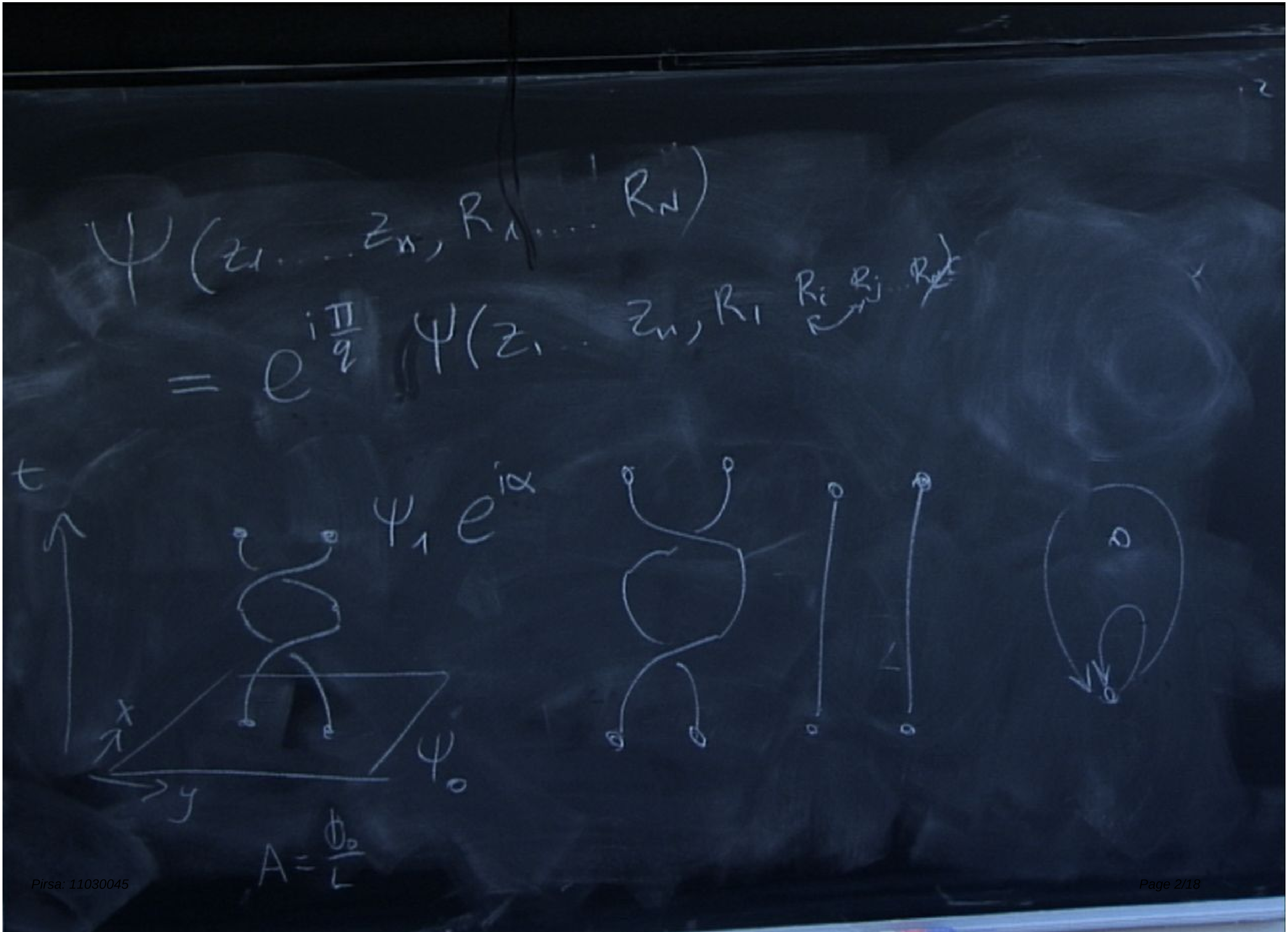
Title: Explorations in Condensed Matter - Lecture 10

