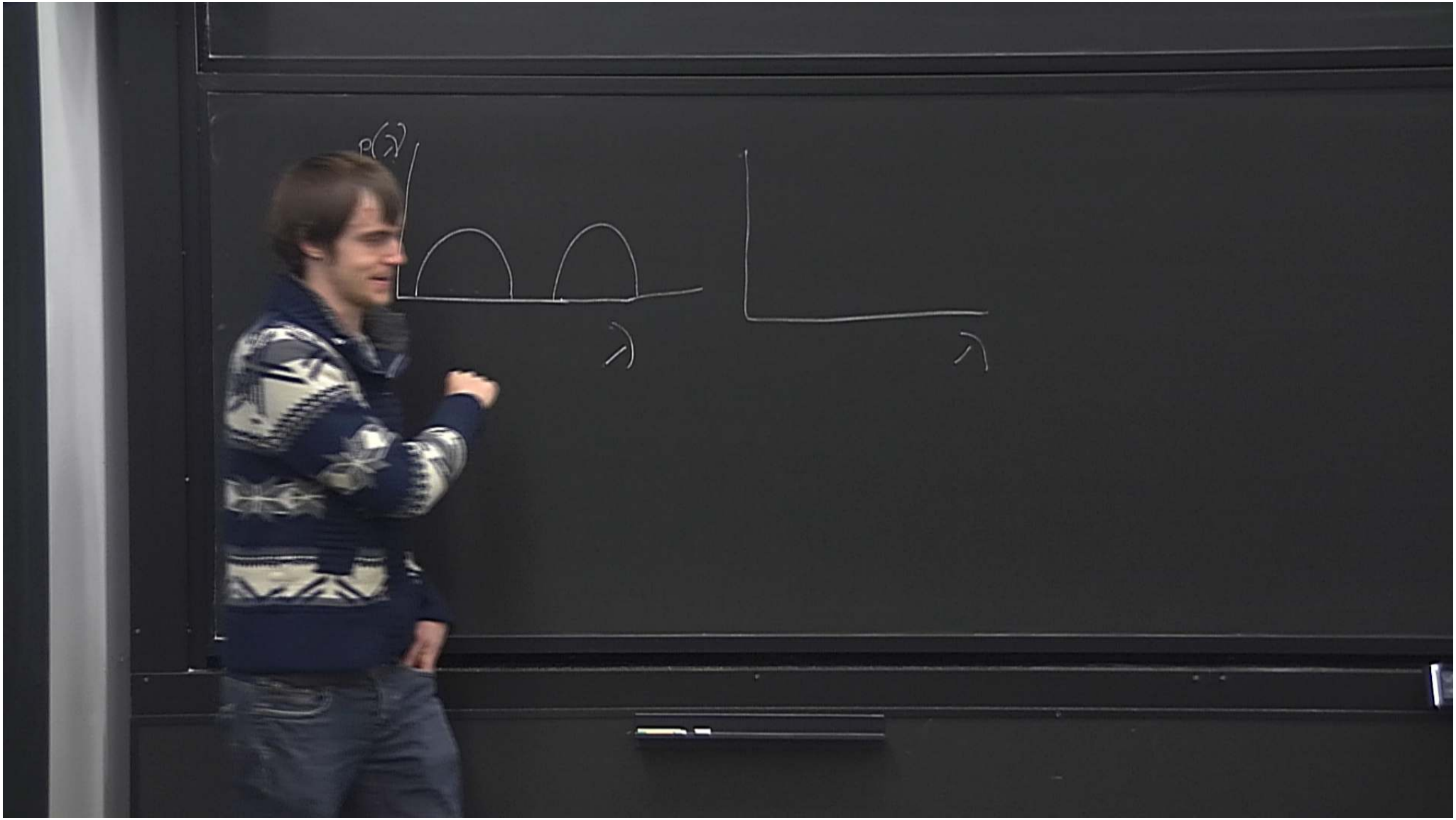
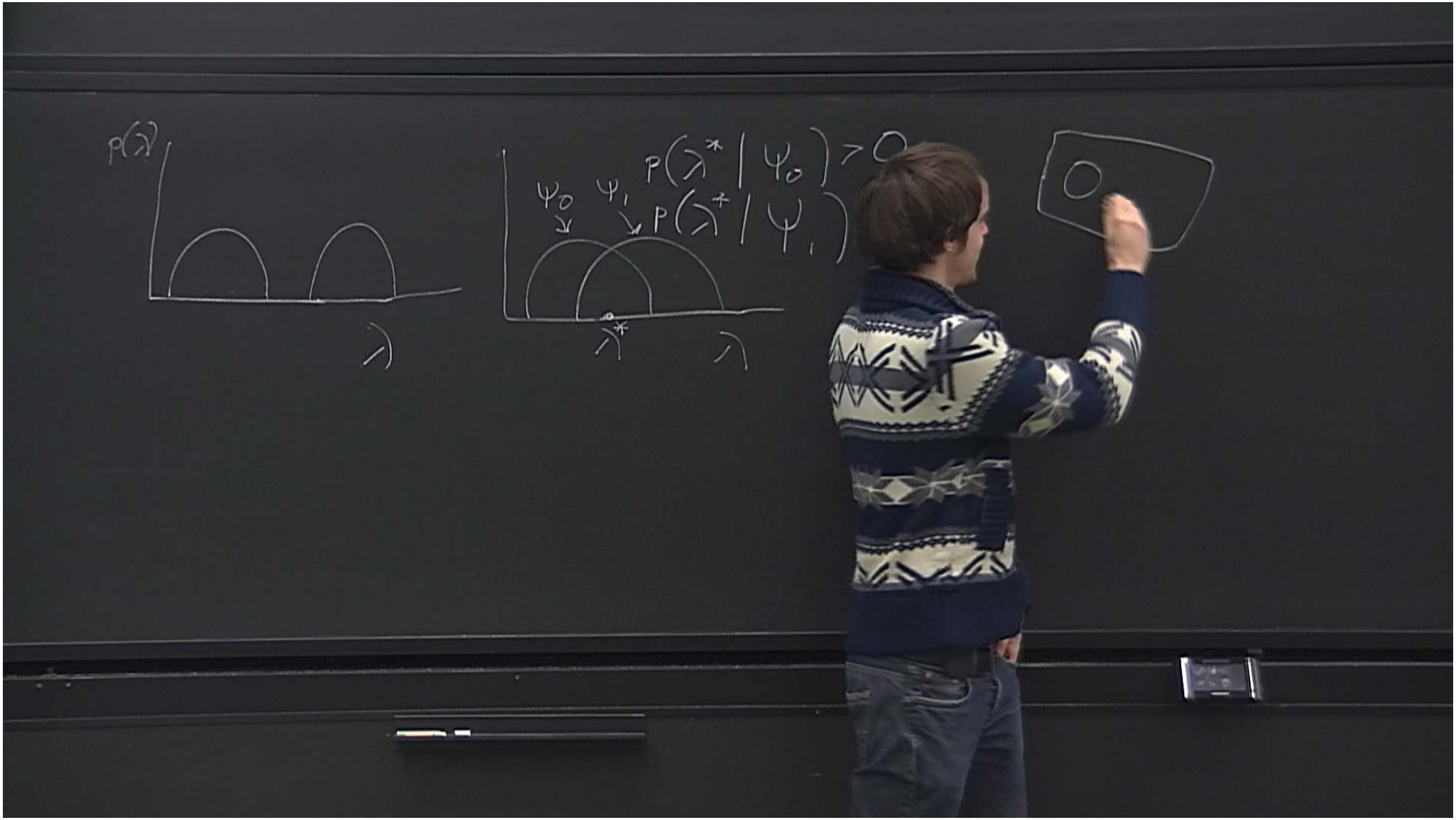
Title: 13/14 PSI - Foundations of Quantum Mechanics - Lecture 11

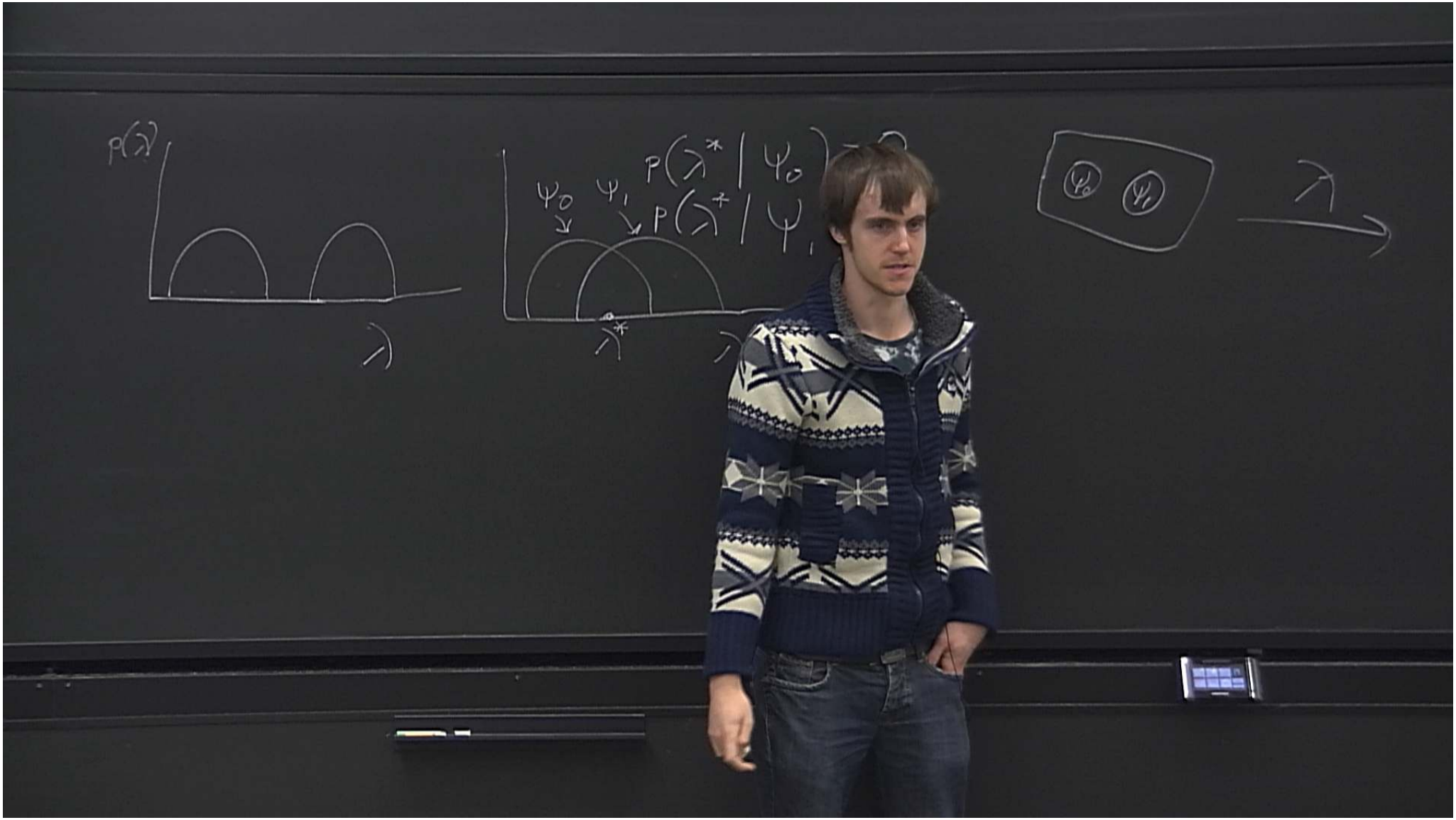
Date: Jan 20, 2014 04:00 PM

URL: http://pirsa.org/14010060

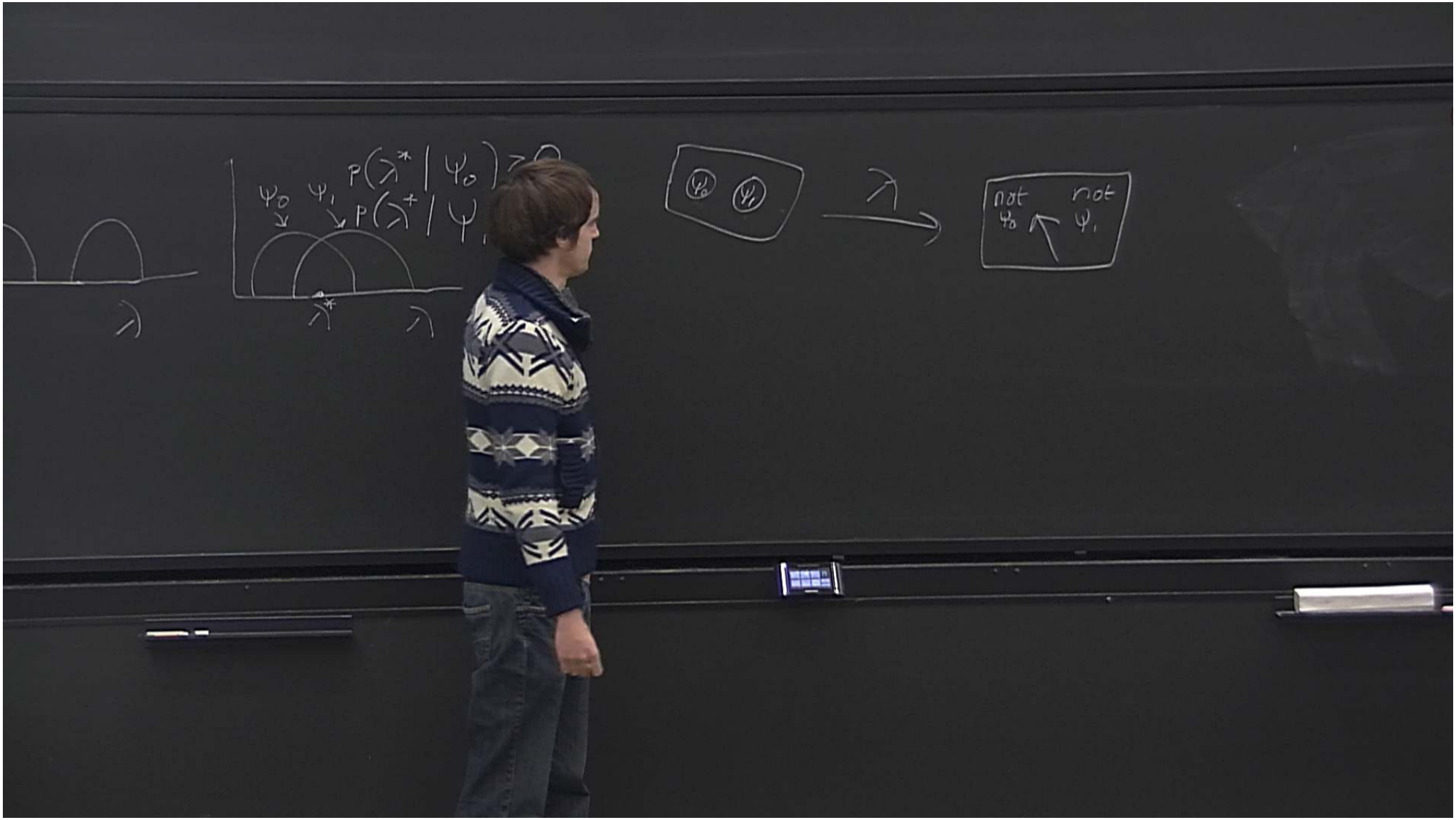
Abstract:

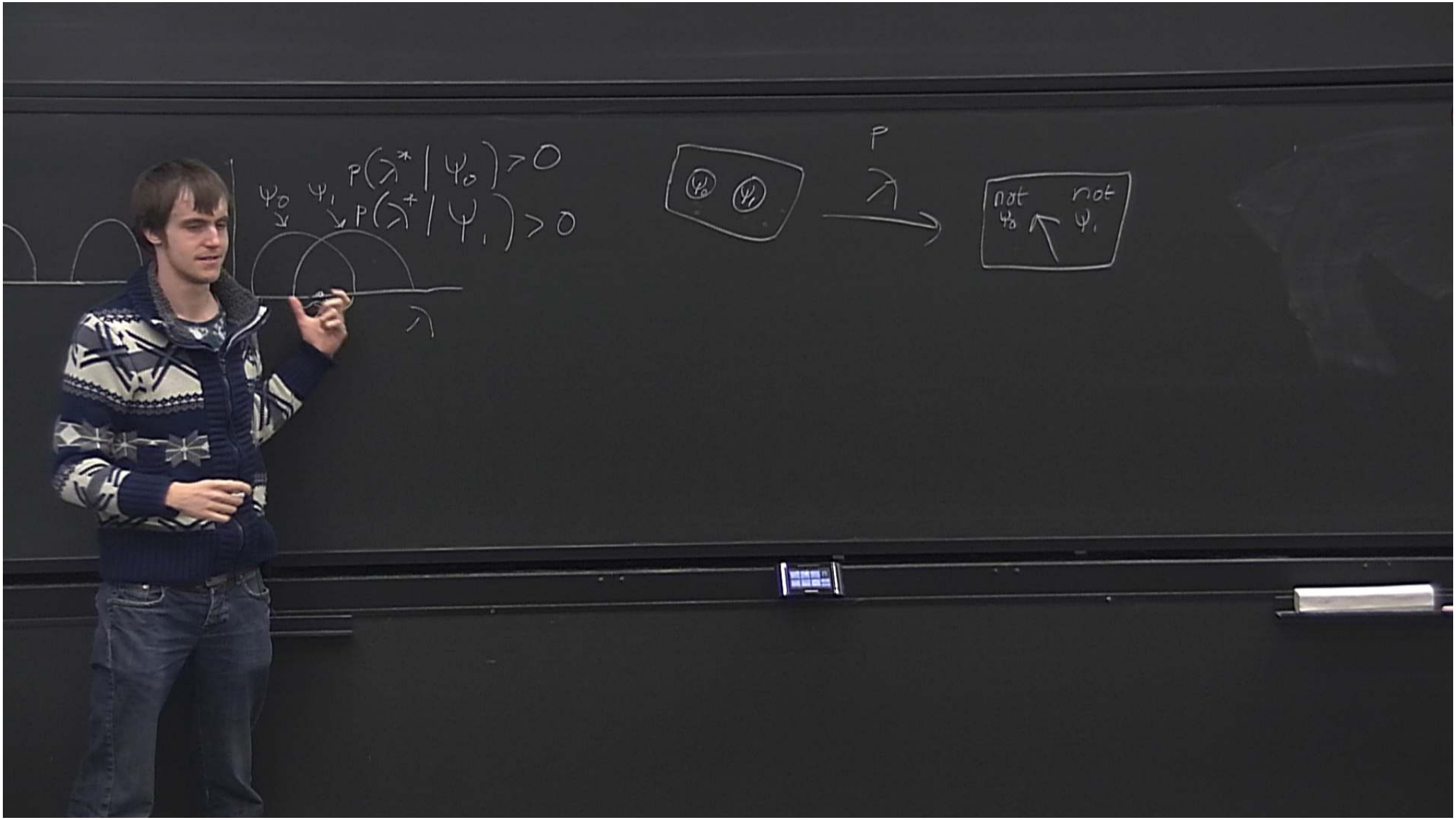

P(λ)
λ
λ


p(λ)
λ
ψ0
ψ1
p(λ*|ψ0) > 0
p(λ*|ψ1)
λ*
λ

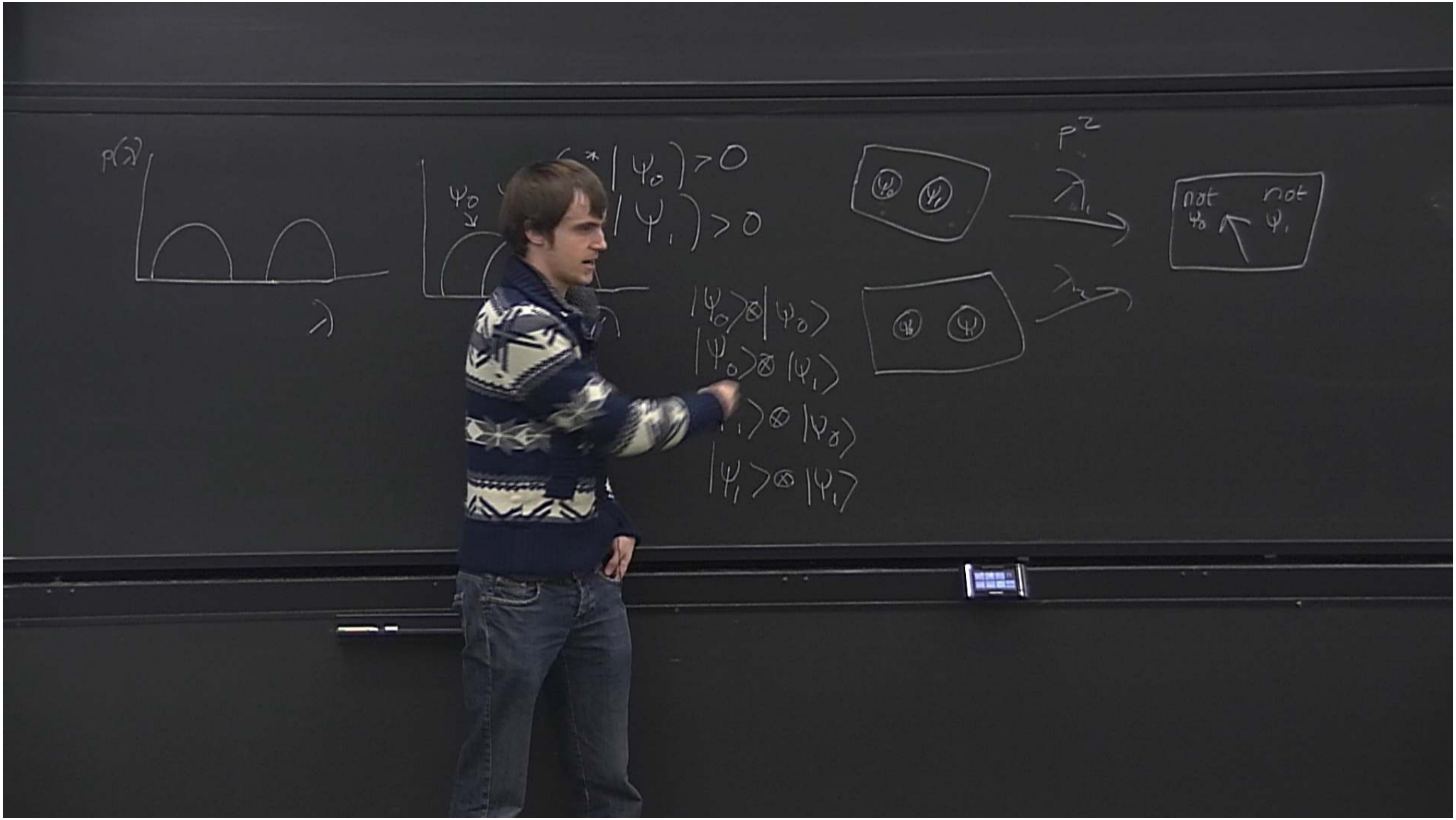

p(λ)
λ
ψ0
ψ1
p(λ*|ψ0)
p(λ*|ψ1)
λ*
λ
ψ0
ψ1
λ

$P(\lambda^* | \psi_0) > 0$
$P(\lambda^+ | \psi_1) > 0$
λ
not
$|\psi_0\rangle \perp |\psi_1\rangle$

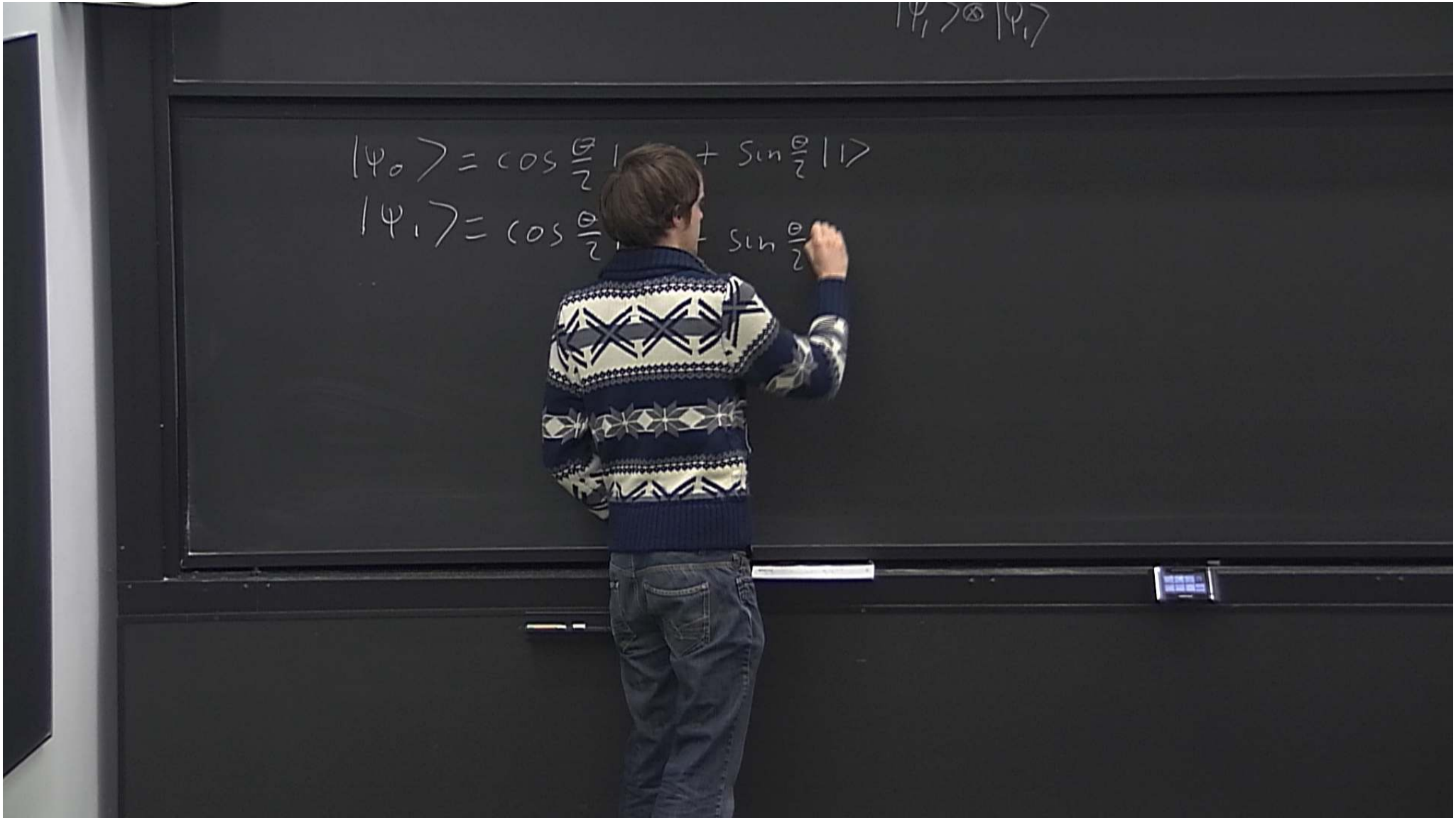

not
not

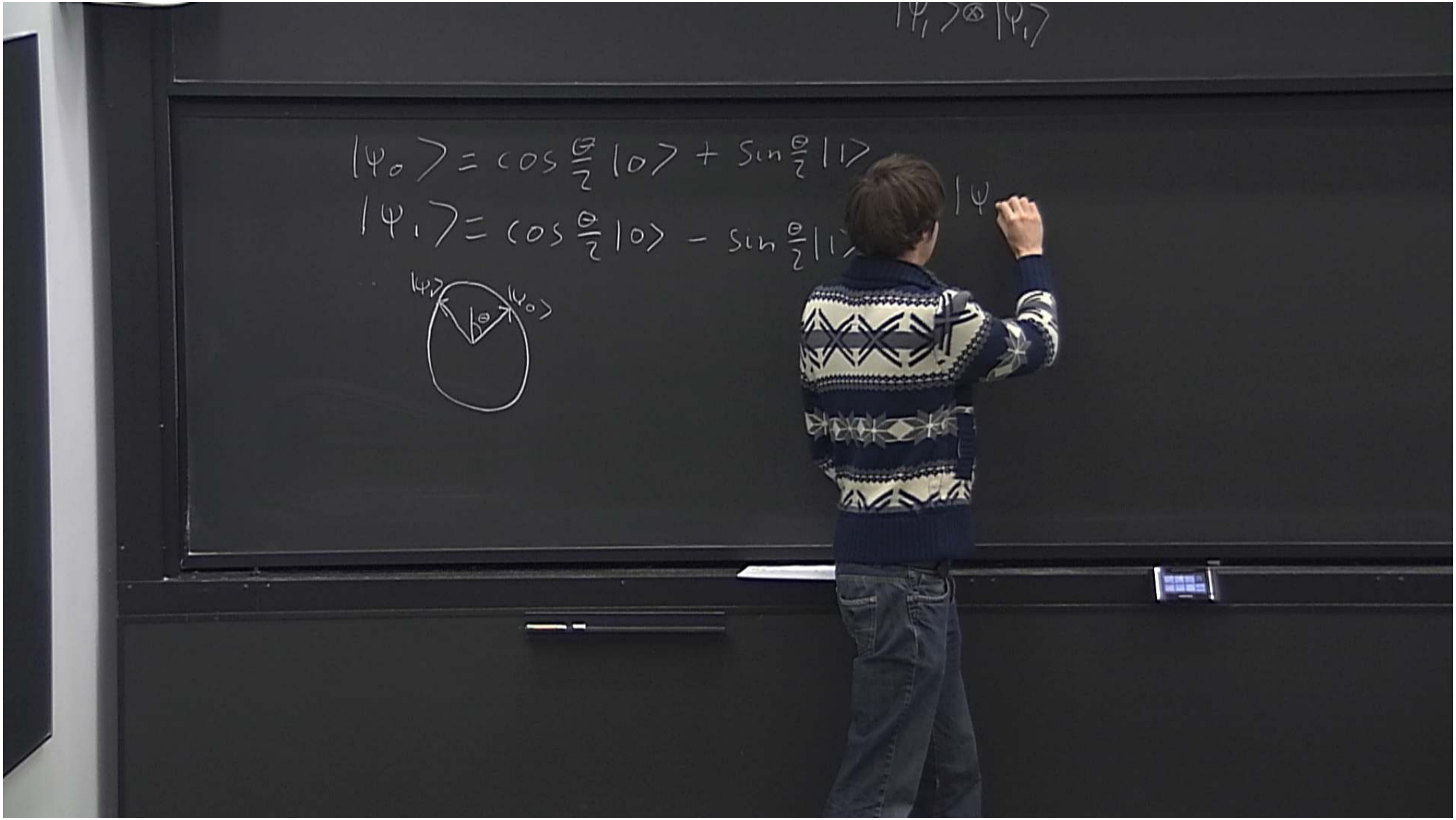

$P(\lambda^* | \psi_0) > 0$
$P(\lambda^* | \psi_1) > 0$
ψ_0
ψ_1
λ
P
not ψ_0
not ψ_1

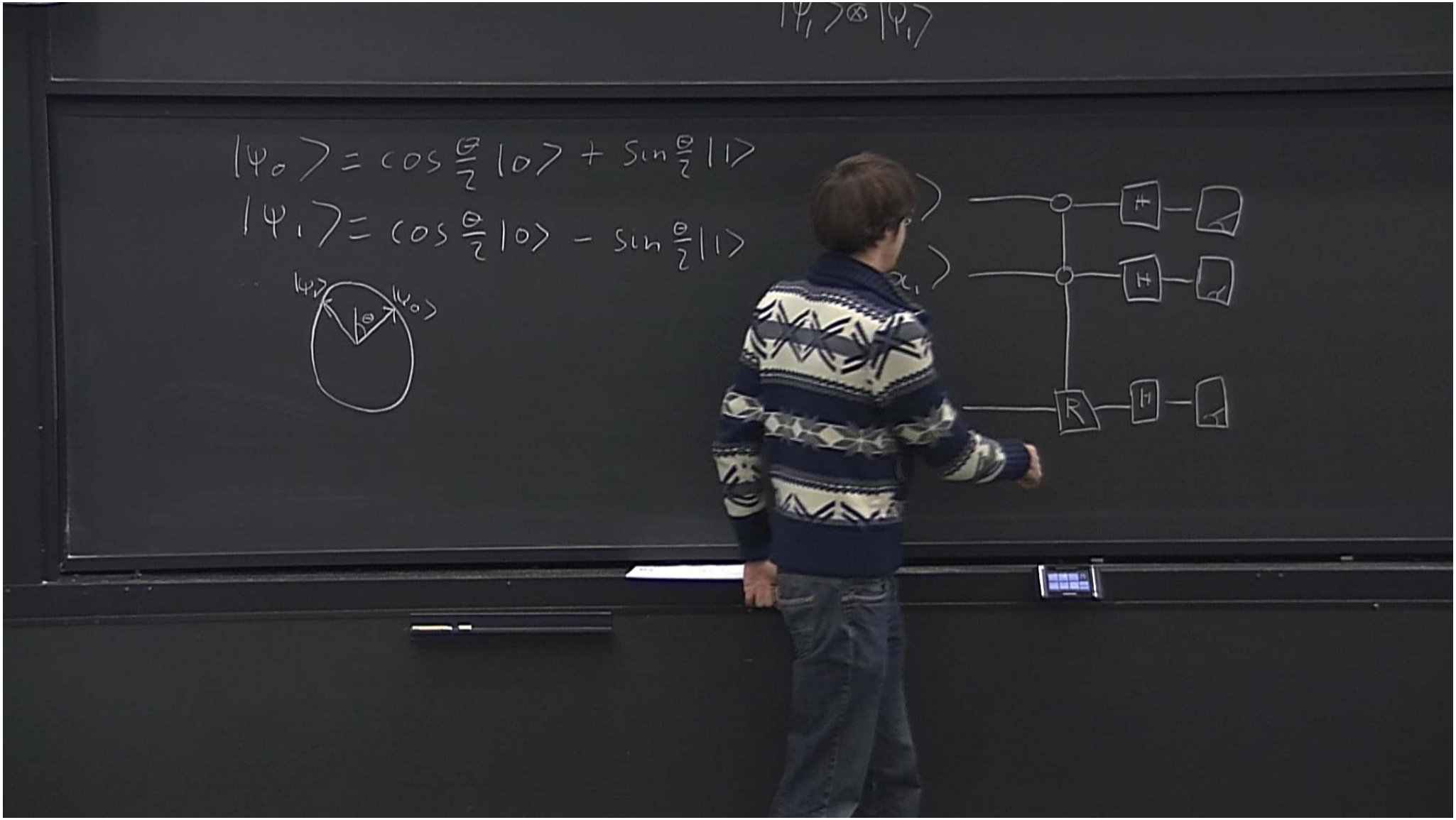
not
not


p(λ)
λ
|ψ0⟩ > 0
|ψ1⟩ > 0
|ψ0⟩⊗|ψ0⟩
|ψ0⟩⊗|ψ1⟩
|ψ1⟩⊗|ψ1⟩
p²
not ψ0
not ψ1

p^2
not
not
not
not
$|\psi_0\rangle \otimes |\psi_0\rangle$
$|\psi_0\rangle \otimes |\psi_1\rangle$
$|\psi_1\rangle \otimes |\psi_0\rangle$
$|\psi_1\rangle \otimes |\psi_1\rangle$


$|\psi_0\rangle = \cos\frac{\theta}{2}|$ + $\sin\frac{\theta}{2}|1\rangle$
$|\psi_1\rangle = \cos\frac{\theta}{2}$ + $\sin\frac{\theta}{2}$


