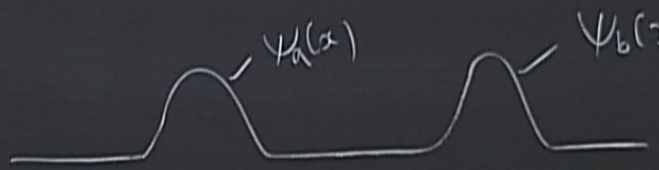
Title: PSI 2015/2016 Foundations of Quantum Mechanics - Lecture 7

Date: Jan 12, 2016 11:30 AM

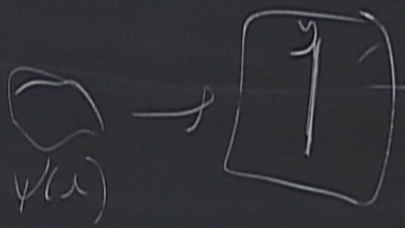
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Abstract:

Meas. in dBB.

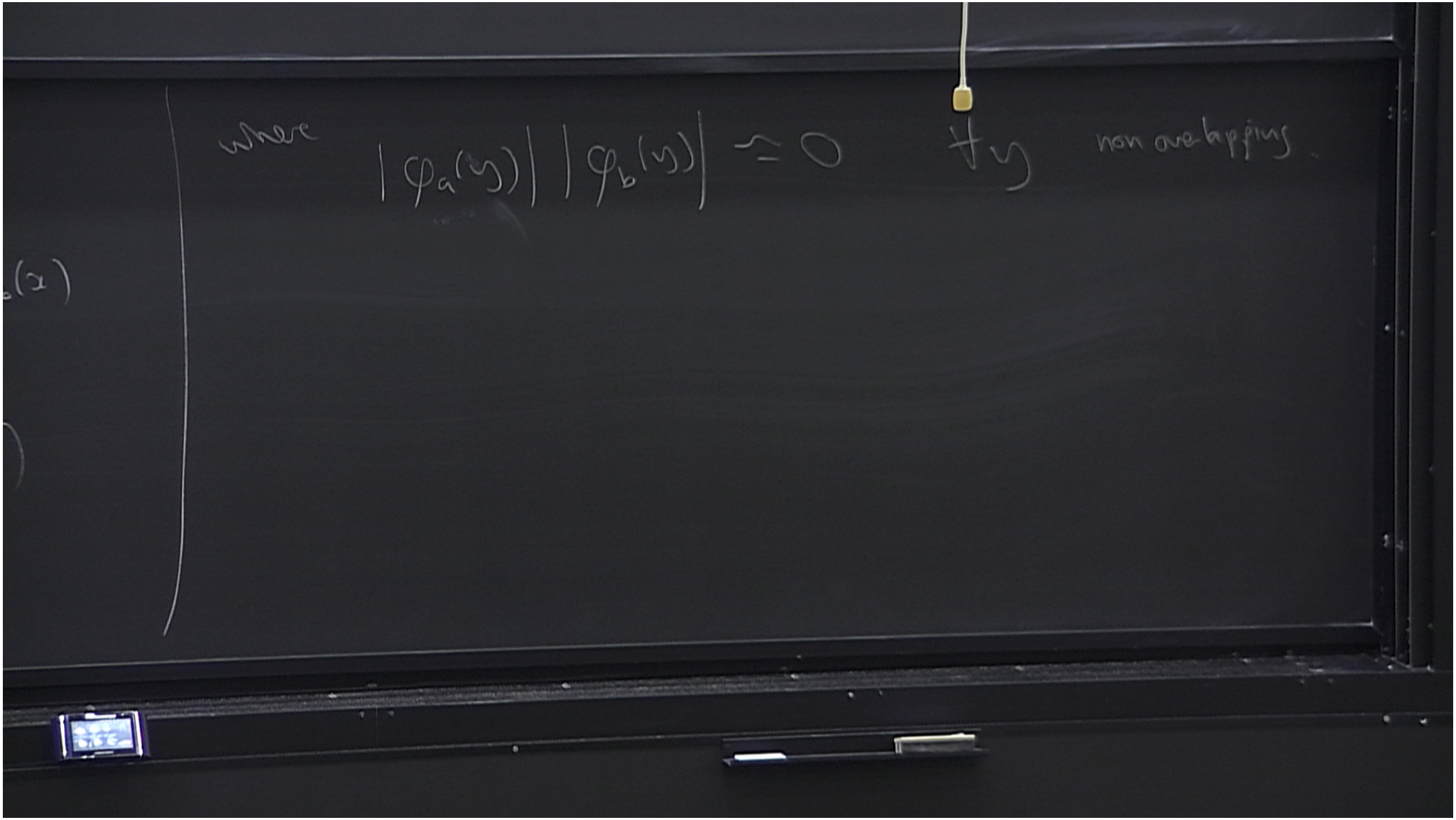


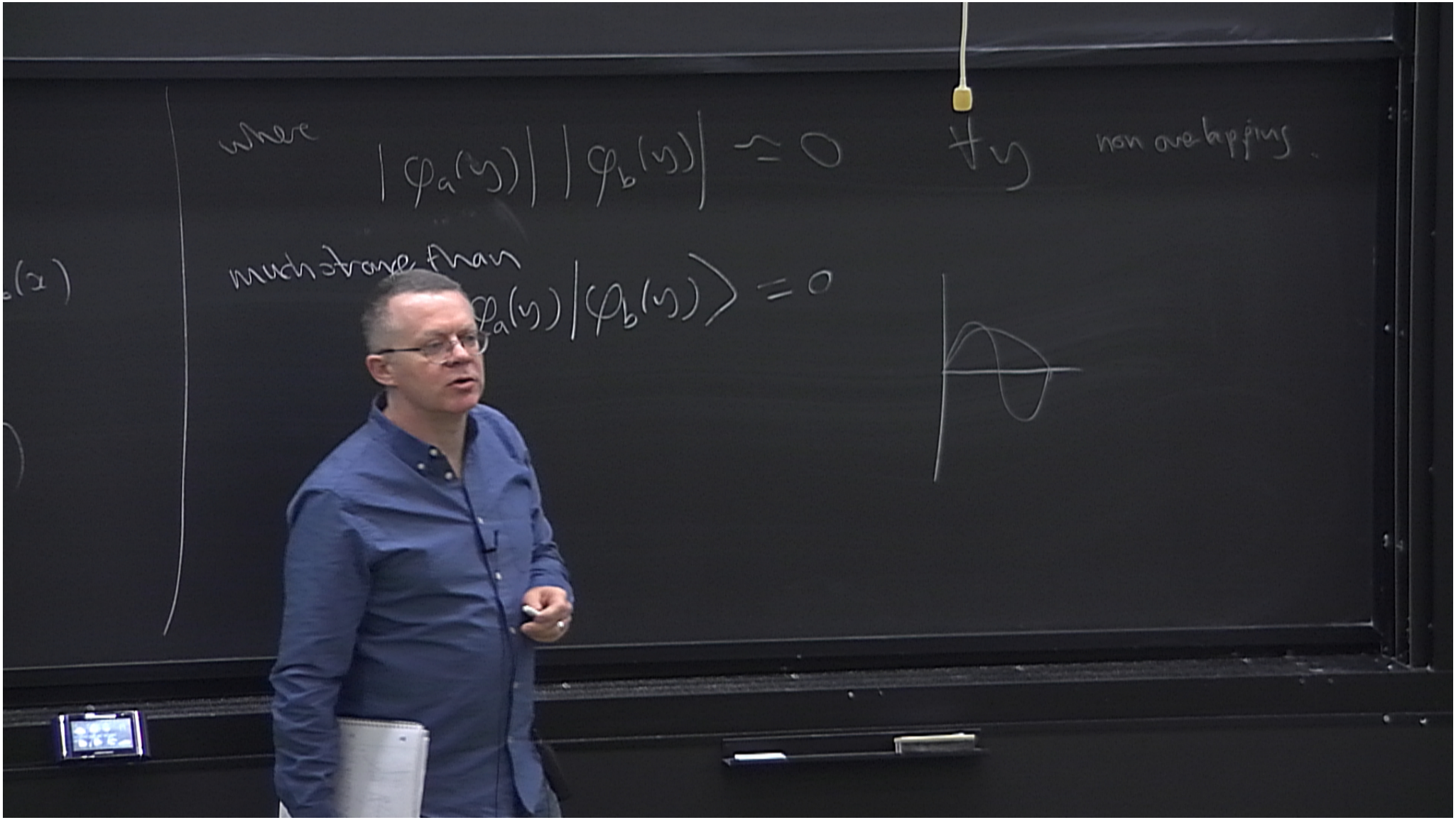
$$\psi(x) = \alpha\,\psi_a(x) + \beta\,\psi_b(x)$$



$$\psi_a(x)\,\varphi_0(y) \longrightarrow \psi_a(x)\,\varphi_a(y)$$

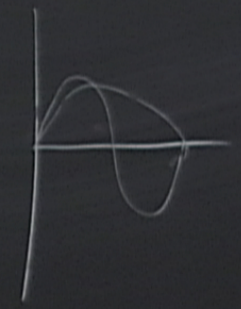
$$\psi_b(x)\,\varphi_0(y) \longrightarrow \psi_b(x)\,\varphi_b(y)$$


where
$|\varphi_a(y)|\,|\varphi_b(y)| \simeq 0$ $\forall y$ non overlapping


where
$|\varphi_a(y)|\,|\varphi_b(y)| \simeq 0$
$\forall y$
non overlapping
much stronger than
$\langle \varphi_a(y) | \varphi_b(y) \rangle = 0$

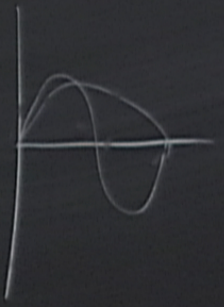
where $|\varphi_a(y)|\,|\varphi_b(y)| \simeq 0$ $\forall y$ non overlapping

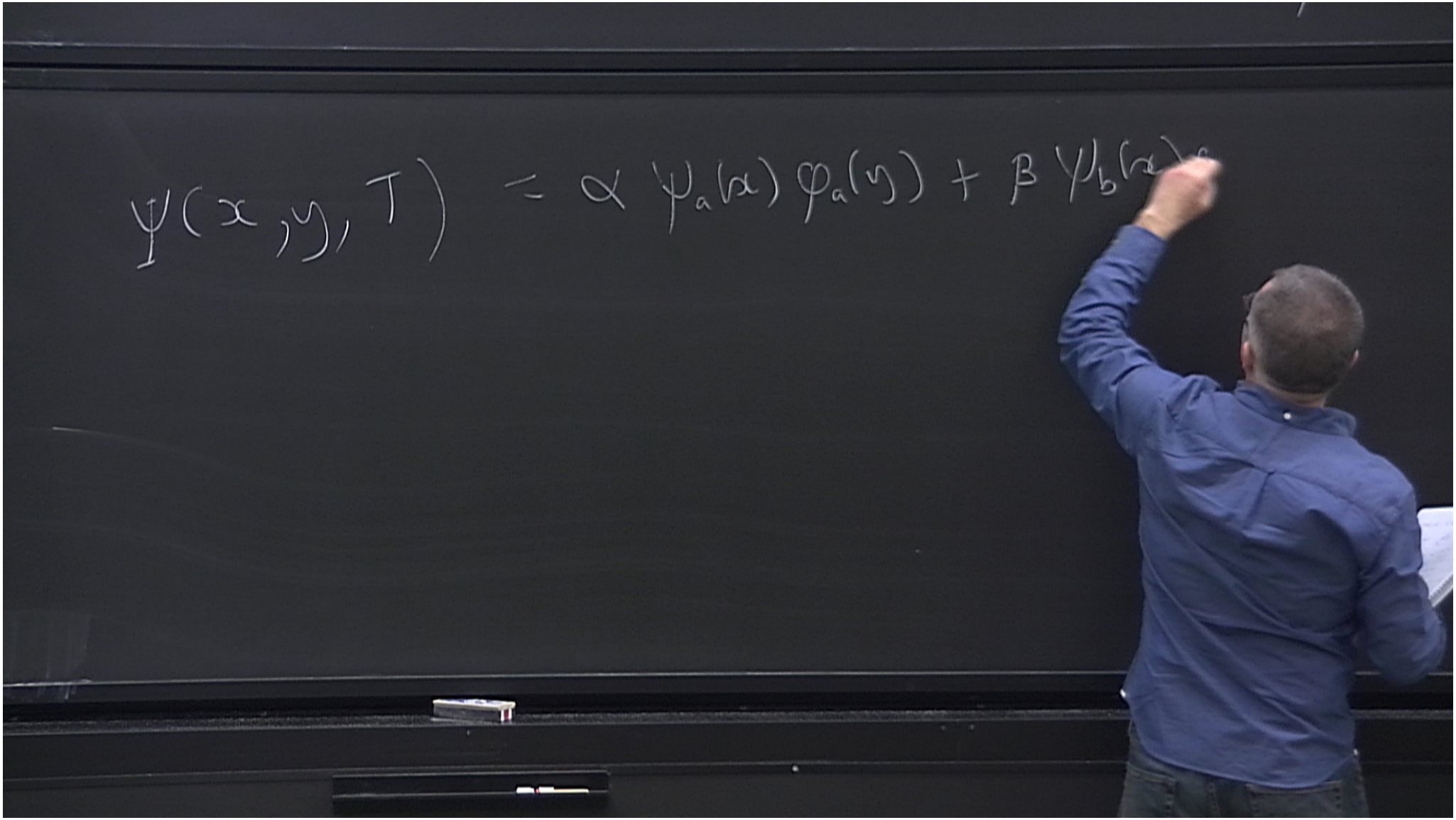
much stronger than $\langle \varphi_a(y) | \varphi_b(y) \rangle = 0$

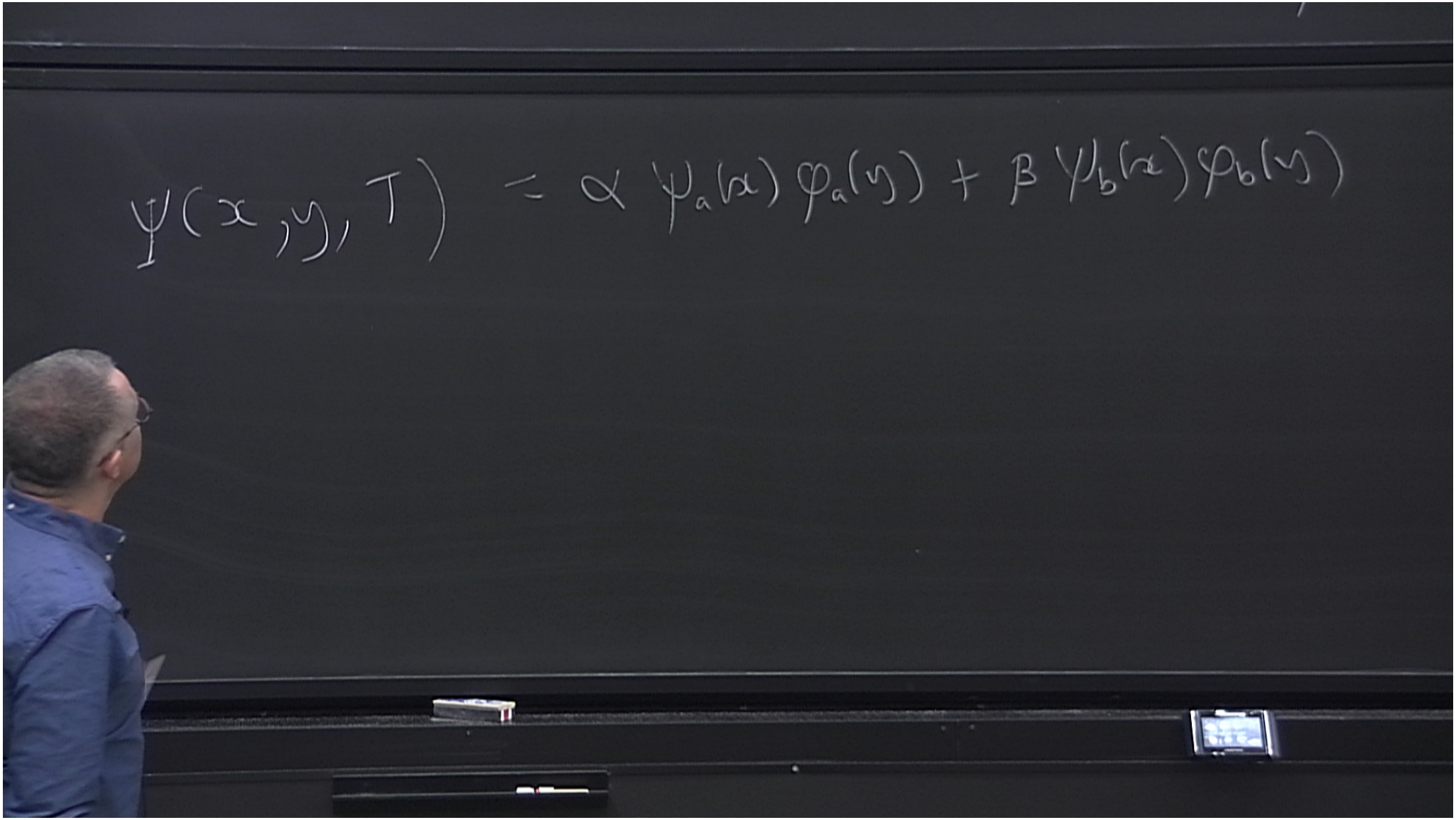


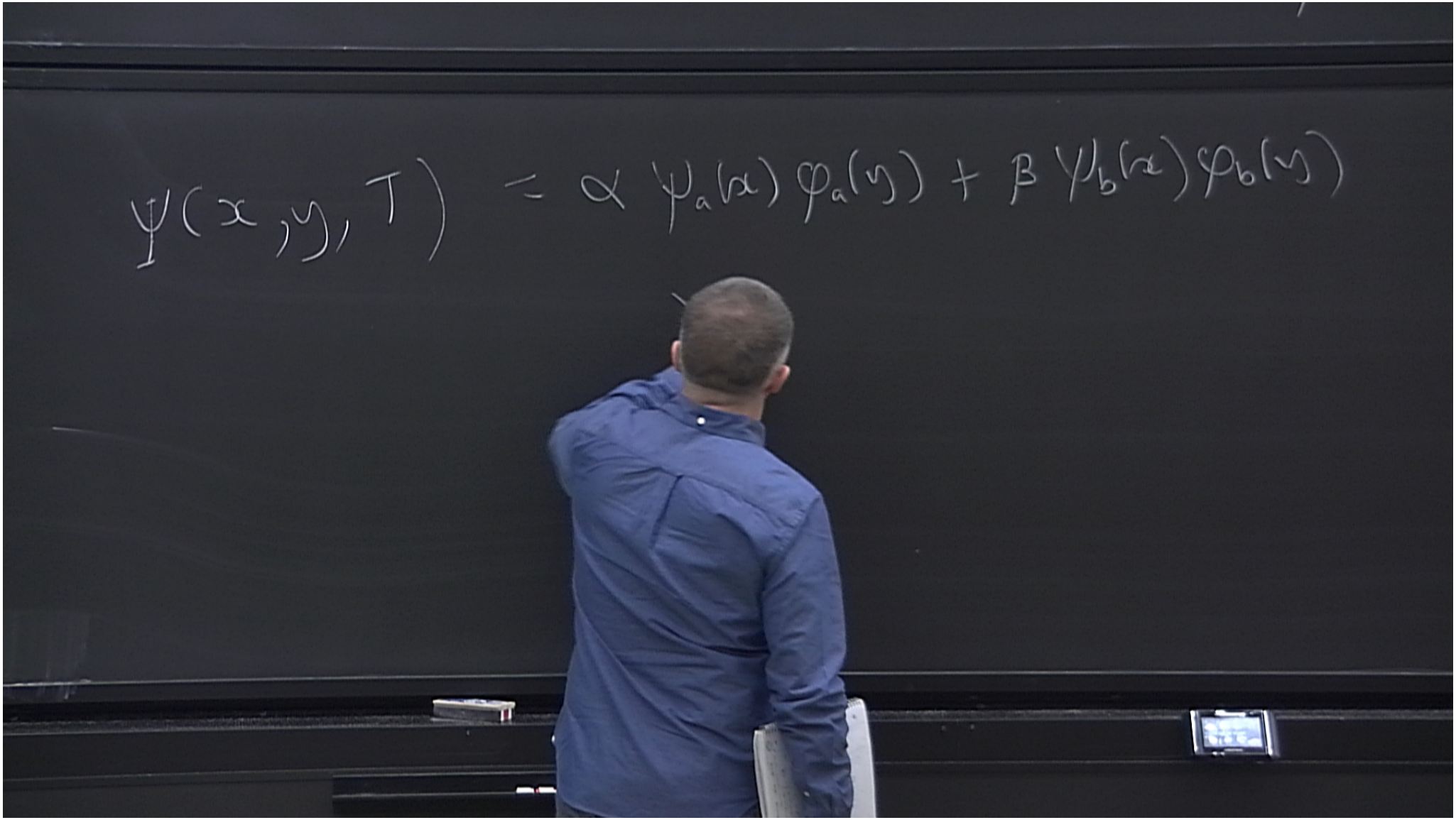
where $|\varphi_a(y)|\,|\varphi_b(y)| \simeq 0$ $\forall y$ non overlapping

