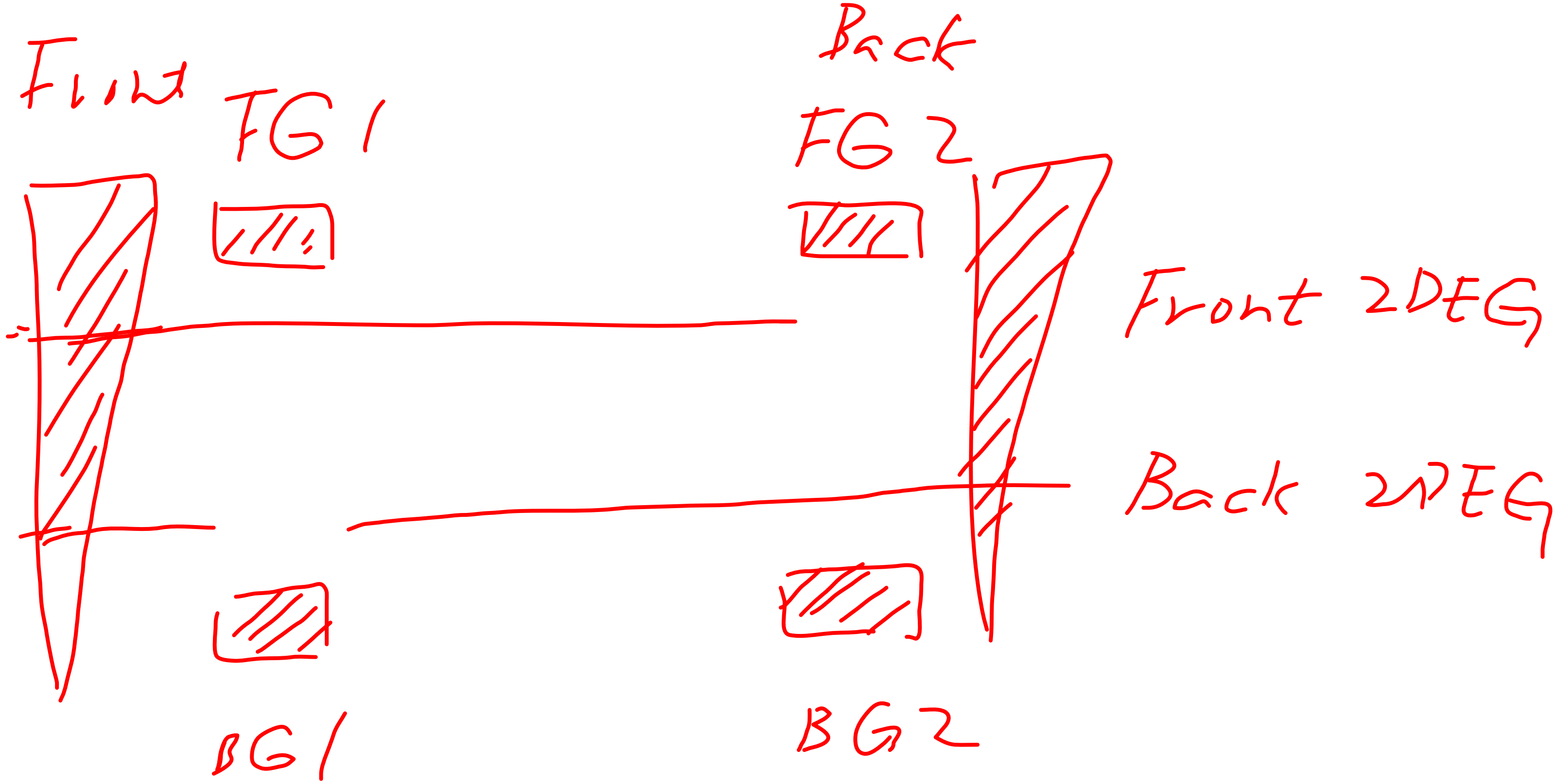
1.