$|\Psi_0\rangle = \cos\frac{\theta}{2}|0\rangle + \sin\frac{\theta}{2}|1\rangle$
$|\Psi_1\rangle = \cos\frac{\theta}{2}|0\rangle - \sin\frac{\theta}{2}|1\rangle$
$|\Psi_1\rangle$
$|\Psi_0\rangle$
θ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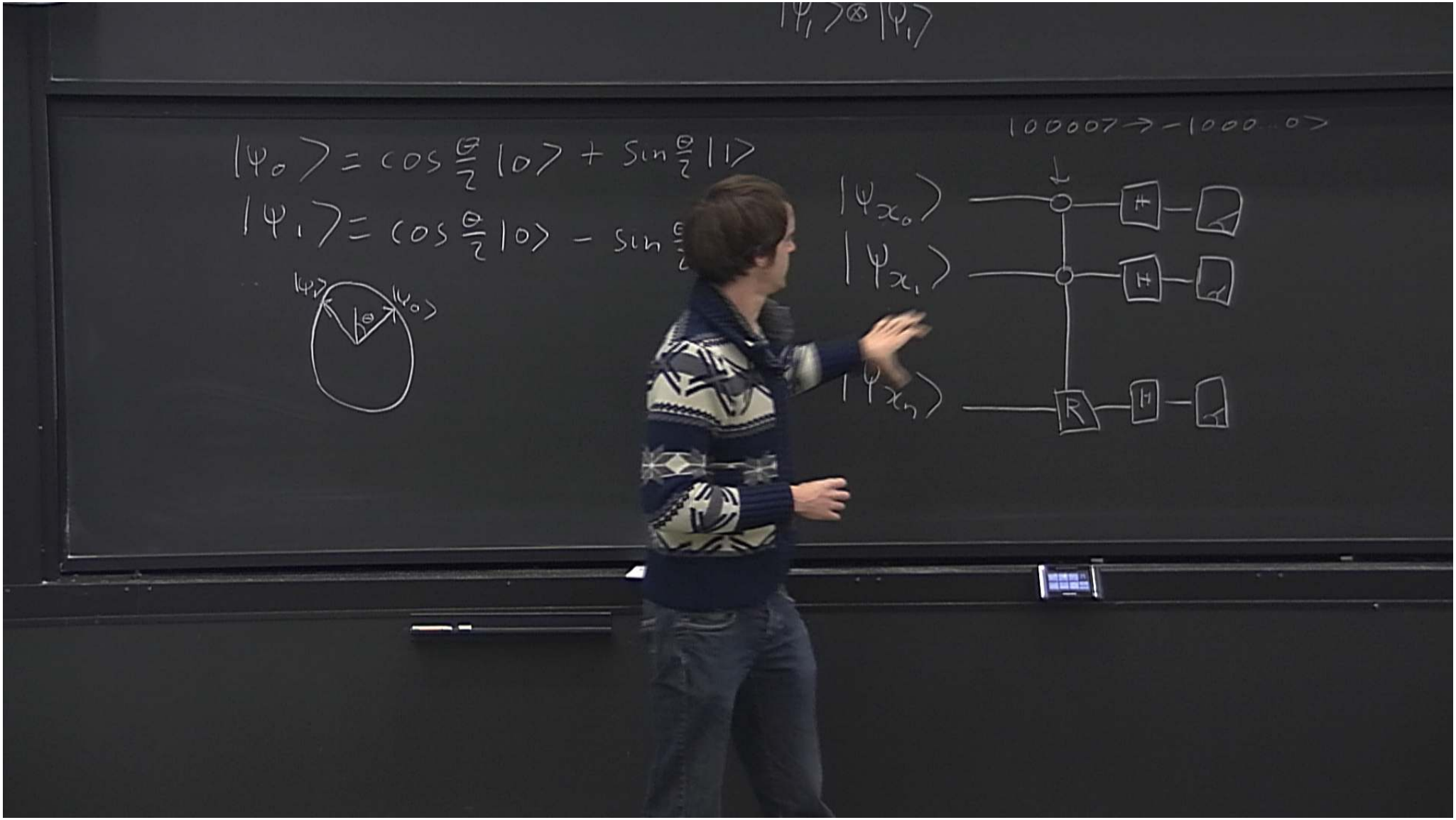
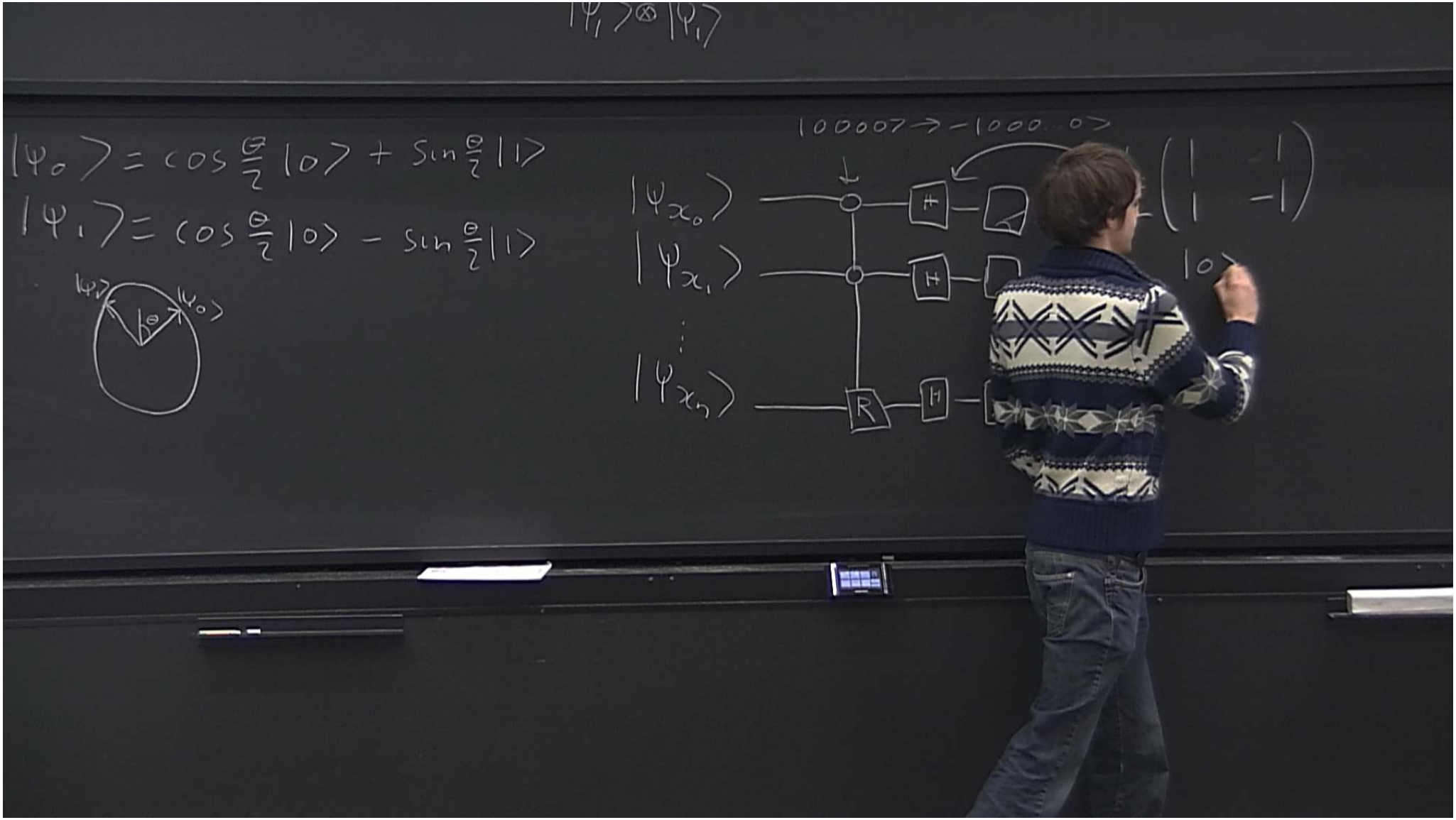
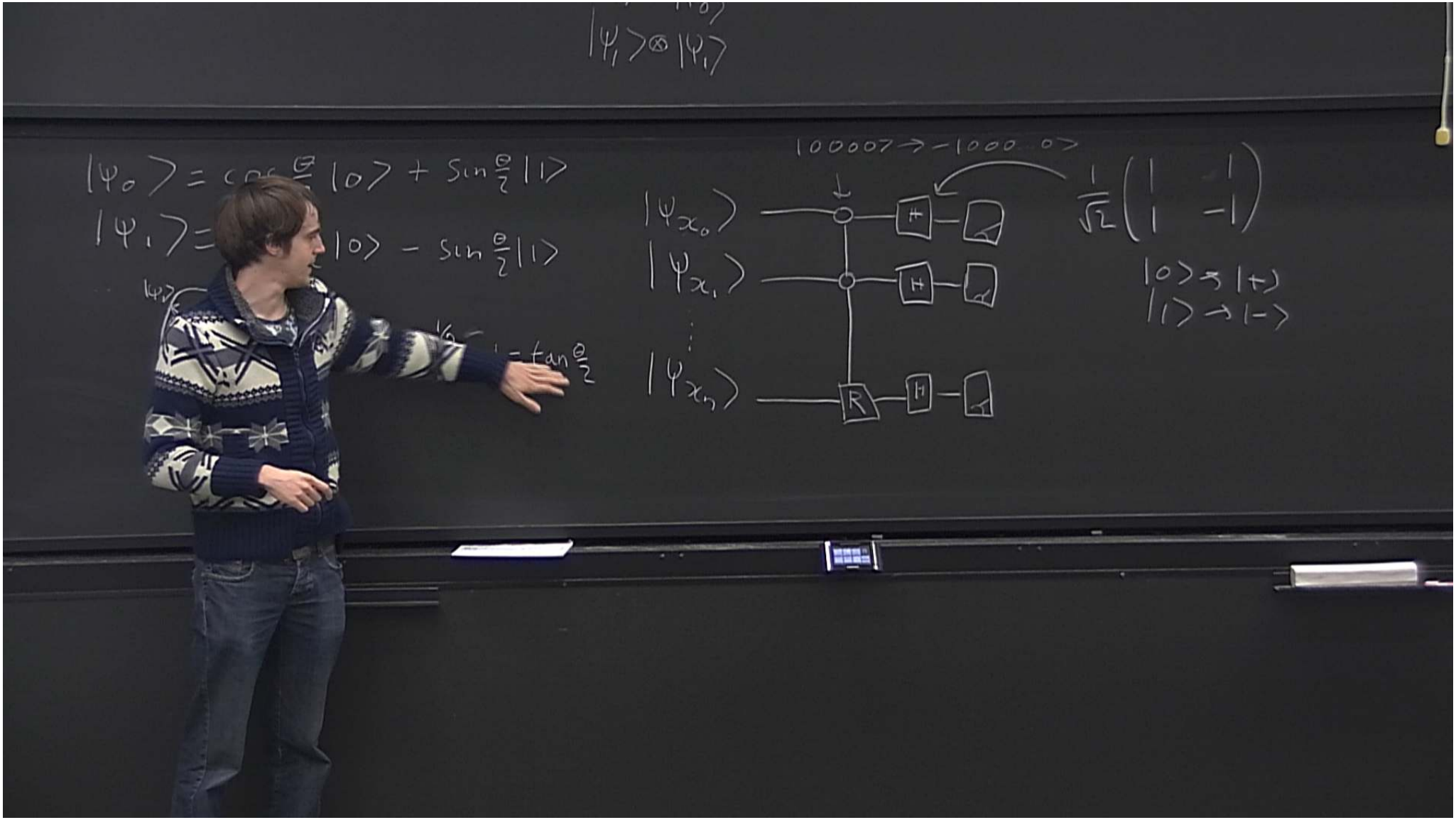
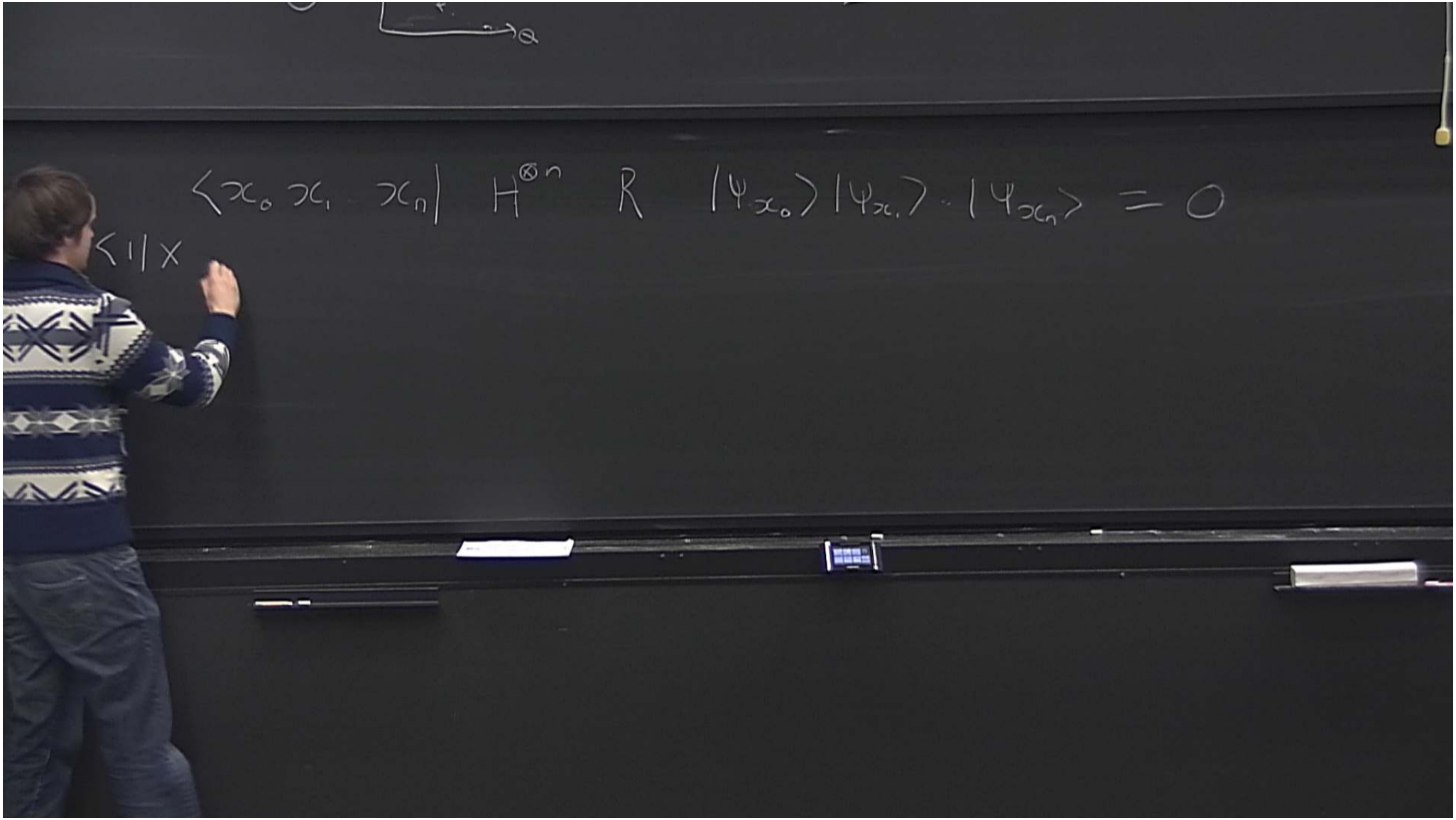
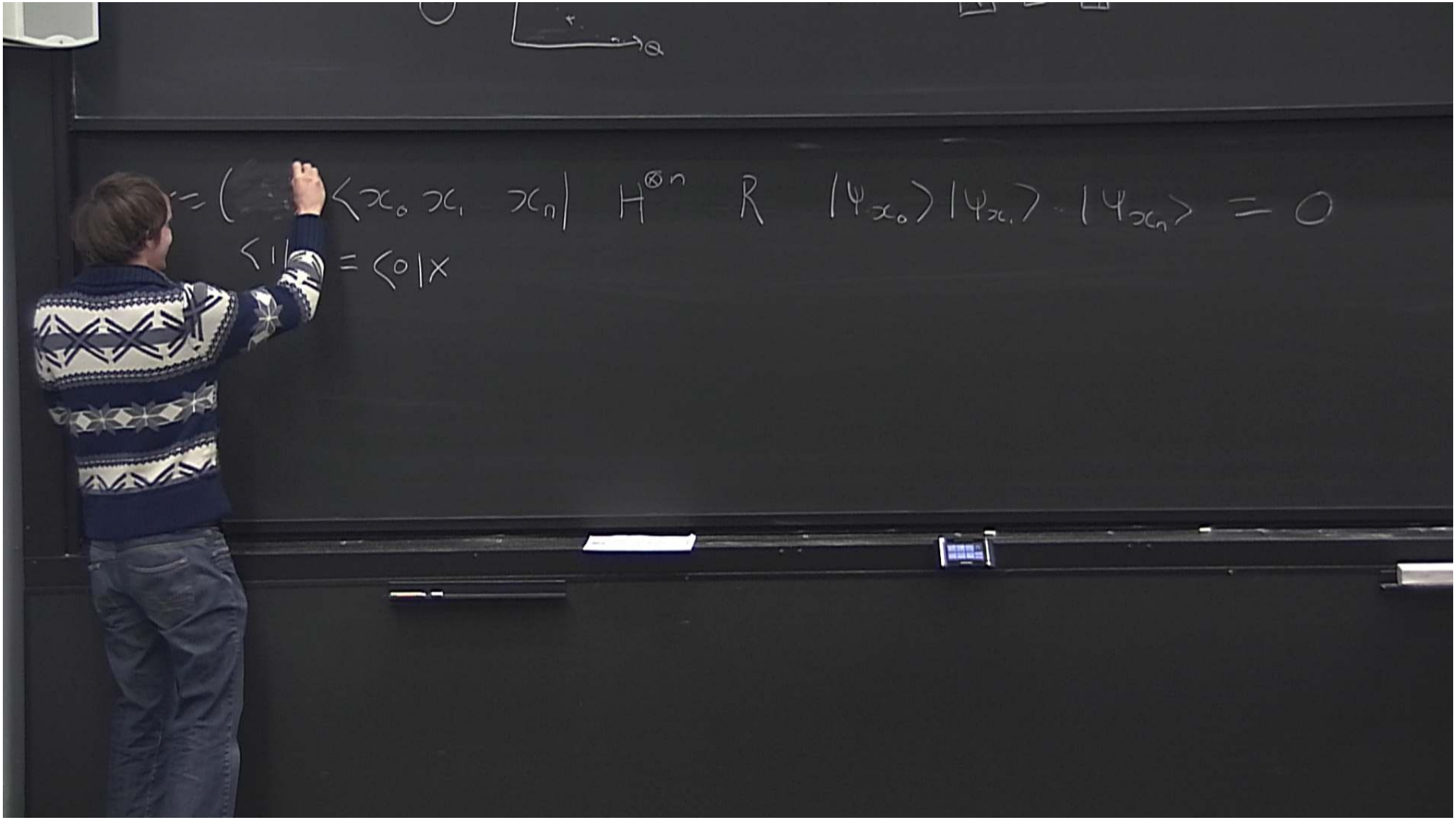
$|\psi_1\rangle = \cos\frac{\theta}{2}|0\rangle - \sin\frac{\theta}{2}|1\rangle$
$|\psi_1\rangle$
$|\psi_0\rangle$
θ
H
H
R
H