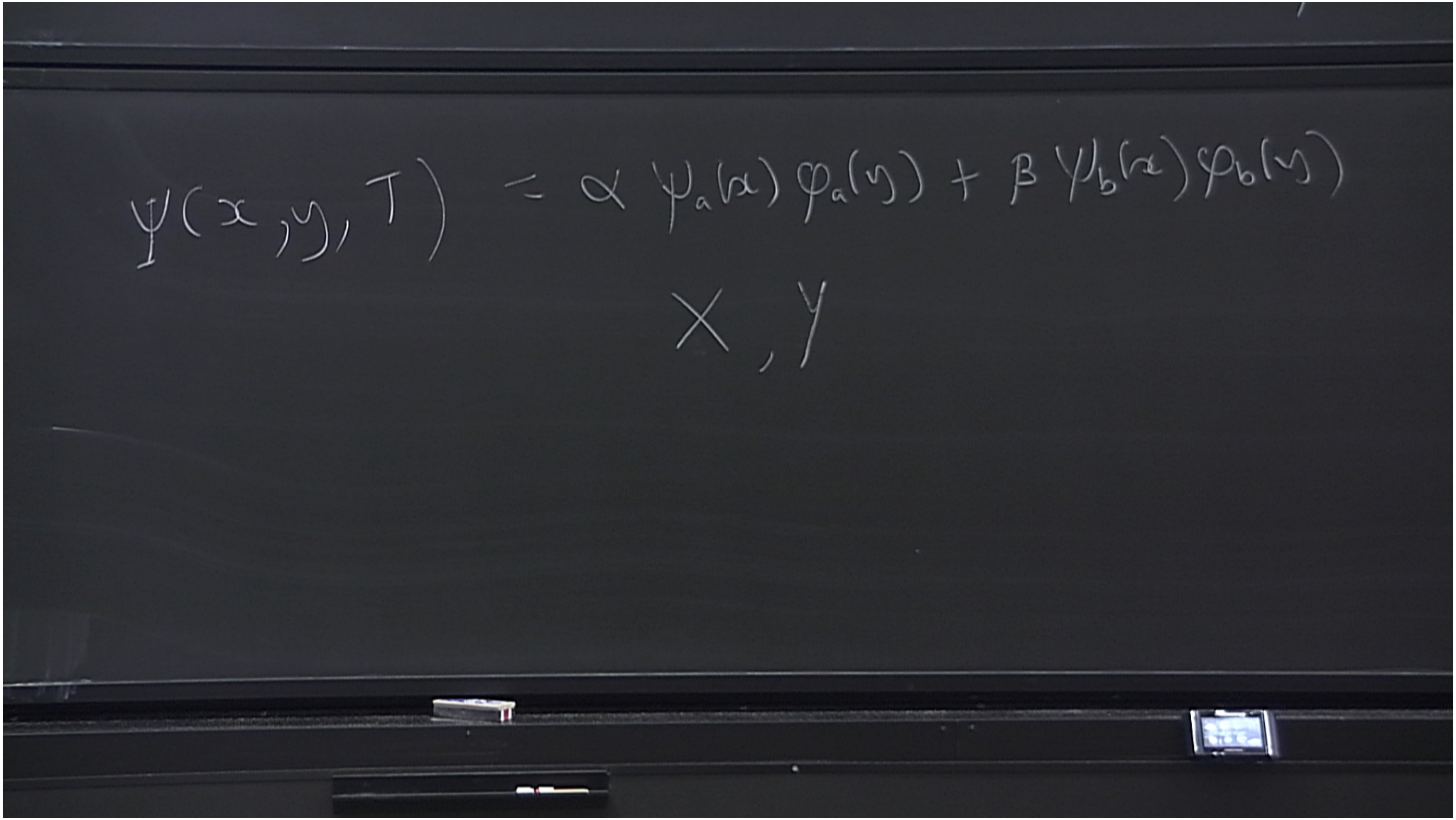
much stronger than $\langle \varphi_a(y) | \varphi_b(y) \rangle = 0$

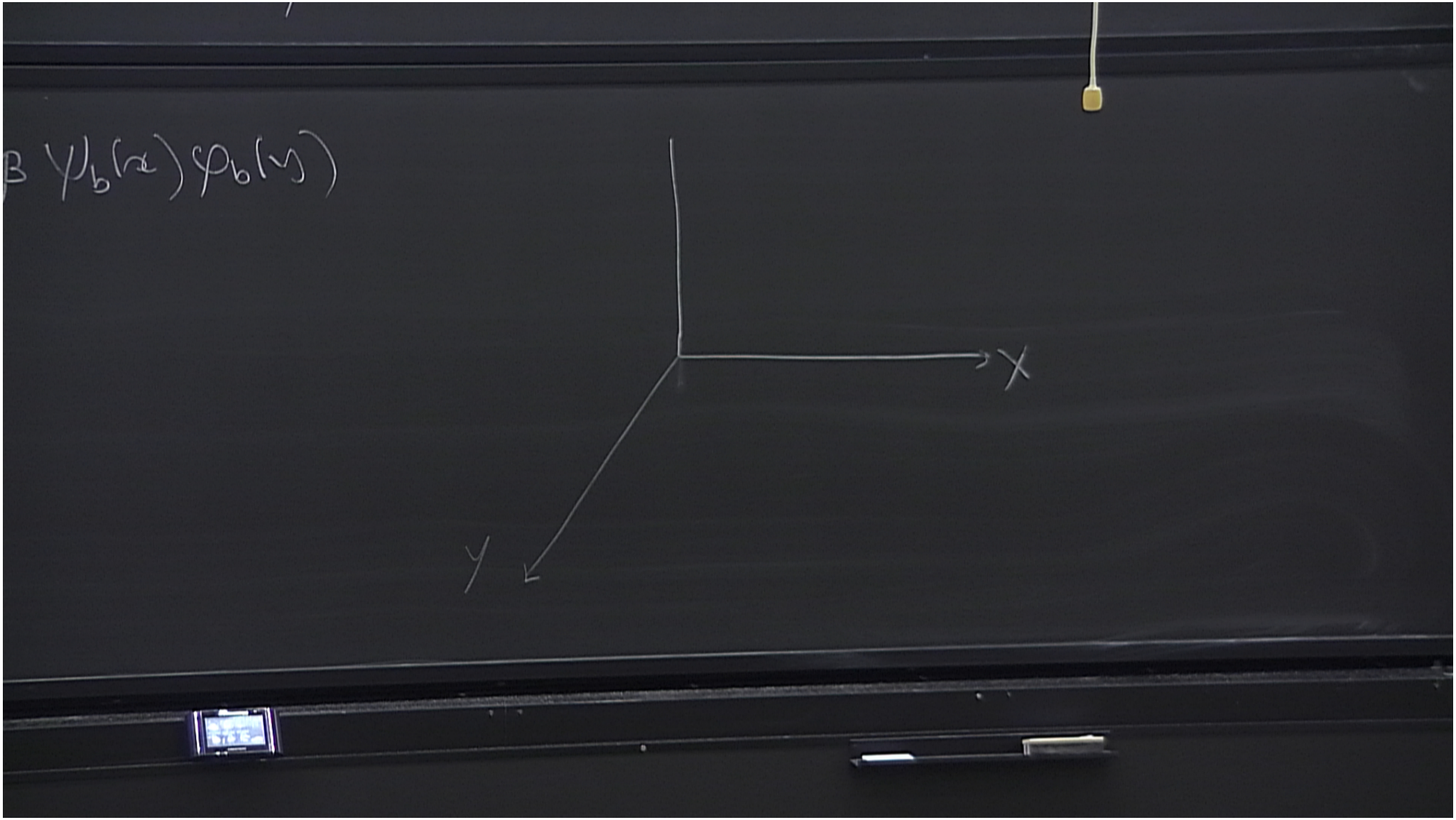


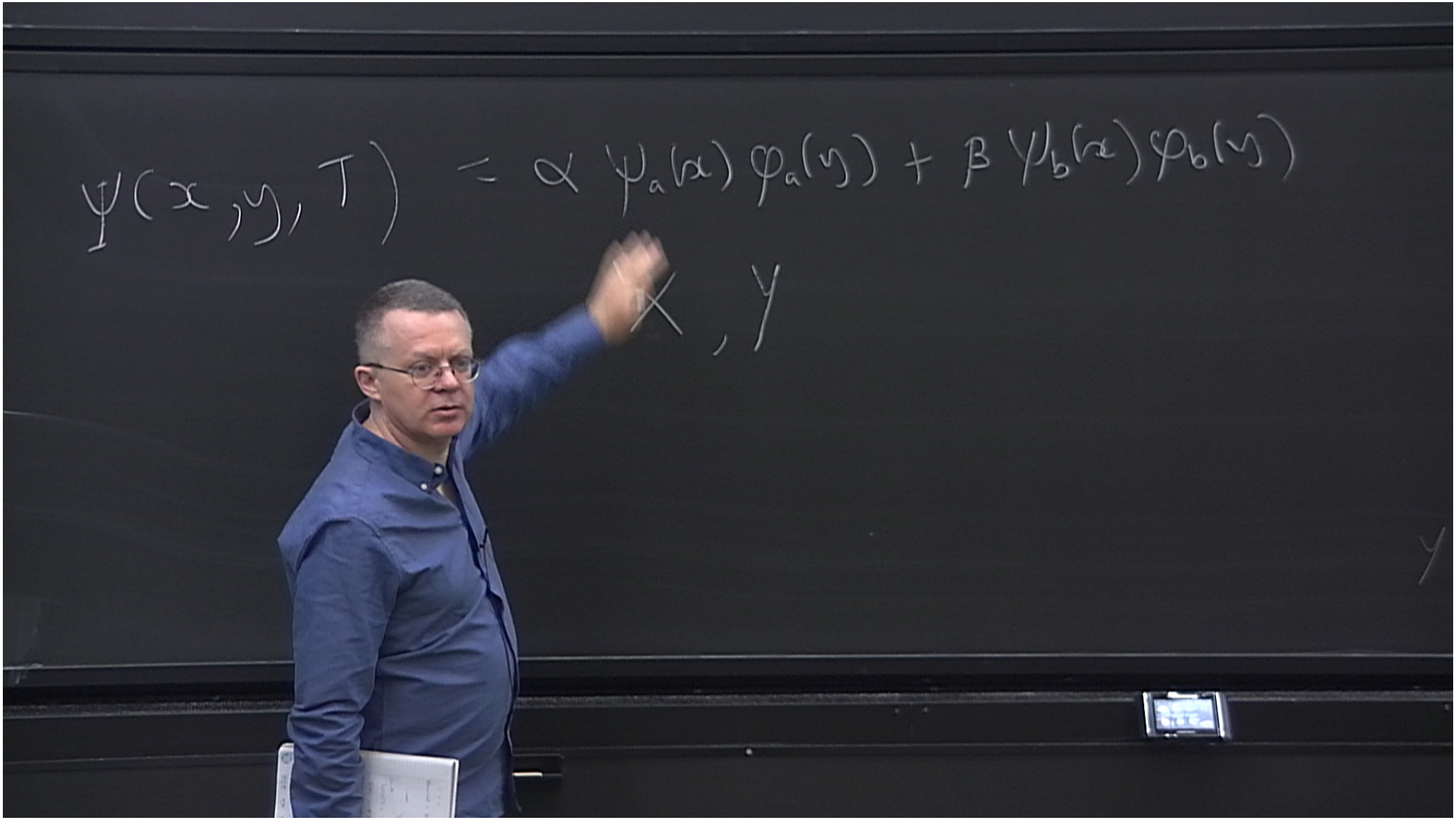

$\psi(x, y, T) = \alpha \psi_a(x) \varphi_a(y) + \beta \psi_b(x)$

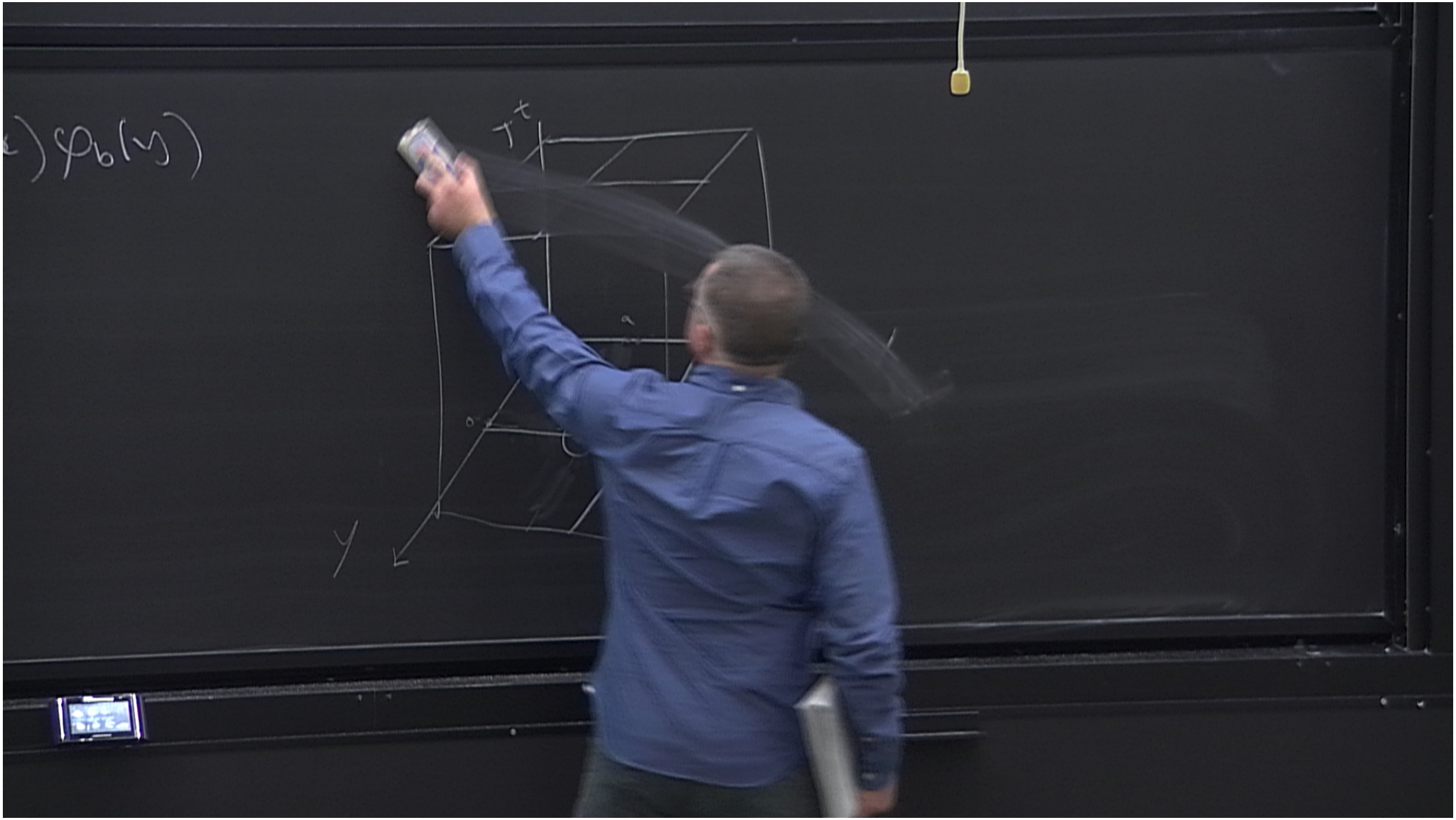

$\Psi(x,y,T) = \alpha \psi_a(x)\varphi_a(y) + \beta \psi_b(x)\varphi_b(y)$

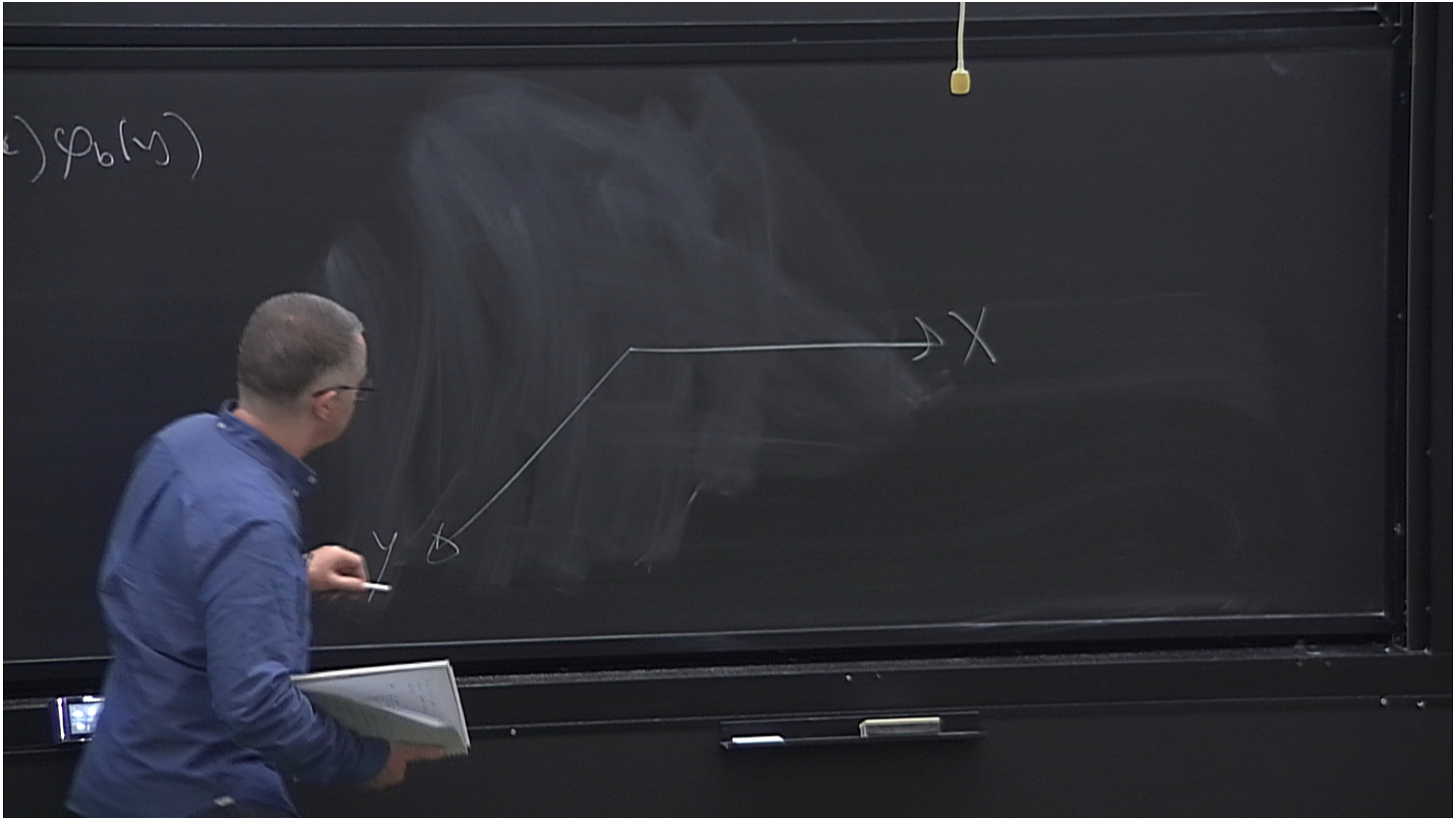

$\psi(x,y,T) = \alpha\,\psi_a(x)\,\varphi_a(y) + \beta\,\psi_b(x)\,\varphi_b(y)$

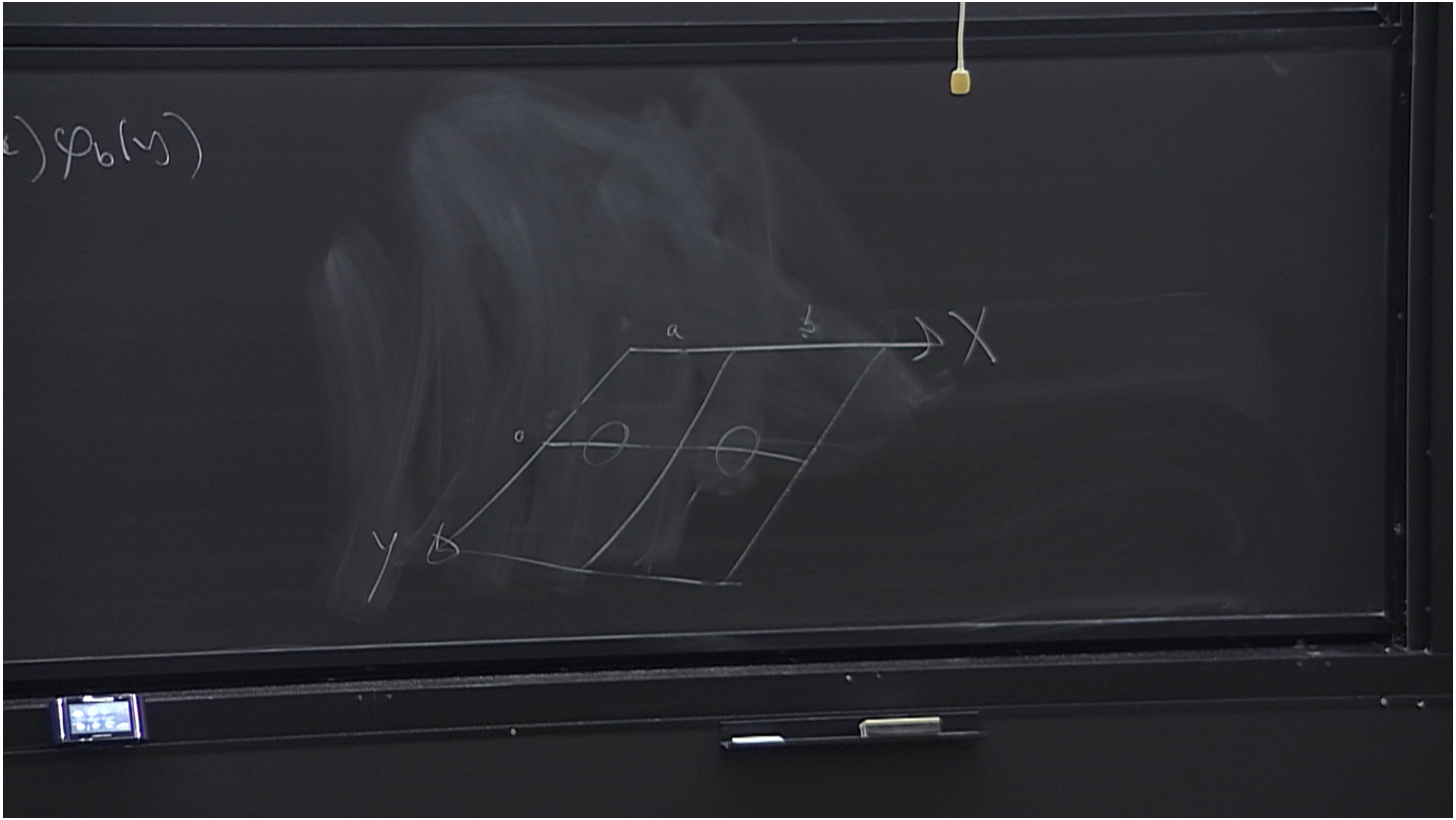

$\Psi(x, y, T) = \alpha \psi_a(x) \varphi_a(y) + \beta \psi_b(x) \varphi_b(y)$
X, Y

