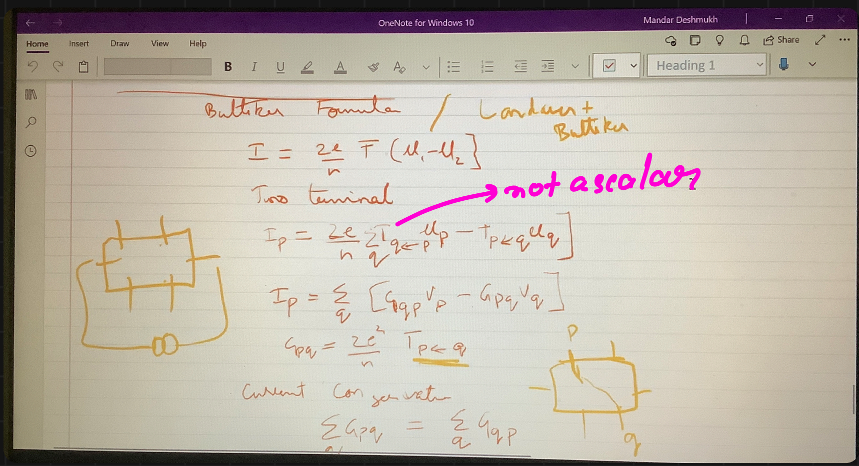
Recap :-

\# Landauer buttiker approach

~10 mins → # ohm's law like behaviour

\# Landauer Buttiker approach

\# G^{-1} → calculated for different regimes



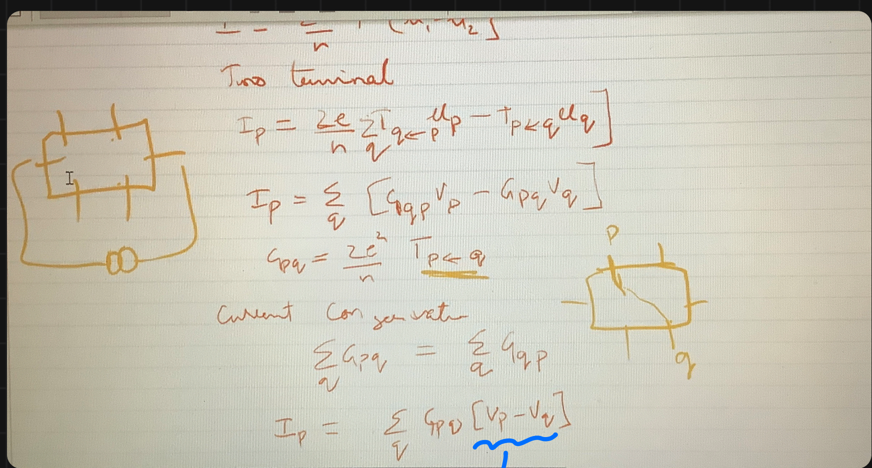
⇒ Datta's book → Buttiker formula

$T_{q\leftarrow p}$: transmission for a mode going from p to q.

$$I_p = \sum_q \left[G_{qp} V_p - G_{pq} V_q \right]$$

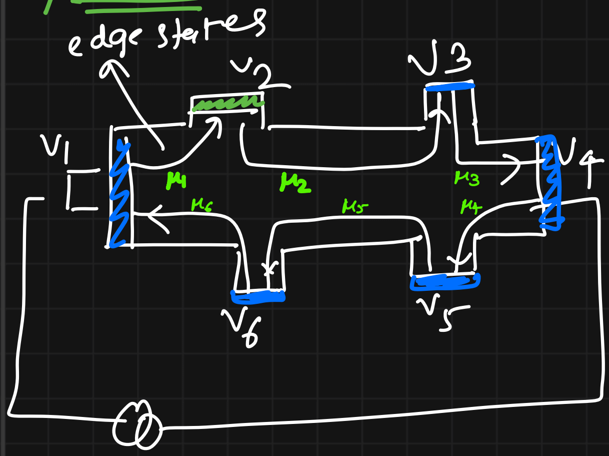
G_{qp} → pairwise conductance from p to q.