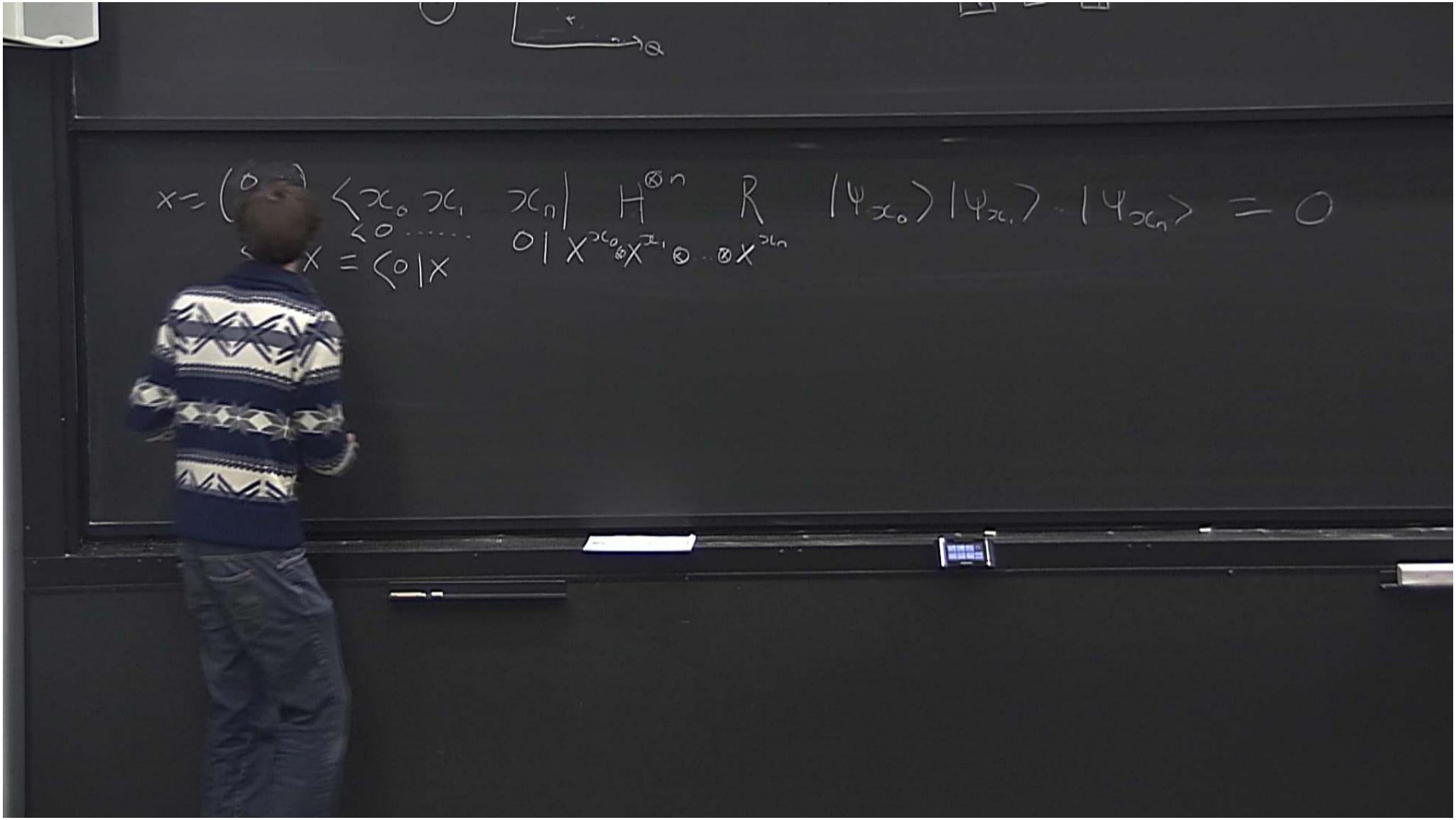

$|\psi_0\rangle = \cos\frac{\theta}{2}|0\rangle + \sin\frac{\theta}{2}|1\rangle$
$|\psi_1\rangle = \cos\frac{\theta}{2}|0\rangle - \sin\frac{\theta}{2}$
$|\psi_1\rangle \otimes |\psi_1\rangle$
$|00007 \rightarrow |1000\ldots0\rangle$
$|\psi_{x_0}\rangle$
$|\psi_{x_1}\rangle$
$|\psi_{x_n}\rangle$
H
R
$|\psi\rangle$
$|\psi_0\rangle$
θ

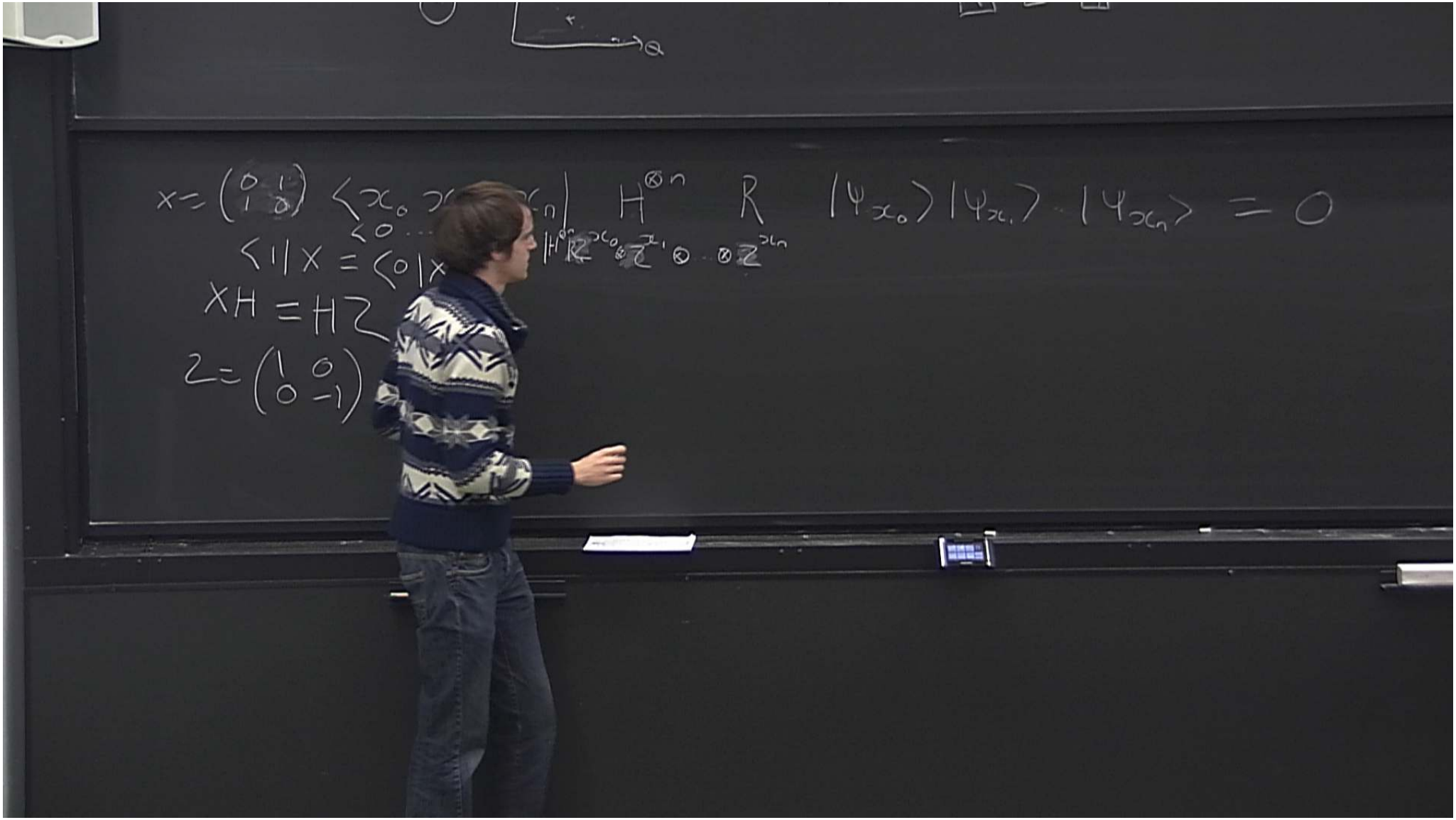

$|\psi_1\rangle \otimes |\psi_1\rangle$
$|\psi_0\rangle = \cos\frac{\theta}{2}|0\rangle + \sin\frac{\theta}{2}|1\rangle$
$|\psi_1\rangle = \cos\frac{\theta}{2}|0\rangle - \sin\frac{\theta}{2}|1\rangle$
$|\psi\rangle$
$|\psi_0\rangle$
θ
$|100007\rangle \rightarrow -|1000\ldots0\rangle$
$|\psi_{x_0}\rangle$
$|\psi_{x_1}\rangle$
$|\psi_{x_n}\rangle$
H
H
R
H
$\begin{pmatrix} 1 & 1 \\ 1 & -1 \end{pmatrix}$
$|0\rangle$

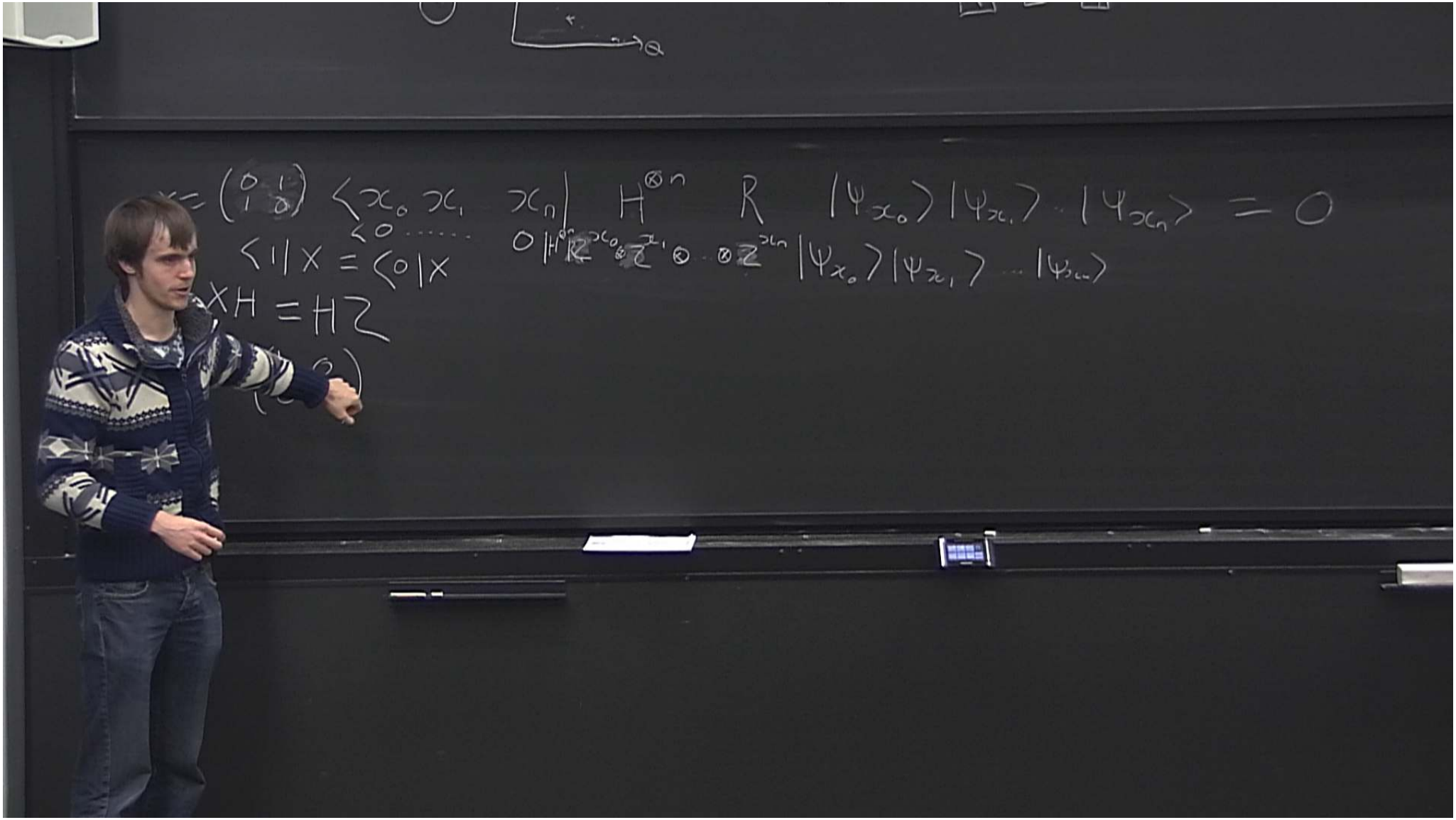

$|\psi_1\rangle \otimes |\psi_1\rangle$
$|\psi_0\rangle = \cos\frac{\theta}{2}|0\rangle + \sin\frac{\theta}{2}|1\rangle$
$|\psi_1\rangle = \cos\frac{\theta}{2}|0\rangle - \sin\frac{\theta}{2}|1\rangle$
$|100007 \rightarrow |1000\ 0\rangle$
$|\psi_{x_0}\rangle$
$|\psi_{x_1}\rangle$
$|\psi_{x_n}\rangle$
H
H
R
H
$\frac{1}{\sqrt{2}}\begin{pmatrix} 1 & 1 \\ 1 & -1 \end{pmatrix}$
$|0\rangle \rightarrow |+\rangle$
$|1\rangle \rightarrow |-\rangle$

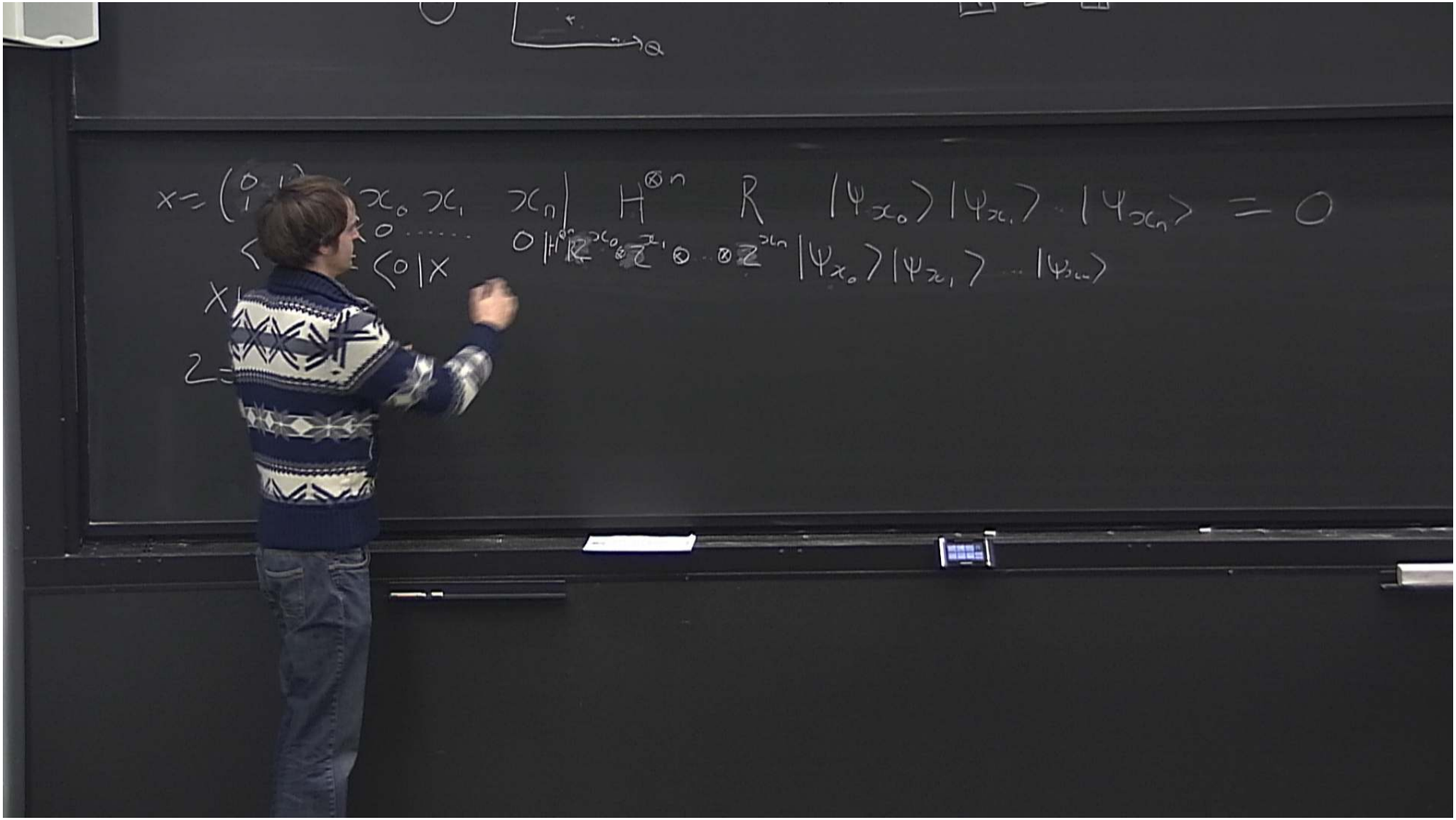

$\langle x_0 x_1 \ldots x_n | \; H^{\otimes n} \; R \; |\psi_{x_0}\rangle |\psi_{x_1}\rangle \cdots |\psi_{x_n}\rangle = 0$
$\langle 1 | X$

