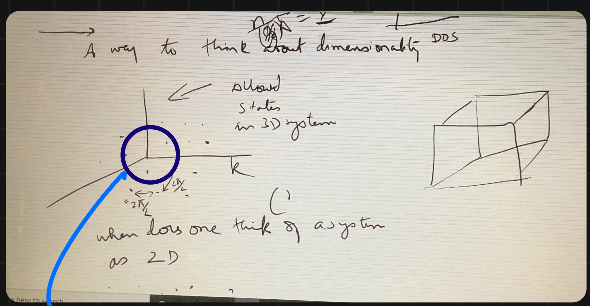
a gap opens up



Gaps open up due to interactions

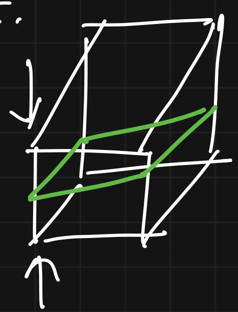
$\nu < 1$

A way to think about dimensionality



(make web notes of it)

Now suppose we hammer the box to thin it out.



→ becomes thin enough that $\left(\frac{2\pi}{L_3}\right)$ is large wrt fermisphere.

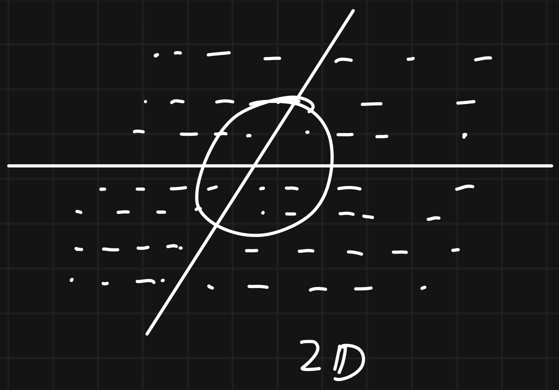
$\frac{2\pi}{L_3} > k_F$, no states associated with k_z.

system behaves more & more 2D like

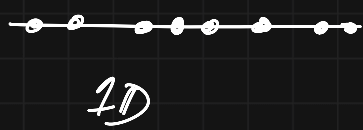
Crossover :- $\frac{2\pi}{L_z} \sim k_F \sim \frac{2\pi}{\lambda_F}$

$\therefore L_z \sim \lambda_F$, then we can start talking of system as 2DEG.

new picture

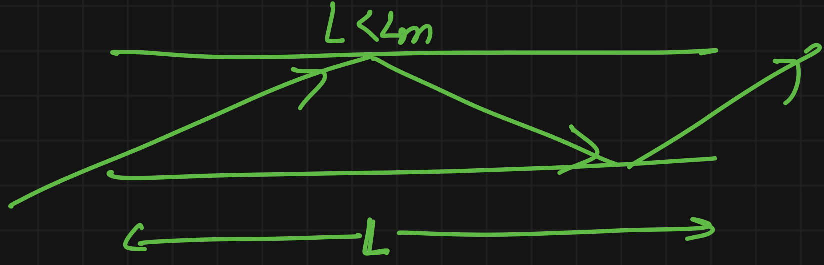


$L_y \sim L_F$ hit more



Question for later

How do we think of ballistic transport of edge modes?



↳ e.g. ① Von wees's expt → Gate → 1d modes

② Q Hall → $\vec{B} \neq 0$ 1d modes

same creatures

confinement

L. Levels

different origins