$$G_{pq} = \frac{2e^2}{m}$$



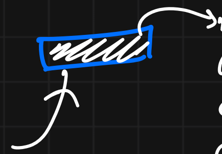
↳ allows us to get different terminal currents (???)

problems:- can be found in Datta's book

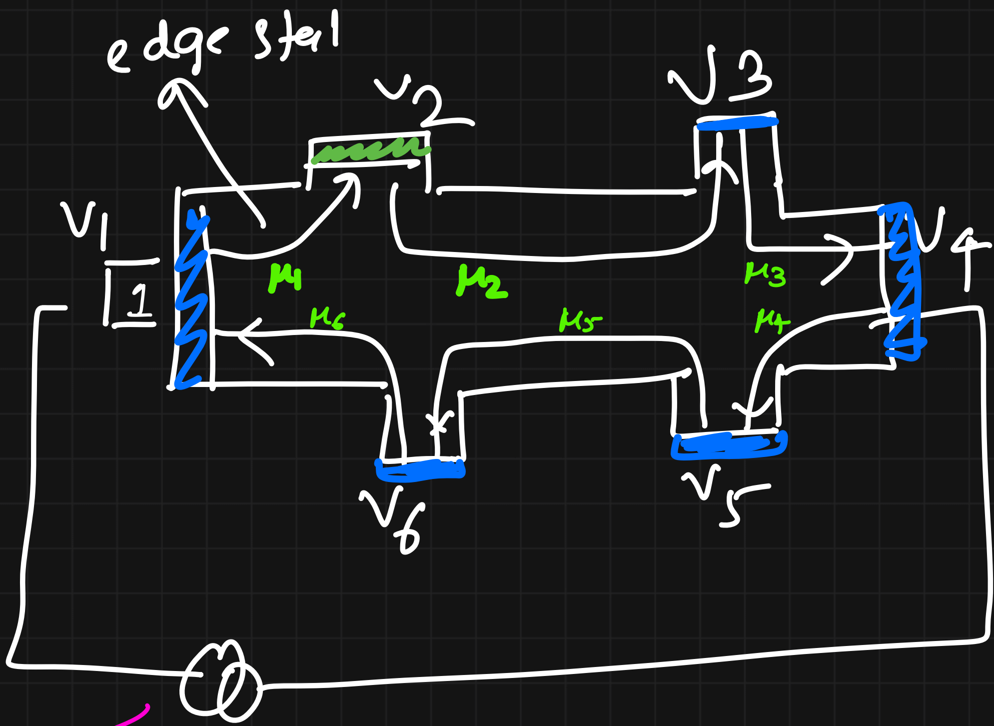


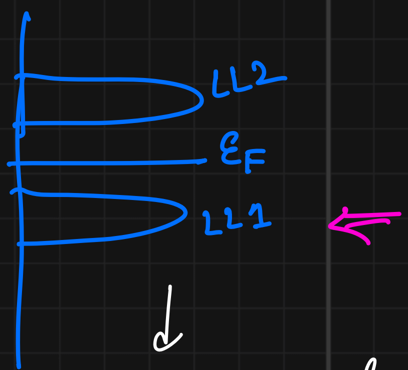
ϕ Hall
$\hookrightarrow$ = edge states

∴ no net current flow
in this Geometry.



