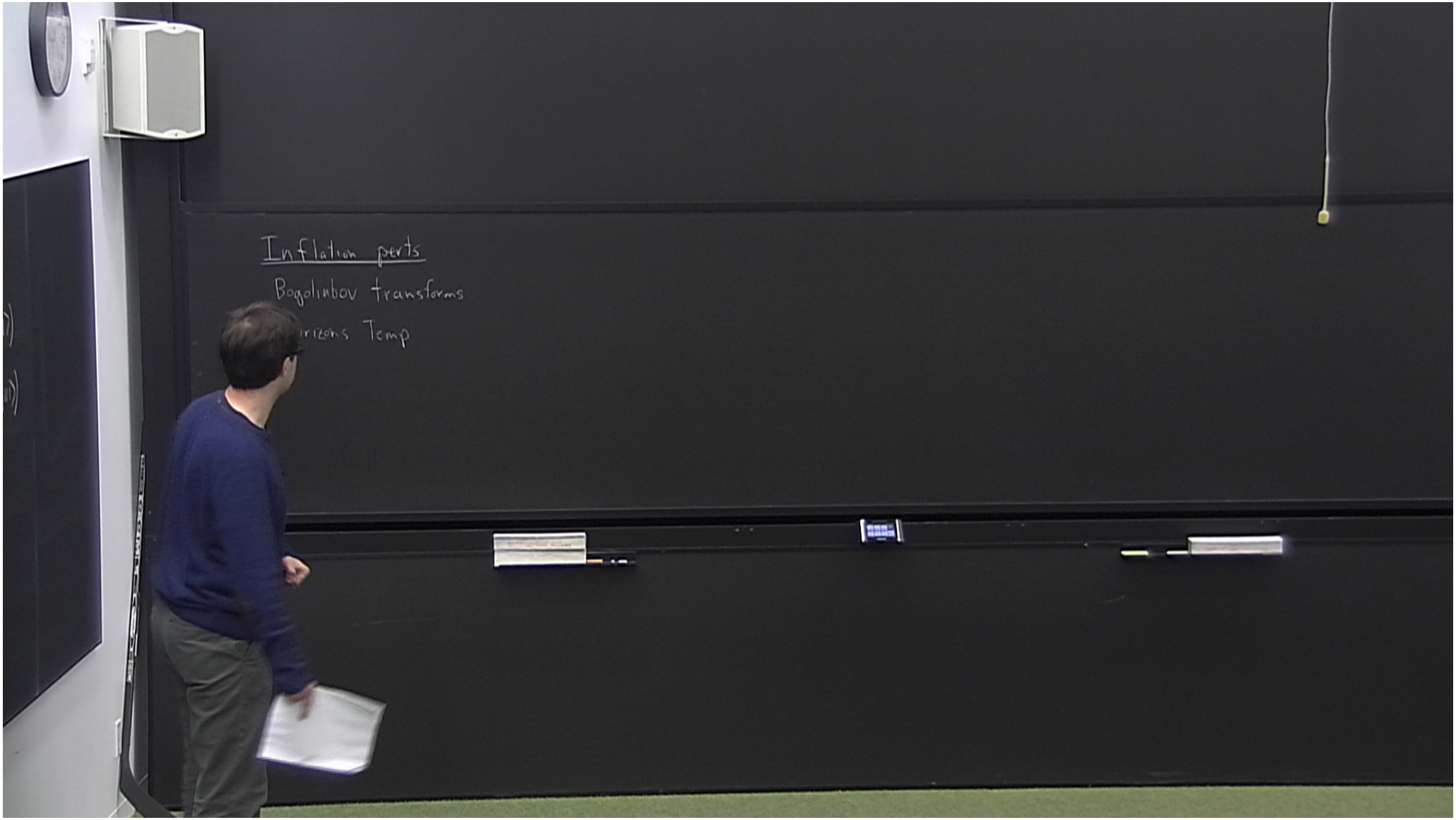
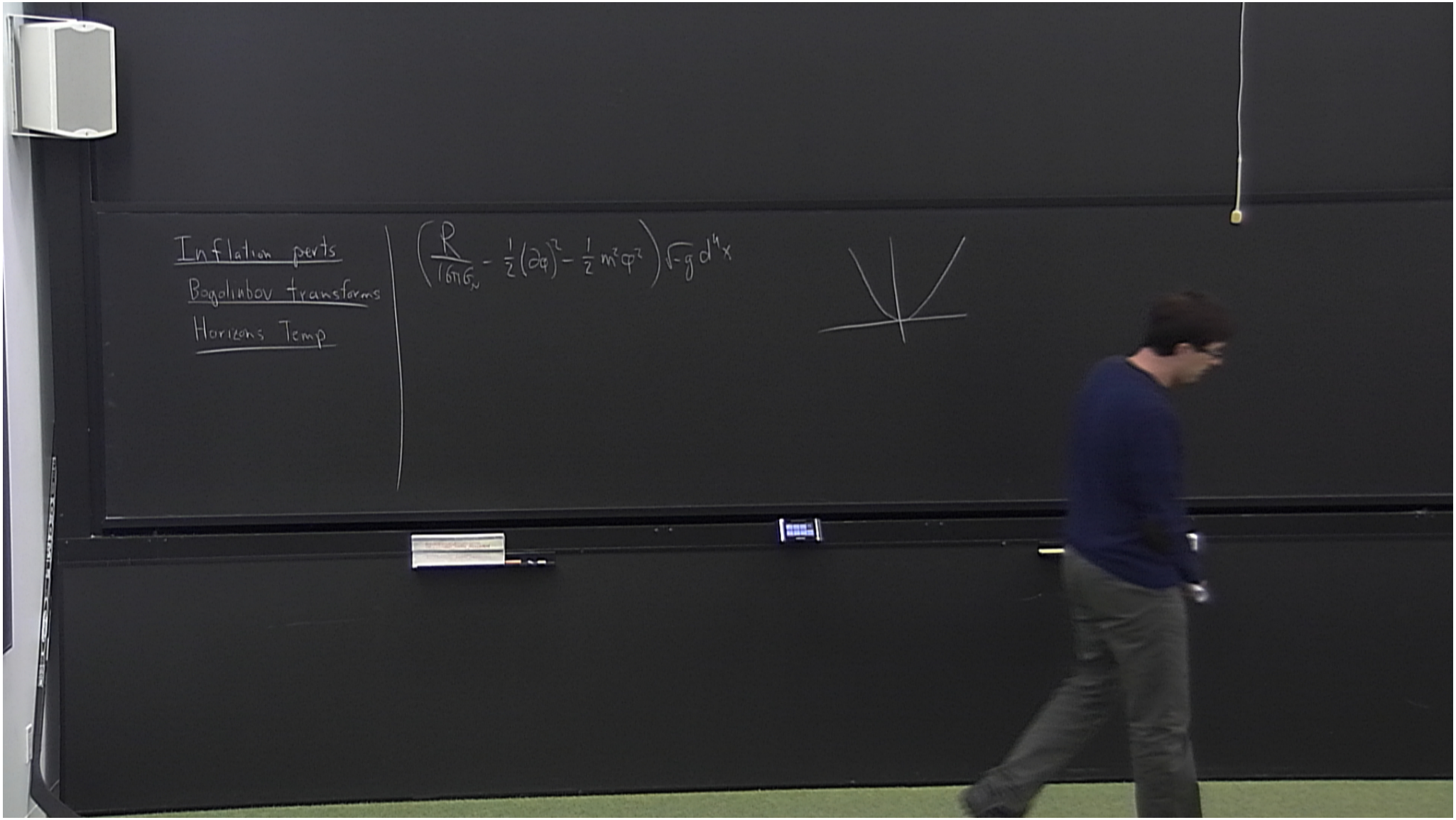
Title: 12/13 PSI - Cosmology Review Lecture 13