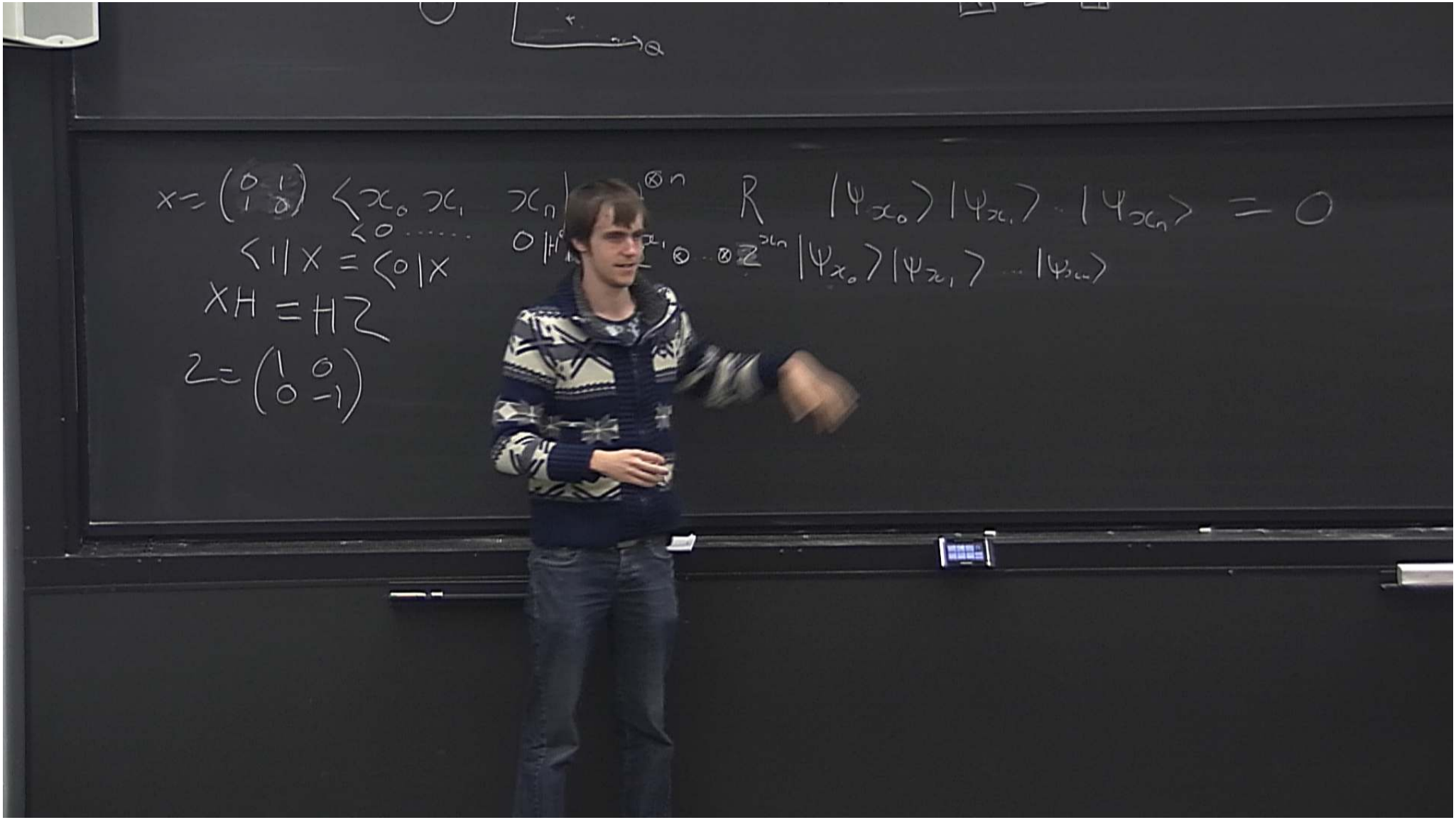

$= (\langle x_0 x_1 \ldots x_n | H^{\otimes n} R |\psi_{x_0}\rangle |\psi_{x_1}\rangle \cdots |\psi_{x_n}\rangle = 0$
$\langle 1| = \langle 0| X$

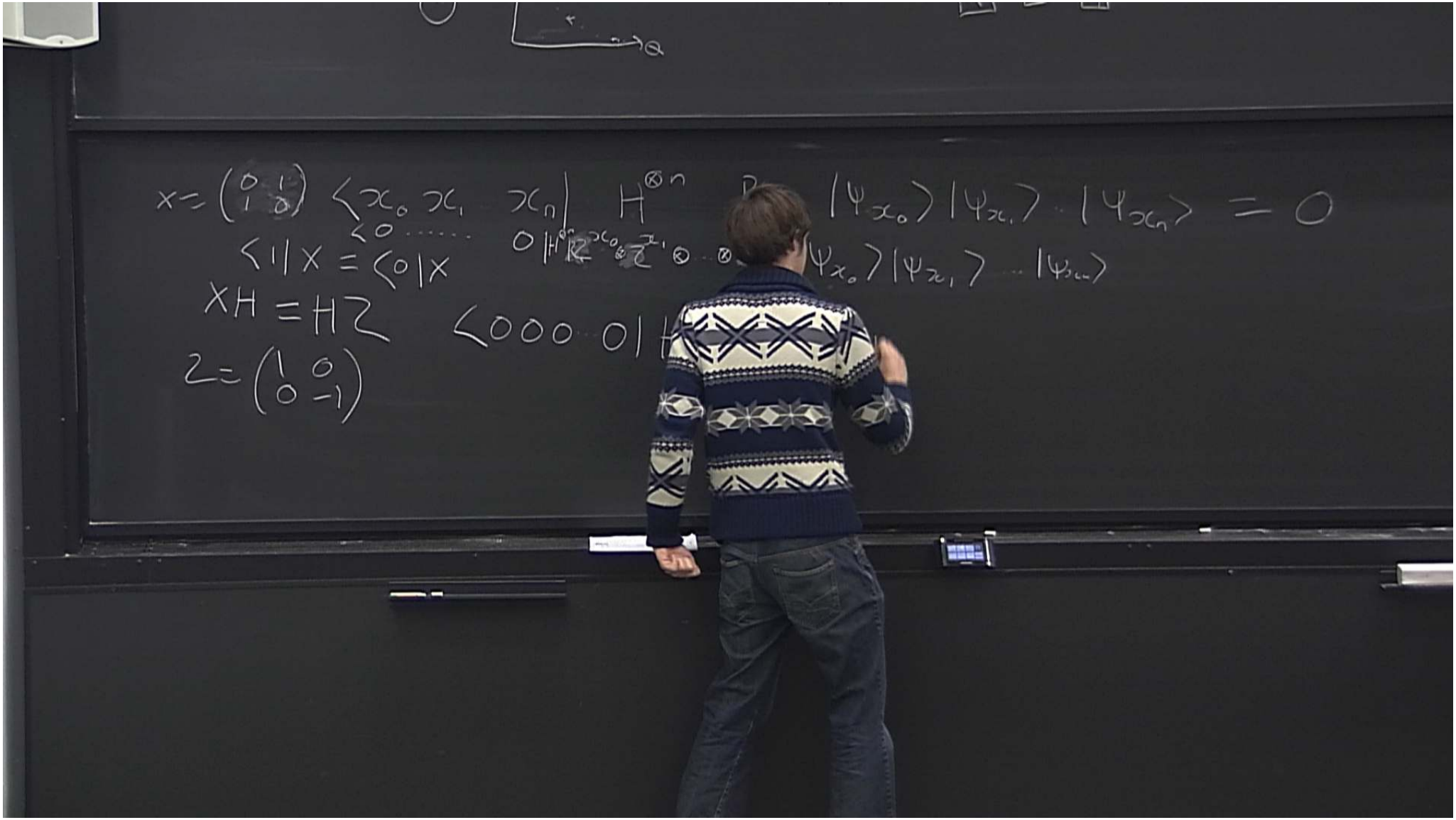

$x = \langle x_0 x_1 \ldots x_n | \; H^{\otimes n} \; R \; |\psi_{x_0}\rangle |\psi_{x_1}\rangle \cdots |\psi_{x_n}\rangle = 0$
$\langle 0 \ldots 0 | X^{x_0} \otimes X^{x_1} \otimes \cdots \otimes X^{x_n}$
$\langle x | = \langle 0 | X$

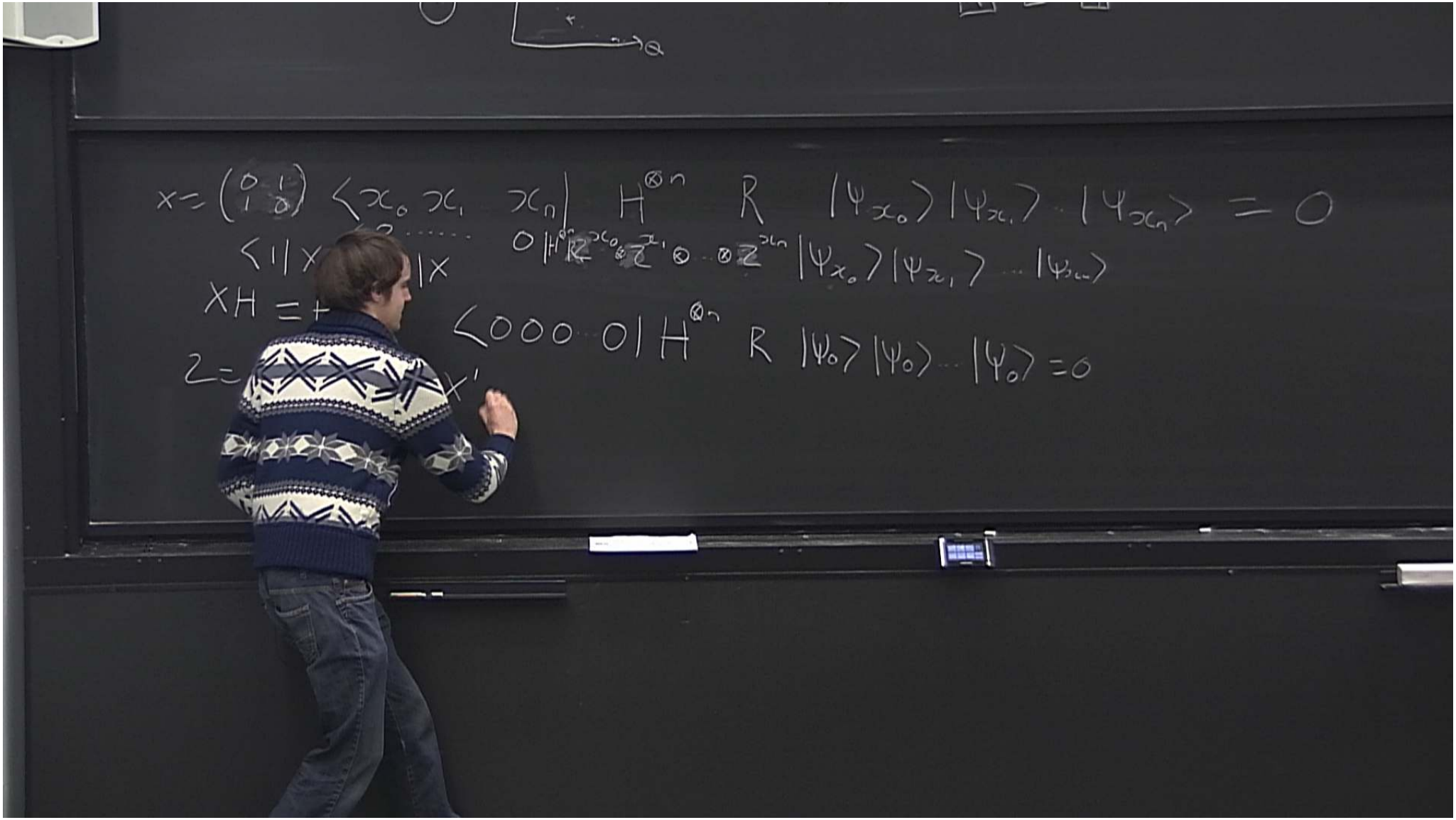

$X = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$
$\langle x_0 x_1 \ldots x_n | \; H^{\otimes n} \; R \; |\psi_{x_0}\rangle |\psi_{x_1}\rangle \cdots |\psi_{x_n}\rangle = 0$
$\langle 1|X = \langle 0|X$
$XH = HZ$
$Z = \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$

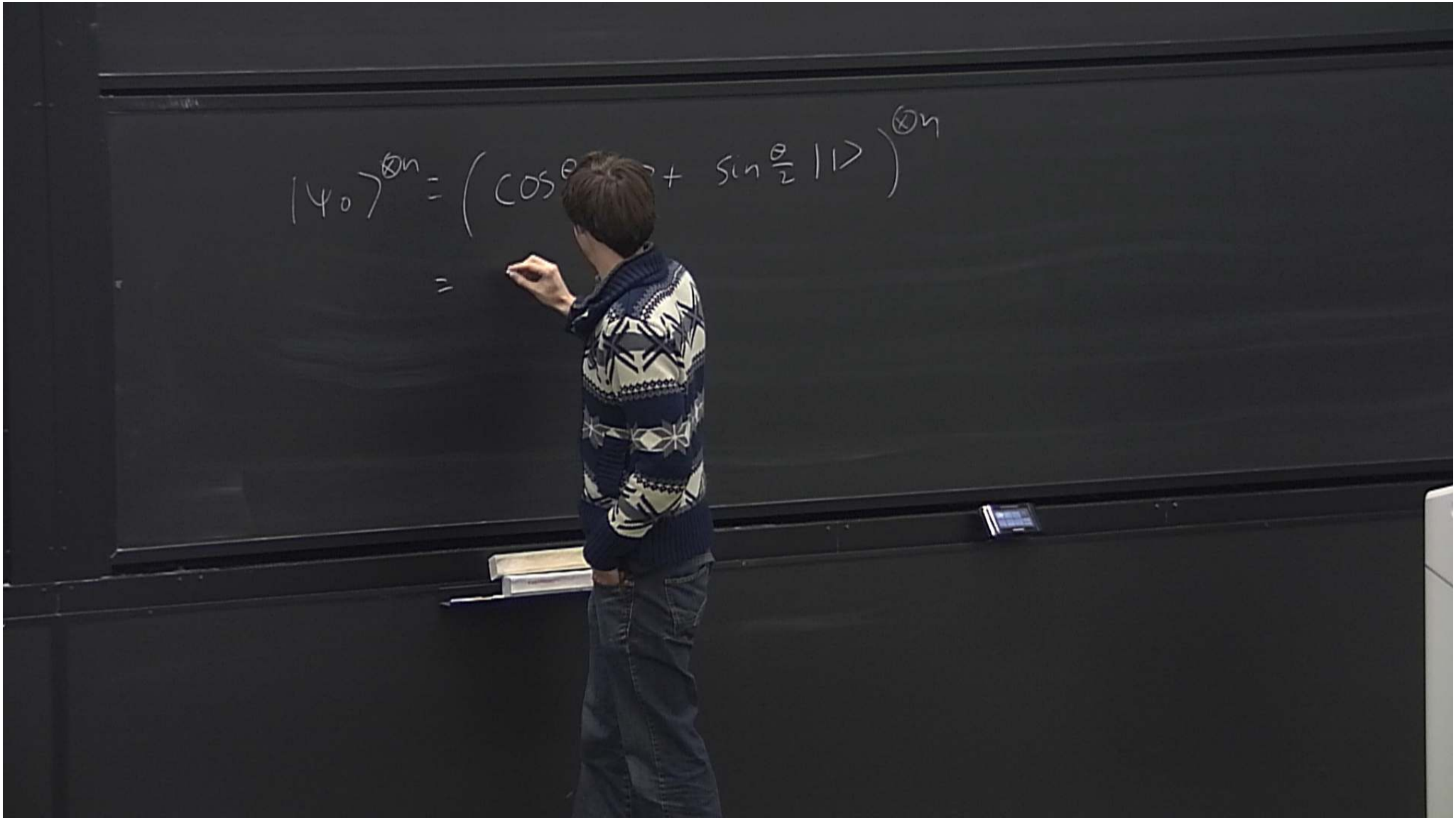

$\langle x_0 x_1 \ldots x_n | H^{\otimes n} R |\psi_{x_0}\rangle|\psi_{x_1}\rangle \ldots |\psi_{x_n}\rangle = 0$
$\langle 1|X = \langle 0|X$
$XH = HZ$

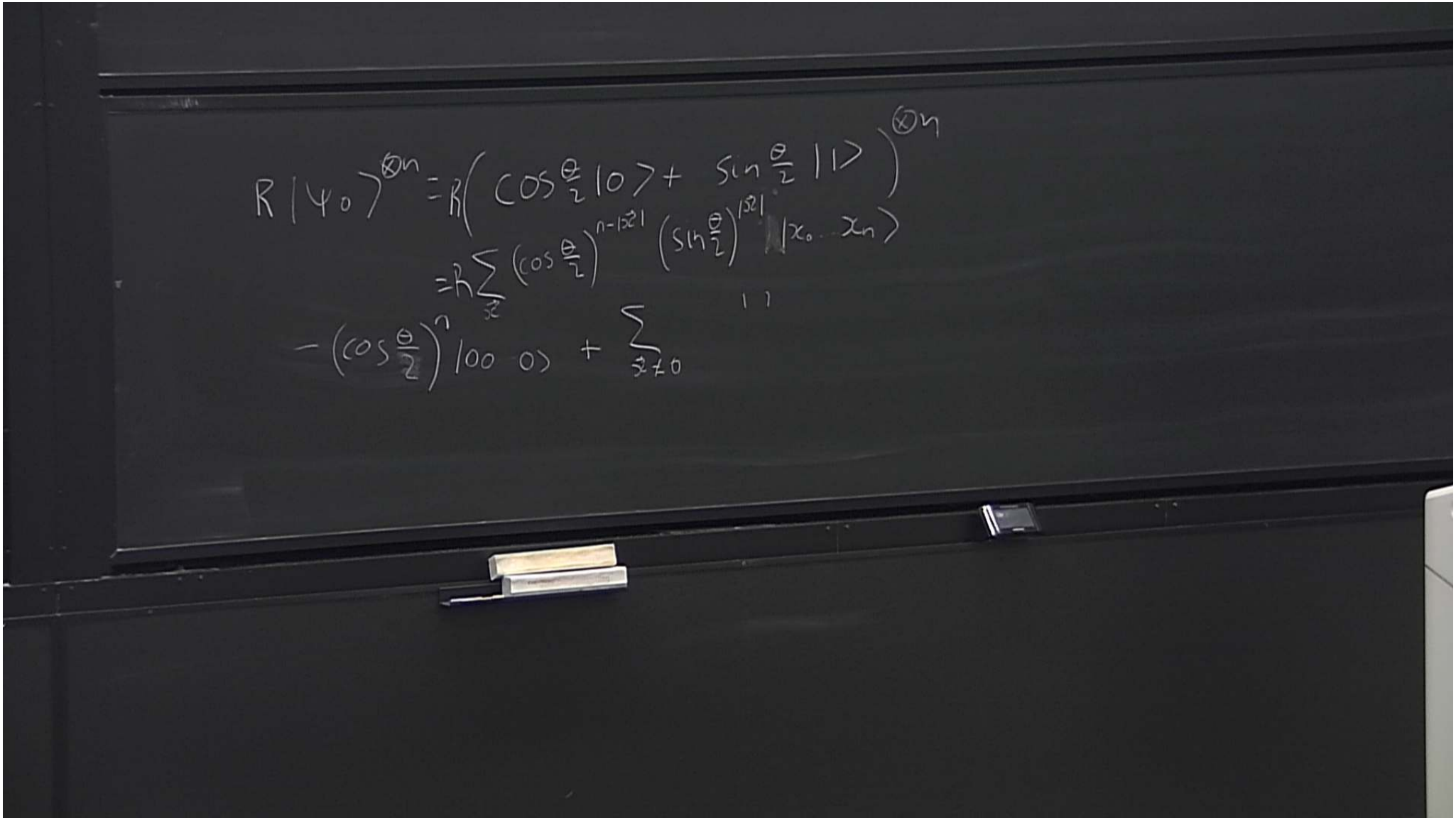

$H^{\otimes n}$ R $|\psi_{x_0}\rangle|\psi_{x_1}\rangle \cdots |\psi_{x_n}\rangle = 0$
$\langle 0|X$