Date: Mar 24, 2011 11:30 AM

URL: http://pirsa.org/11030045

Abstract:


Ψ(z1 ..... zn, R1 ..... RN)
= e^{iπ/q} Ψ(z1 ... zn, R1 Ri Rj ... RN)
t
Ψ1 e^{iα}
x
y
Ψ0
A = Φ0/L

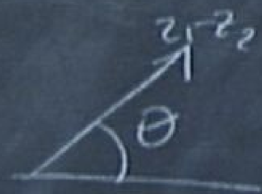
$$\Psi_1(z_1 \ldots z_N, R_1 \ldots R_N)$$

$$= e^{i\frac{\pi}{q}} \Psi(z_1 \ldots z_N, R_1 \; R_i \; R_j \ldots R_N)$$

$$\Theta_{ij} \Psi_p = \Psi_{p'}$$

$$\Psi_p(z_1 \ldots z_N, R_1 \ldots R_N)$$

$$\sum_{p'} \underbrace{M_{pp'}}_{e^{i\pi}} \Psi_{p'} = \Psi_p$$



$$H_{mn} = \langle \Psi_m | H | \Psi_n \rangle$$

$$= \langle \Psi_m U^\dagger \underbrace{U | H | U^\dagger}_{} U \Psi_n \rangle$$

$$\langle \chi_m | \tilde{H} | \chi_n \rangle$$

$$\boxed{U = e^{i\tilde{\Phi} \sum_{i<j} \mathrm{Arg}(z_i - z_j)}}$$

$$\psi \rightarrow e^{i a_{cs}} \psi$$

$$H = \frac{(p - eA)^2}{2m} \longrightarrow \frac{(p - A - a)^2}{2m}$$

$$\nabla \times a = n(\vec{r})$$

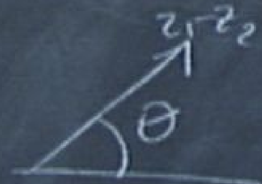
$$\psi \to e^{i a_{cs}} \psi$$

$$H = \frac{(p - eA)^2}{2m} \longrightarrow \frac{(p - A + a)^2}{2m}$$

$$\nabla \times a = n(\vec{r}) \longrightarrow \text{mean field } (\nabla \times a) = \langle n(r) \rangle$$

$$B_{eff} = \nabla \times (A - a) = B - \tilde{\phi}\, \phi_0 \cdot n$$

$$H_{mn} = \langle \Psi_m | H | \Psi_n \rangle$$



$$= \langle \Psi_m U^\dagger \underbrace{U | H | U^\dagger}_{} U \Psi_n \rangle$$

$$\langle \chi_m | \tilde{H} | \chi_n \rangle$$

$$\boxed{U = e^{i \tilde{\Phi} \sum_{i<j} \mathrm{Arg}(z_i - z_j)}}$$

$$\nu = \frac{N}{D_{LL}} = \frac{N}{\text{Area}/2\pi l_B^2} = \frac{2\pi\hbar N}{eB \cdot A} = \frac{h}{e}\frac{1}{\Phi} =$$

$$\boxed{\nu = N \cdot \frac{\Phi_0}{\Phi}}$$

$\psi \to$

$\Psi_i \rangle$

$H =$

$\nabla \times$

$$\boxed{U = e^{i\tilde{\Phi}\sum_{i<j} \mathrm{Arg}(z_i - z_j)}}$$

$\text{Area}\, B_{\text{ec}}$

$$\psi \rightarrow e^{i a_{cs}} \psi$$

$$H = \frac{(p - eA)^2}{2m} \longrightarrow \frac{(p - A + a)^2}{2m}$$

$$\nabla \times a = n(\vec{r}) \longrightarrow \text{mean field } (\nabla \times a) = \langle$$

$$\text{Area } B_{eff} = \nabla \times (A - a) = \phi - \underbrace{\tilde{\phi}\, \phi_0 N}$$