By negatively biasing BG1

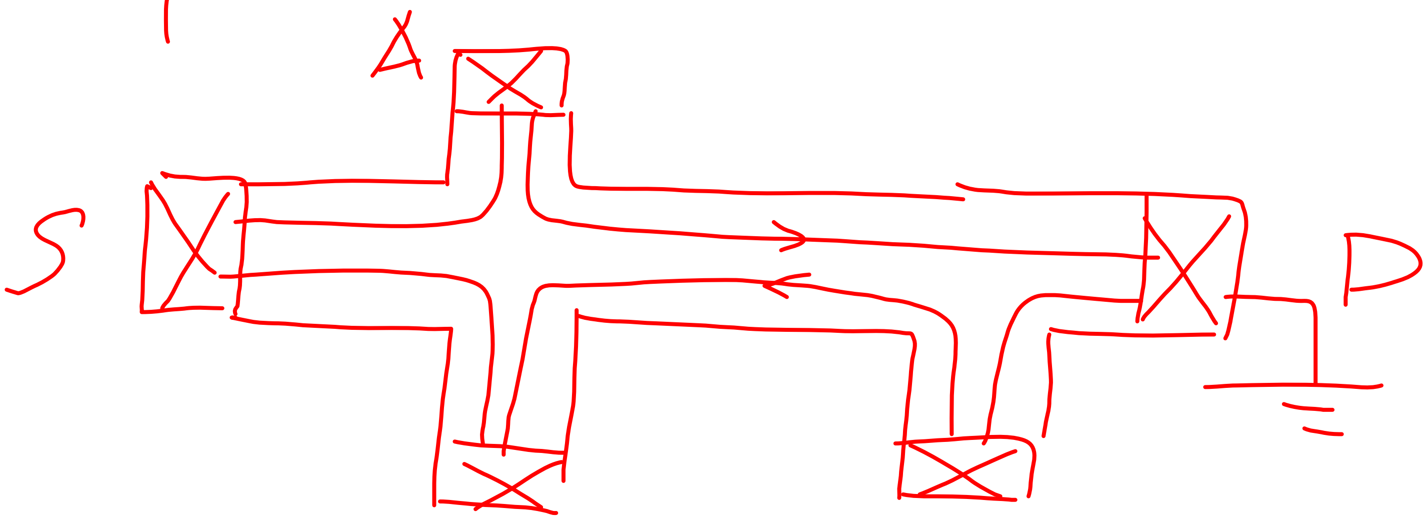
" FG2

2. $\rho_{xy} = R_{xy} = \dfrac{h}{\nu e^2}$

ν is the filling factor

ν : integer

ρ_{xx} and $\sigma_{xx} \to 0$ as $T \to 0$



Edge-state

$$N V_S e^2/h - N V_B e^2/h = I \quad (1)$$

$$N V_A e^2/h - N V_S e^2/h = 0 \quad (2)$$

$$N V_D e^2/h - N V_A e^2/h = -I \quad (3)$$

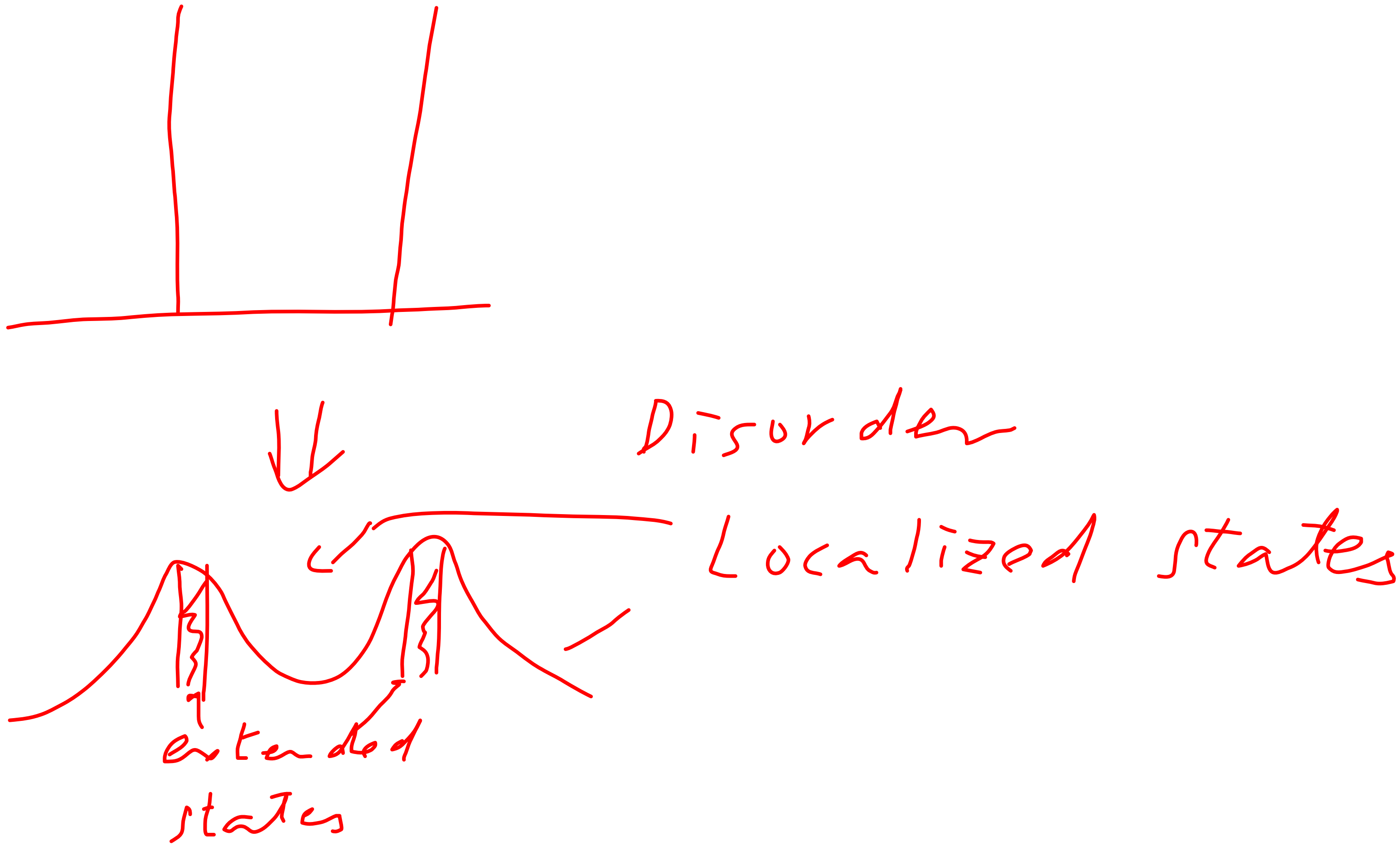
$$N V_C e^2/h - N V_D e^2/h = 0 \quad (4)$$