metal contact equilibriates an arriving electron



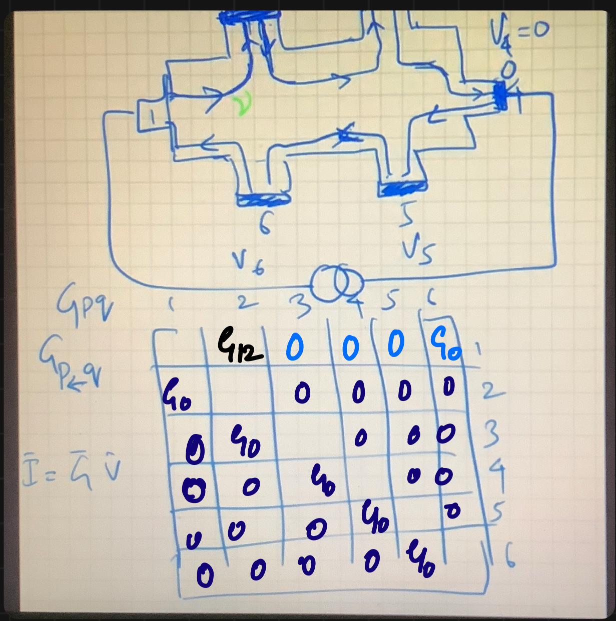


$\hookrightarrow$ bulk will have e-states & backscatter.

⇒ we currently take

Current source

Current cons:- ~~Σcol~~ Σ row or Σ column = 0



$G_{12} \leftarrow$ transmission from electrode 2 to 1.

$\hookrightarrow$ edge states → chiral

$G_{12} = 0$ → since no states go from ② to ①

$G_{matrix} > 0$

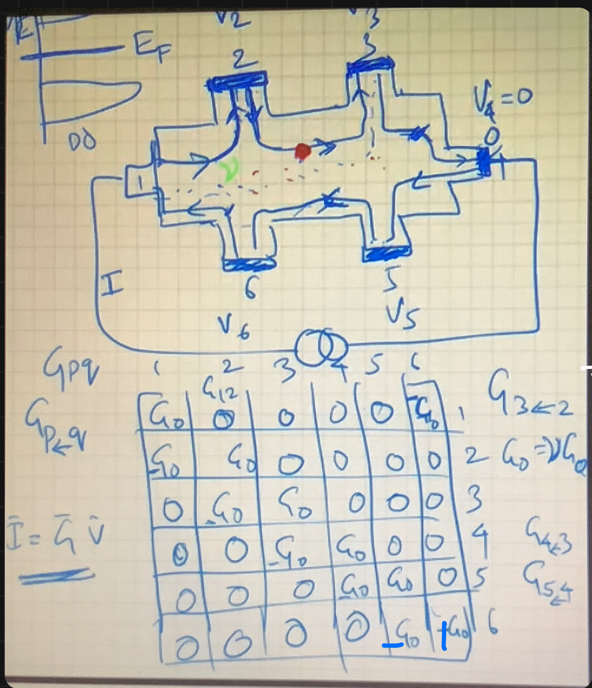
∘ take only direct transmission

$G_0 = \nu\left(\frac{2e^2}{h}\right)$ ν = filling factor

$\hookrightarrow$ Quantum of conductance

$$G_{65} = G_{6\leftarrow 5}$$

To get current cons, make all row sums & column summations to be 0.



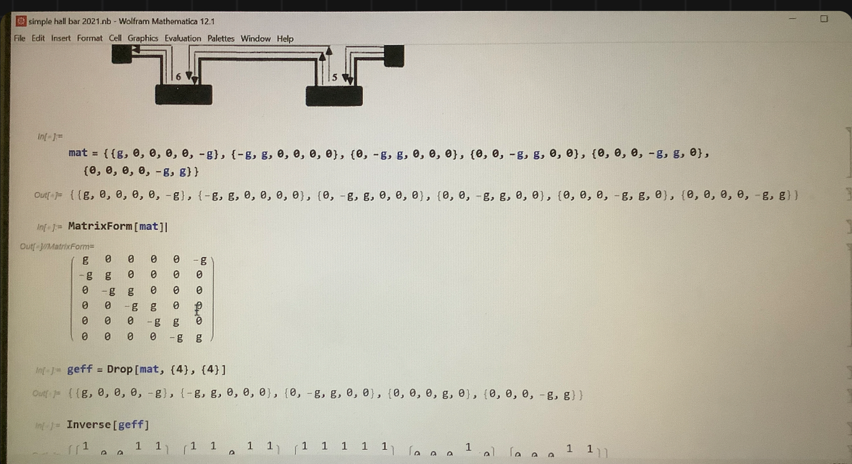
$\Rightarrow$ we conserve the current by flipping the sign on an off diagonal element (just a convention)