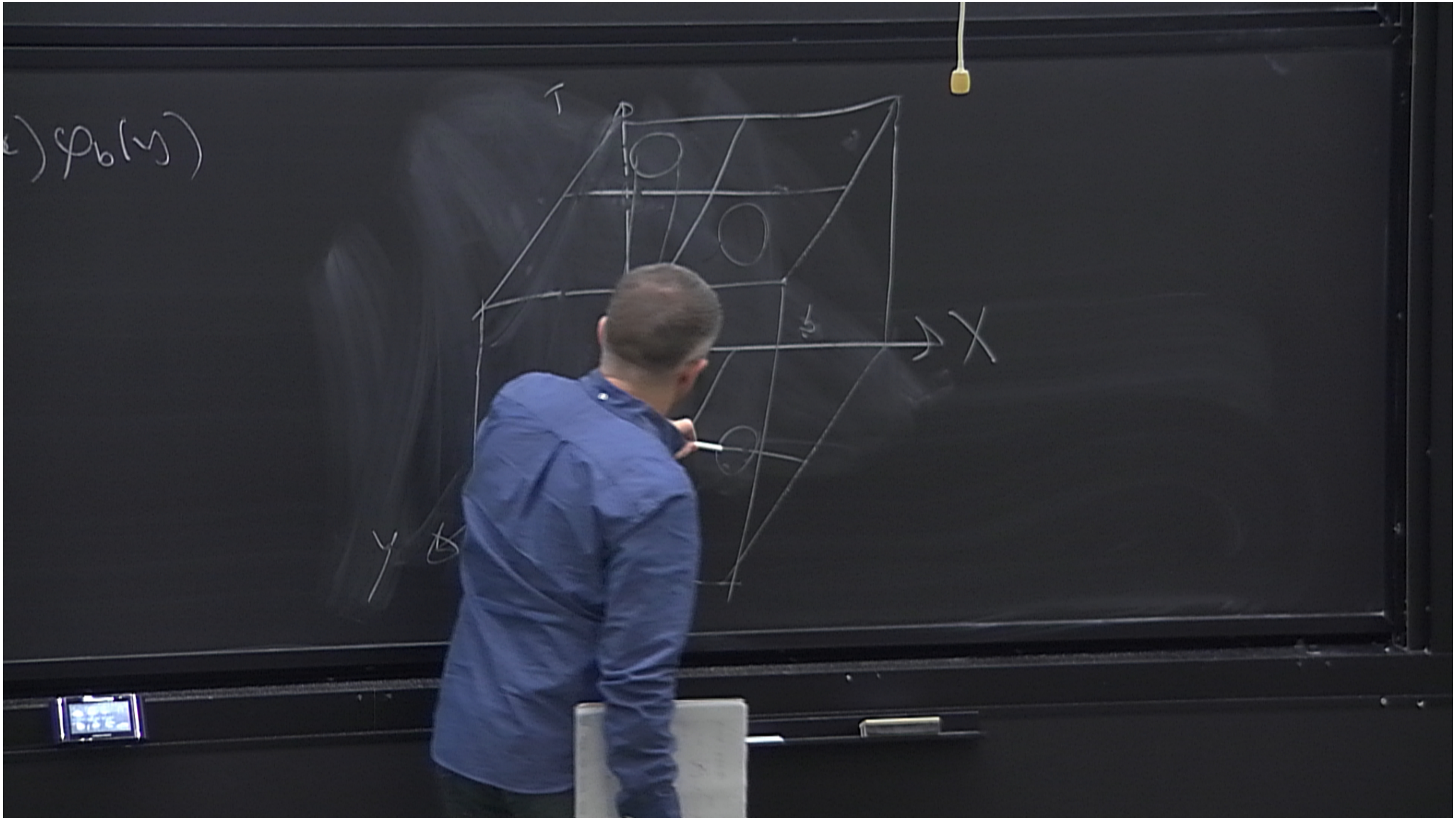

$\beta\ \psi_b(x)\varphi_b(y)$
x
y

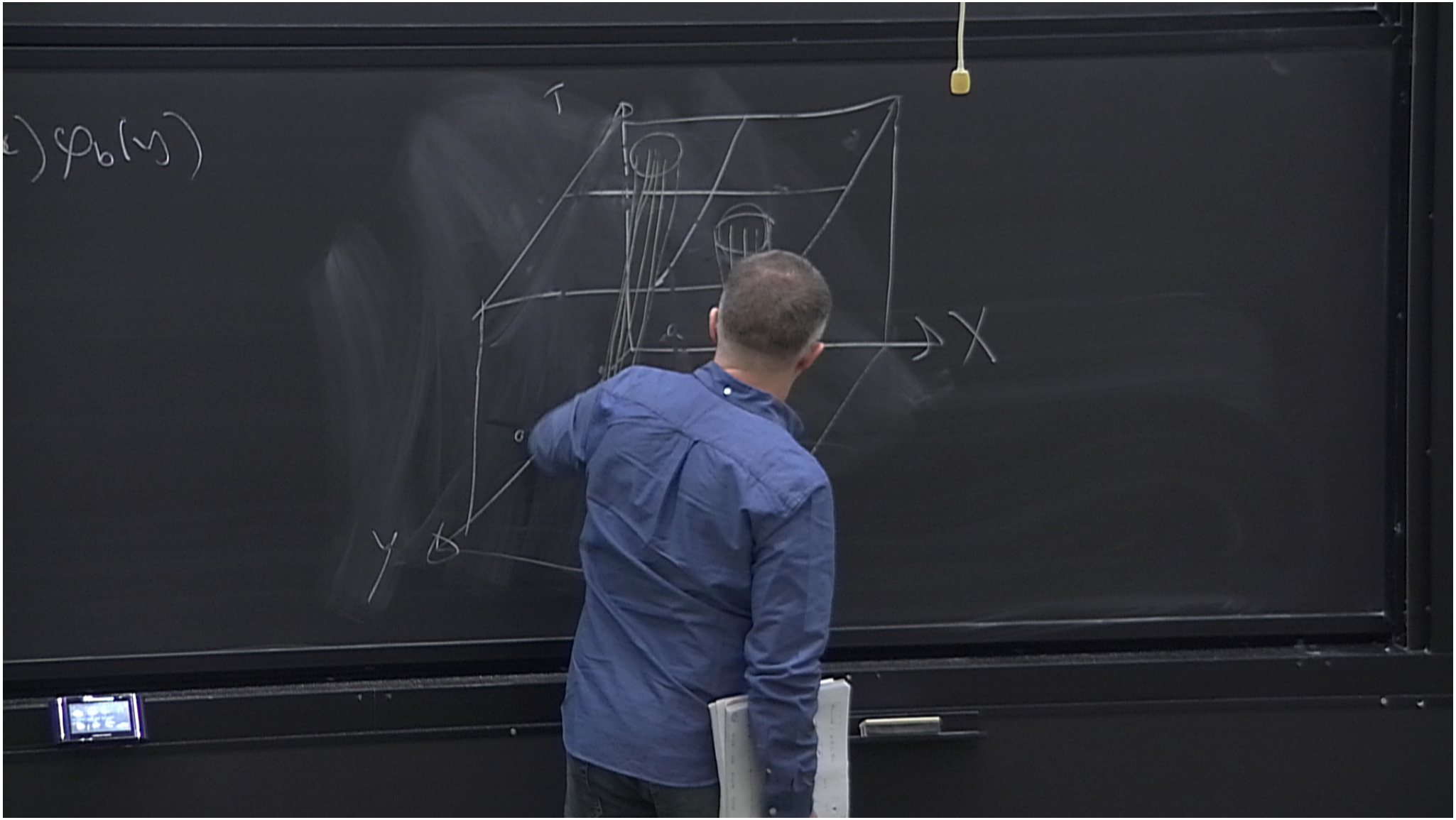

$\psi(x, y, T) = \alpha \psi_a(x) \varphi_a(y) + \beta \psi_b(x) \varphi_b(y)$
x, y
y


$\varphi_b(y)$
J^+
y


X
Y


a
b
X
0
y


T
X
Y


T
X
y

$$\Psi(x, y, T) = \alpha\, \psi_a(x)\, \varphi_a(y) + \beta\, \psi_b(x)\, \varphi_b(y)$$

X, Y

$y = (y_1, y_2, \ldots\ldots y_N)$ $\quad N \simeq 10^{23}$ say

then we expect that

$|\varphi_a(y,t)|\,|\varphi_b(y,t)| \simeq 0$ for all y, t.

$$\Psi(x, y, T) = \alpha\, \psi_a(x)\, \varphi_a(y) + \beta\, \psi_b(x)\, \varphi_b(y)$$

X, Y

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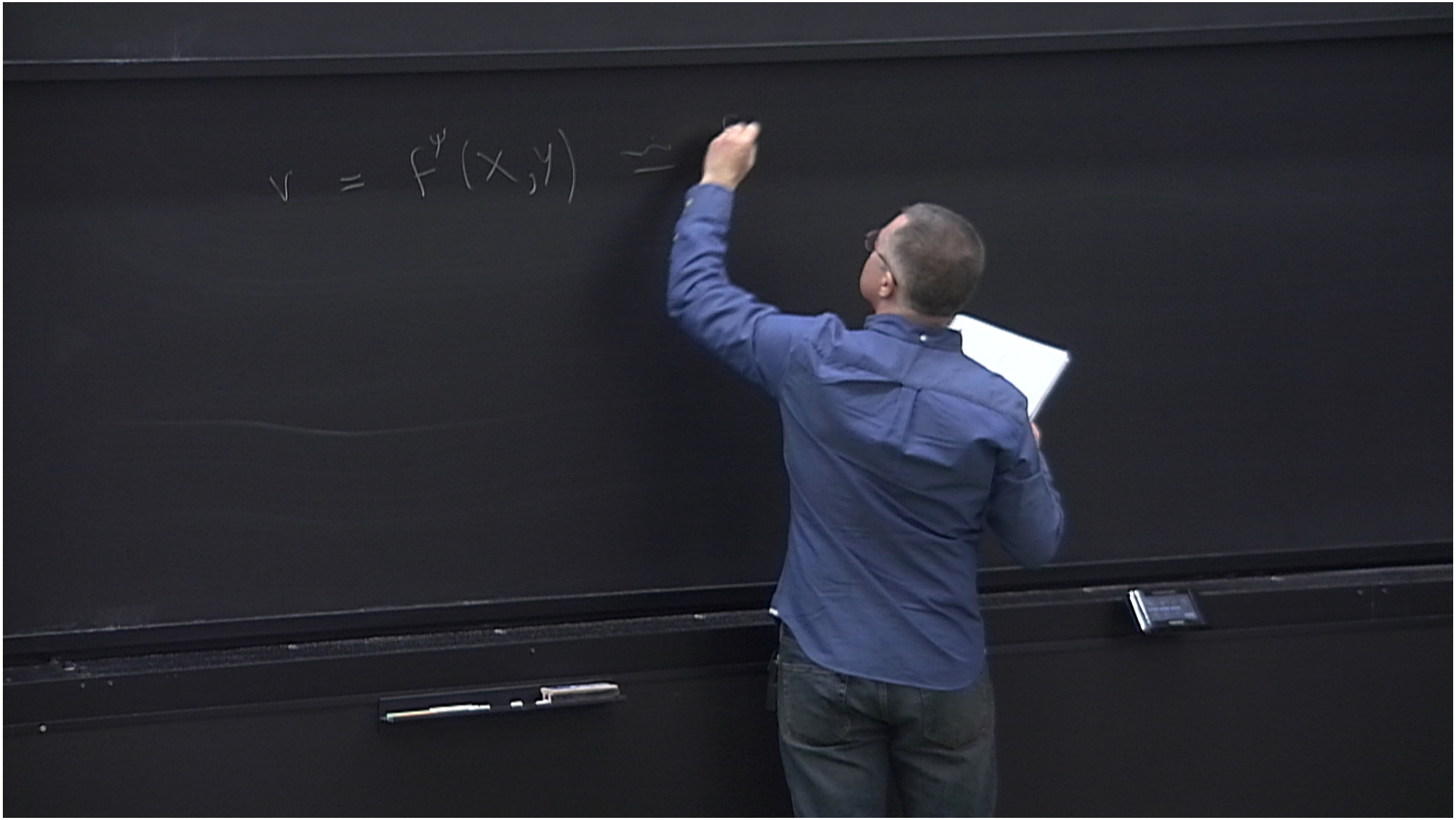
$$\Psi(x, y, T) = \alpha\, \psi_a(x)\, \varphi_a(y) + \beta\, \psi_b(x)\, \varphi_b(y)$$

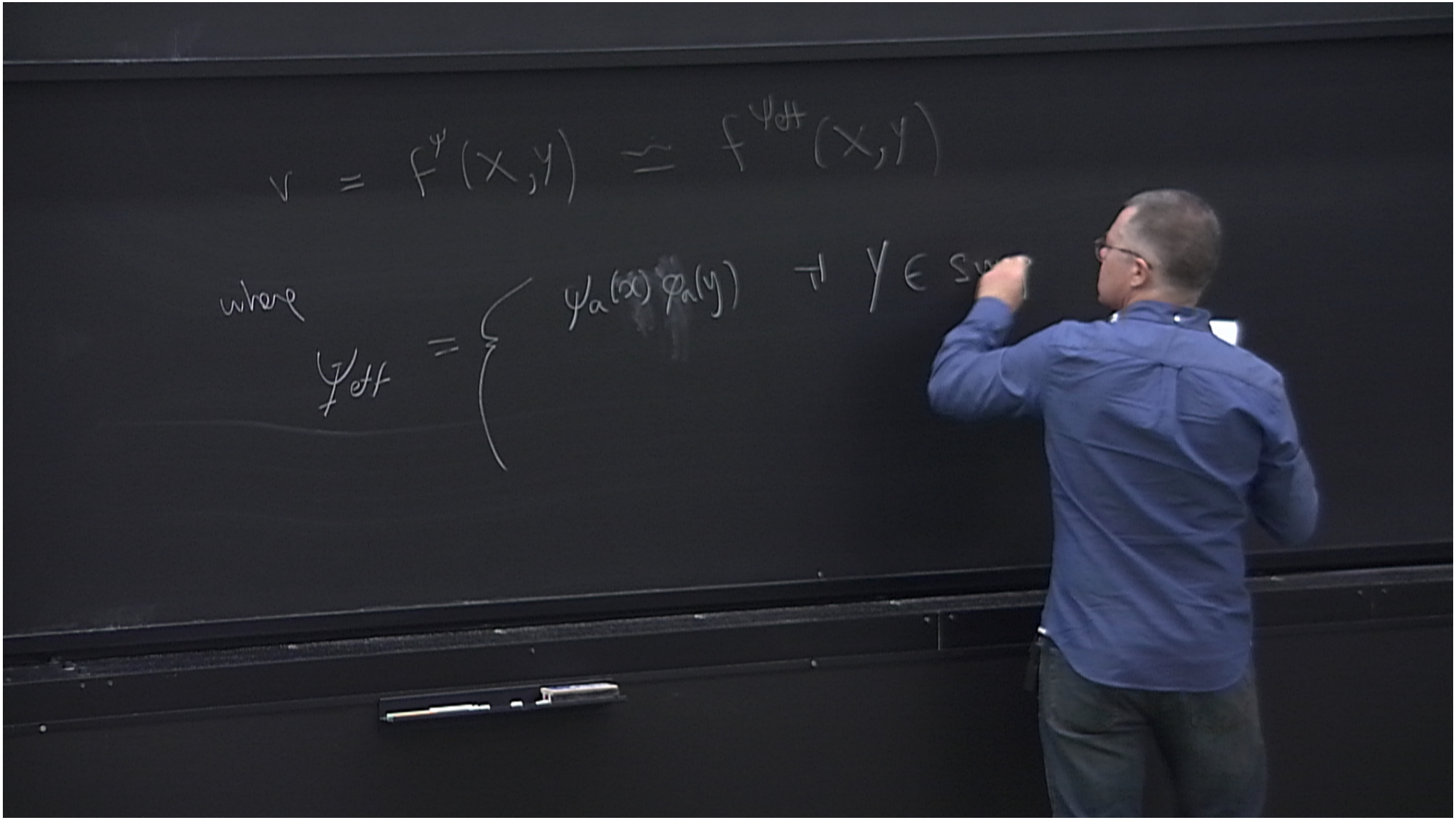
X, Y

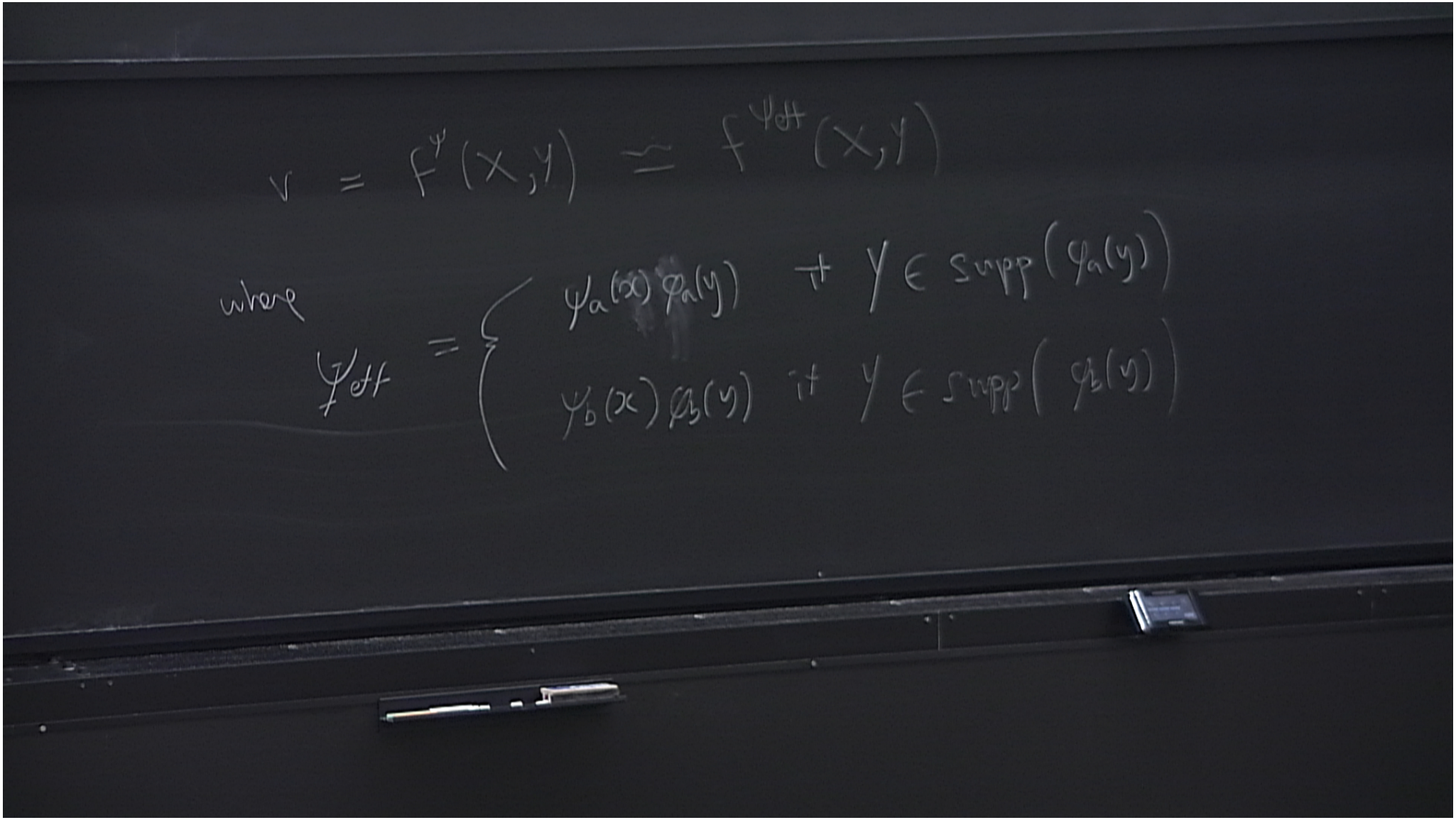
$y = (y_1, y_2, \ldots\ldots y_N)$ $\quad N \simeq 10^{23}$ say