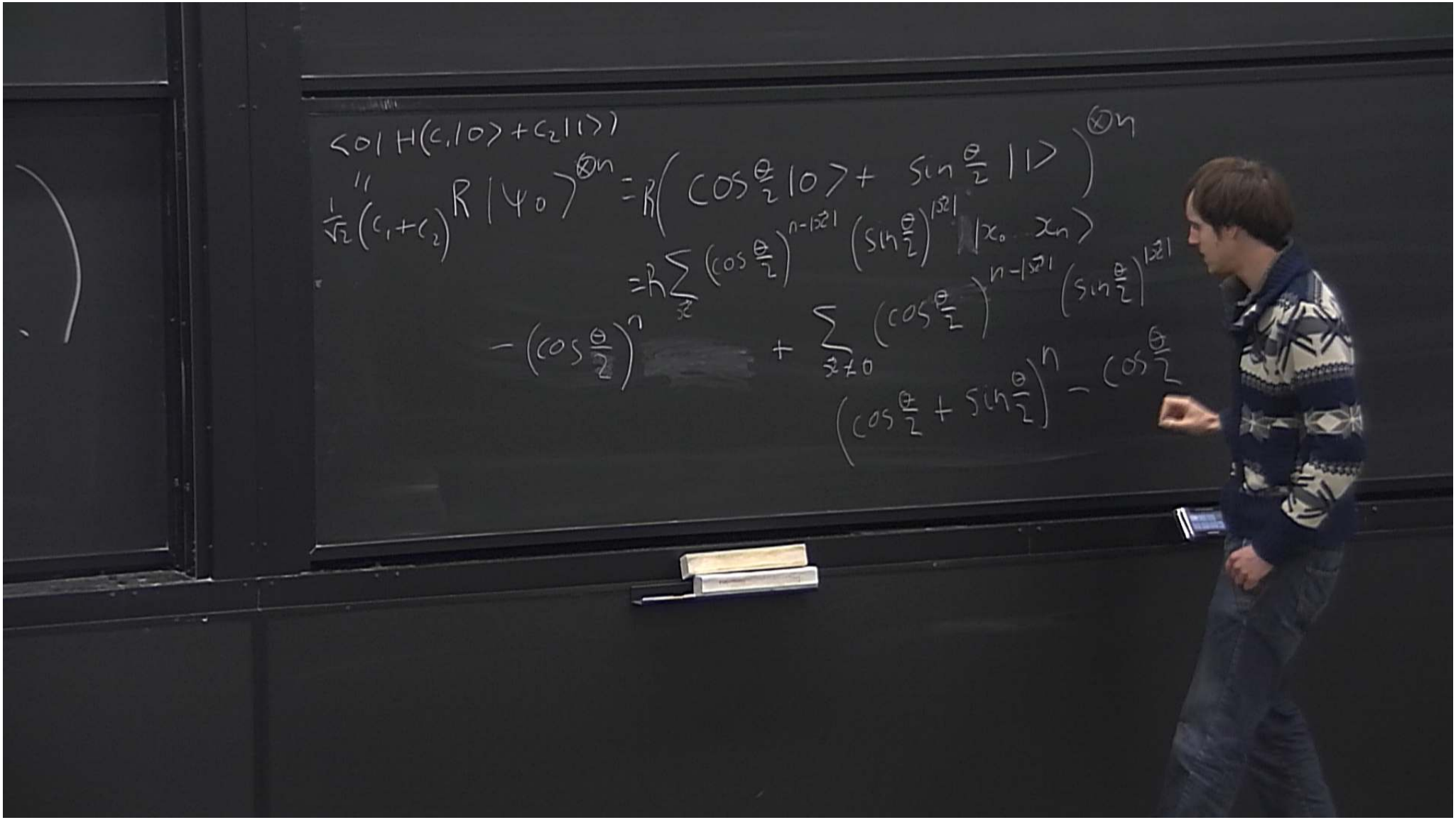

XH = HZ

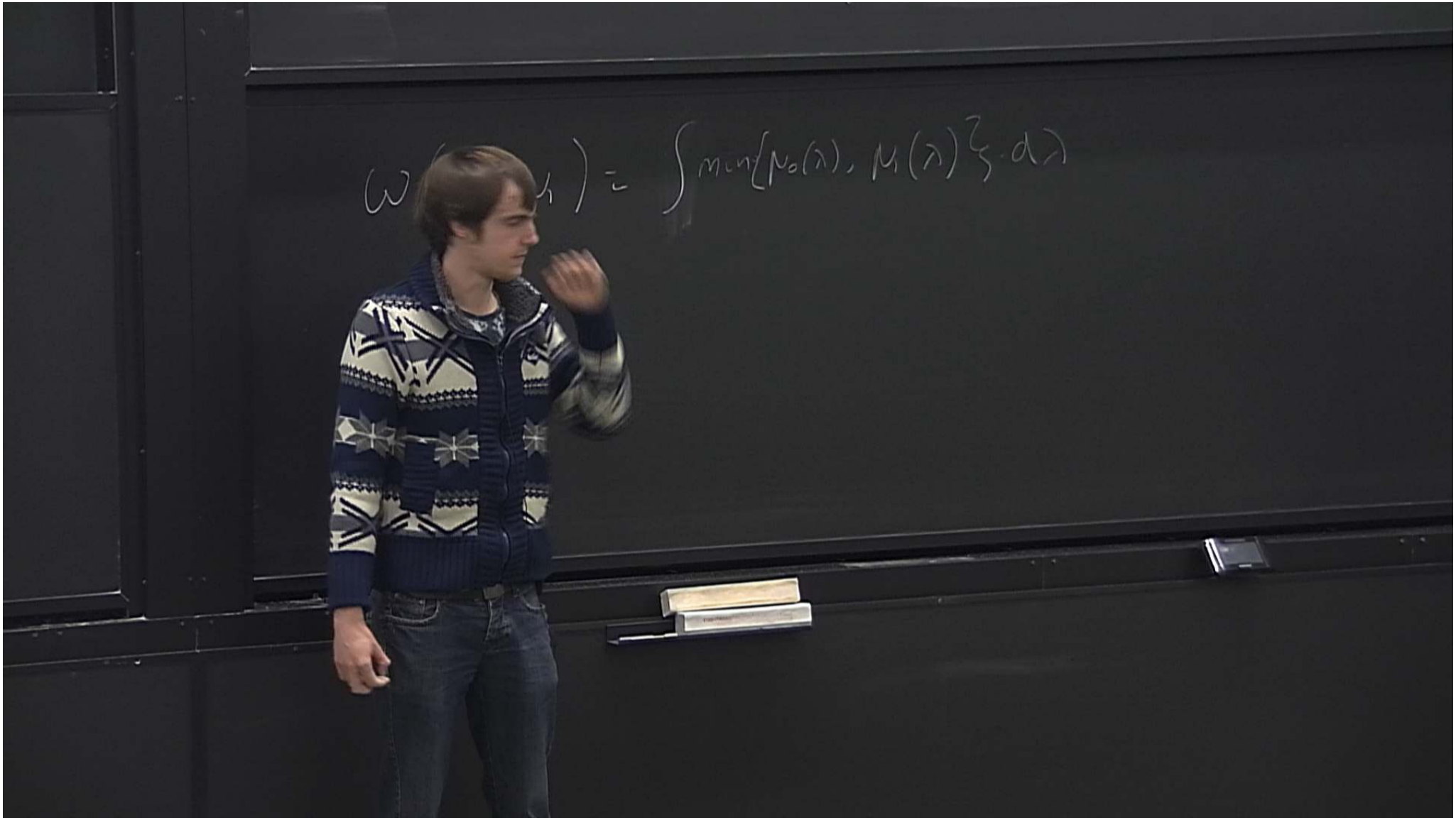

$X = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$
$\langle x_0 x_1 \ldots x_n | H^{\otimes n}$
$|\psi_{x_0}\rangle |\psi_{x_1}\rangle \ldots |\psi_{x_n}\rangle = 0$
$\langle 0 \ldots$
$\langle 1|X = \langle 0|X$
$XH = HZ$
$\langle 000 \ldots 0|H$
$Z = \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$

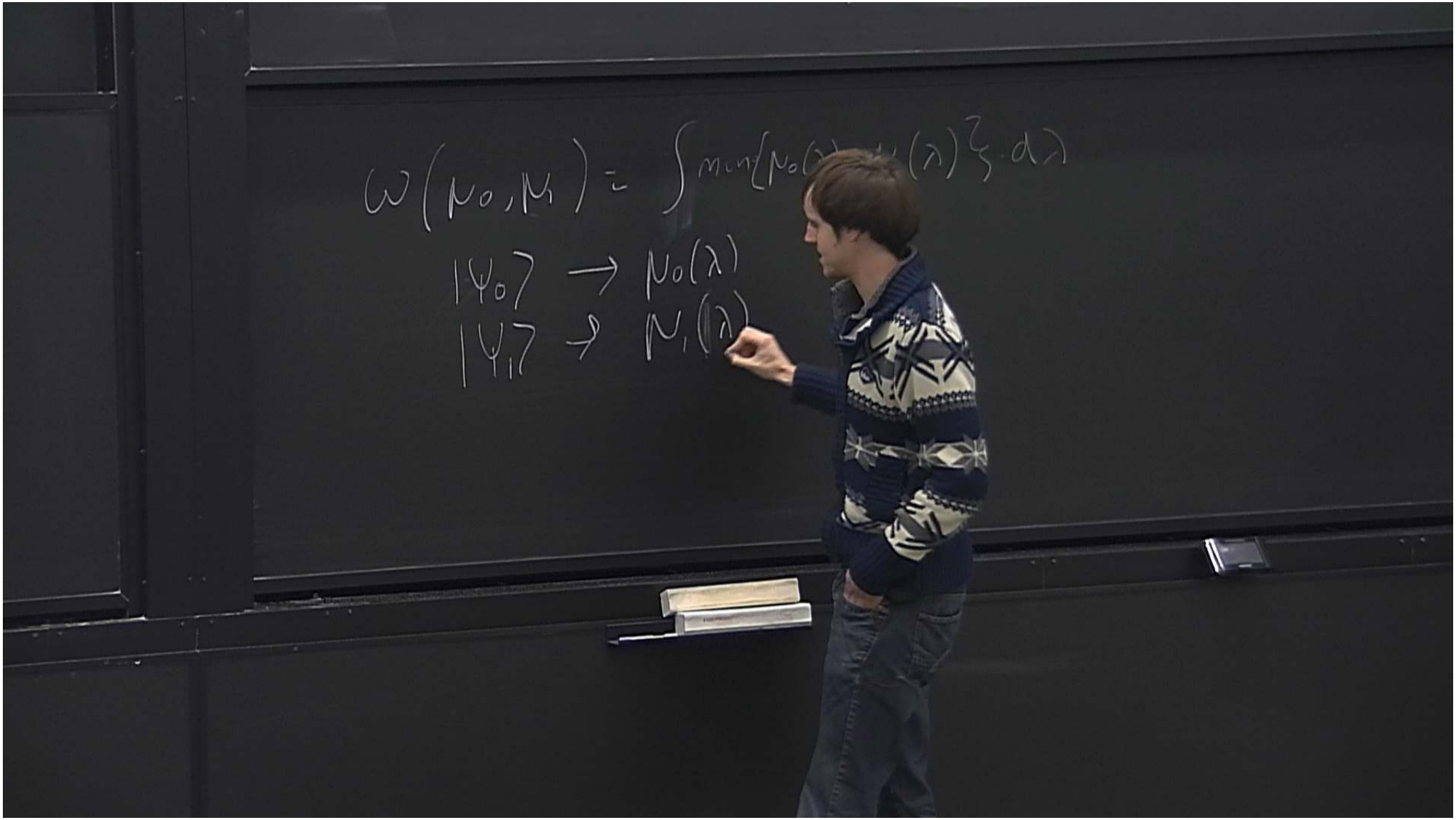

$x = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$ $\langle x_0 x_1 \ldots x_n | H^{\otimes n} R |\psi_{x_0}\rangle |\psi_{x_1}\rangle \ldots |\psi_{x_n}\rangle = 0$
$\langle 1 | X$
$0 | H^{\otimes n} R^{x_0} \otimes Z^{x_1} \otimes \ldots \otimes Z^{x_n} |\psi_{x_0}\rangle |\psi_{x_1}\rangle \ldots |\psi_{x_n}\rangle$
$XH = +$
$\langle 000 \ldots 0 | H^{\otimes n} R |\psi_0\rangle |\psi_0\rangle \ldots |\psi_0\rangle = 0$
$Z =$

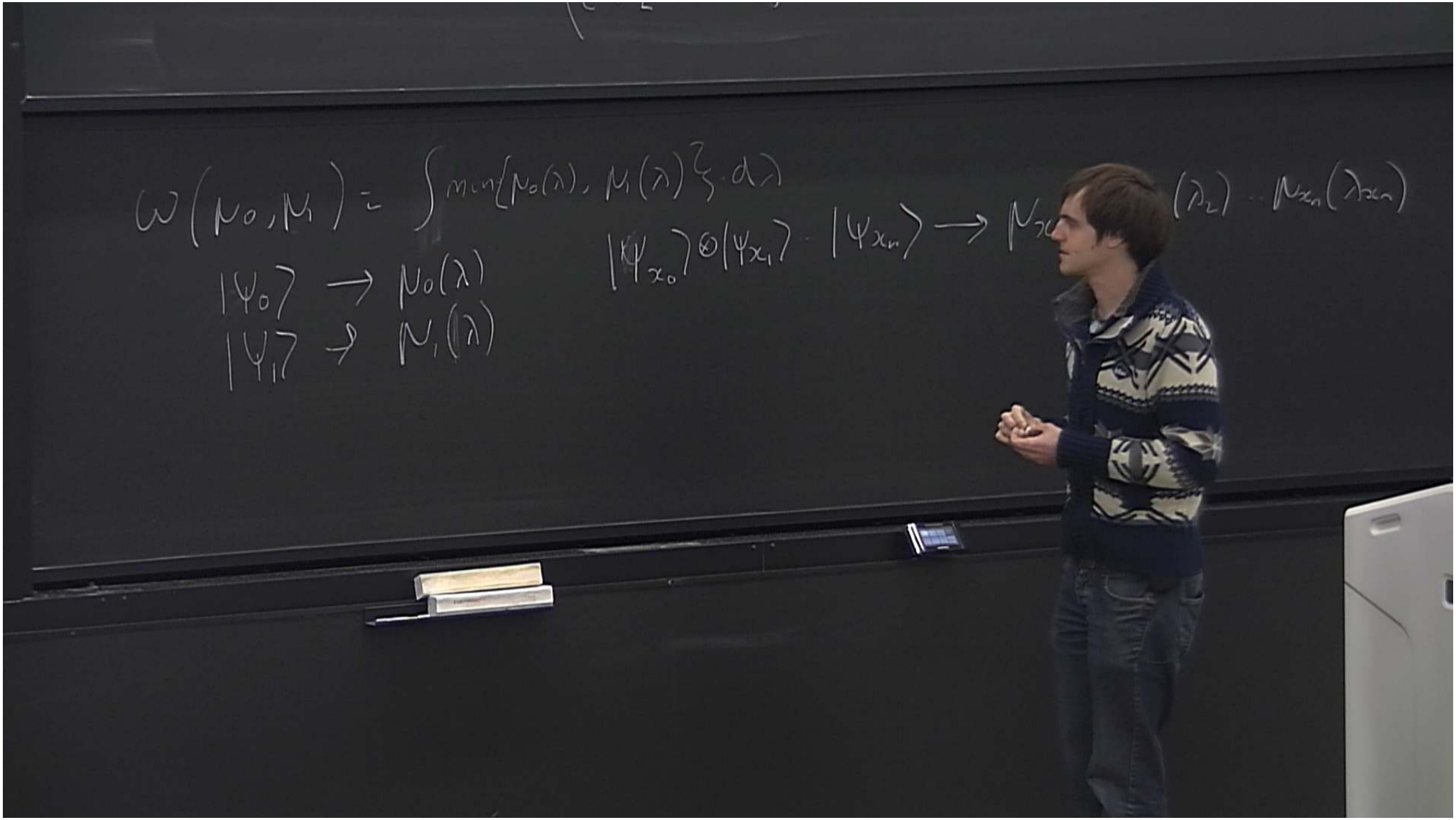

$|\psi_0\rangle^{\otimes n} = \left(\cos\frac{\theta}{2}|0\rangle + \sin\frac{\theta}{2}|1\rangle\right)^{\otimes n}$
=