$$N V_B e^2/h - N V_C e^2/h = 0 \quad (5)$$

$$\frac{V_A - V_B}{I} = \frac{h}{N e^2} \qquad (1) \,\&\, (2)$$

$$V_B - V_C = 0 \qquad (5)$$

Disorder to introduce extended &
localized states



3. CFs

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

ν at $1/2$ $\quad \Phi \quad e^- + 2\,\text{flux}$: CF

$\nu = 1, \ \frac{2}{3}, \ \frac{3}{5}, \ \frac{4}{7}$

integer QHE for CFs

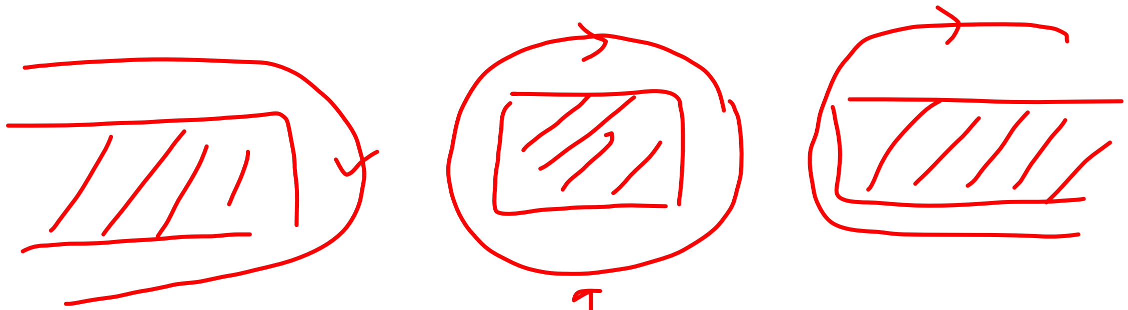
$\nu_{eff} = -1, -2, -3, -4 \ldots$