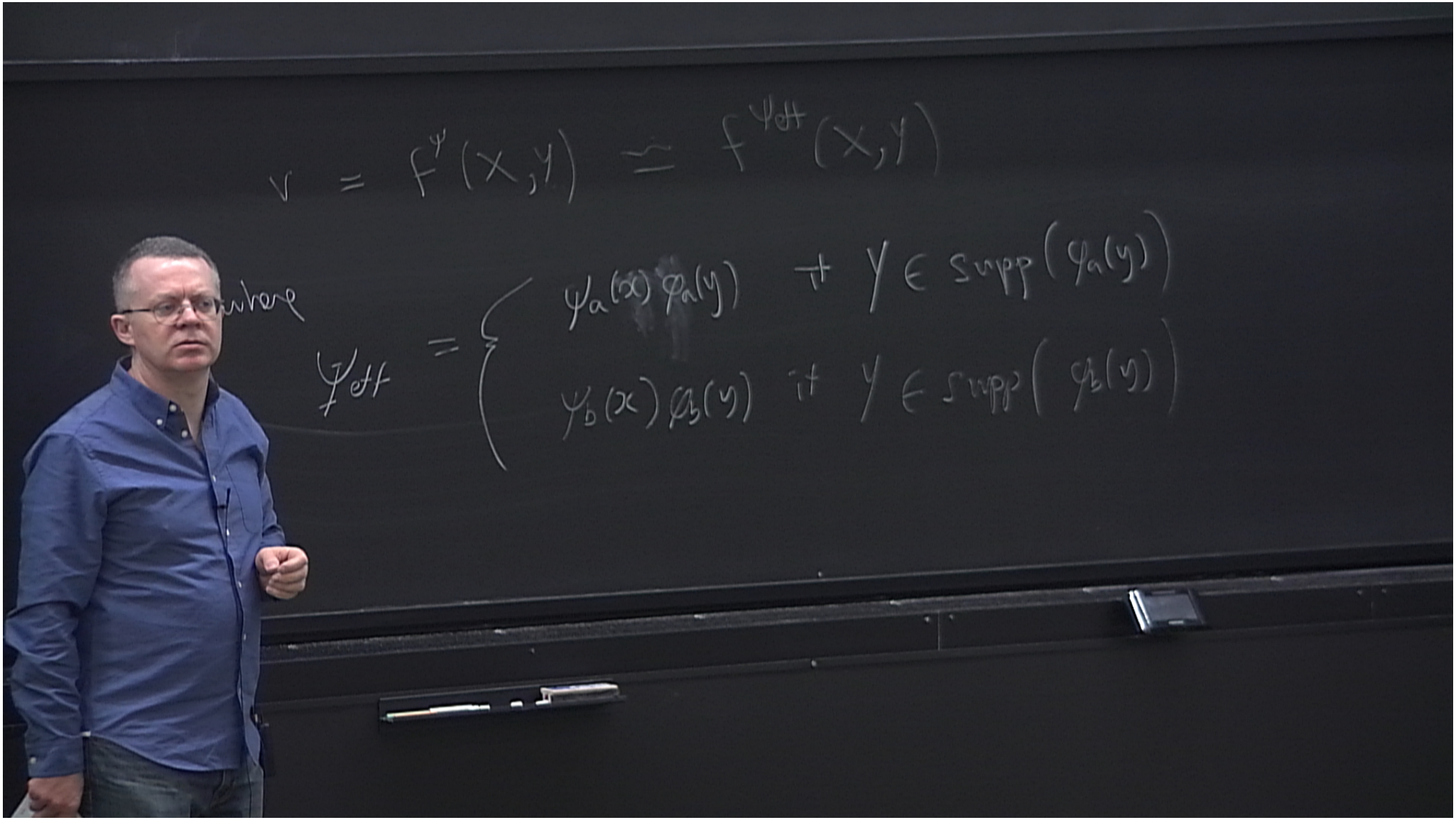
then we expect that

$|\varphi_a(y,t)|\,|\varphi_b(y,t)| \simeq 0$ for all y, t.


v = f^v(x,y)


$V = f^{\psi}(x,y) \simeq f^{\psi_{eff}}(x,y)$
where
$\psi_{eff} = \begin{cases} \psi_a(x)\varphi_a(y) \end{cases}$ $\forall\, Y \in S$


$v = f^{\psi}(x,y) \simeq f^{\psi_{eff}}(x,y)$
where
$\psi_{eff} = \begin{cases} \psi_a(x)\varphi_a(y) & \text{if } y \in \text{supp}(\varphi_a(y)) \\ \psi_b(x)\varphi_b(y) & \text{if } y \in \text{supp}(\varphi_b(y)) \end{cases}$


$v = f^{\psi}(x,y) \simeq f^{\psi_{eff}}(x,y)$
$\psi_{eff} = \begin{cases} \psi_a(x)\varphi_a(y) & \text{if } y \in \text{Supp}(\varphi_a(y)) \\ \psi_b(x)\varphi_b(y) & \text{if } y \in \text{Supp}(\varphi_b(y)) \end{cases}$

$$v = f^{\psi}(x,y) \simeq f^{\psi_{eff}}(x,y)$$

where

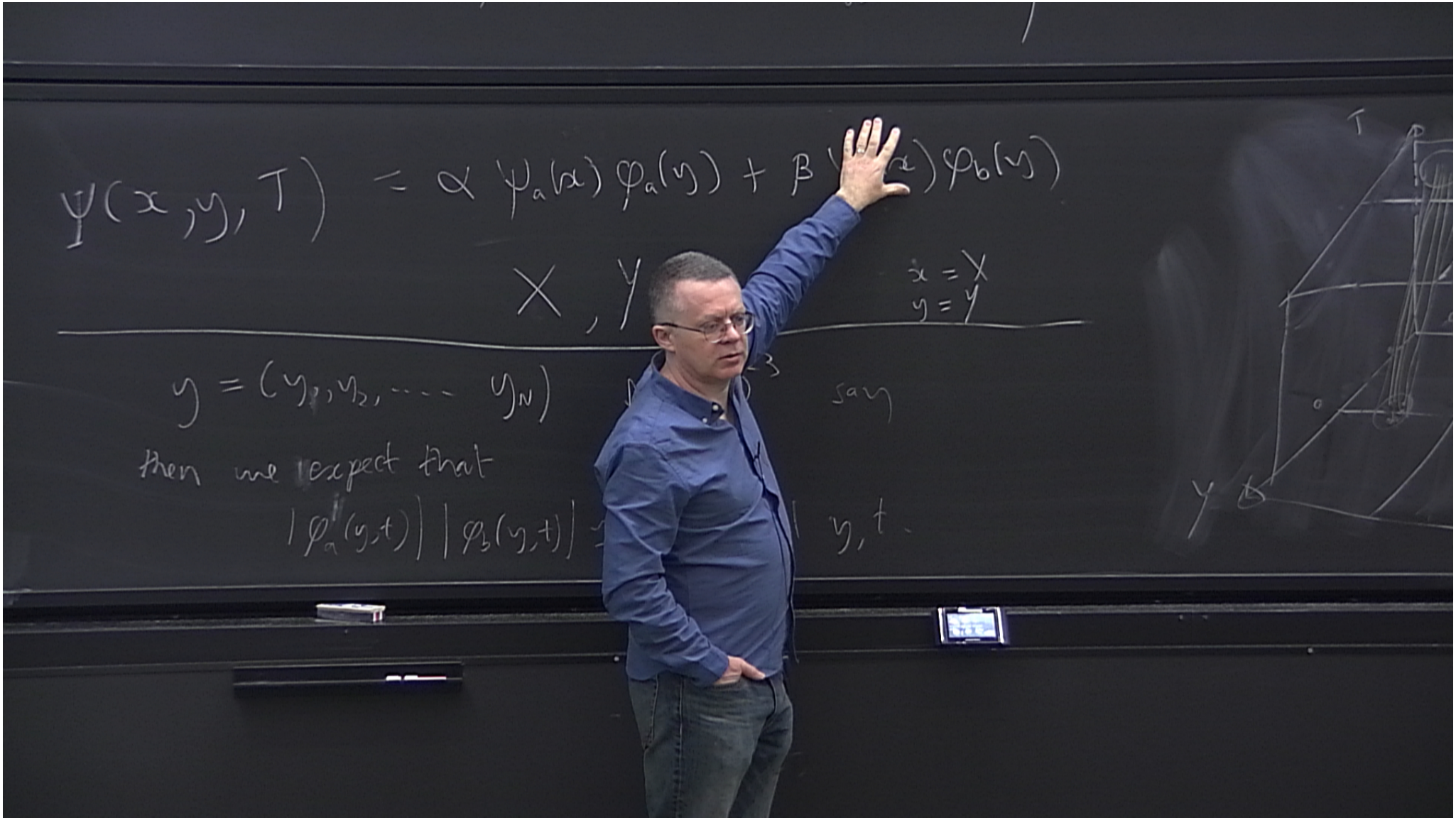
$$\psi_{eff} = \begin{cases} \psi_a(x)\varphi_a(y) & \text{if } y \in \text{supp}(\varphi_a(y)) \\ \psi_b(x)\varphi_b(y) & \text{if } y \in \text{supp}(\varphi_b(y)) \end{cases}$$

$$V = f^{\psi}(X,Y) \simeq f^{\psi_{eff}}(X,Y)$$

where

$$\psi_{eff} = \begin{cases} \psi_a(x)\,\varphi_a(y) & \text{if } Y \in \mathrm{Supp}(\varphi_a(y)) \\ \psi_b(x)\,\varphi_b(y) & \text{if } Y \in \mathrm{Supp}(\varphi_b(y)) \end{cases}$$

Projection postulate recovered.


$\Psi(x, y, T) = \alpha \psi_a(x) \varphi_a(y) + \beta$
$x = X$
$y = Y$
$y = (y_1, y_2, \ldots y_N)$
say
then we expect that
T
y

$$\Psi(x, y, T) = \alpha\, \psi_a(x)\, \varphi_a(y) + \beta\, \psi_b(x)\, \varphi_b(y)$$

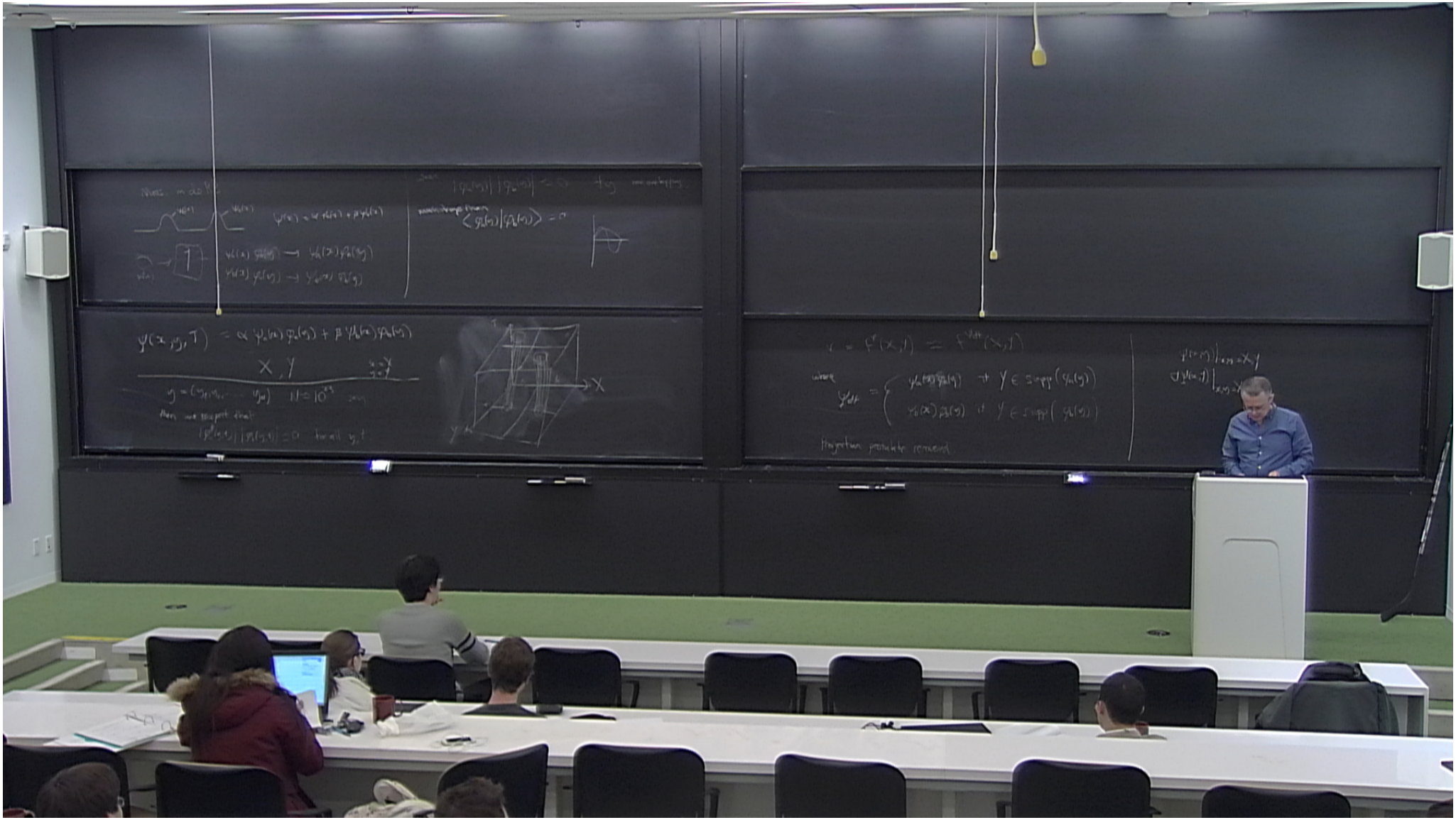
X, Y $\quad x = X$, $y = Y$

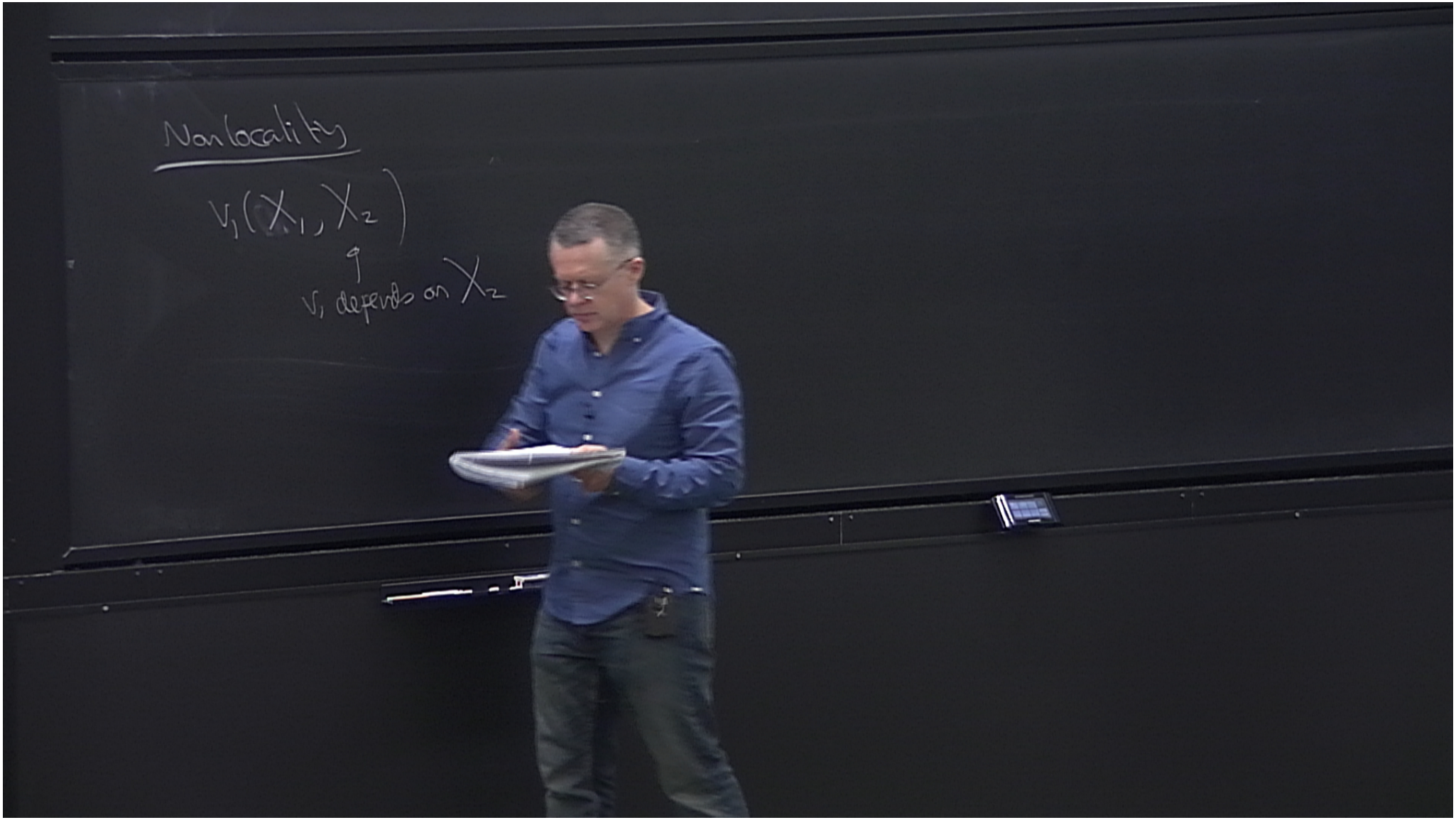
$y = (y_1, y_2, \ldots\ldots y_N)$ $\quad N \simeq 10^{23}$ say

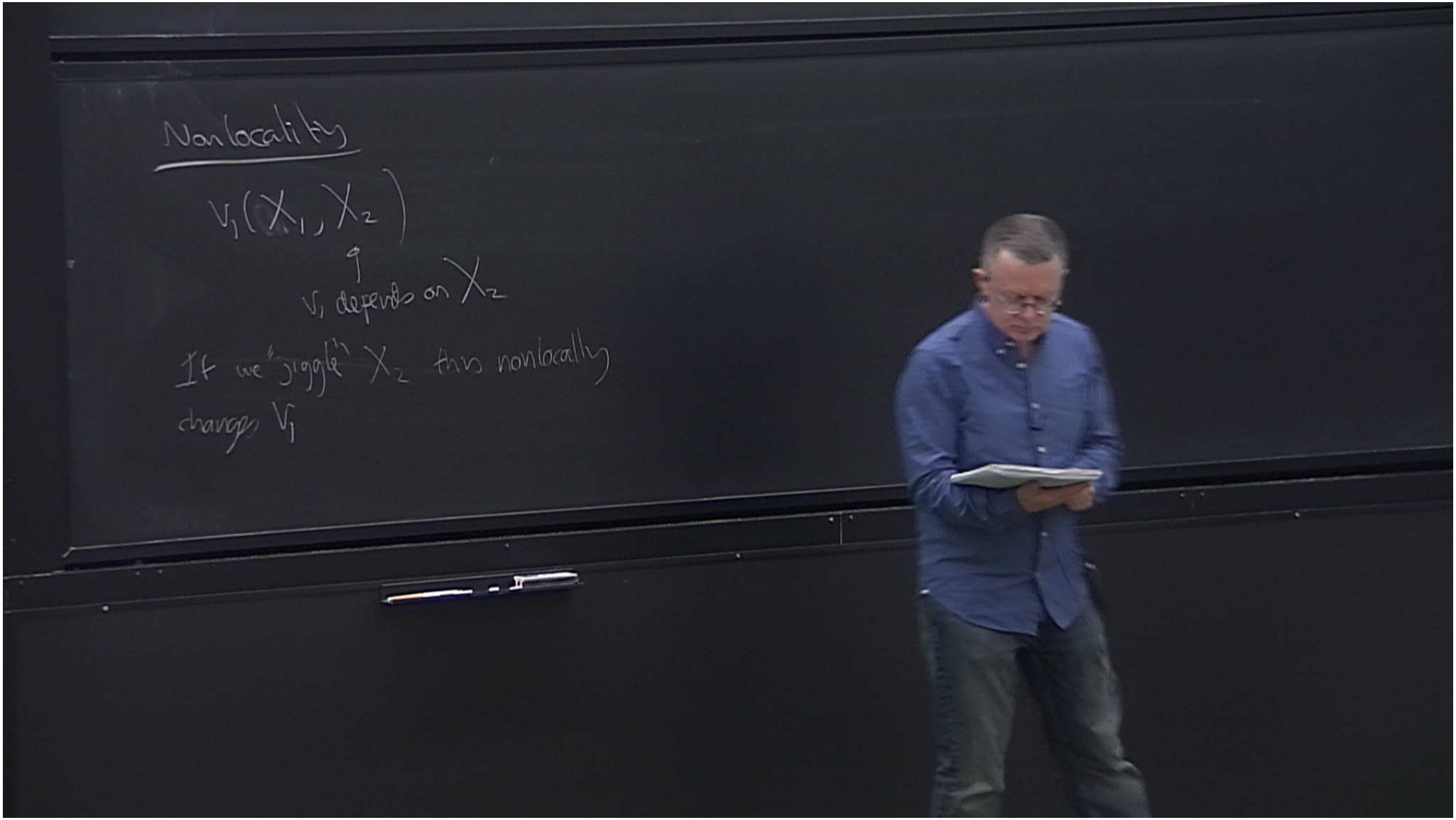
then we expect that

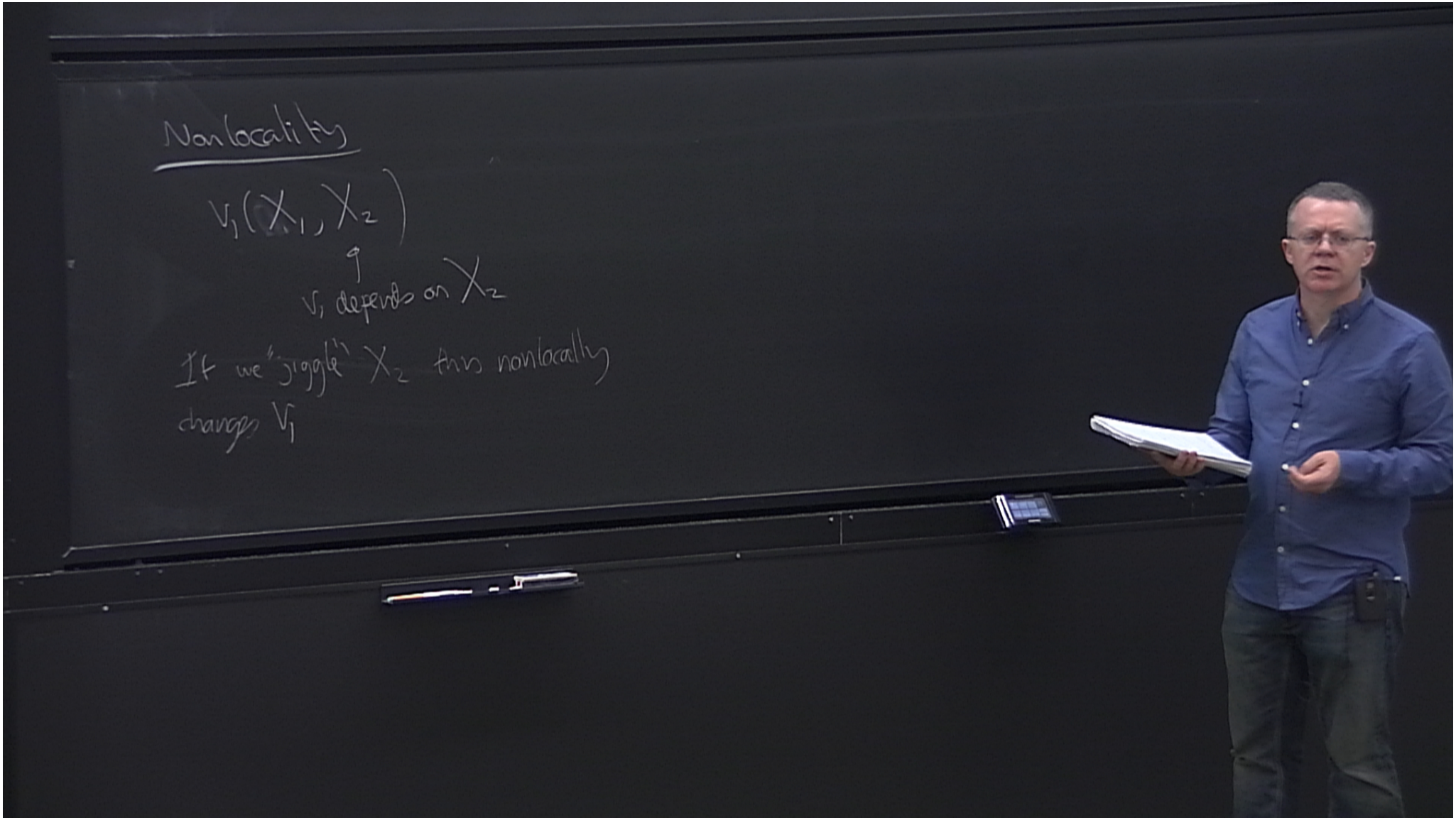
$|\varphi_a(y,t)|\,|\varphi_b(y,t)| \simeq 0$ for all y, t.