send current here

take it out here

$$\begin{pmatrix} 2 \\ 0 \\ 0 \\ -2 \\ 0 \\ 0 \end{pmatrix} = \left(\begin{array}{c|c} & \\ \hline & \end{array} \right) \begin{bmatrix} V_1 \\ V_2 \\ V_3 \\ V_4 = 0 \\ V_5 \\ V_6 \end{bmatrix}$$

$\hookrightarrow$ omit 4th row & column



we want to find other voltages

$V_{23} \to 0$ longitudinal resistance $= 0$

Hall mark of Hall effect

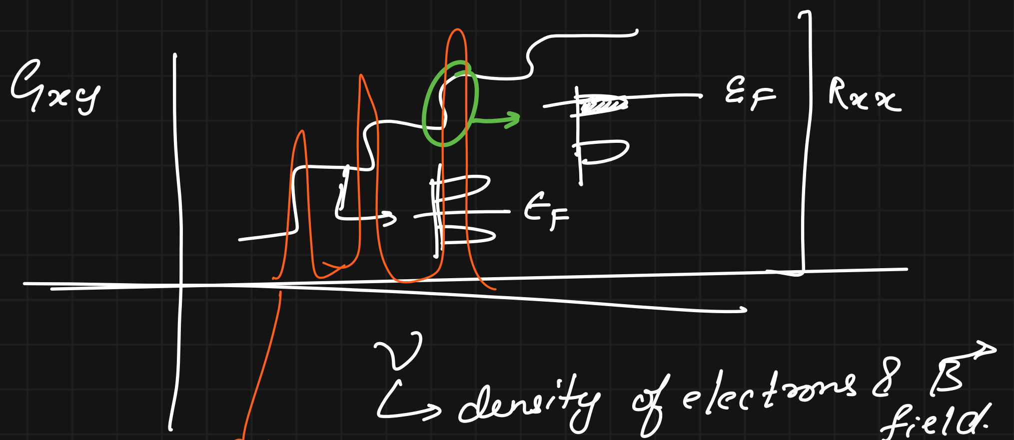
QHall hallmark → transverse voltage drop is same & related to filling factors

related to conductance

⇒ no backscattering → # of channels are same
∴ conductance is same

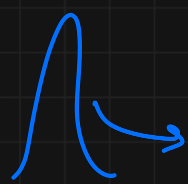
× no density gradient → magnetic field has to be uniform.

⇒ E_F b/w L.Levels, then things are complicated.



ν
↳ density of electrons & $\vec{B}$ field.

R_{xx}
= backscattering allowed
resistance



→ exponentially goes to zero

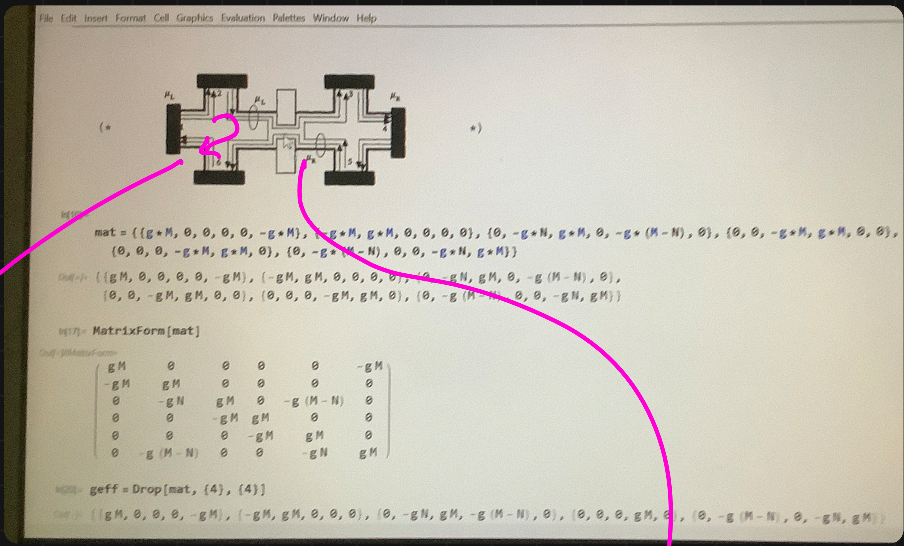
Note:- We currently work at 0 Temp.