$\nu = \frac{1}{3}, \ \frac{2}{5}, \ \frac{3}{7}, \ \frac{4}{9}$

$\nu_{eff} = 1, 2, 3, 4 \ldots$

4. Chapter 8

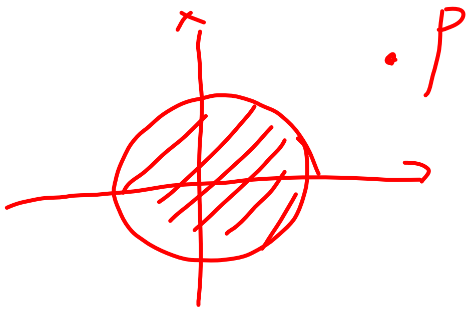
Anti-dot

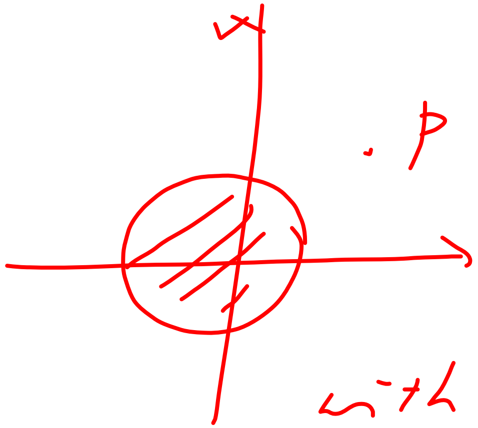


Nothing underneath the gate

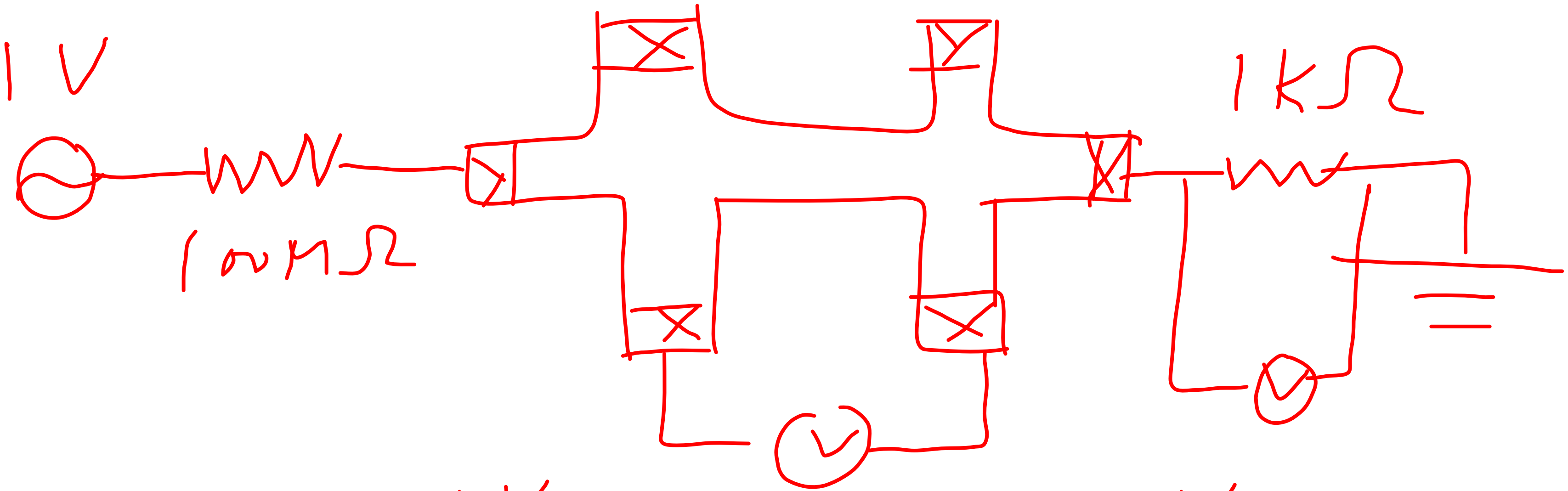
5. QP

An additional particle plus the perturbation



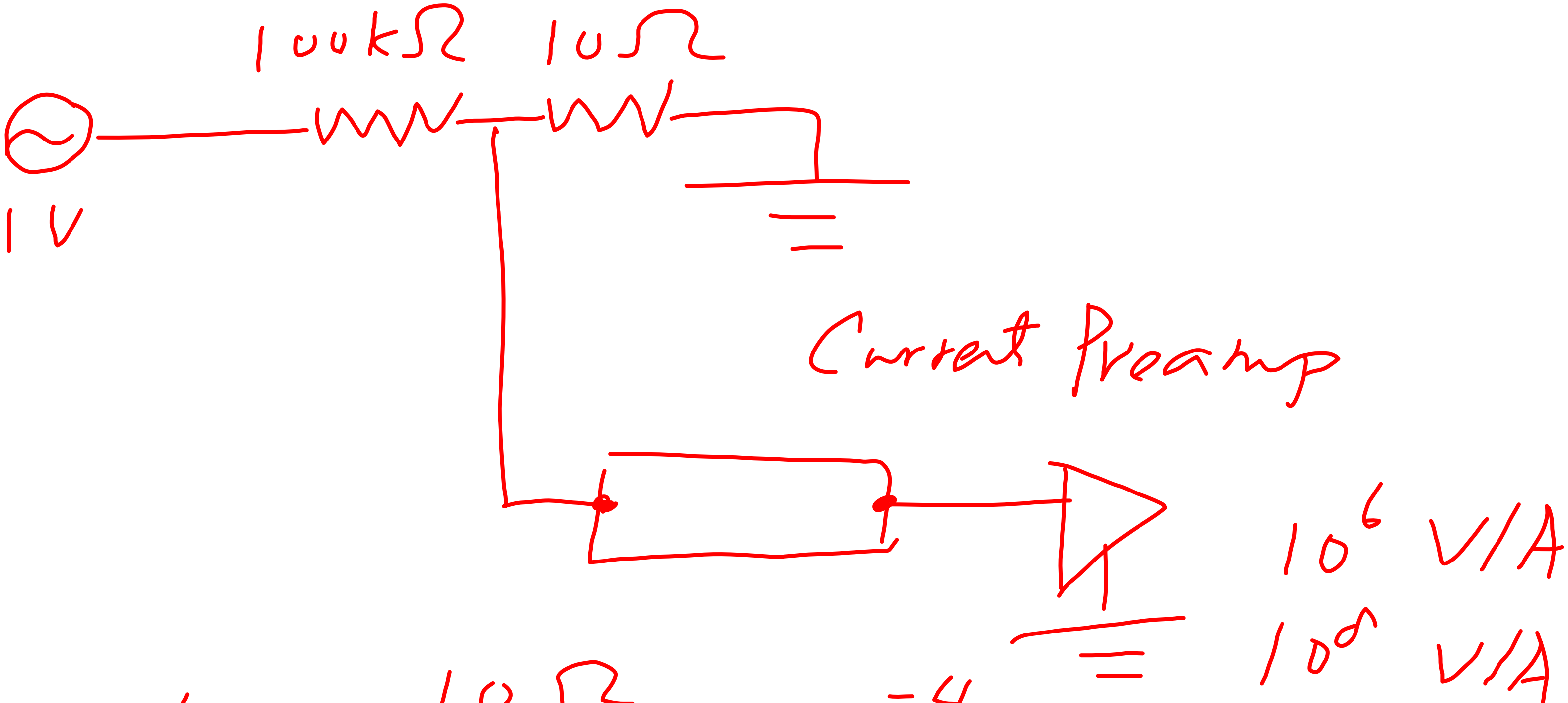


⇒ Momentum conservation with or without interaction, a single-particle picture is sufficient