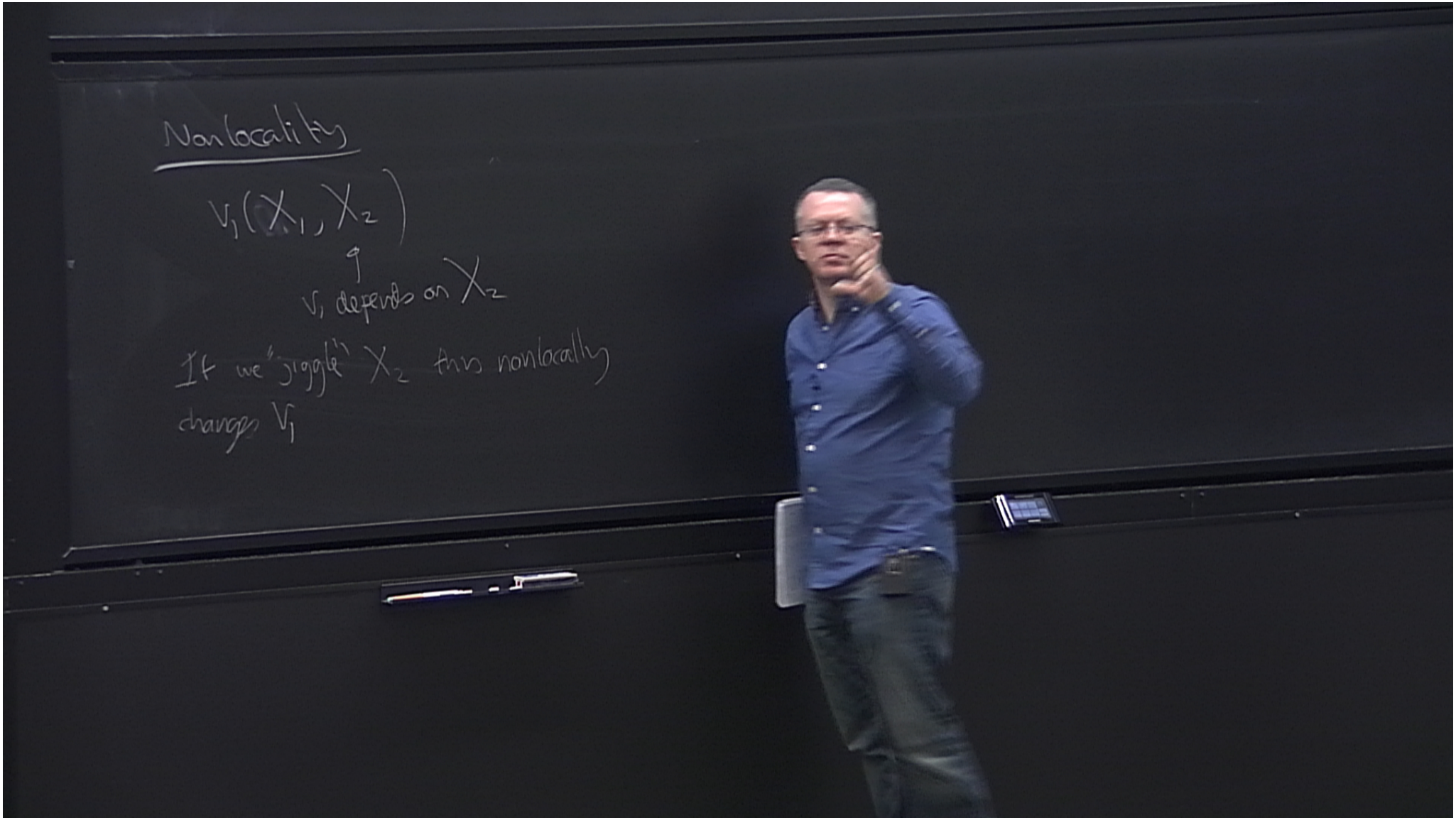


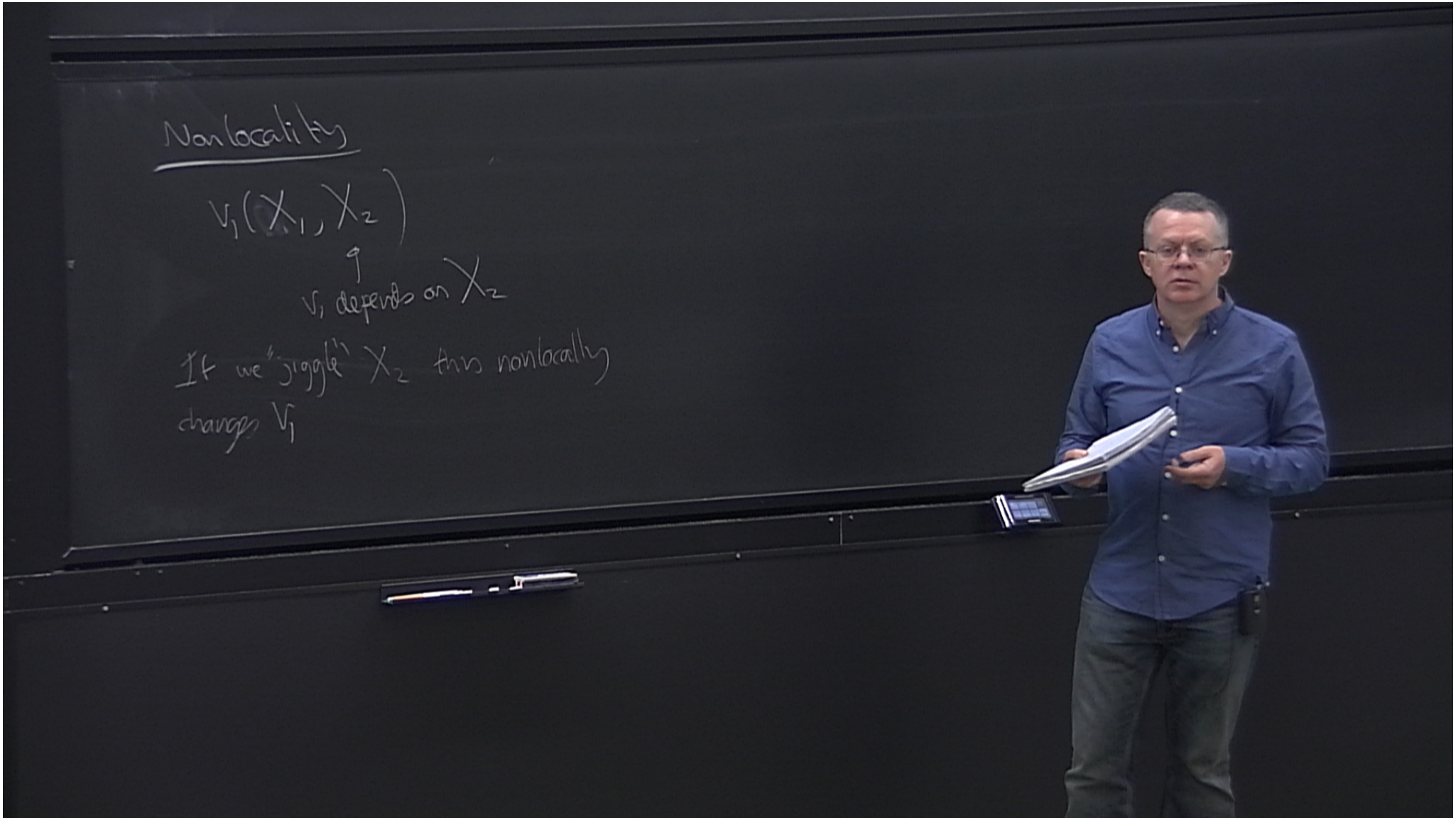


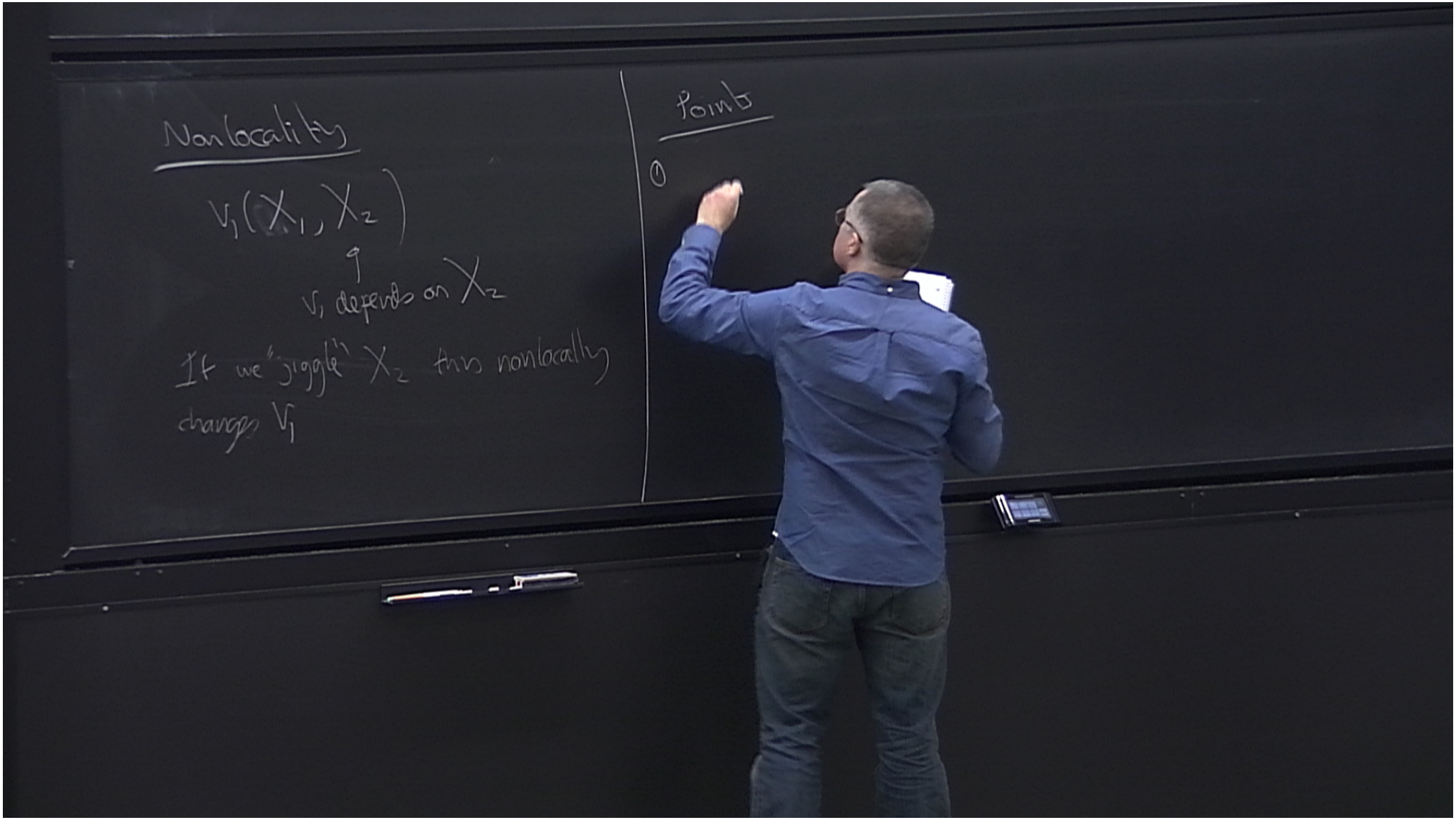

Nonlocality
$V_1(X_1, X_2)$
V_1 depends on X_2

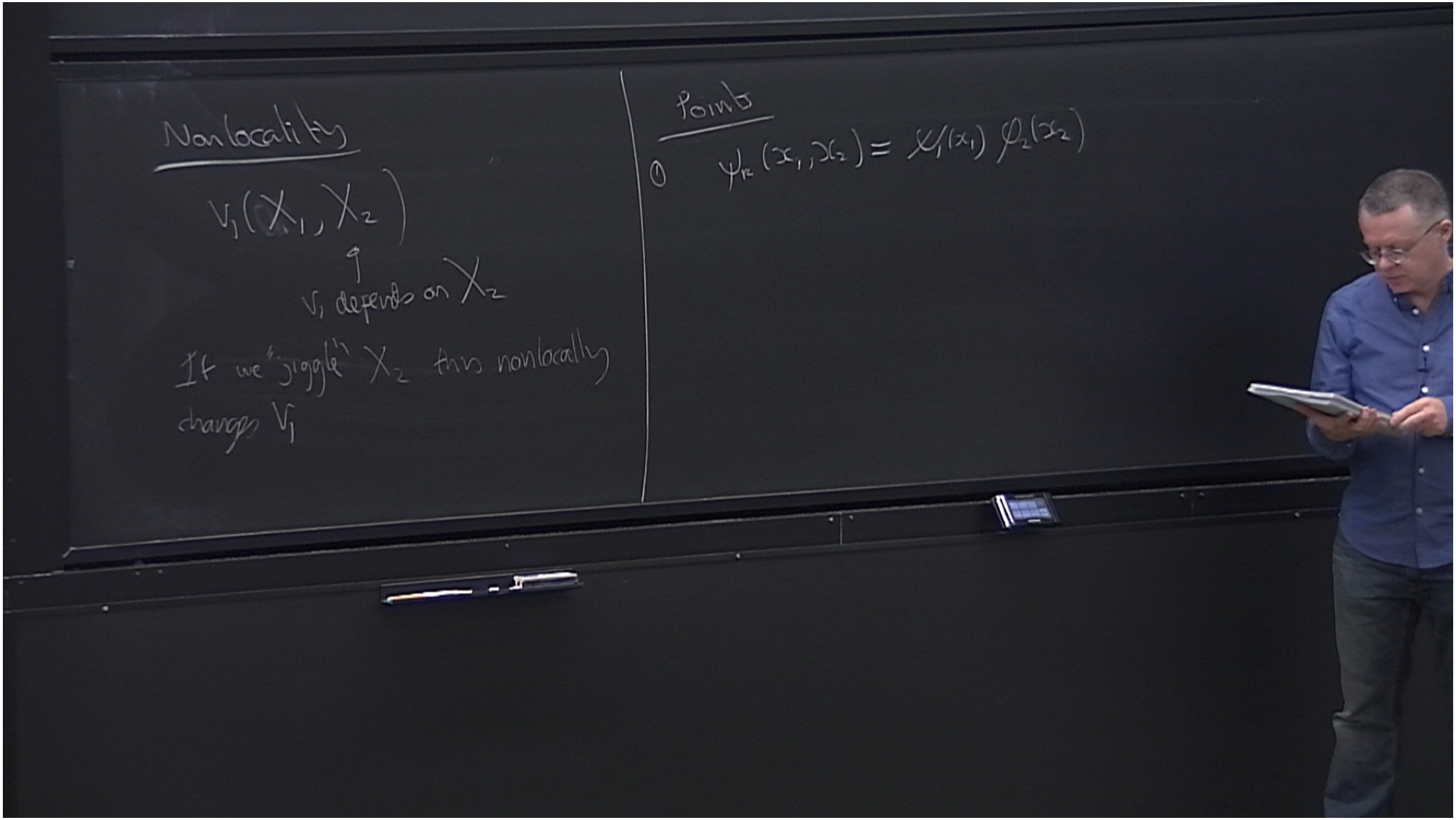

Nonlocality
$V_1(X_1, X_2)$
V_1 depends on X_2
If we "jiggle" X_2 this nonlocally changes V_1

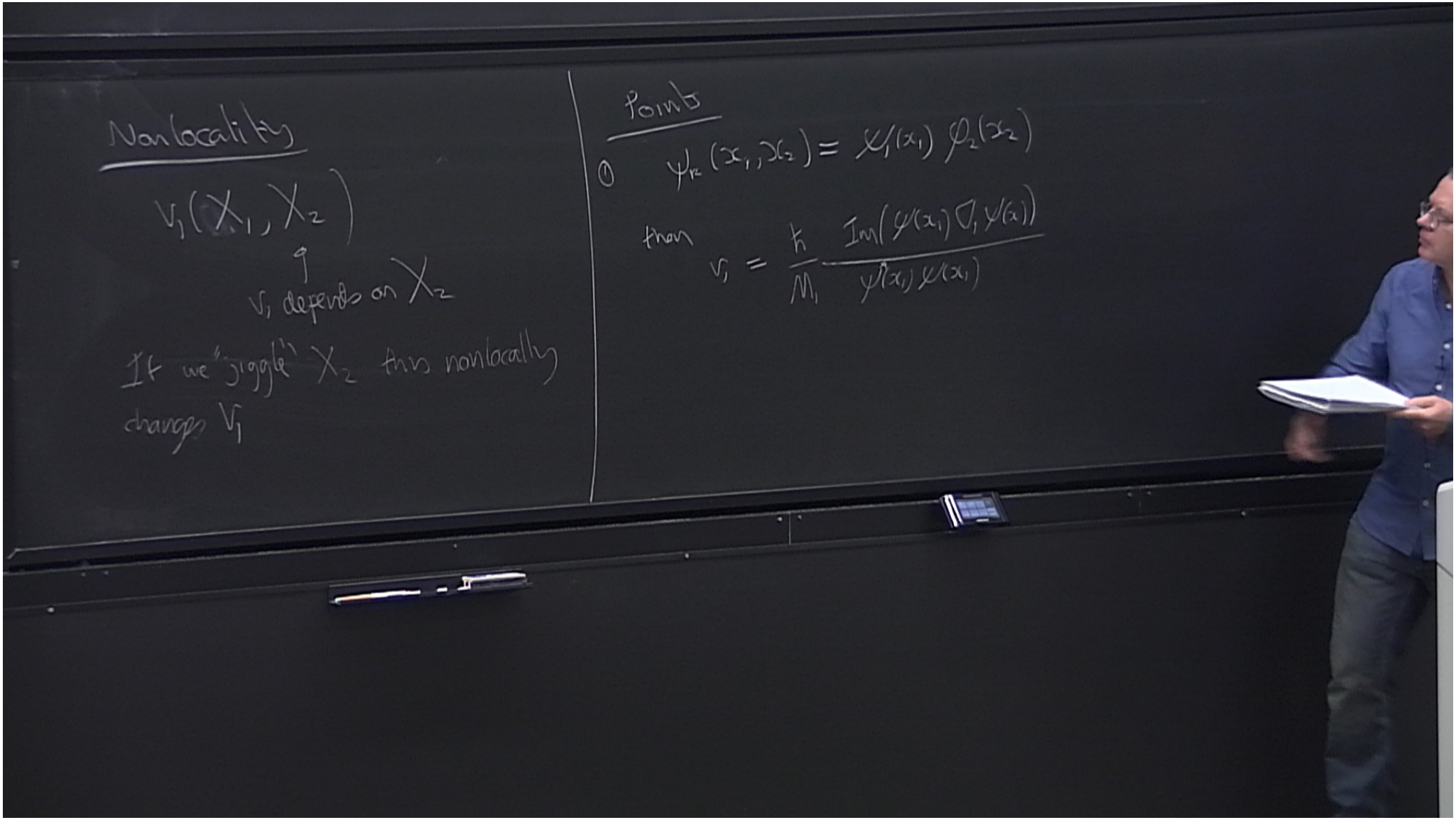

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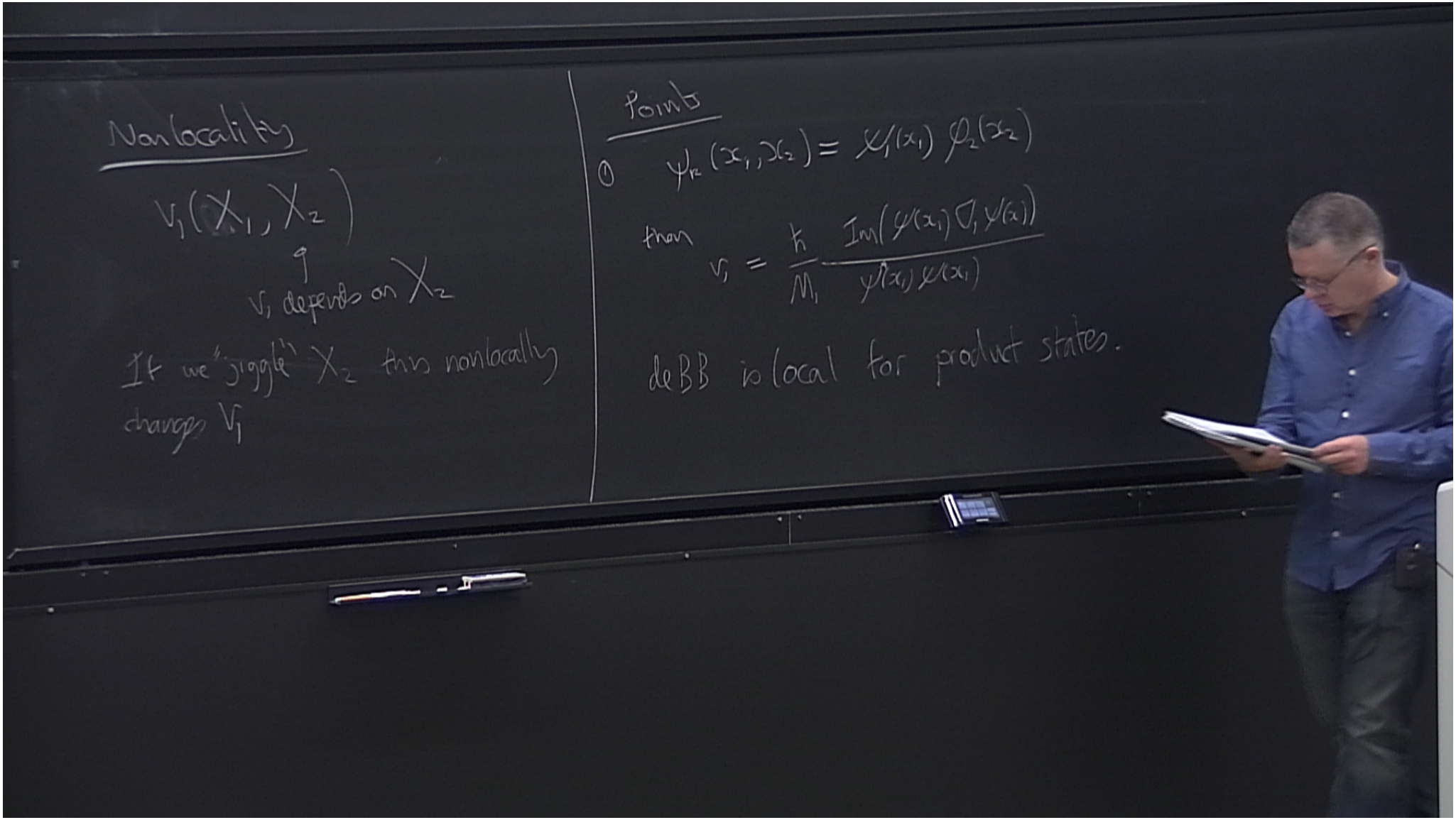