$$\boxed{\nu_{eff}^{-1} = \nu^{-1} - \tilde{\phi}}$$

$3 \quad 3, -2$

$\nu_{eff} = 1$ (started with 1/3, attache

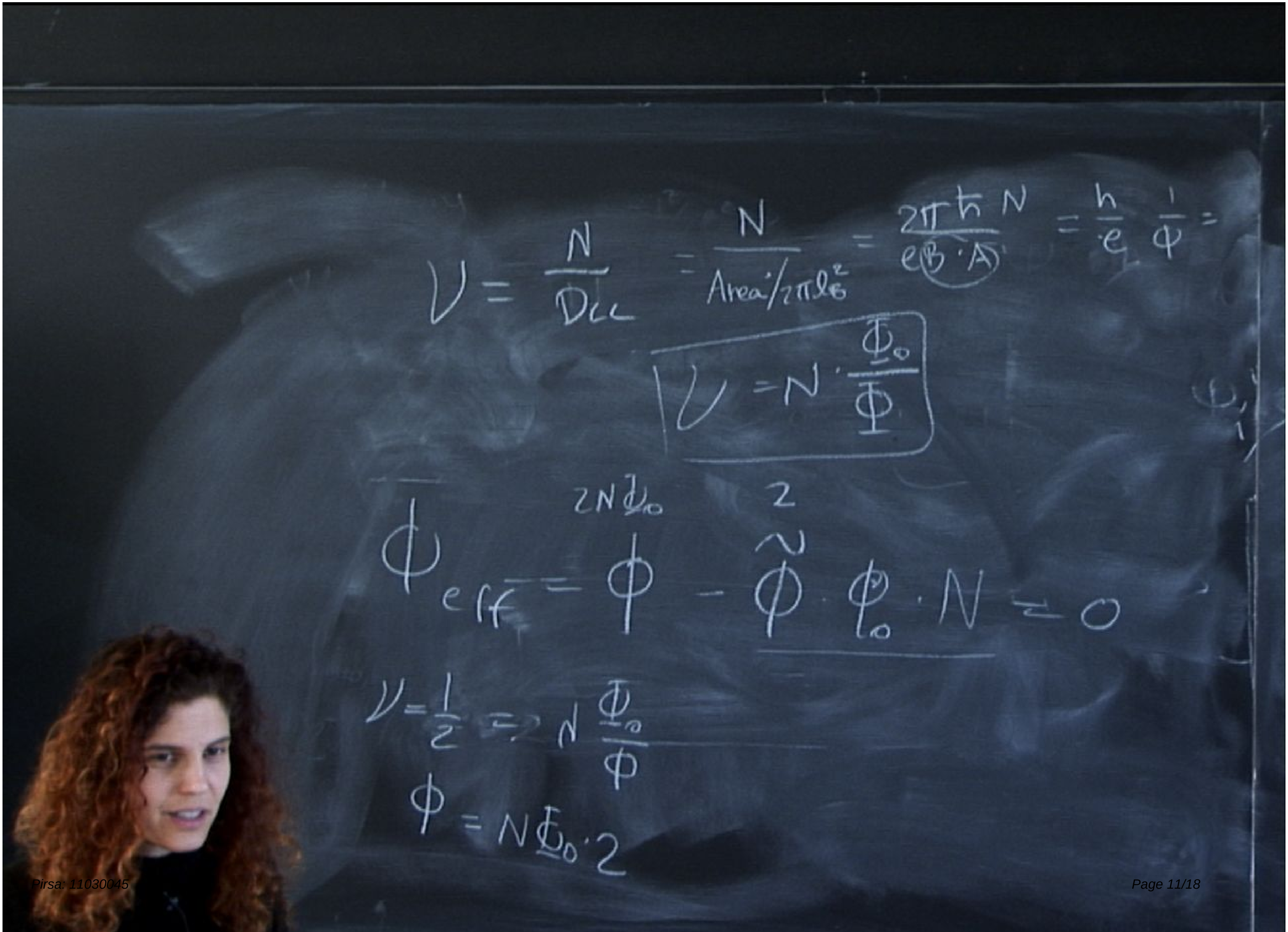
$$\rightarrow e^{i a_{cs}} \psi$$

$$= \frac{(p - eA)^2}{2m} \longrightarrow \frac{(p - A + a)^2}{2m}$$

$$\nabla \times a = n(\vec{r}) \longrightarrow \text{mean field } (\nabla \times a) = \underline{\langle n(r) \rangle}$$

$$_{eff} = \nabla \times (A - a) = \phi - \underbrace{\tilde{\phi}\, \phi_0}\, N$$