$$I = \frac{1\,V}{100\,M\Omega + R_S} \approx \frac{1\,V}{100\,M\Omega} = 10\,nA$$

$$10^8 : 10^3$$



$$1\,V \cdot \frac{10\,\Omega}{100\,k\Omega} = 10^{-4}\,V$$

$$= 100\,\mu V$$

limit: $R_s >> 10\,\Omega$

7.

$$\rho_{xx} = 50\,\Omega$$

$$\sigma = \frac{1}{\rho_{xx}} = n e \mu$$

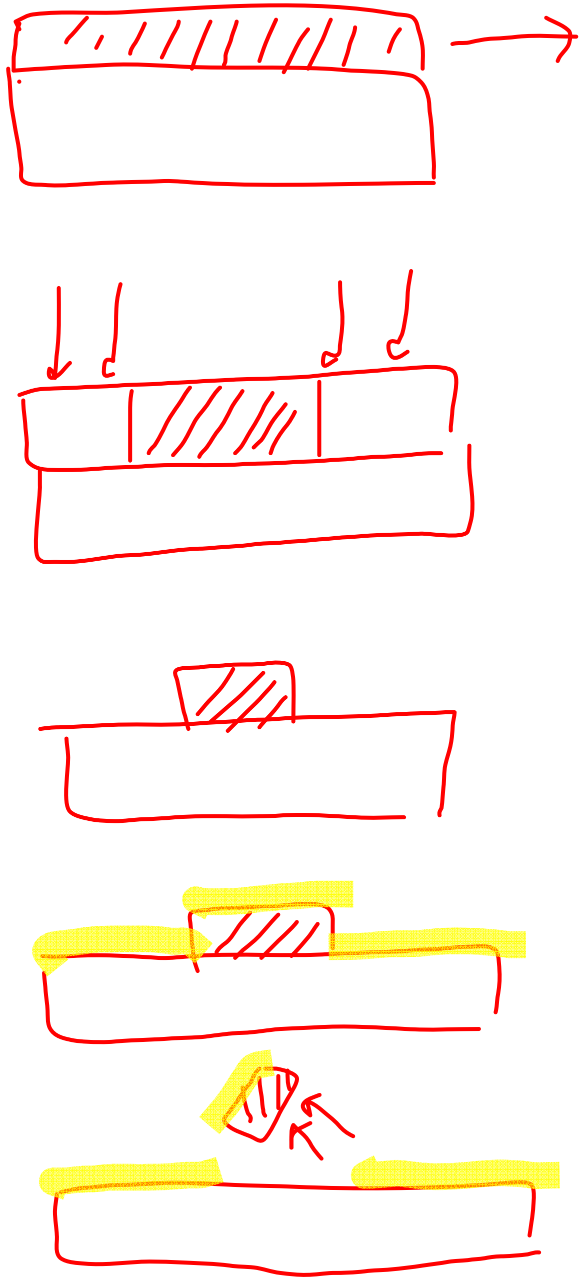
$$\mu = \frac{1}{\rho_{xx} n e} = \frac{e\tau}{m^*}$$

$$v_F \tau = l$$

$$m^* v_F = \hbar k_F = \hbar\sqrt{2\pi n}$$

$$v_F = \frac{\hbar\sqrt{2\pi n}}{m^*} \quad (1) \qquad v_F \tau \quad \frac{(1)\,\tau}{e m^*}$$

8.