Nonlocality
$V_1(X_1, X_2)$
V_1 depends on X_2
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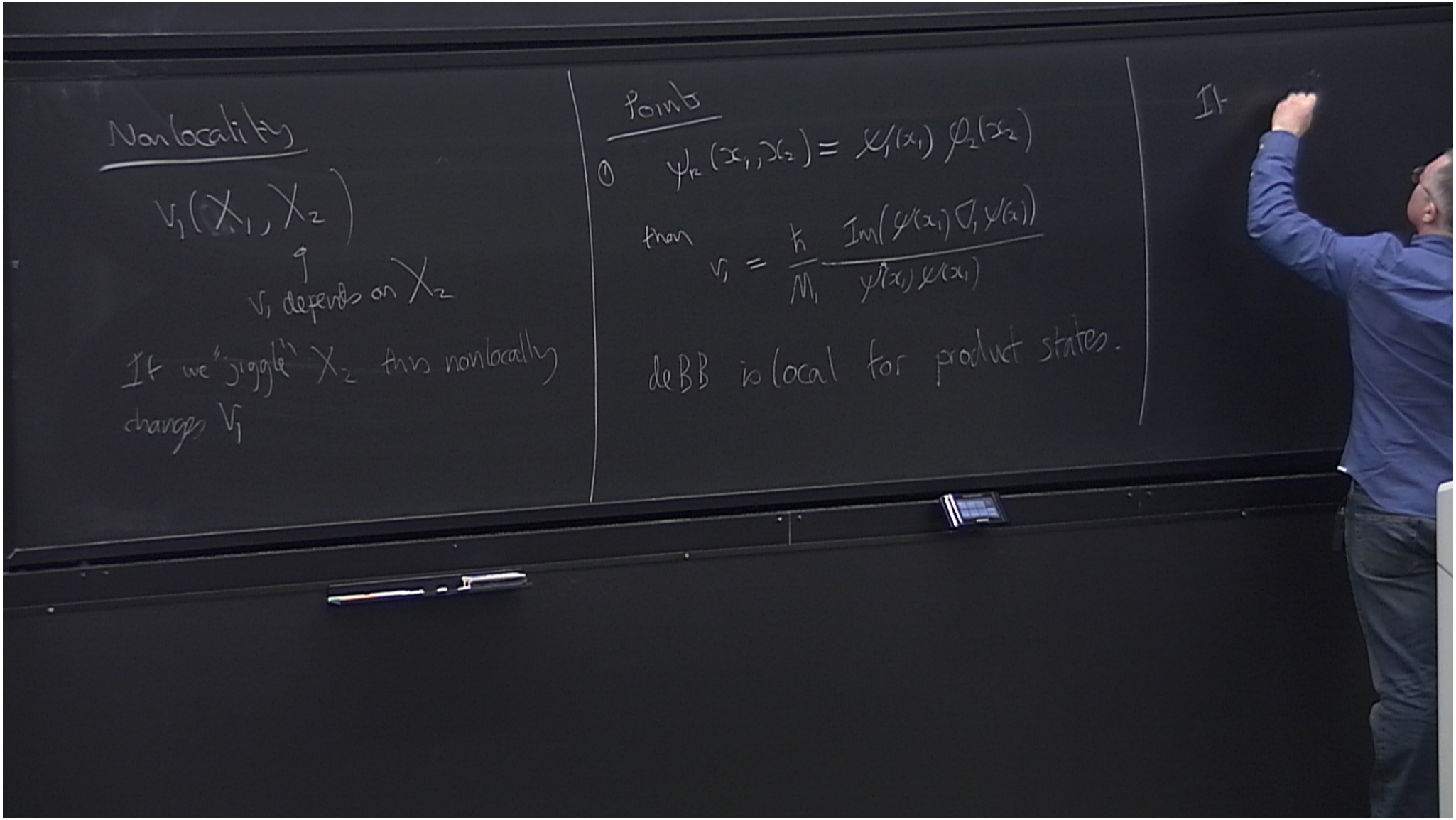

Nonlocality
$V_1(X_1, X_2)$
V_1 depends on X_2
If we "jiggle" X_2 this nonlocally changes V_1

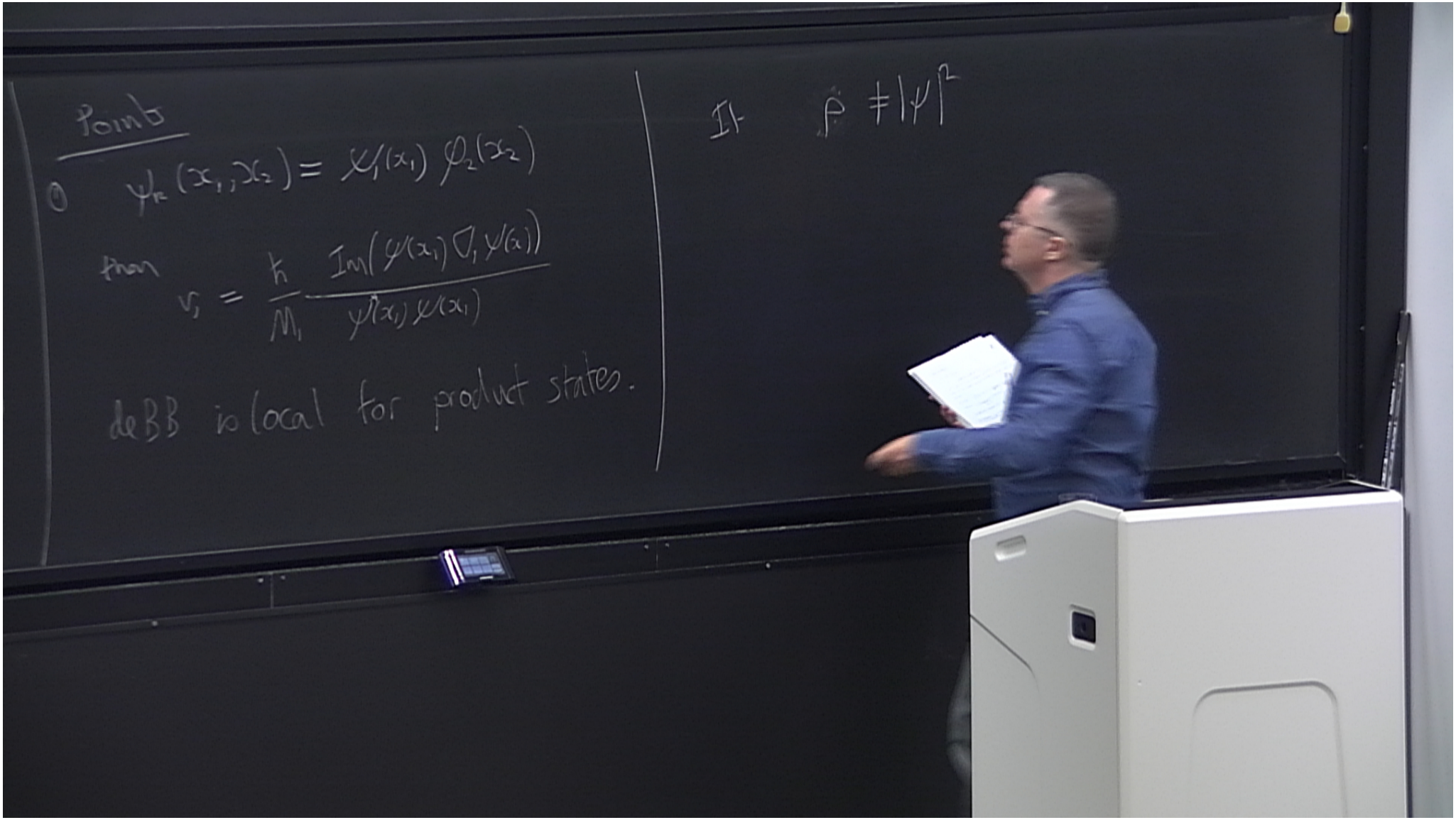

Nonlocality
$V_1(X_1, X_2)$
V_1 depends on X_2
If we 'jiggle' X_2 this nonlocally changes V_1
Point
0

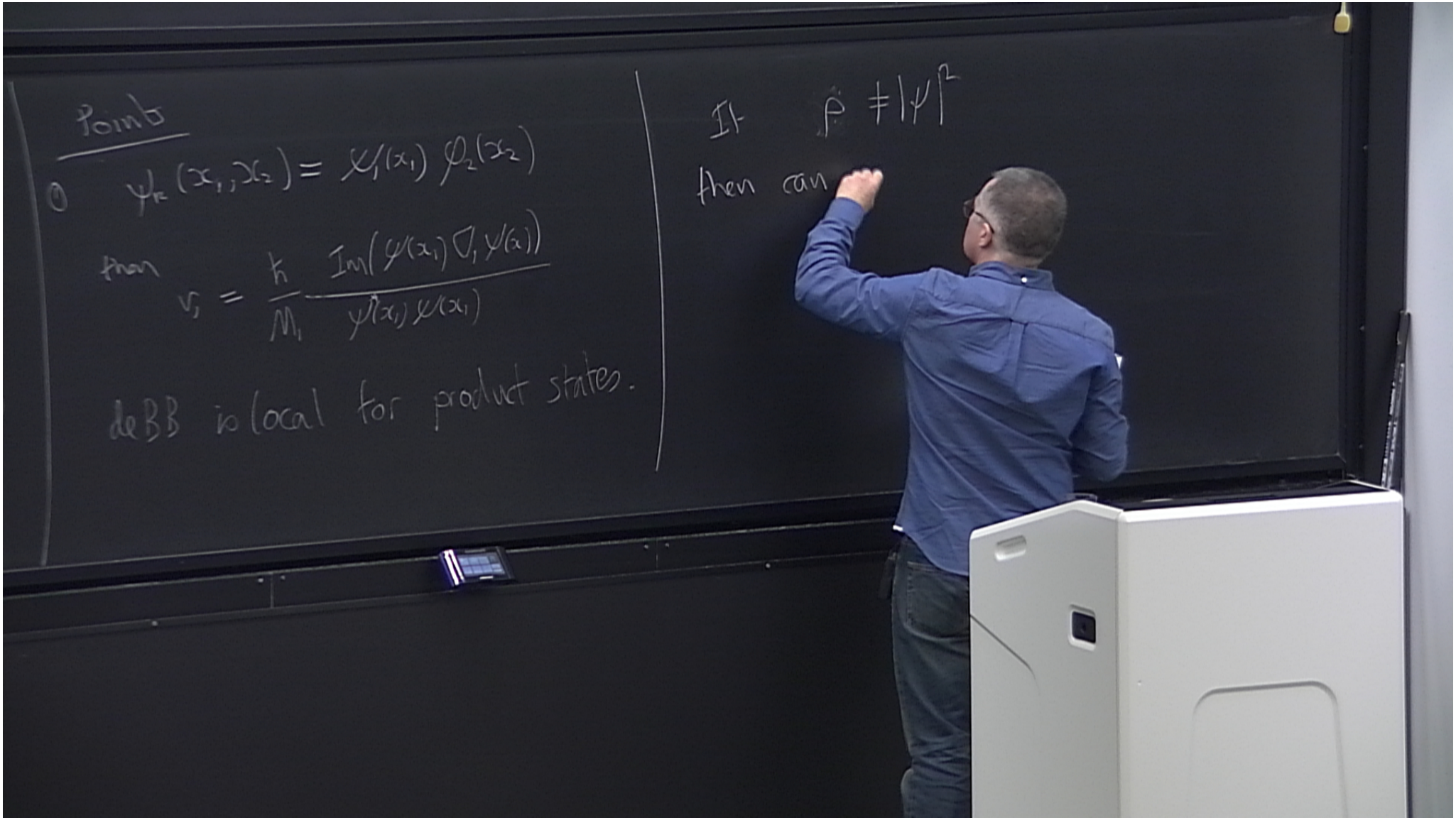

Nonlocality
$V_1(X_1, X_2)$
V_1 depends on X_2
If we "jiggle" X_2 this nonlocally changes V_1
Bomb
0 $\psi_{12}(x_1, x_2) = \varphi_1(x_1)\,\varphi_2(x_2)$

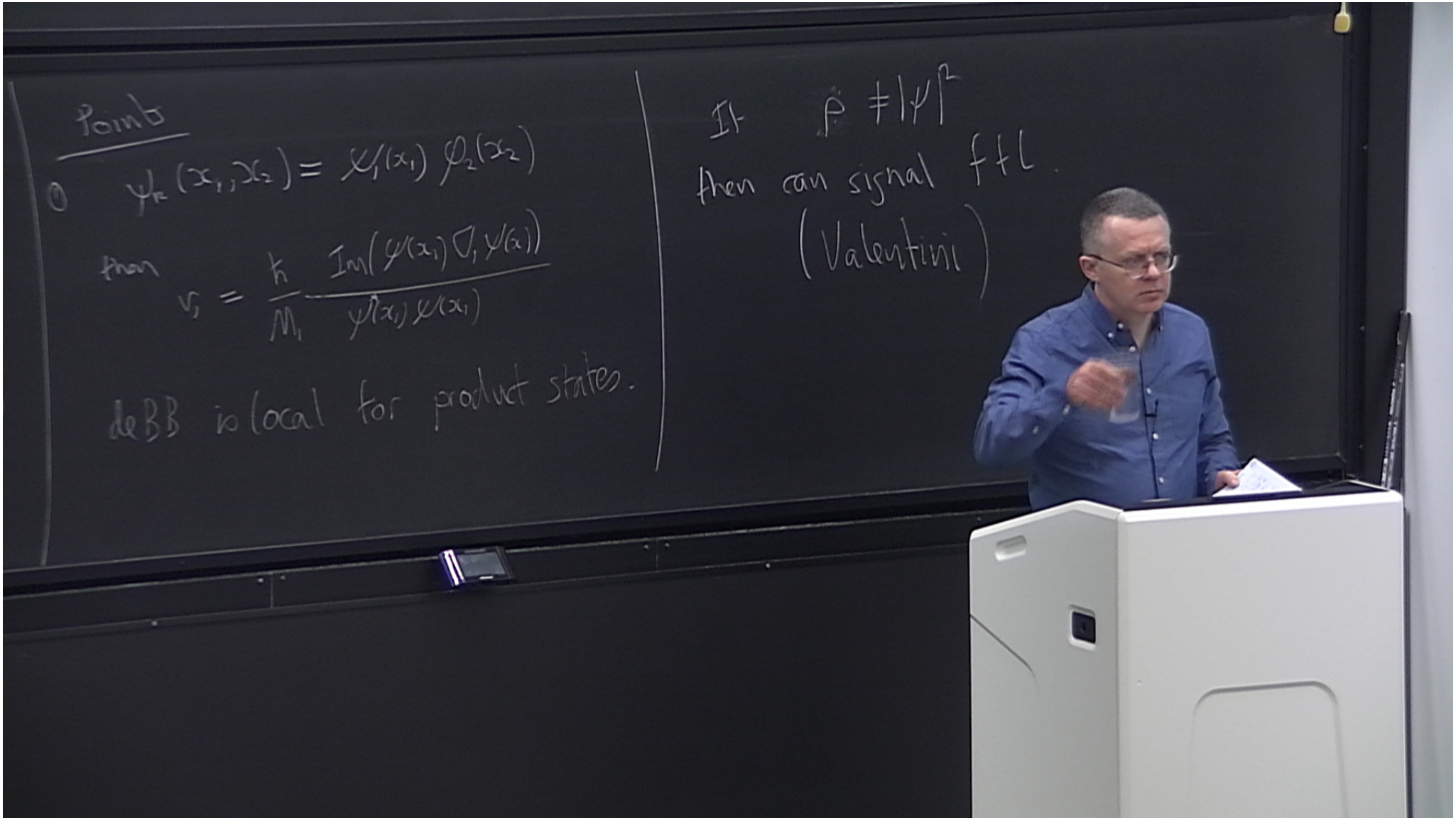

Nonlocality
$V_1(X_1, X_2)$
V_1 depends on X_2
If we "jiggle" X_2 this nonlocally changes V_1
Points
① $\psi_R(x_1, x_2) = \varphi_1(x_1)\,\varphi_2(x_2)$
than
$v_1 = \frac{\hbar}{M_1} \frac{\mathrm{Im}(\psi(x_1)\nabla_1\psi(x_1))}{\psi^*(x_1)\psi(x_1)}$

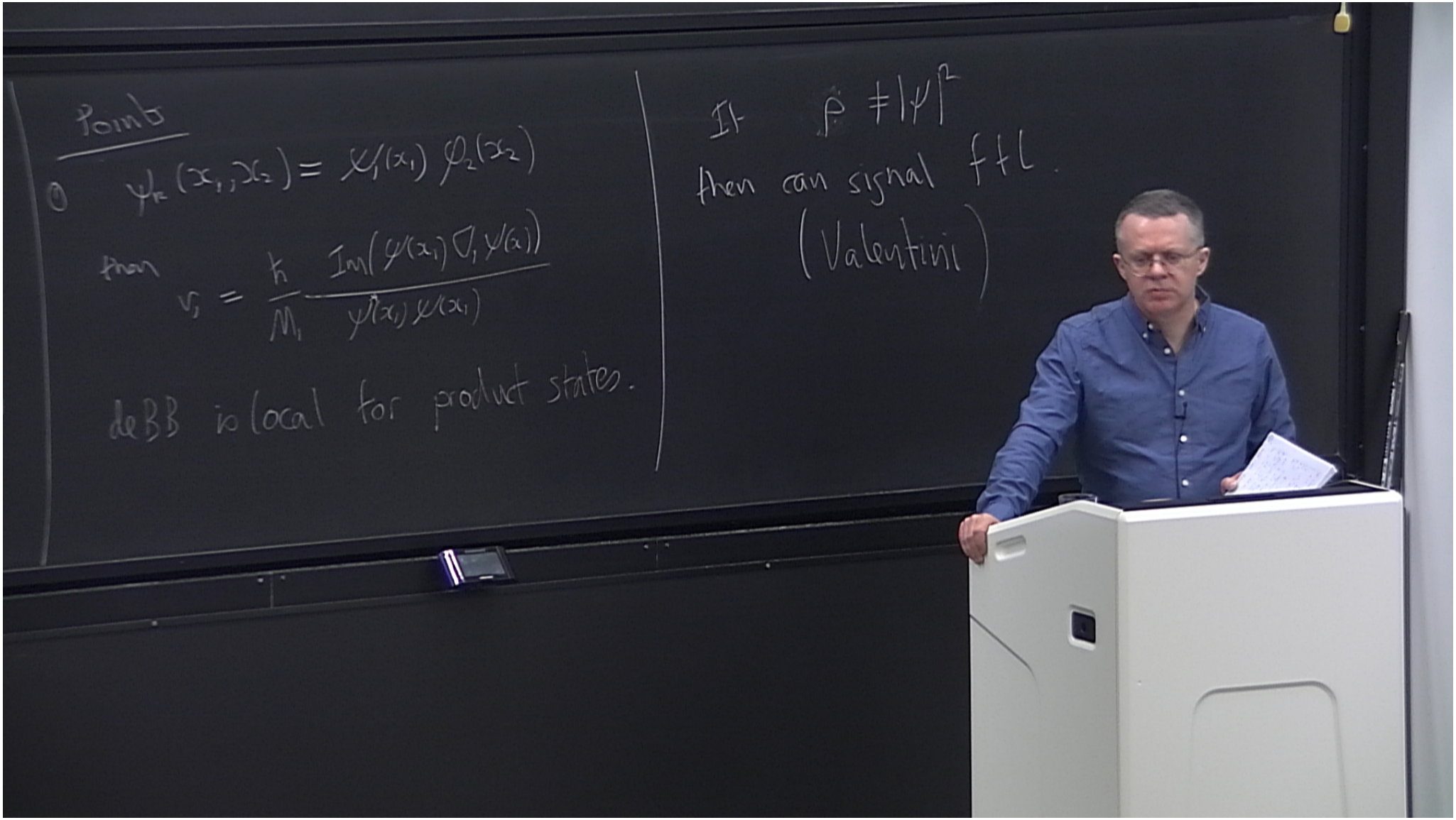

Nonlocality
$v_1(X_1, X_2)$
v_1 depends on X_2
If we "jiggle" X_2 this nonlocally changes v_1
Points
① $\psi_R(x_1, x_2) = \varphi_1(x_1)\,\varphi_2(x_2)$
than
$v_i = \frac{\hbar}{M_i} \frac{\mathrm{Im}(\psi(x_i)\nabla_i\psi(x_i))}{\psi^*(x_i)\psi(x_i)}$
deBB is local for product states.