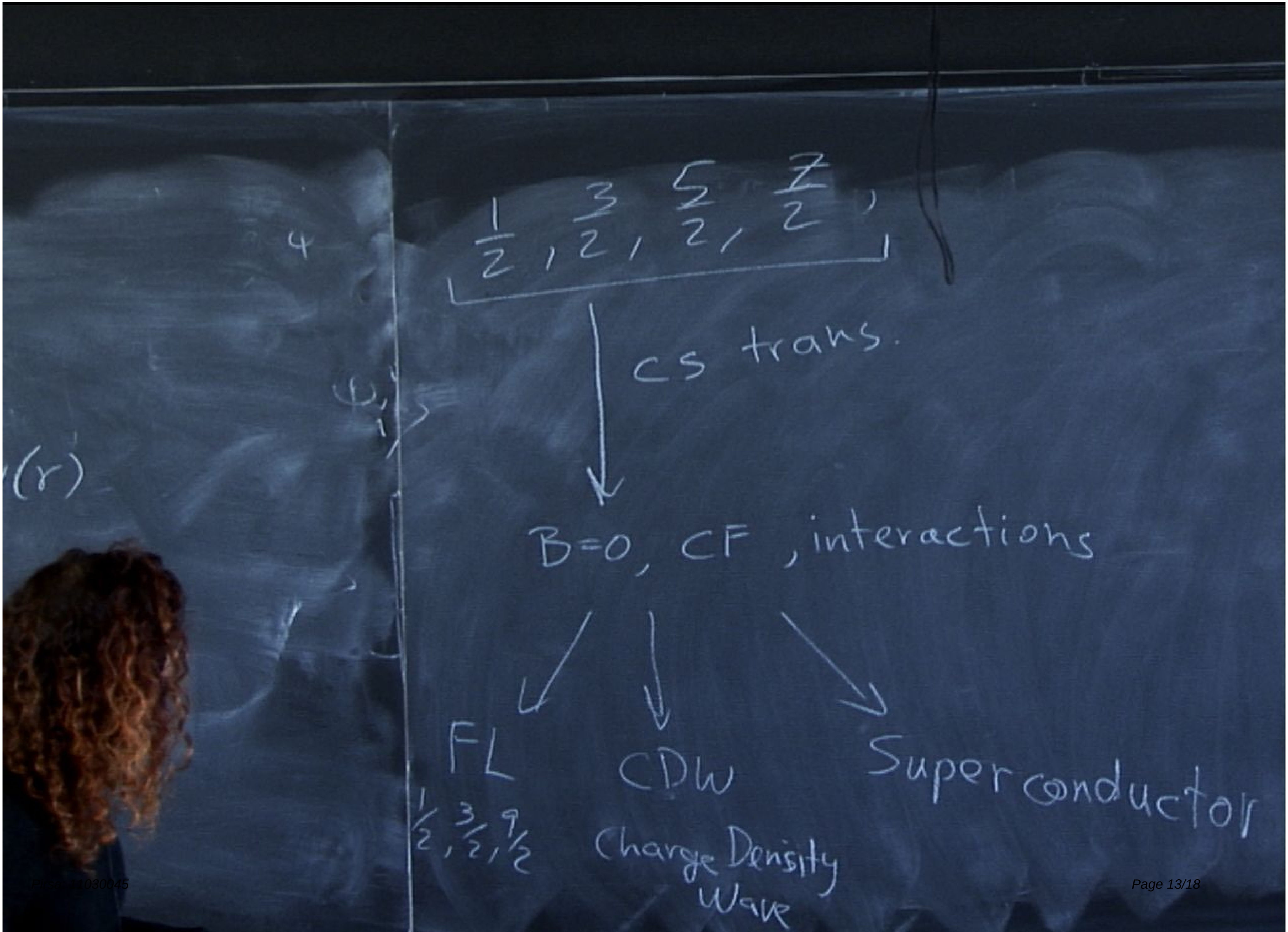
$$\boxed{{}_{f}^{-1} = \nu^{-1} - \tilde{\phi}} \quad \nu_{eff} = 1 \quad \text{(started with } 1/3\text{, attached 2 flux)}$$