PMMA

Spin coating + Bake

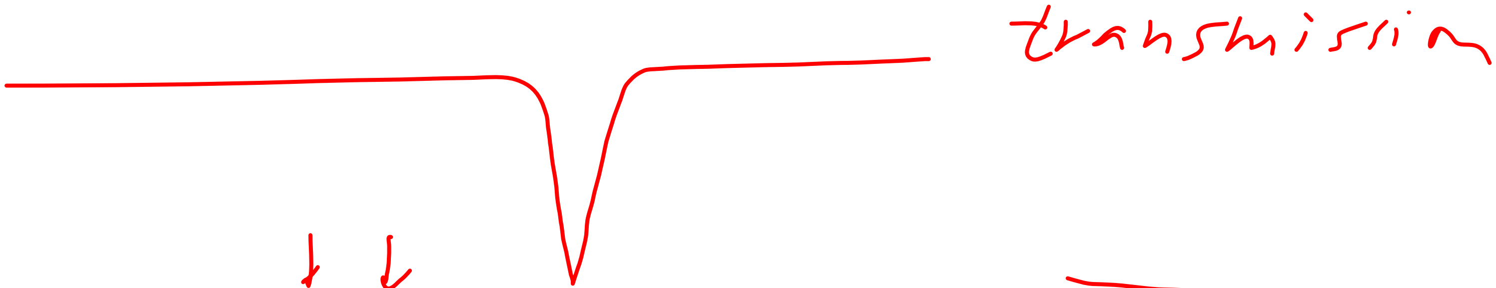
E-beam patterning

Develop

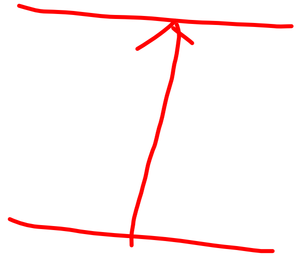
Evaporation

Lift-off in acetone

9. Cyclotron Resonance (CR)



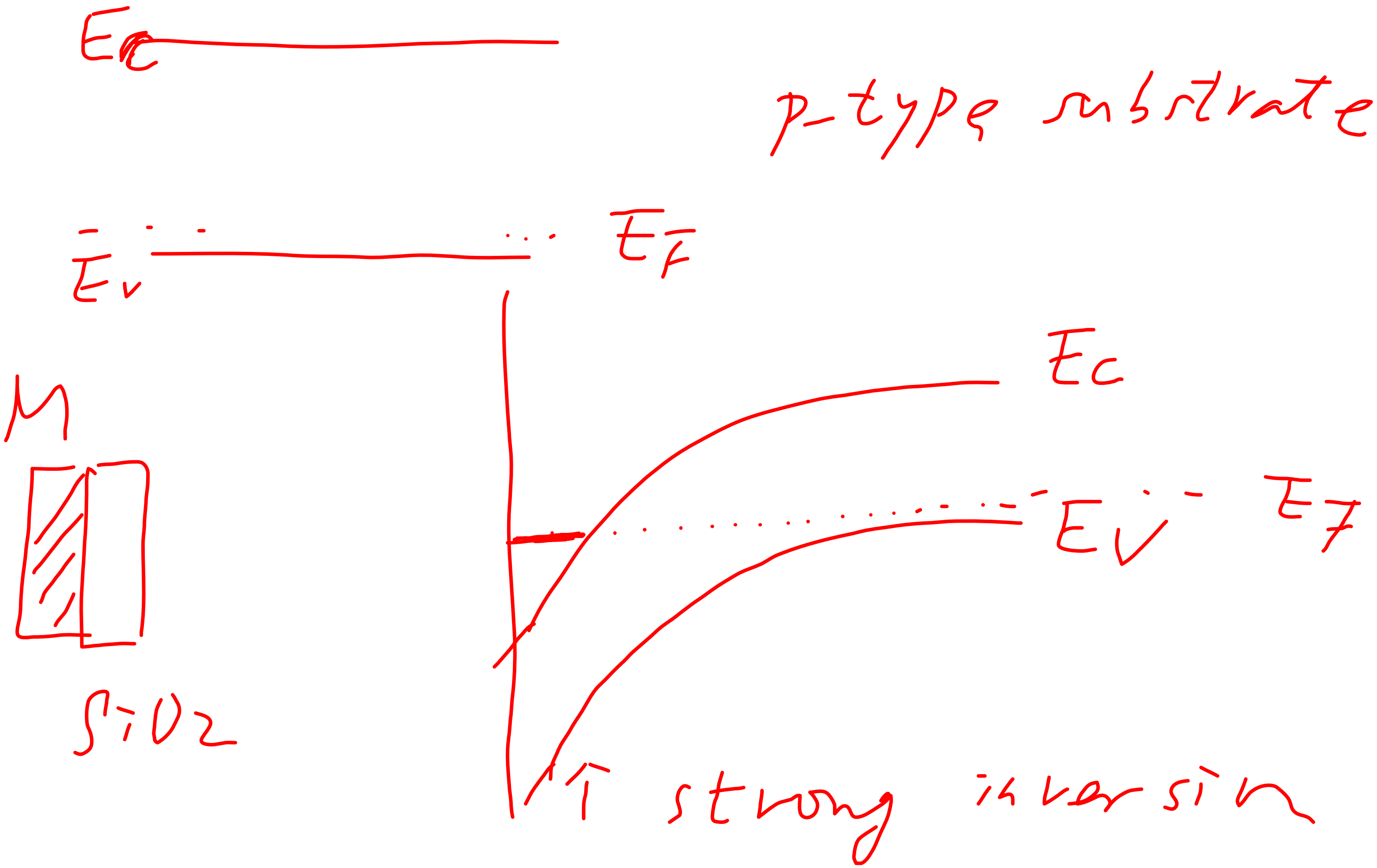
$$\hbar\omega_c = \frac{\hbar e B}{m^*} = E$$