In 2D, resistence → conductance matrix transf.'s tricky

↓

$\sigma_{xx} \to 0$ in b/w the landau levels

Example 2:-

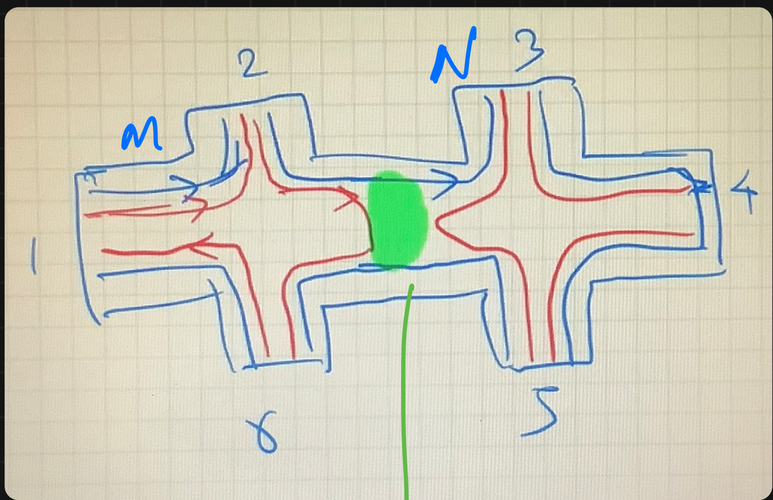


```
(* *)

mat = {{g*M, 0, 0, 0, 0, -g*M}, {-g*M, g*M, 0, 0, 0, 0}, {0, -g*N, g*M, 0, -g*(M-N), 0}, {0, 0, -g*M, g*M, 0, 0},
  {0, 0, 0, -g*M, g*M, 0}, {0, -g*(M-N), 0, 0, -g*N, g*M}}

MatrixForm[mat]

geff = Drop[mat, {4}, {4}]
```

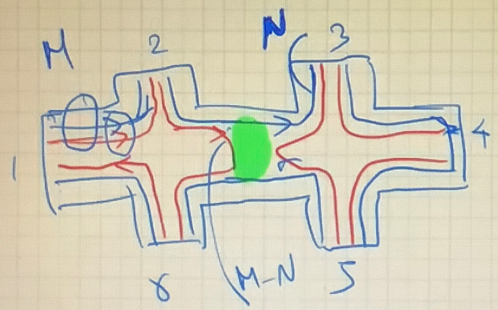
$$\begin{pmatrix} gM & 0 & 0 & 0 & 0 & -gM \\ -gM & gM & 0 & 0 & 0 & 0 \\ 0 & -gN & gM & 0 & -g(M-N) & 0 \\ 0 & 0 & -gM & gM & 0 & 0 \\ 0 & 0 & 0 & -gM & gM & 0 \\ 0 & -g(M-N) & 0 & 0 & -gN & gM \end{pmatrix}$$

few edge modes shall get affected

Charge density is different



region of non-uniform density



$G_{2\to 0}$

	1	2	3	4	5	6	
		0	0	0	0	$G_0 M$	1
	$G_0 M$		0	0	0	0	2
	0	NG_0		0	$G_0(M-N)$	0	3
	0	0	MG_0		0	0	4
	0	0	0	MG_0		0	5
	[illegible]	$(M-N)G_0$	0	0	NG_0		6