$\nu = \frac{N}{D_{LL}} = \frac{N}{\mathrm{Area}/2\pi l_B^2} = \frac{2\pi\hbar N}{eB\cdot A} = \frac{h}{e}\frac{1}{\phi} =$
$\boxed{\nu = N \cdot \frac{\Phi_0}{\Phi}}$
$2N\Phi_0$ 2
$\phi_{eff} = \phi - \tilde{\phi} \cdot \Phi_0 \cdot N = 0$
$\nu = \frac{1}{2} \Rightarrow N\frac{\Phi_0}{\phi}$
$\phi = N\Phi_0 \cdot 2$

$\frac{1}{2}, \frac{3}{2}, \frac{5}{2}, \frac{7}{2},$

$\Big\downarrow$ CS trans.

$B=0$, CF, interactions



1/2, 3/2, 5/2, 7/2,
cs trans.
B=0, CF, interactions
FL
CDW
Superconductor
1/2, 3/2, 9/2
Charge Density Wave

$$\underbrace{\frac{1}{2}, \frac{3}{2}, \frac{5}{2}, \frac{7}{2},}$$

$$\Big\downarrow \text{ CS trans.}$$

B=0, CF, interactions

FL	CDW	IQH
$\frac{1}{2}, \frac{3}{2},$	$9/2 \ldots$	"
	Charge Density Wave	Superconductor
		$5/2, 7/2$

$\frac{1}{2}, \frac{3}{2}, \frac{5}{2}, \frac{7}{2},$

$\downarrow$ CS trans.