SdH oscillations

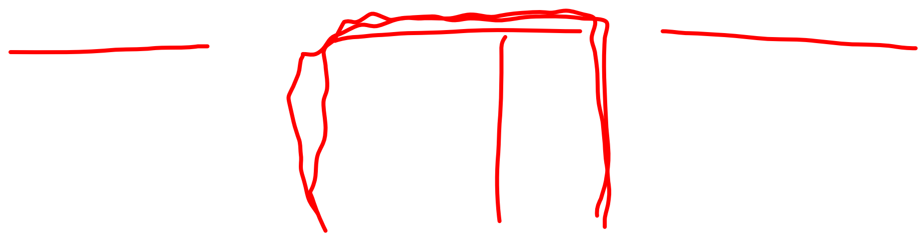
$$\Delta\rho_{xx} \simeq \exp\left(-\frac{\pi}{\omega_c \tau}\right) \frac{X}{\sinh X}$$

$$\Delta\rho_{SdH}(B,T) = C\exp\left(\frac{-\pi}{\mu B}\right)\frac{\dfrac{2\pi^2 k_B m^* T}{\hbar eB}}{\sinh\left(\dfrac{2\pi^2 k_B m^* T}{\hbar eB}\right)}$$



Ec
p-type substrate
Ev
EF
Ec
M
Ev
EF
SiO2
strong inversion

For electrons



No focussing for $B = 9T$

$$\frac{\hbar k_F}{eB}$$

For CFs

$$\frac{\hbar k_F}{e B_{eff}}$$

B_{eff} low

For electrons $B \to 0$ $\quad k_F = \sqrt{2\pi n}$

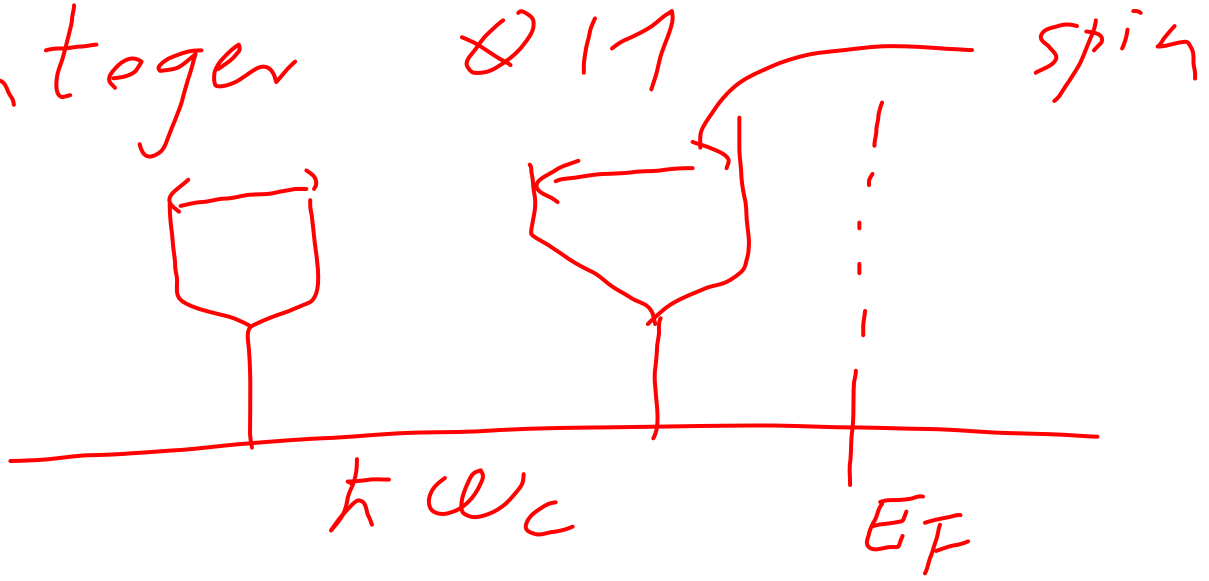
For electrons $\quad k_F = \sqrt{4\pi n}$

$B_{eff} \to 0 \quad B$ high

no spin degeneracy (g_s)