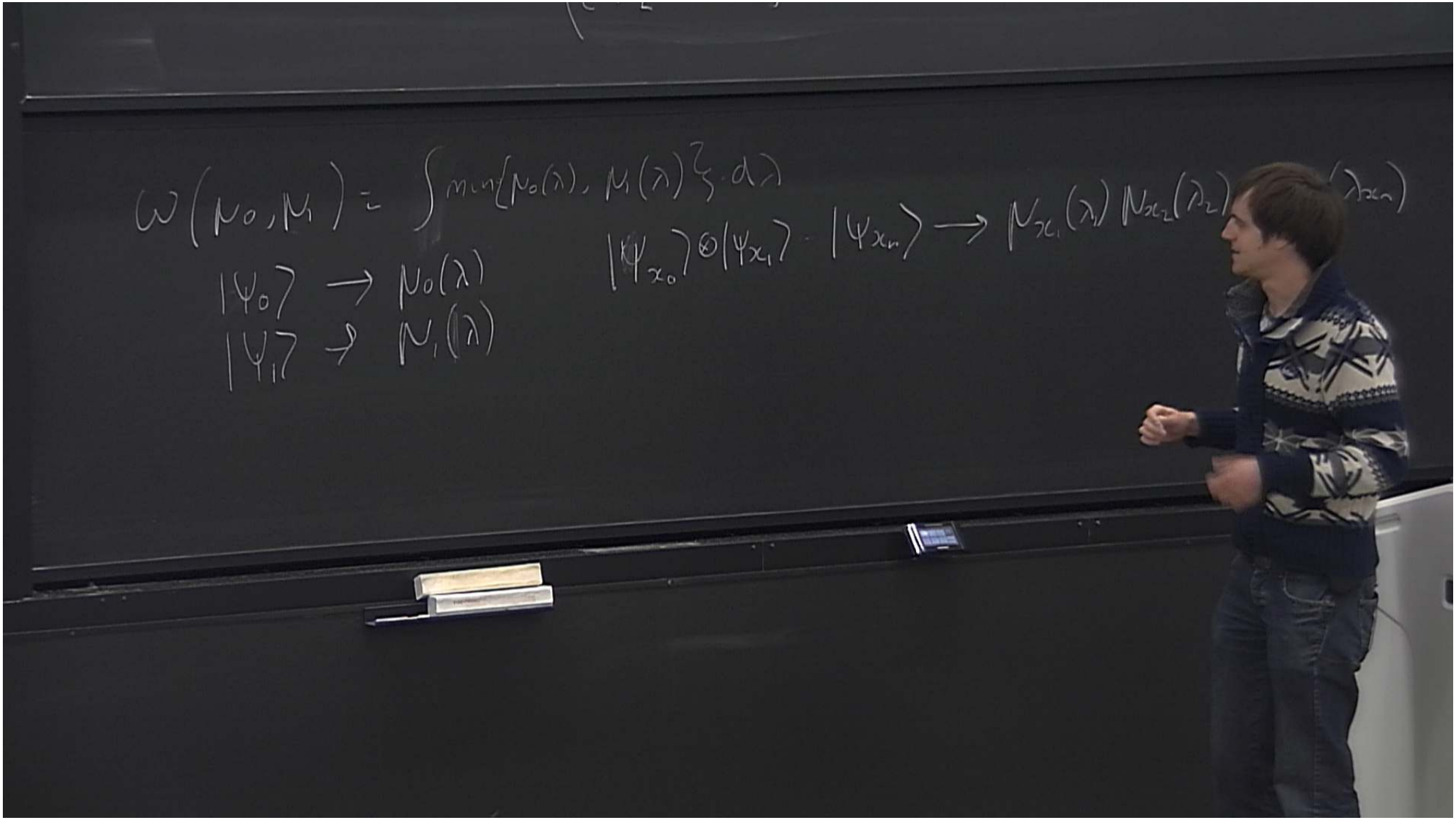

$R|\psi_0\rangle^{\otimes n} = R\left(\cos\frac{\theta}{2}|0\rangle + \sin\frac{\theta}{2}|1\rangle\right)^{\otimes n}$
$= R\sum_{x} \left(\cos\frac{\theta}{2}\right)^{n-|x|} \left(\sin\frac{\theta}{2}\right)^{|x|} |x_0 \ldots x_n\rangle$
$-\left(\cos\frac{\theta}{2}\right)^n |00\ldots0\rangle + \sum_{x\neq 0}$

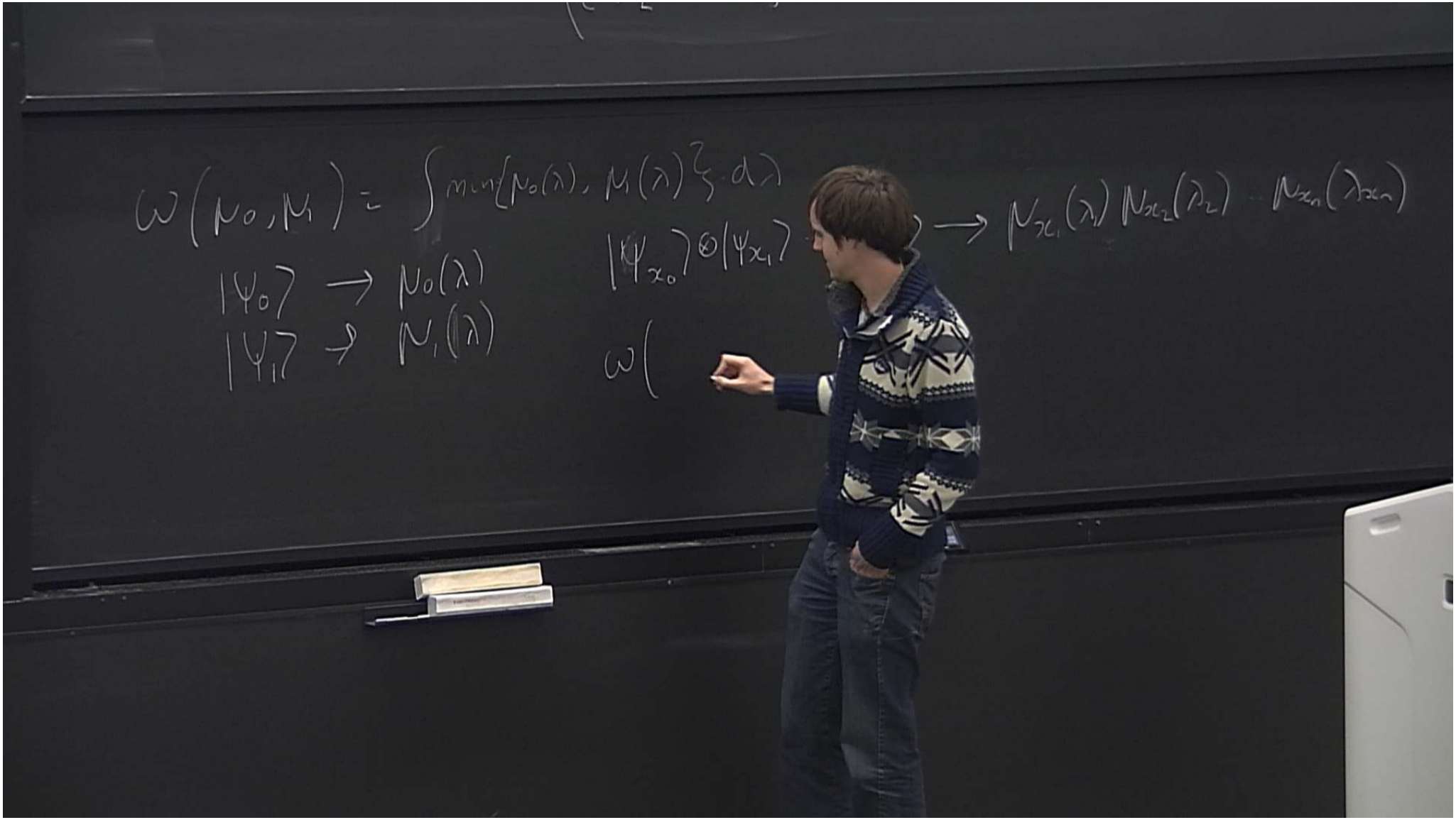

$\langle 0|H(c_1|0\rangle + c_2|1\rangle)$
$\frac{1}{\sqrt{2}}(c_1+c_2)R|\psi_0\rangle^{\otimes n} = R(\cos\frac{\theta}{2}|0\rangle + \sin\frac{\theta}{2}|1\rangle)^{\otimes n}$
$= R\sum_{\vec{x}} (\cos\frac{\theta}{2})^{n-|\vec{x}|} (\sin\frac{\theta}{2})^{|\vec{x}|} |x_0 \ldots x_n\rangle$
$-(\cos\frac{\theta}{2})^n + \sum_{\vec{x}\neq 0} (\cos\frac{\theta}{2})^{n-|\vec{x}|} (\sin\frac{\theta}{2})^{|\vec{x}|}$
$(\cos\frac{\theta}{2} + \sin\frac{\theta}{2})^n - \cos\frac{\theta}{2}$

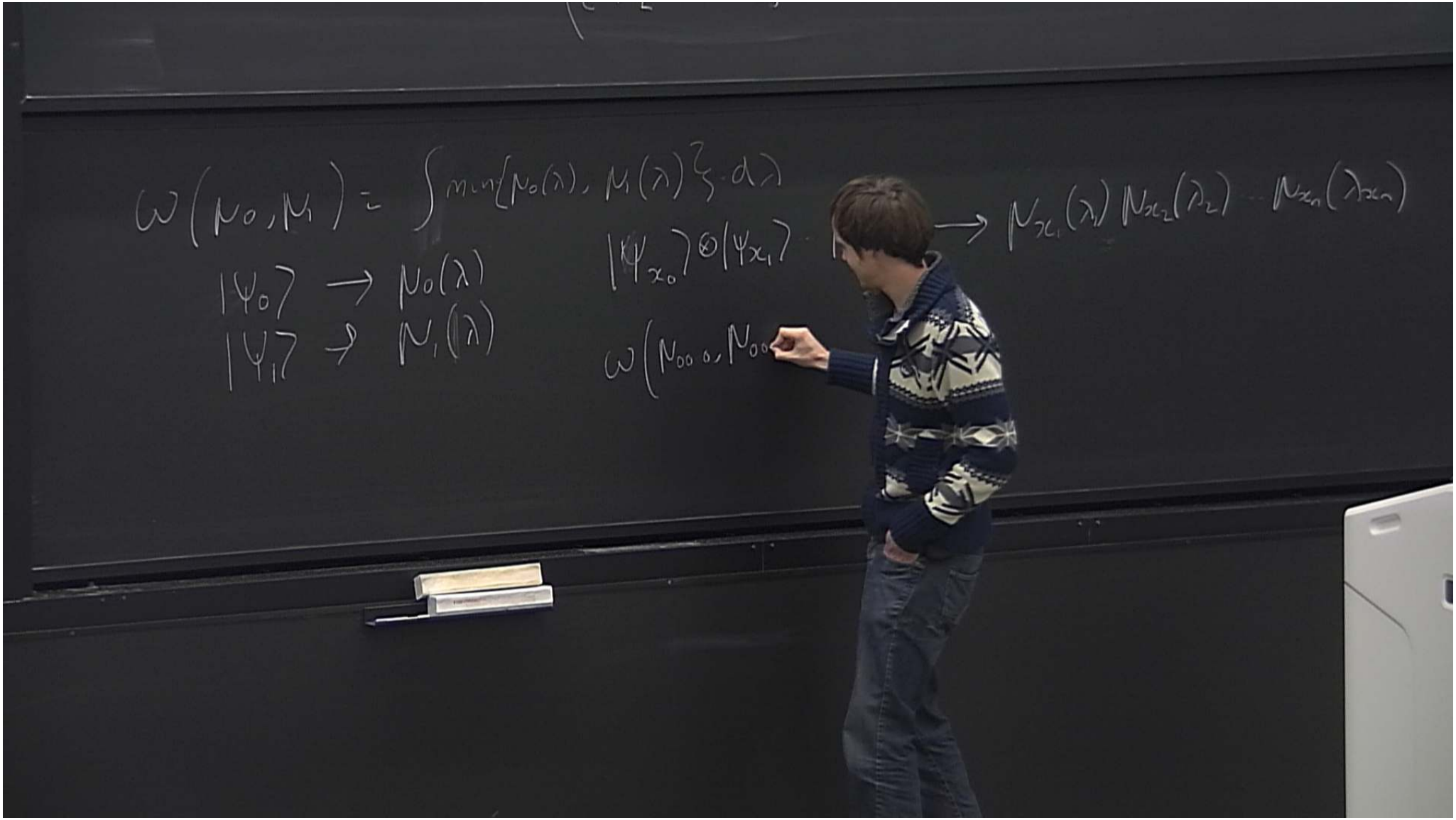

$\int \min[N_0(\lambda), N_1(\lambda)] \xi \cdot d\lambda$

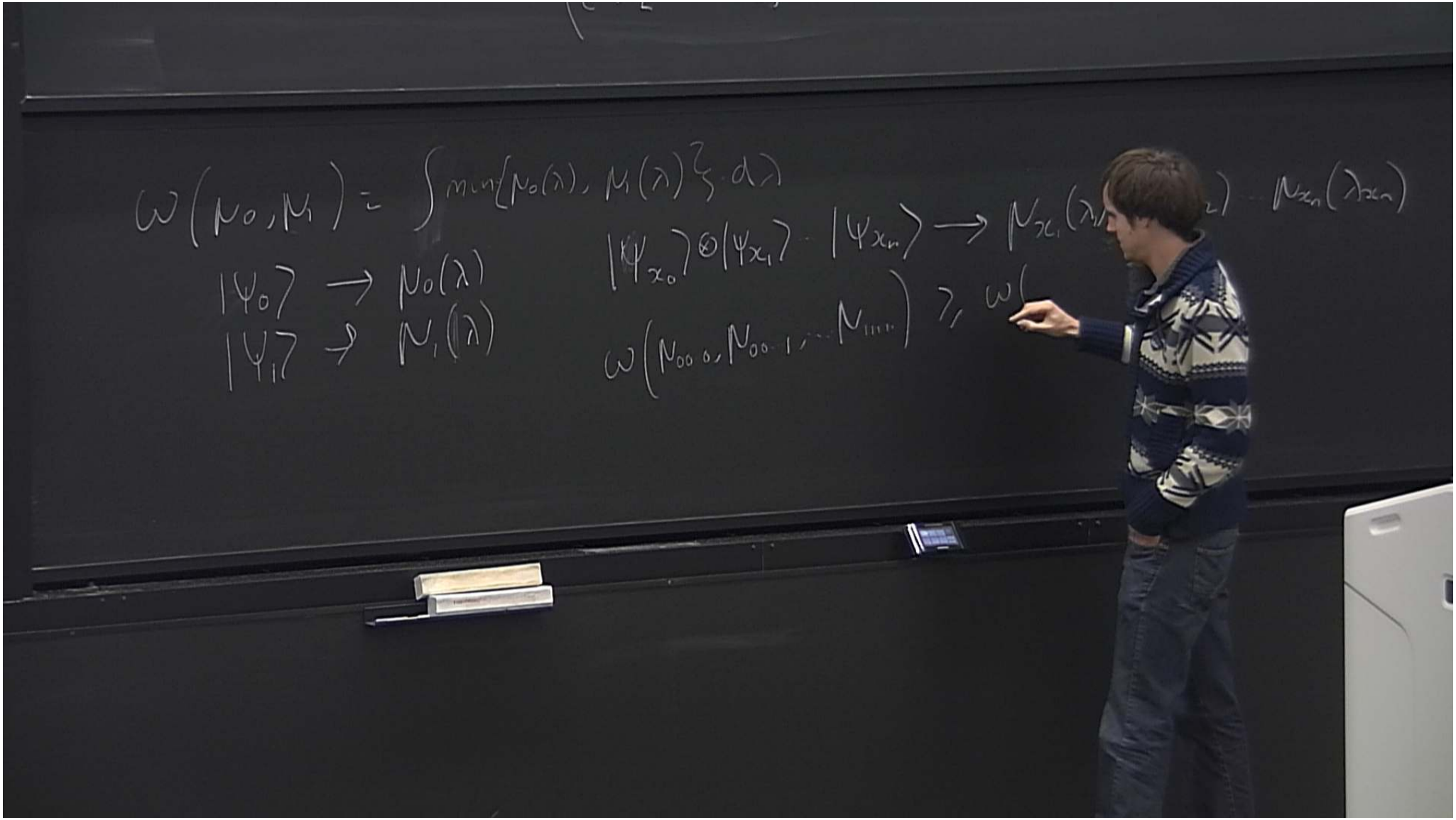

$\omega(N_0, N_1) = \int \min[N_0(\lambda), N_1(\lambda)]\, \xi \cdot d\lambda$
$|\psi_0\rangle \rightarrow N_0(\lambda)$
$|\psi_1\rangle \rightarrow N_1(\lambda)$