Date: Mar 07, 2013 11:30 AM

URL: http://www.pirsa.org/13030044

Abstract:


Inflation perts
Bogolinbov transforms
rizons Temp


Inflation perts
Bogolinbov transforms
Horizons Temp
$\left(\frac{R}{16\pi G_N} - \frac{1}{2}(\partial\phi)^2 - \frac{1}{2}m^2\phi^2\right)\sqrt{-g}\,d^4x$

Inflation perts

Bogolinbov transforms

Horizons Temp

$$\left(\frac{R}{16\pi G_N} - \frac{1}{2}(\partial\varphi)^2 - \frac{1}{2}m^2\varphi^2\right)\sqrt{-g}\,d^4x$$

$\varphi = \bar{\varphi}(\eta) + \delta\varphi(\vec{x},\eta)$

$g_{\mu\nu} = \bar{g}_{\mu\nu}(\eta) + \delta g_{\mu\nu}(\vec{x},\eta)$

$g_{\mu\nu} \to g'_{\mu\nu} = \frac{\partial x^\alpha}{\partial x'^\mu}\frac{\partial x^\beta}{\partial x'^\nu} g_{\alpha\beta} = g_{\mu\nu} + \xi_{\mu,\nu} + \xi_{\nu,\mu}$

$x^\mu \to x^\mu + \xi^\mu(x) = x'^\mu$ $\quad G_{\mu\nu}{}^{;\nu} = 0$

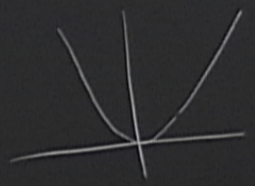
$A^\mu \to 2$ polarizations

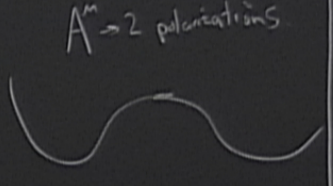
Inflation perts

Bogolinbov transforms

Horizons Temp

$$\left(\frac{R}{16\pi G_N} - \frac{1}{2}(\partial\varphi)^2 - \frac{1}{2}m^2\varphi^2\right)\sqrt{-g}\,d^4x$$