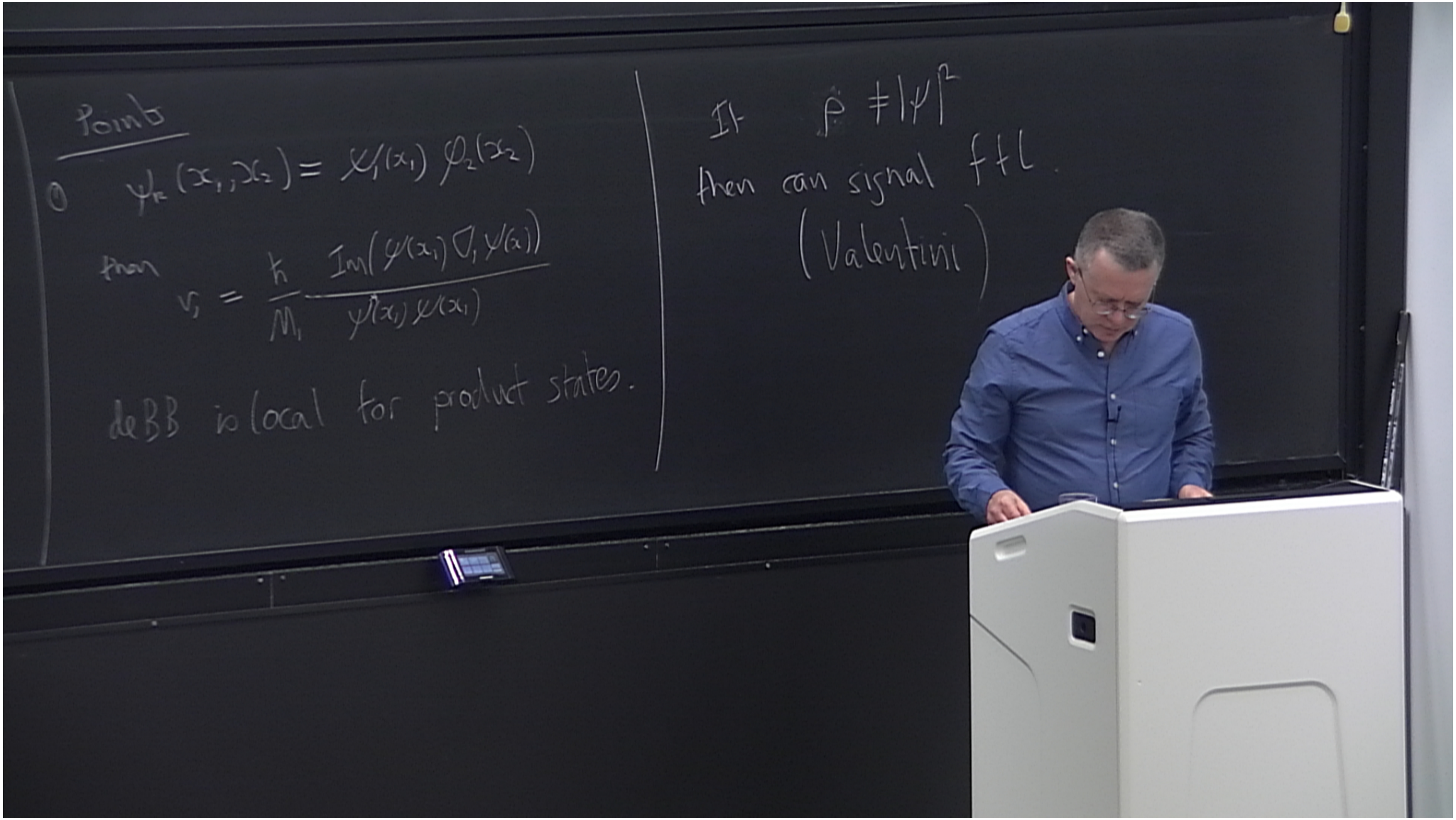

Nonlocality
$v_1(X_1, X_2)$
v_1 depends on X_2
If we "jiggle" X_2 then nonlocally changes v_1
Points
① $\psi_R(x_1, x_2) = \varphi_1(x_1)\,\varphi_2(x_2)$
than $v_1 = \frac{\hbar}{M_1} \frac{\mathrm{Im}(\psi(x_1)\nabla_1\psi(x_1))}{\psi^*(x_1)\psi(x_1)}$
deBB is local for product states.
If

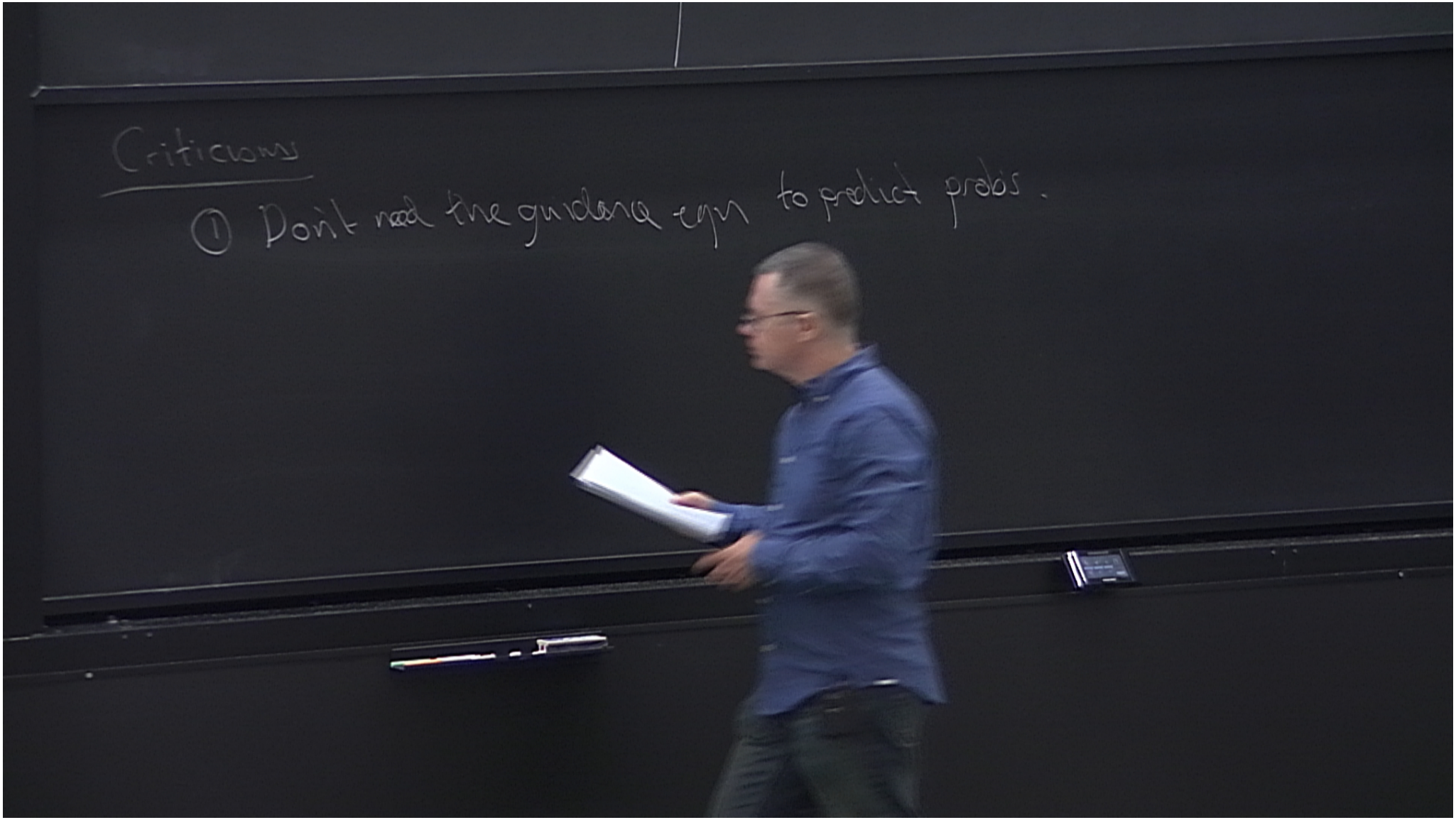

Point
$\psi_R(x_1, x_2) = \varphi_1(x_1)\,\varphi_2(x_2)$
than
$v_i = \frac{\hbar}{M_i} \frac{\mathrm{Im}(\psi(x_1)\nabla_i\psi(x_1))}{\psi^*(x_1)\psi(x_1)}$
deBB is local for product states.
II. $\hat{\rho} \neq |\psi|^2$

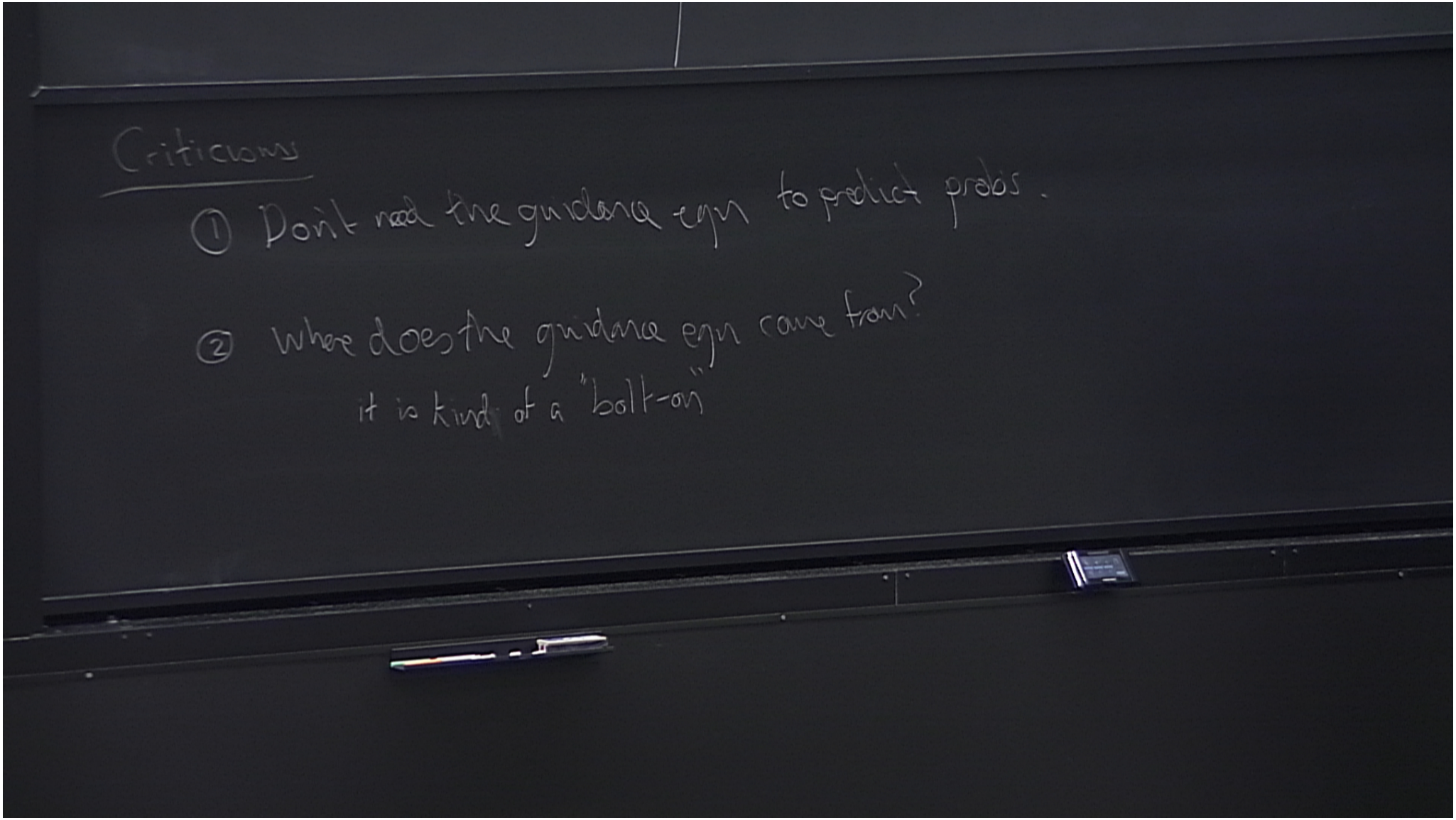

Points
$\psi_R(x_1, x_2) = \varphi_1(x_1)\,\varphi_2(x_2)$
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$v_j = \frac{\hbar}{M_j} \frac{\mathrm{Im}(\psi(x_1)\nabla_j\psi(x_1))}{\psi^*(x_1)\psi(x_1)}$
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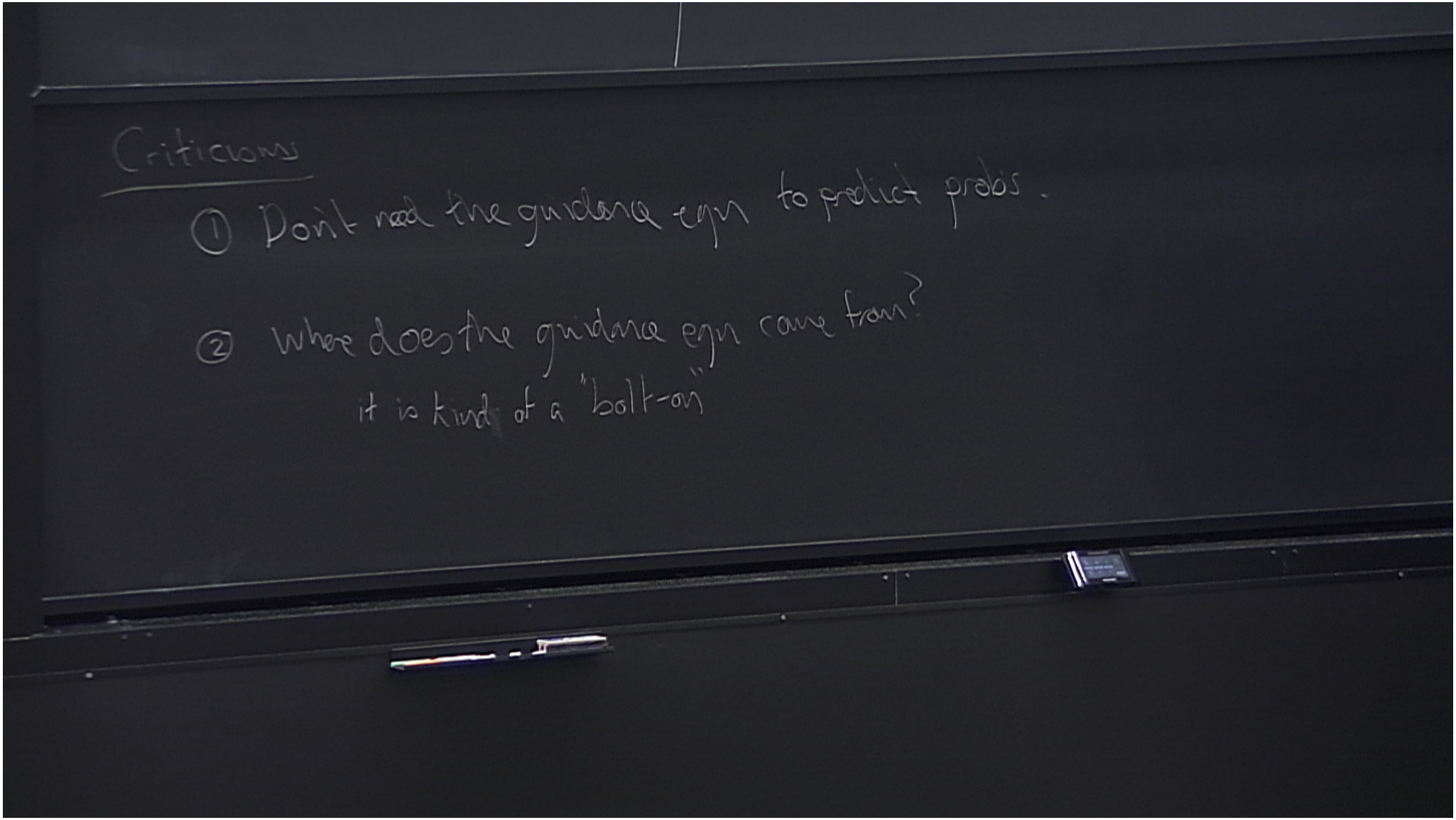

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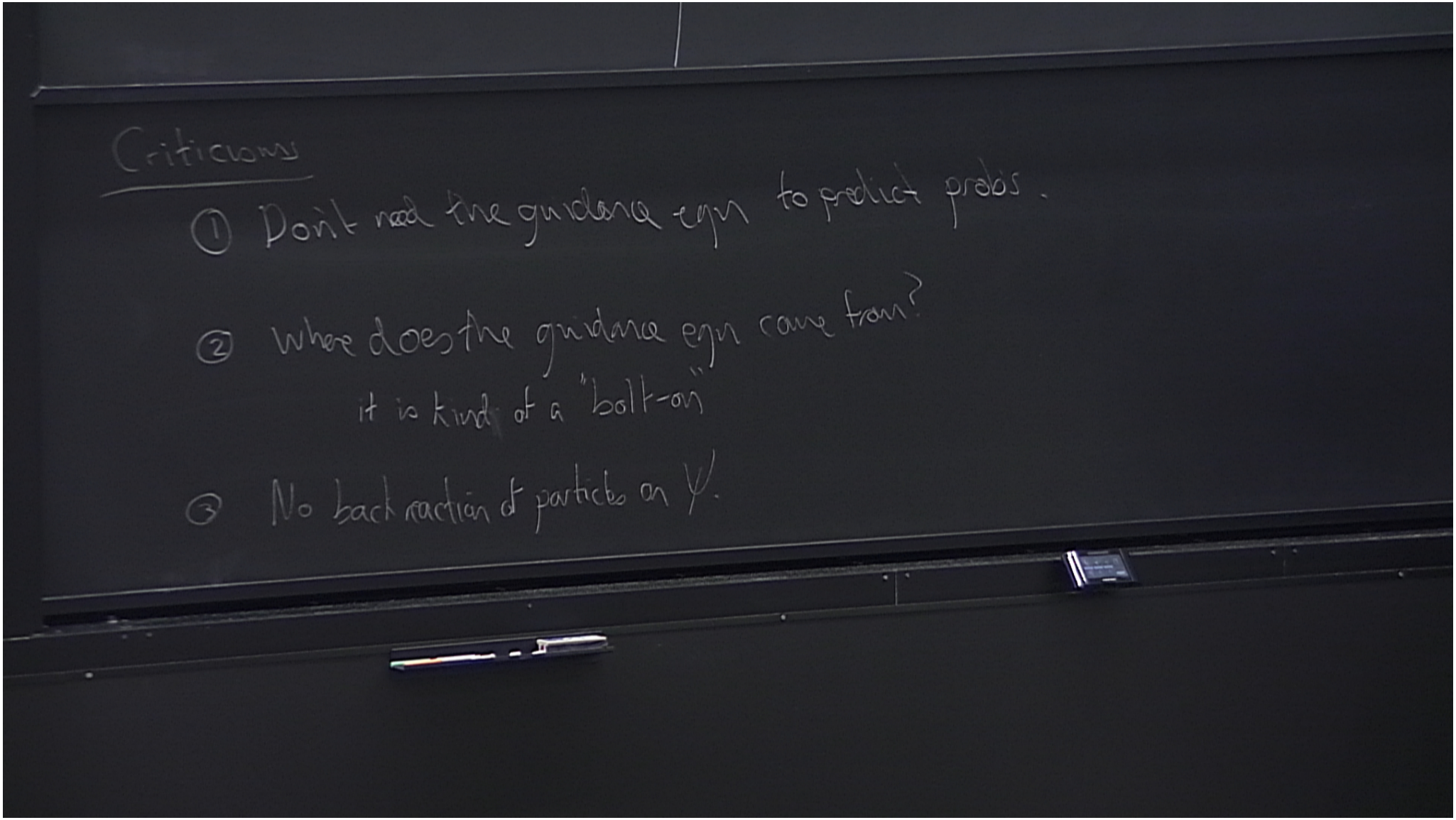