$$k_F = \sqrt{\frac{4\pi n}{g_s}}$$

Integer QH



FQH

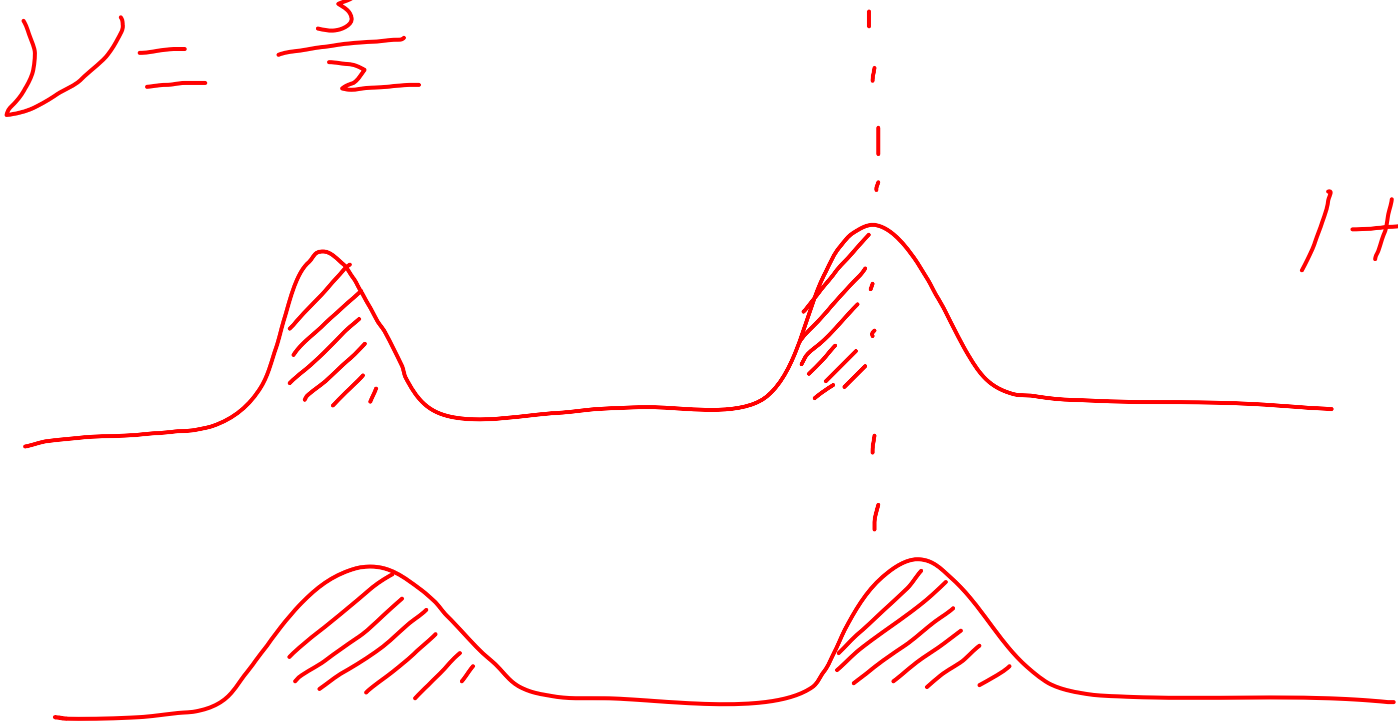
CF

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

No spin degeneracy

$\lambda_{CF} \simeq 1\,\mu m$

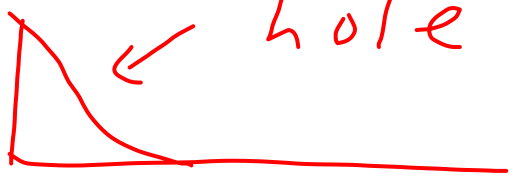
$\nu = \frac{3}{2}$



$1 + \frac{1}{2}$

$-$

$2 + \left(-\frac{1}{2}\right)$



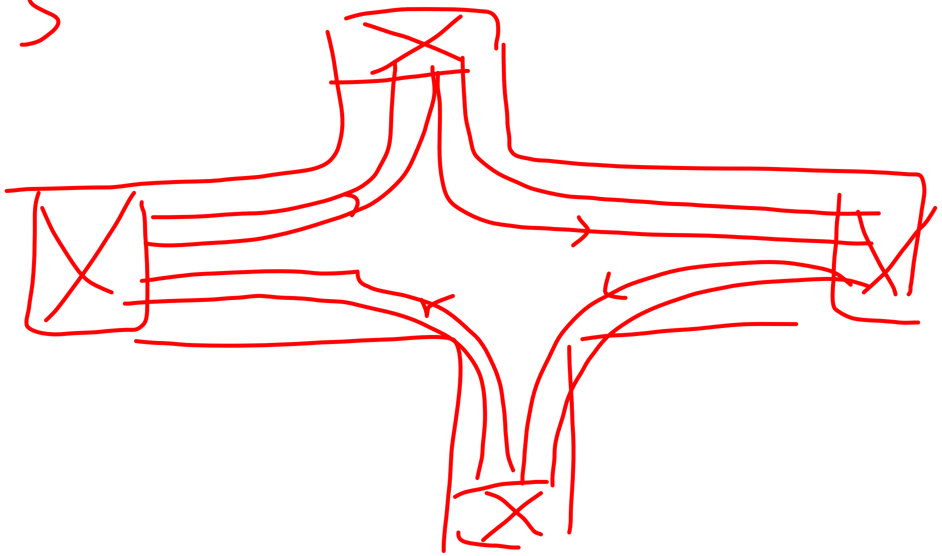
hole

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

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

$\nu = \frac{2}{5}$ $\nu_{eff} = 2$ $N = 2$

CF



E : e^- $\quad V_1, V_2$

E_{eff} : CF $\quad V_1^*$ & V_2^*

$$E_{eff} = E(1-2\nu)$$

$$V = E\,W$$

↑

width of the Hall bar