$B=0$, CF, interactions

FL

$\frac{1}{2}, \frac{3}{2},$

CDW $\quad 9/2$

Charge Density Wave

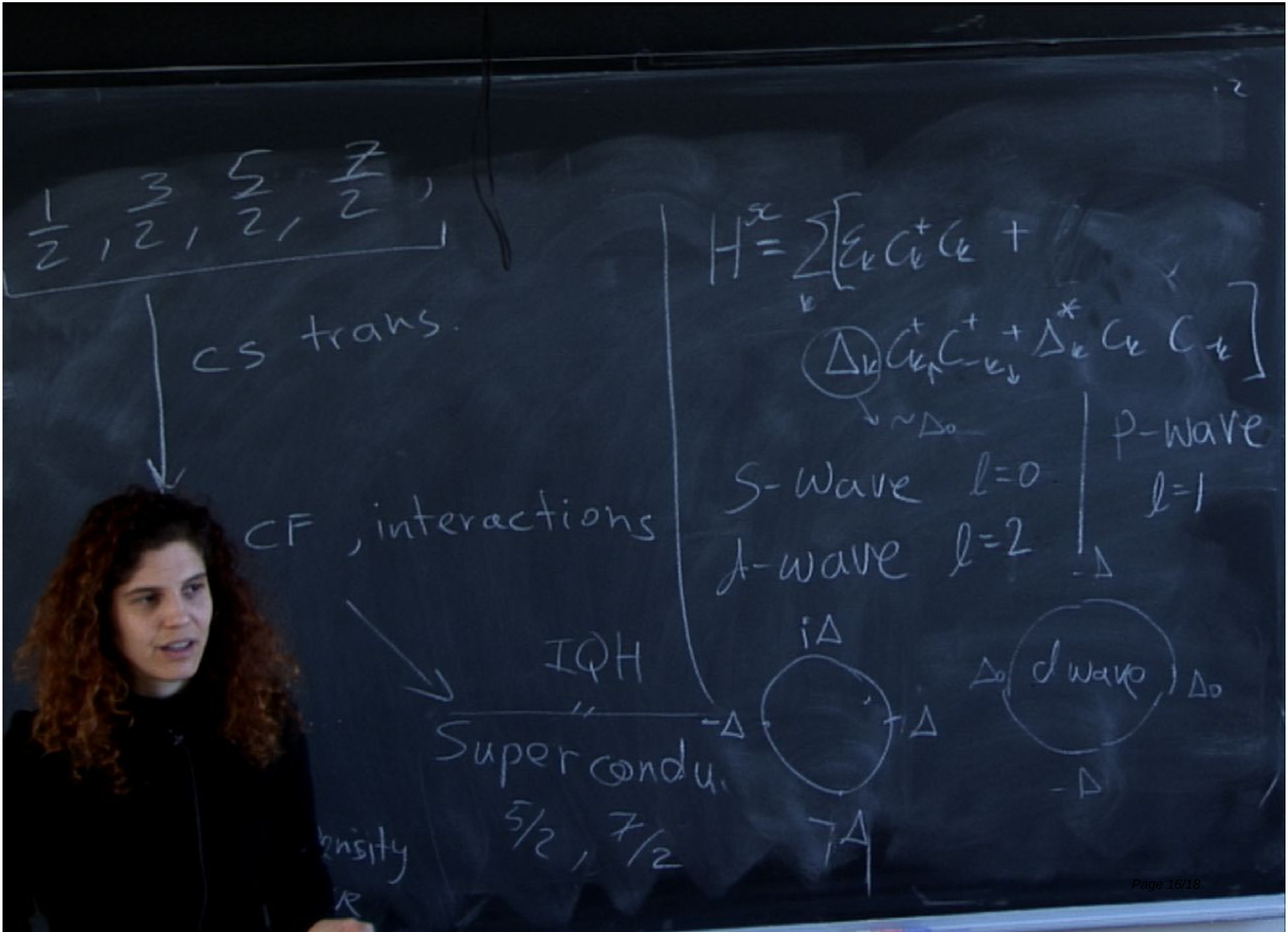
IQH

"

Superconductor

$5/2, \; 7/2$

$$H^{sc} = \sum_k \left[\varepsilon_k c_k^{\dagger} c_k + \Delta_k c_k^{\dagger} c_{-k}^{\dagger} + \Delta_k^{*} c_k c_{-k} \right]$$


1/2, 3/2, 5/2, 7/2,
cs trans.
CF, interactions
IQH
Superconduc.
5/2, 7/2
$H^{sc} = \sum_k [\varepsilon_k c_k^+ c_k + \Delta_k c_{k\uparrow}^+ c_{-k\downarrow}^+ + \Delta_k^* c_k c_{-k}]$
$\sim\Delta_0$
s-wave $l=0$
d-wave $l=2$
p-wave
$l=1$
$i\Delta$
$-\Delta$
Δ
d wave
Δ_0

$\frac{1}{2}, \frac{3}{2}, \frac{5}{2}, \frac{7}{2},$

cs trans.

$B=0$, CF, interactions

FL

$\frac{3}{2}$,

CDW $9/2$..

Charge Density Wave

Supercondu. IQH

$5/2$, $7/2$

$$H^{\alpha} = \sum_k \left[\varepsilon_k c_k^{+} c_k + \Delta_k c_{k\uparrow}^{+} c_{-k\downarrow}^{+} + \Delta_k^{*} c_k c_{-k} \right]$$

$\Delta_k \sim \Delta_0$

s-wave $l=0$

d-wave $l=2$

p-wave $l=1$

$i\Delta$, $-\Delta$, Δ

Δ_0 d wave Δ_0

$-\Delta$

$\psi_1(z_1 \ldots z_n, R_1 \ldots R_N)$

4

$\vdots$

$\psi_p(z_1 \ldots z_n, R_1 \ldots R_N)$