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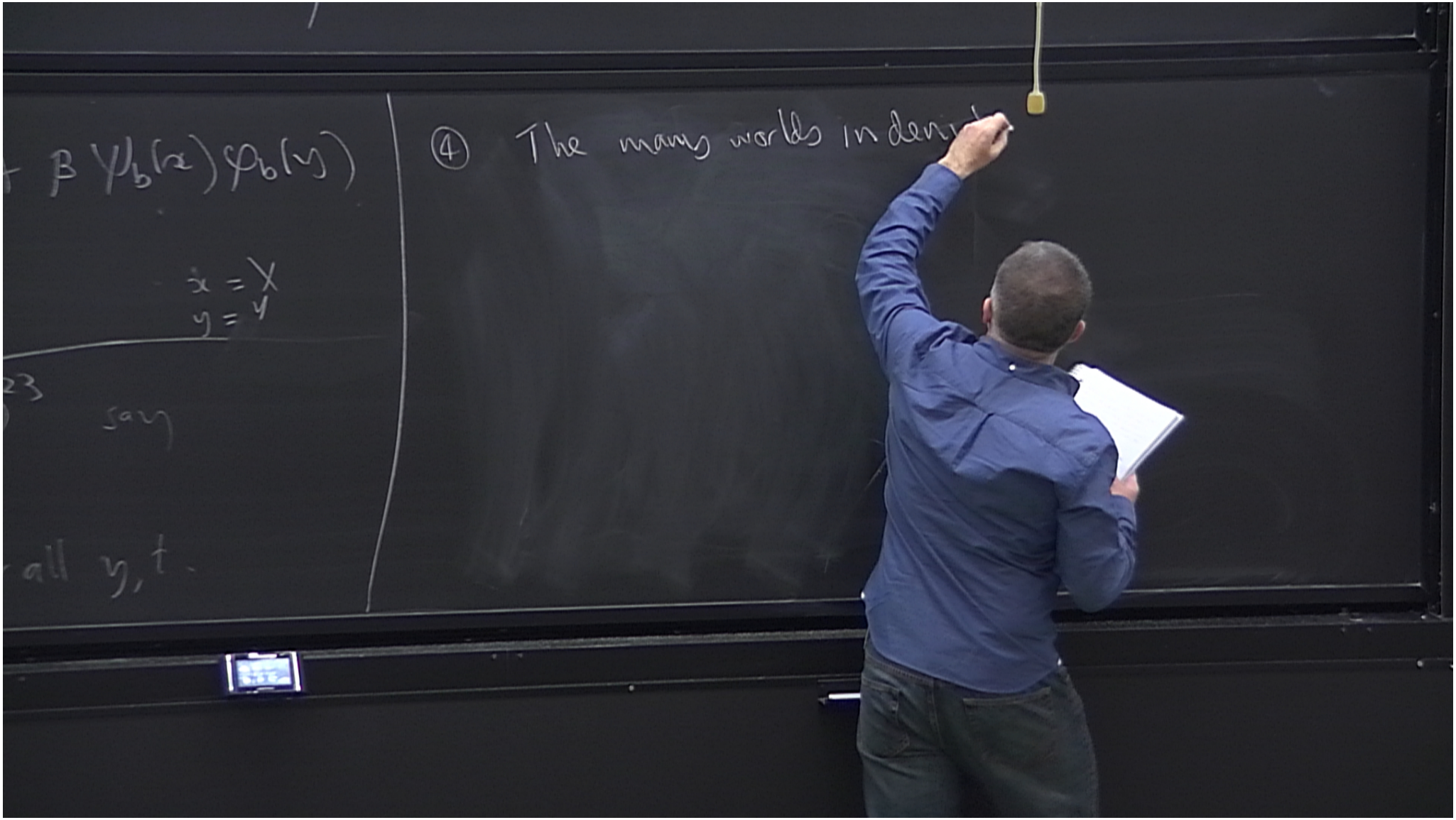

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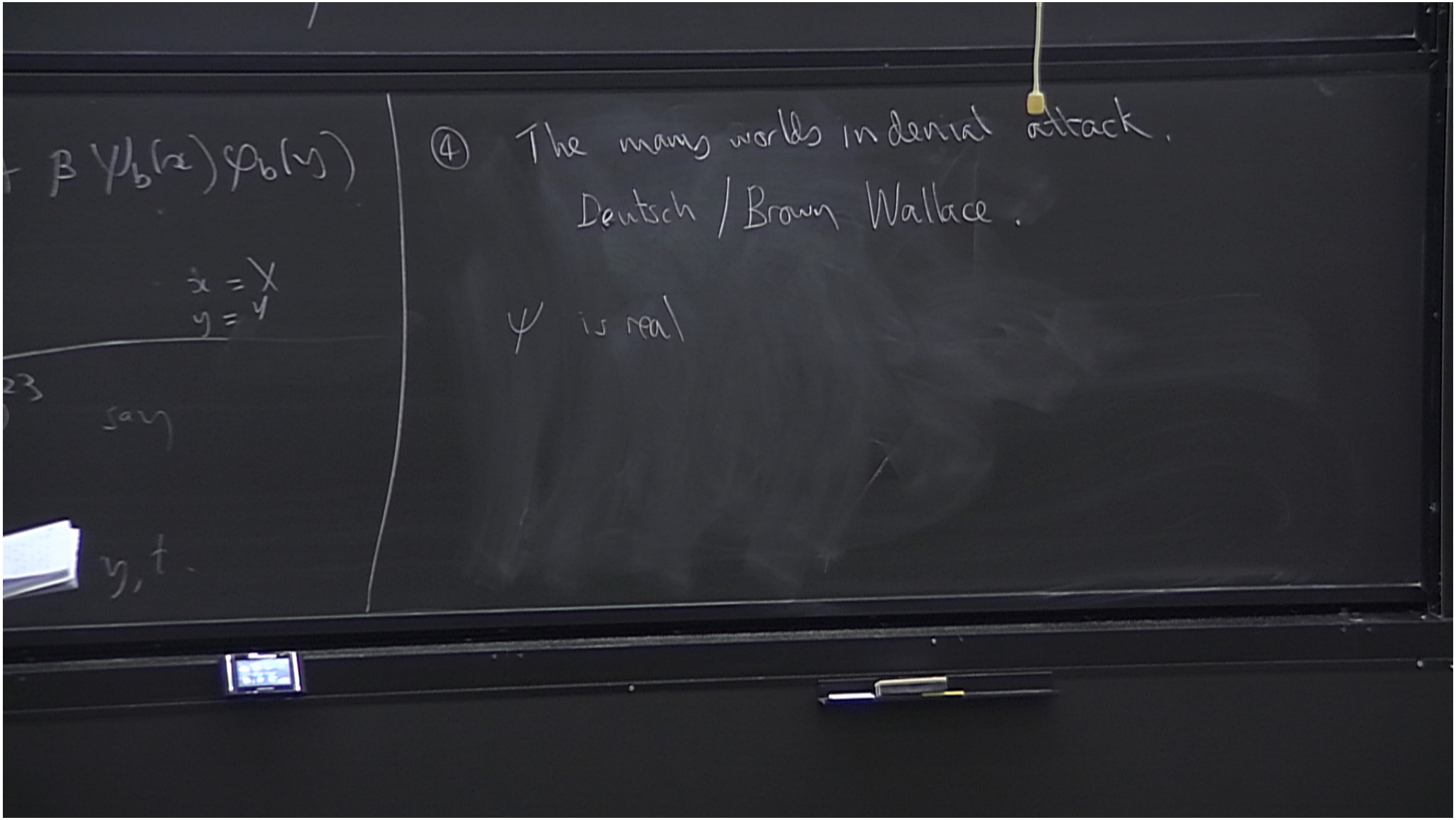

Criticisms
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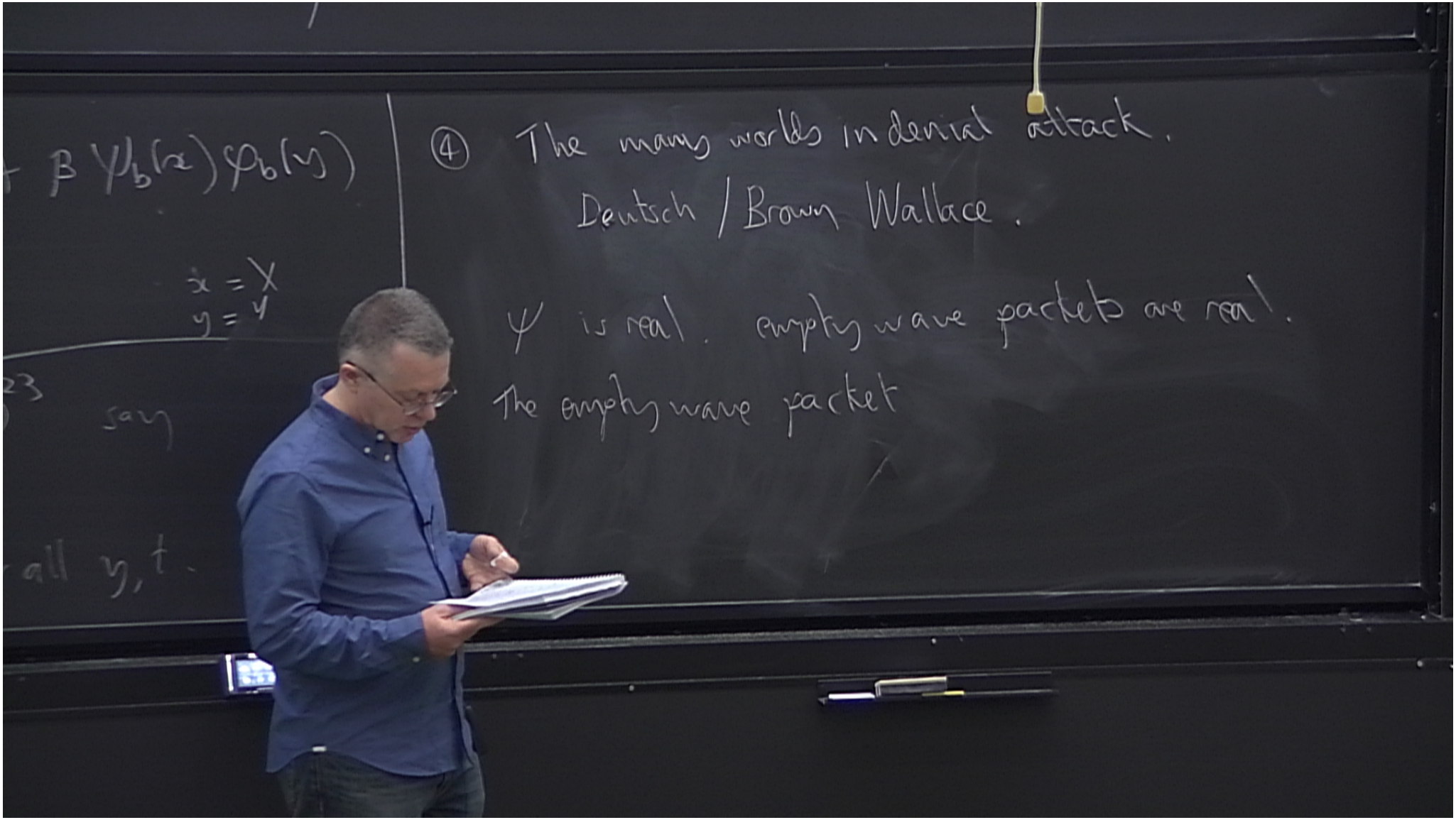

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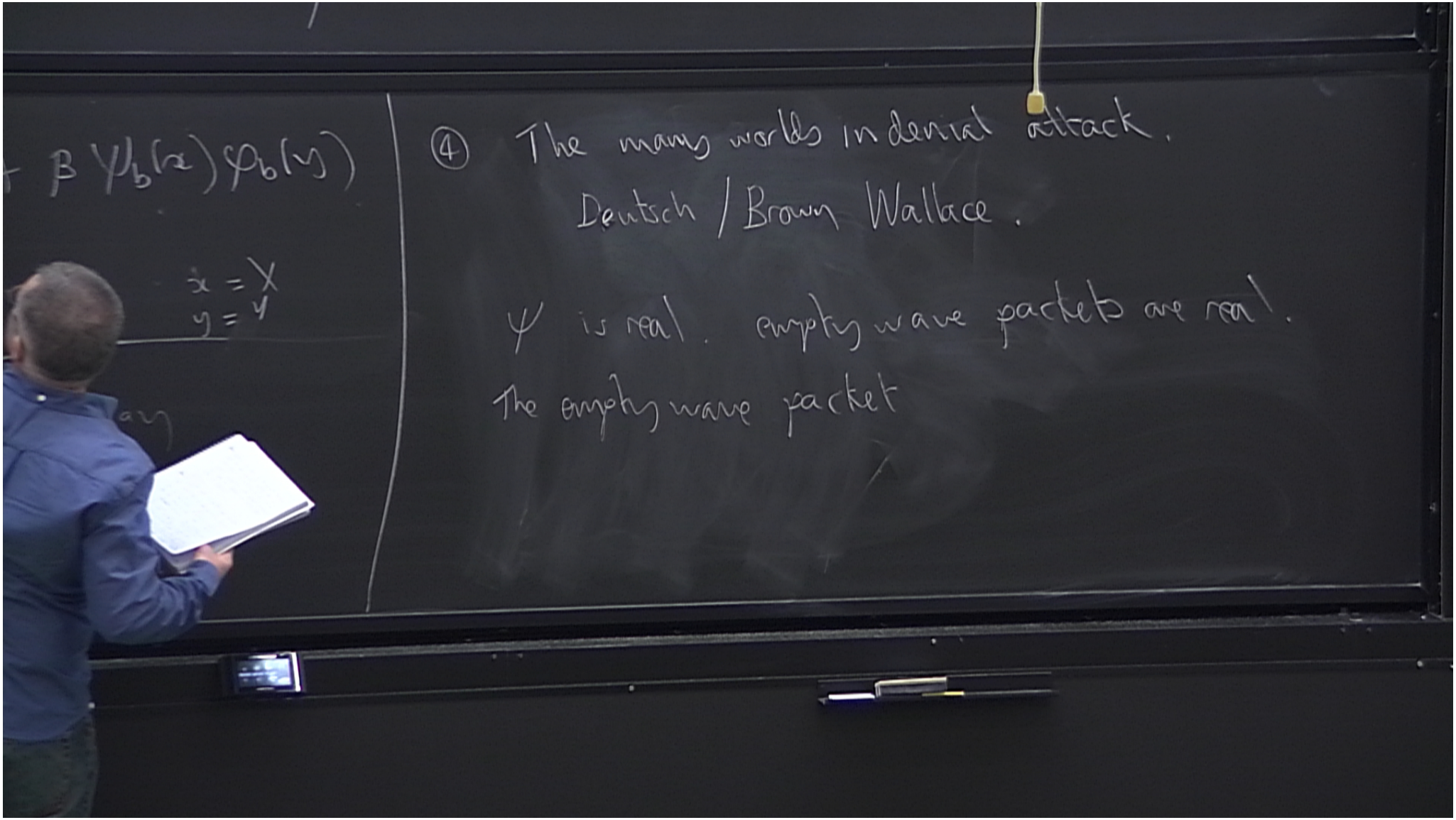

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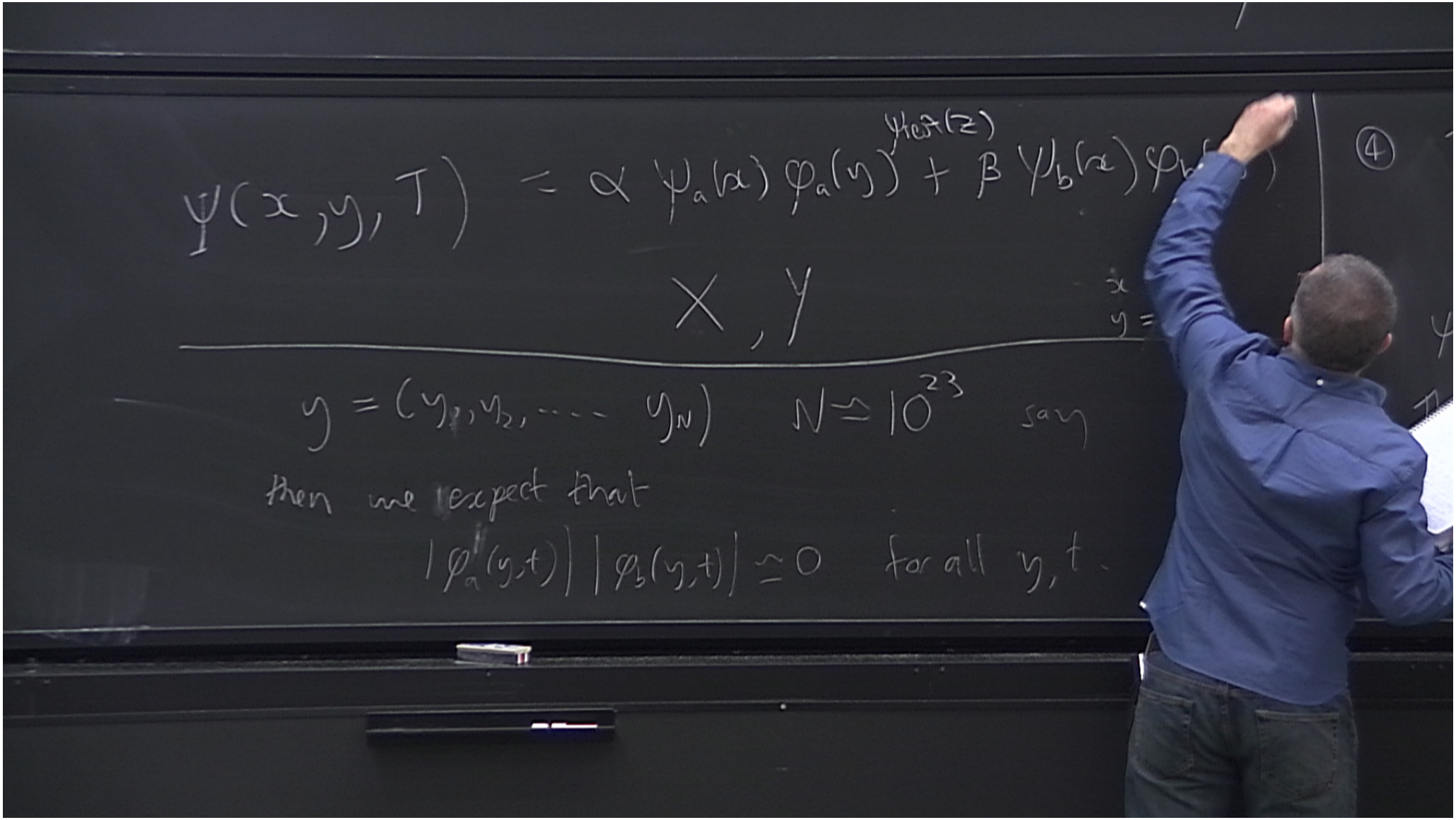

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④ The many worlds
say
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$\Psi(x, y, T) = \alpha \psi_a(x) \varphi_a(y) e^{i\omega T(z)} + \beta \psi_b(x) \varphi_b($
X, Y
④
$y = (y_1, y_2, \ldots y_N)$ $N \simeq 10^{23}$ say
then we expect that
$|\varphi_a(y,t)|\,|\varphi_b(y,t)| \simeq 0$ for all y, t.

$$\Psi(x,y,T) = \alpha\, \psi_a(x)\,\varphi_a(y)^{\psi_{cat}(z)} + \beta\, \psi_b(x)\,\varphi_b(y)^{\psi_d(z)}$$

$x = X$
$y = Y$

X, Y

$y = (y_1, y_2, \ldots\ldots y_N)$ $\quad N \simeq 10^{23}$ say

then we expect that

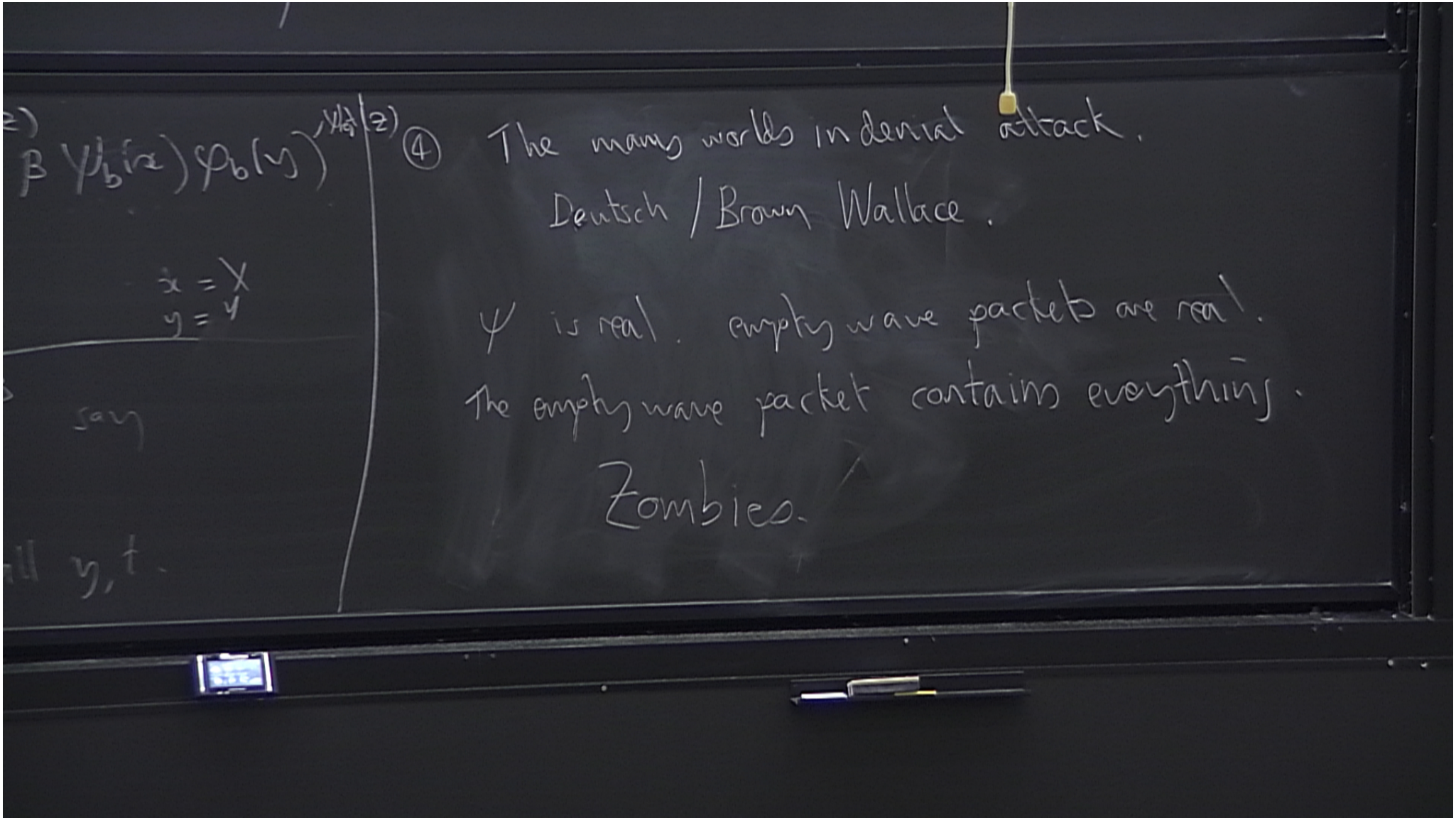
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Zombies.