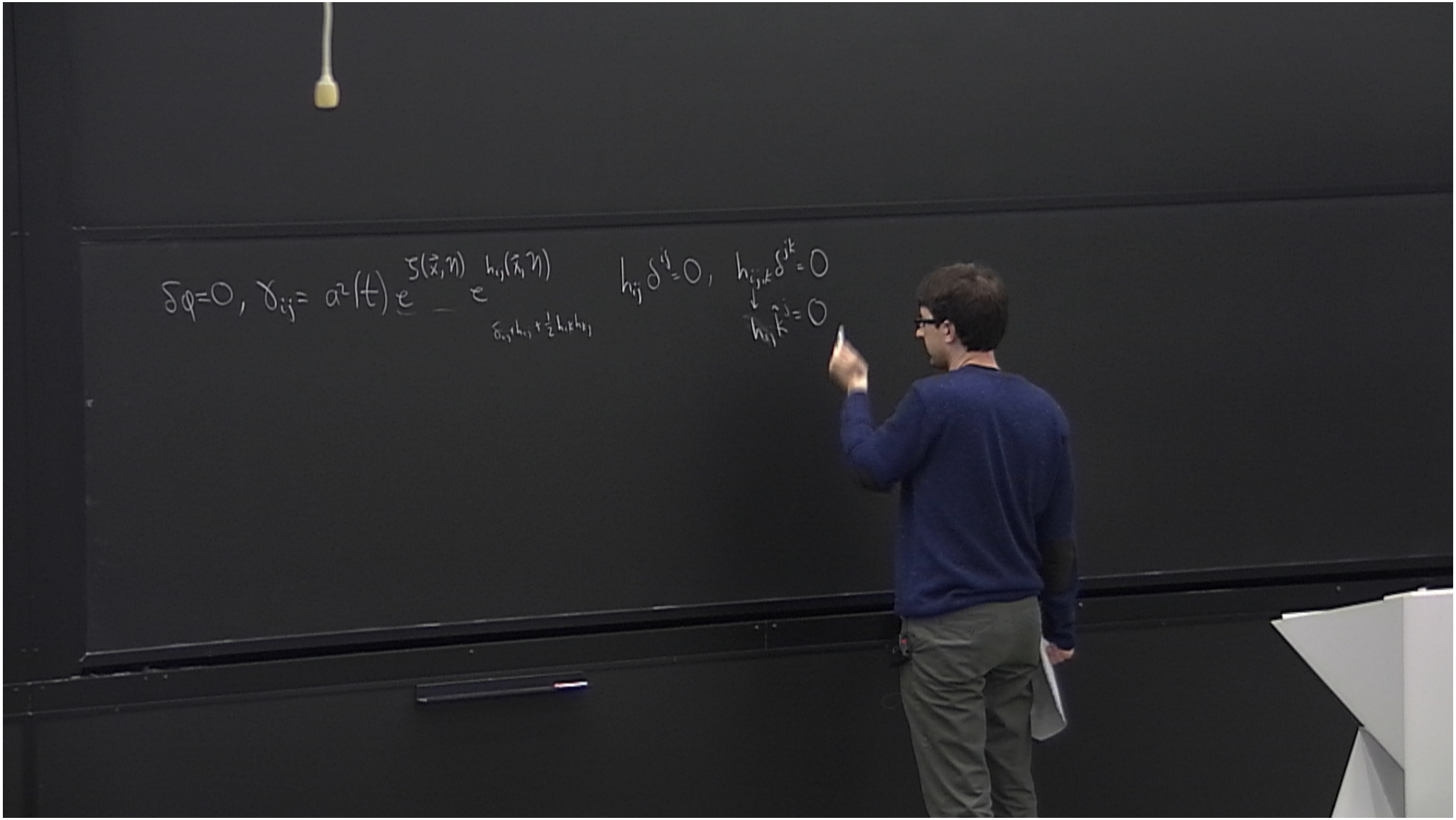


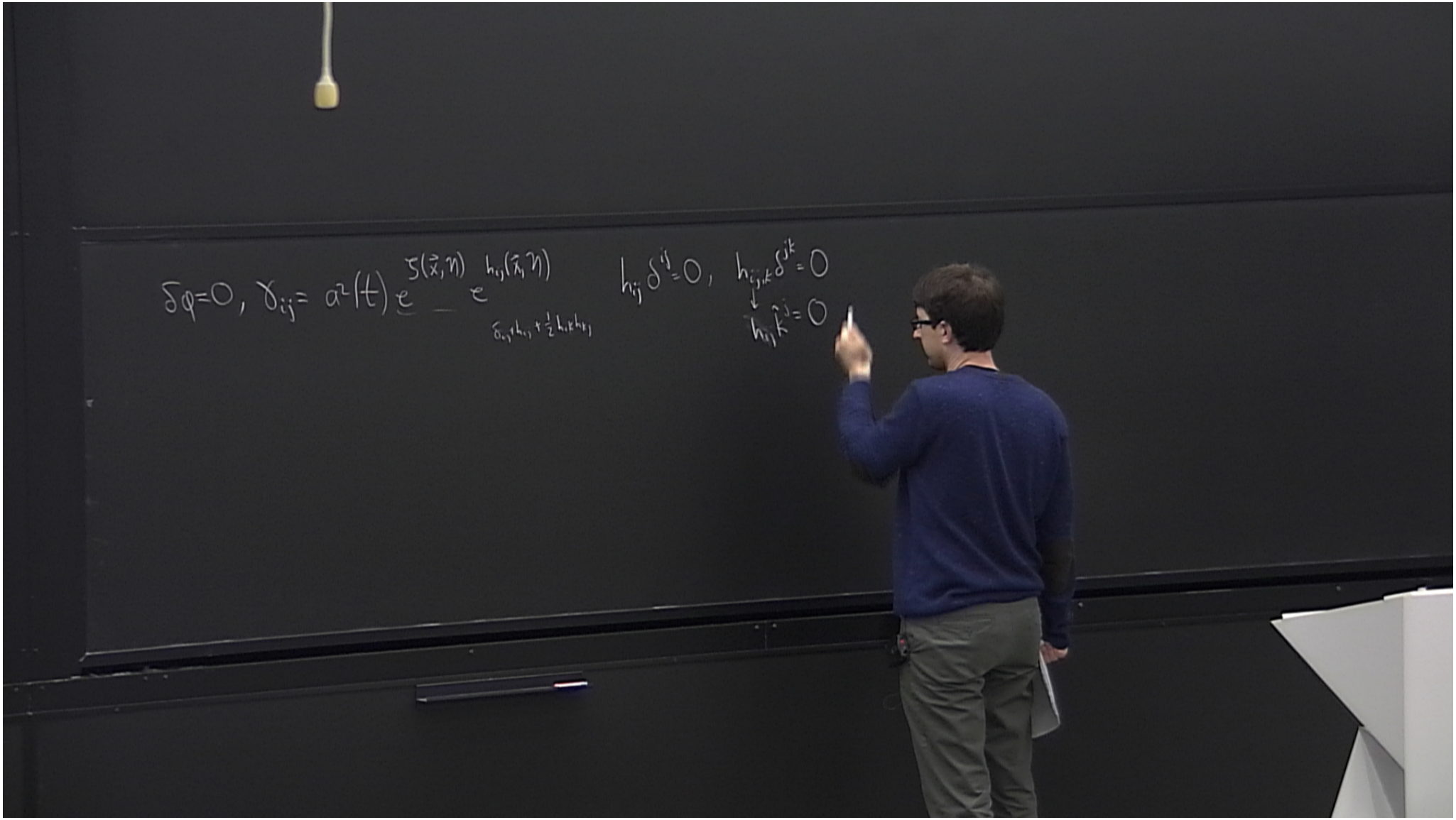
$\varphi = \bar{\varphi}(\eta) + \delta\varphi(\vec{x},\eta)$