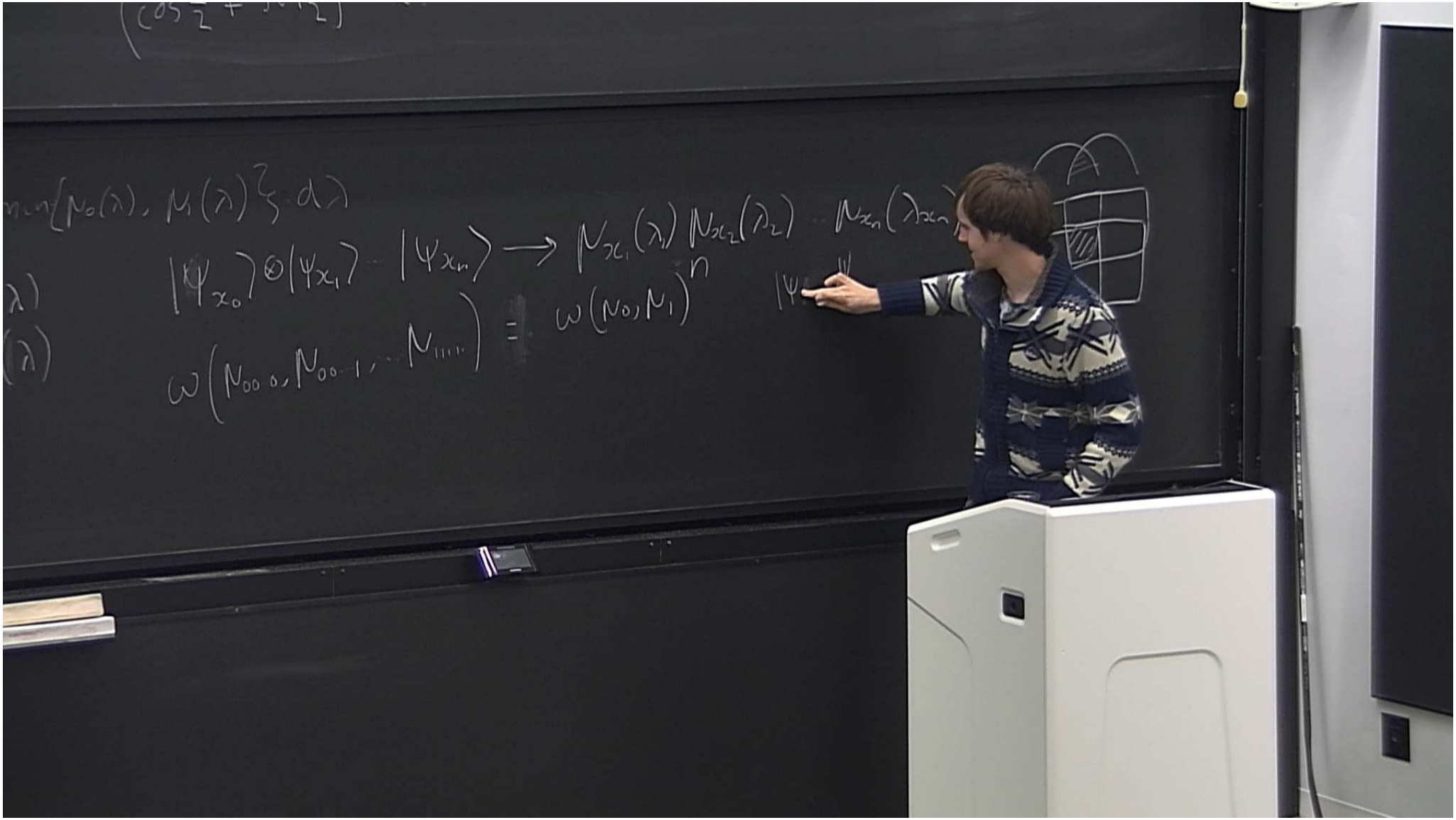

$\omega(\mu_0, \mu_1) = \int \min[\mu_0(\lambda), \mu_1(\lambda)]\, d\lambda$
$|\psi_0\rangle \to \mu_0(\lambda)$
$|\psi_1\rangle \to \mu_1(\lambda)$
$|\psi_{x_0}\rangle \otimes |\psi_{x_1}\rangle \cdots |\psi_{x_n}\rangle \to \mu_{x_0}(\lambda_{x_0})\, \mu_{x_1}(\lambda_{x_1}) \cdots \mu_{x_n}(\lambda_{x_n})$

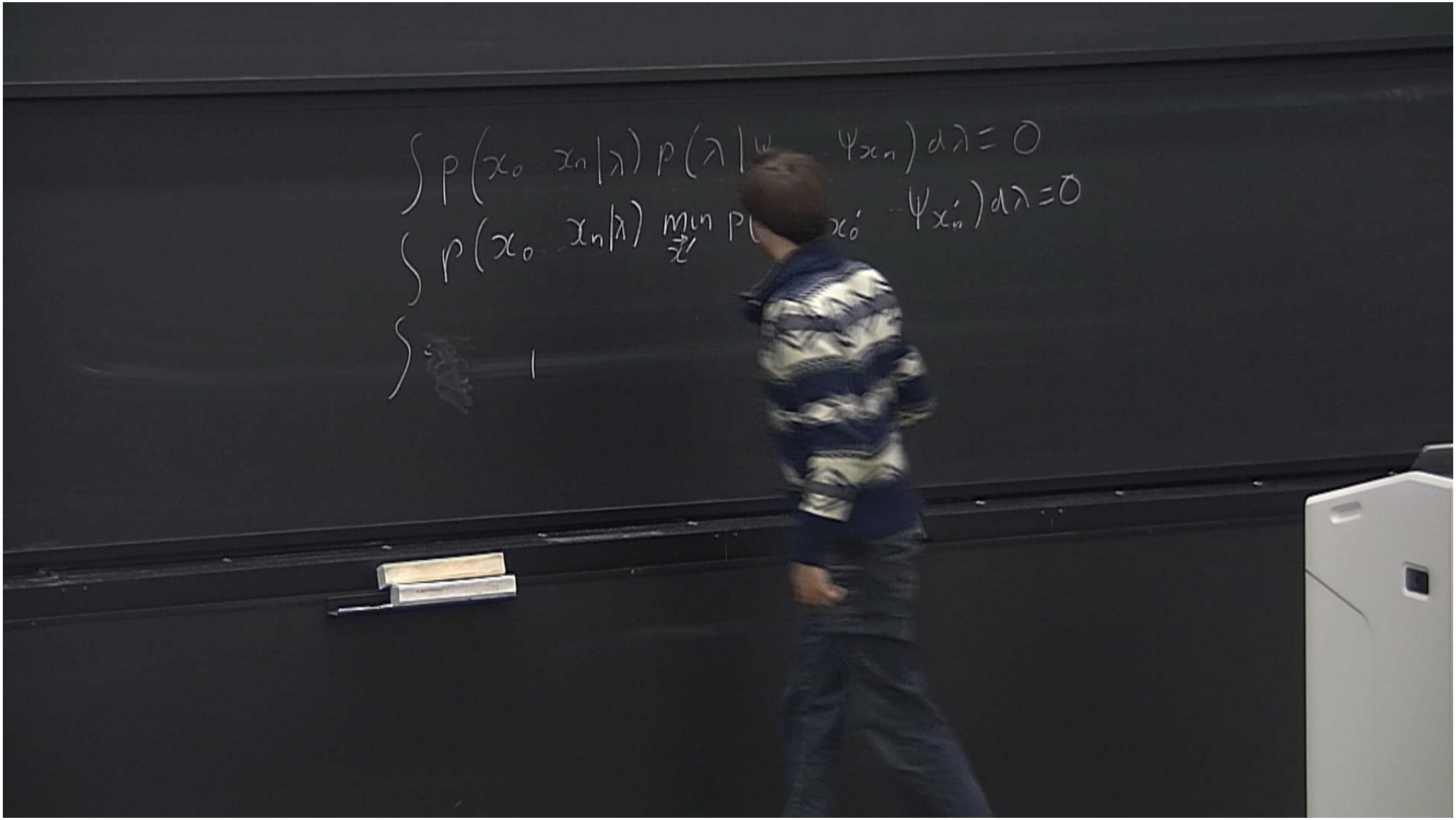

$\omega(N_0, N_1) = \int \min[N_0(\lambda), N_1(\lambda)]\, \xi \cdot d\lambda$
$|\psi_0\rangle \to N_0(\lambda)$
$|\psi_1\rangle \to N_1(\lambda)$
$|\psi_{x_0}\rangle \otimes |\psi_{x_1}\rangle \cdots |\psi_{x_m}\rangle \to N_{x_1}(\lambda_1) N_{x_2}(\lambda_2)$

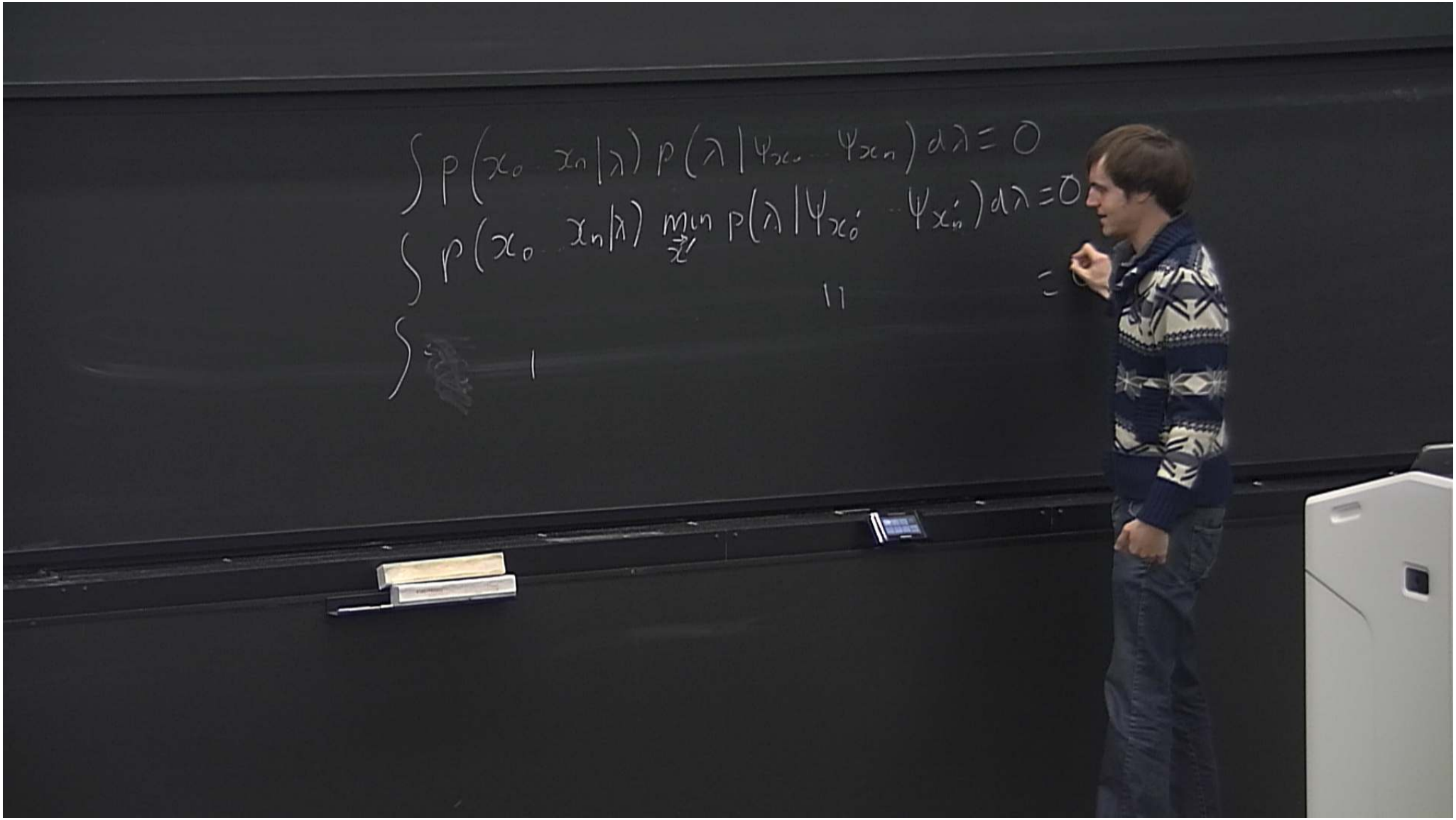

$\omega(\mu_0, \mu_1) = \int \min[\mu_0(\lambda), \mu_1(\lambda)] \xi \, d\lambda$
$|\psi_0\rangle \to \mu_0(\lambda)$
$|\psi_1\rangle \to \mu_1(\lambda)$
$|\psi_{x_0}\rangle \otimes |\psi_{x_1}\rangle$
$\omega($
$\to \mu_{x_1}(\lambda_1)\, \mu_{x_2}(\lambda_2) \cdots \mu_{x_n}(\lambda_{x_n})$

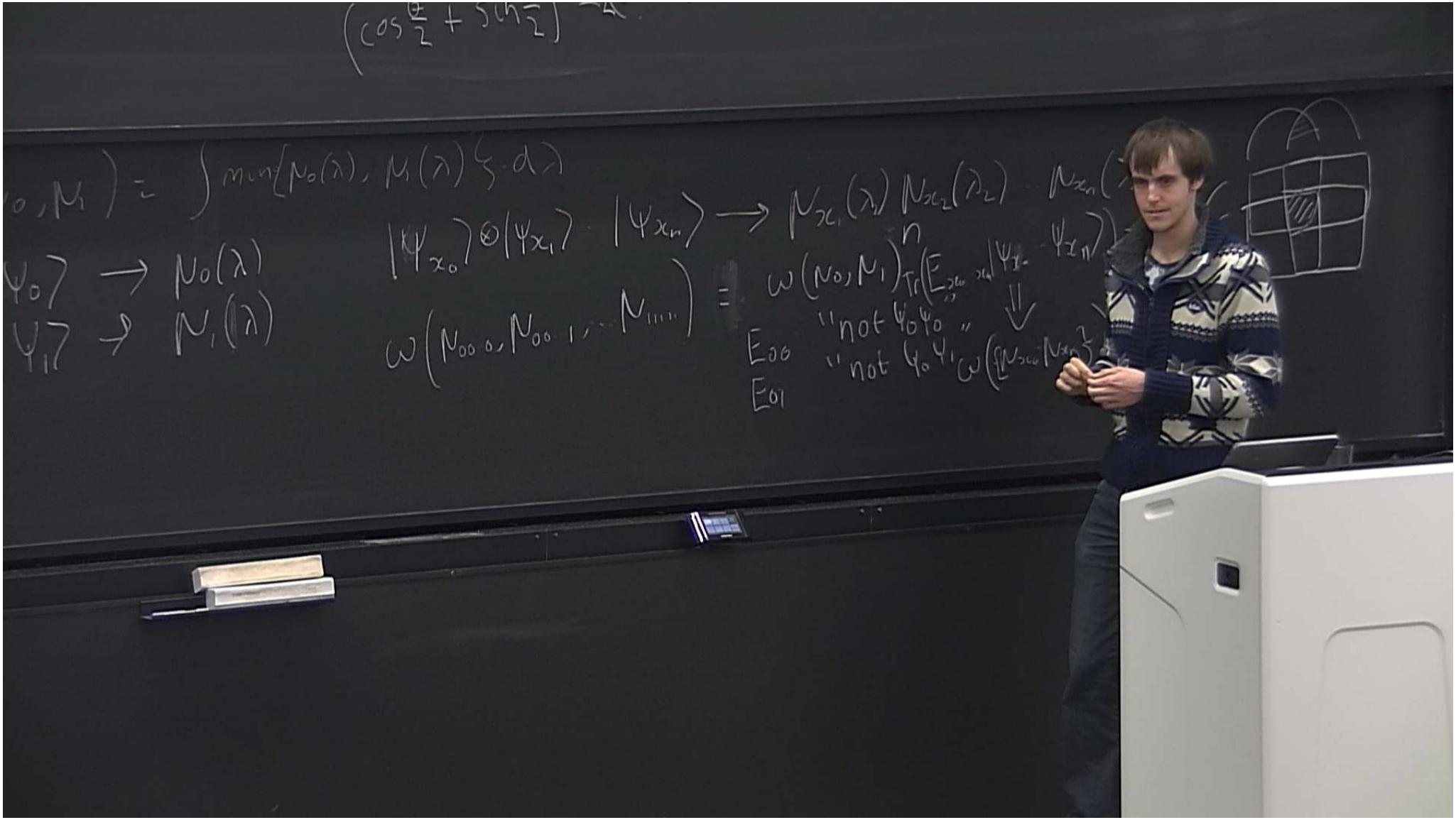

$\omega(\mu_0, \mu_1) = \int \min[\mu_0(\lambda), \mu_1(\lambda)]\, d\lambda$
$|\psi_0\rangle \to \mu_0(\lambda)$
$|\psi_1\rangle \to \mu_1(\lambda)$
$|\psi_{x_0}\rangle \otimes |\psi_{x_1}\rangle$
$\to \mu_{x_1}(\lambda_1)\, \mu_{x_2}(\lambda_2) \cdots \mu_{x_n}(\lambda_{x_n})$
$\omega(\mu_{00\ldots0}, \mu_{00}$


$\omega(N_0, N_1) = \int \min[N_0(\lambda), N_1(\lambda)]\, d\lambda$
$|\psi_0\rangle \to N_0(\lambda)$
$|\psi_1\rangle \to N_1(\lambda)$
$|\psi_{x_0}\rangle \otimes |\psi_{x_1}\rangle \cdots |\psi_{x_n}\rangle \to N_{x_1}(\lambda_1) \cdots N_{x_n}(\lambda_{x_n})$
$\omega(N_{00\ldots0}, N_{00\ldots1}, \ldots N_{11\ldots1}) \geq \omega($


$|\psi_{x_0}\rangle \otimes |\psi_{x_1}\rangle \cdots |\psi_{x_n}\rangle \longrightarrow N_{x_1}(\lambda) N_{x_2}(\lambda_2) \cdots N_{x_n}(\lambda_{x_n})$
$\omega(N_{00\ldots0}, N_{00\ldots1}, \ldots N_{11\ldots1}) = \omega(N_0, N_1)^n$


$\int p(x_0 \ldots x_n|\lambda)\, p(\lambda|\psi_{x_0} \ldots \psi_{x_n})\, d\lambda = 0$
$\int p(x_0 \ldots x_n|\lambda) \min_{x'} p(\lambda|\psi_{x_0} \ldots \psi_{x_n})\, d\lambda = 0$
$\int \ldots = 1$


$\int p(x_0 \ldots x_n|\lambda)\, p(\lambda|\psi_{x_0} \ldots \psi_{x_n})\, d\lambda = 0$
$\int p(x_0 \ldots x_n|\lambda) \min_{\vec{x}'} p(\lambda|\psi_{x_0'} \ldots \psi_{x_n'})\, d\lambda = 0$
$\int$


$\omega(N_0, N_1) = \int \min[N_0(\lambda), N_1(\lambda)]\, d\lambda$
$|\psi_0\rangle \to N_0(\lambda)$
$|\psi_1\rangle \to N_1(\lambda)$
$|\psi_{x_0}\rangle \otimes |\psi_{x_1}\rangle \cdots |\psi_{x_m}\rangle \to N_{x_1}(\lambda_1) N_{x_2}(\lambda_2) \cdots$
$\omega(N_{00\ldots0}, N_{00\ldots1}, \ldots N_{11\ldots1}) =$
$\omega(N_0, N_1)^n$
E_{00} "not $\psi_0\psi_0$"
E_{01} "not $\psi_0\psi_1$"