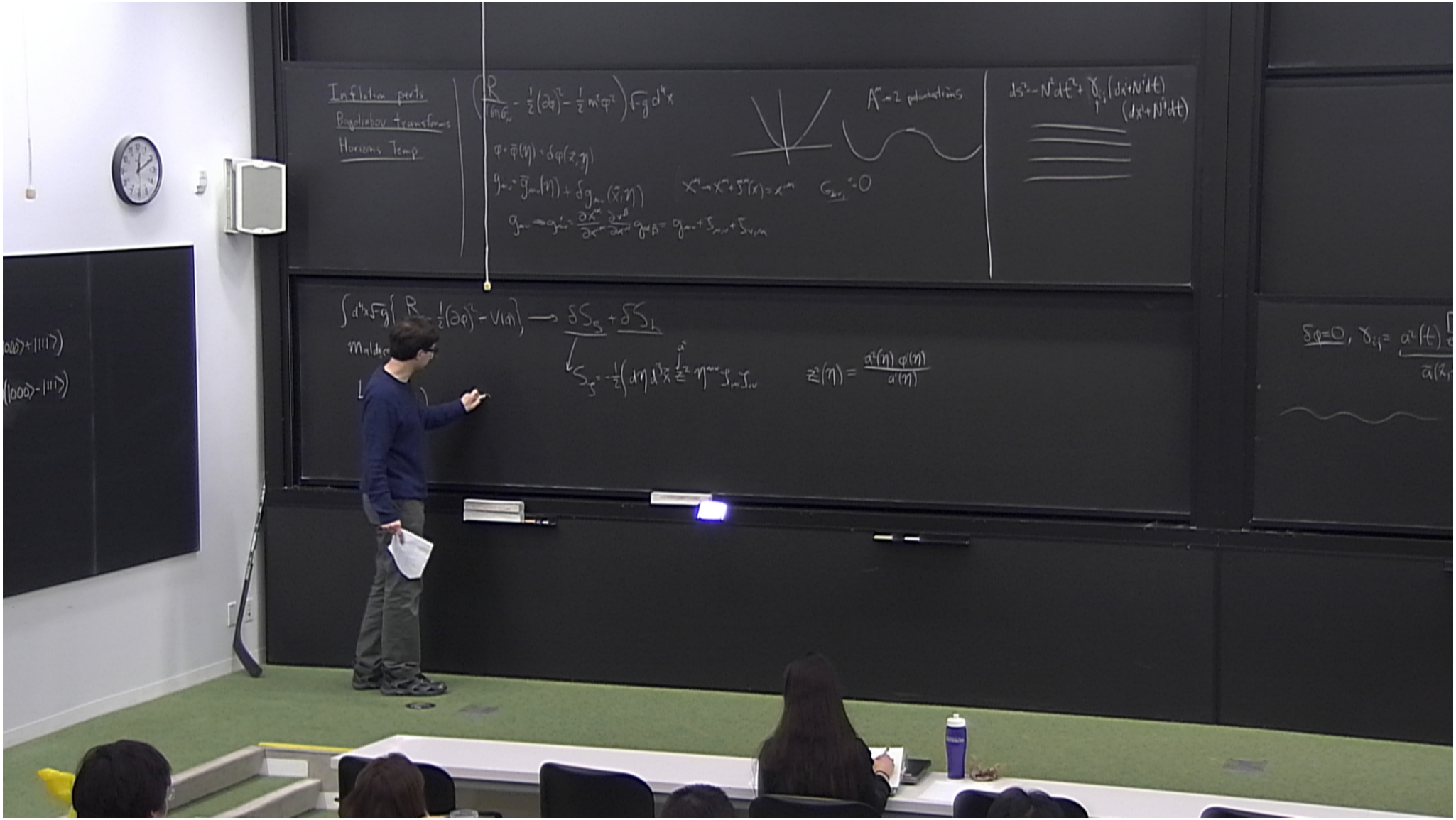
$g_{\mu\nu} = \bar{g}_{\mu\nu}(\eta) + \delta g_{\mu\nu}(\vec{x},\eta)$

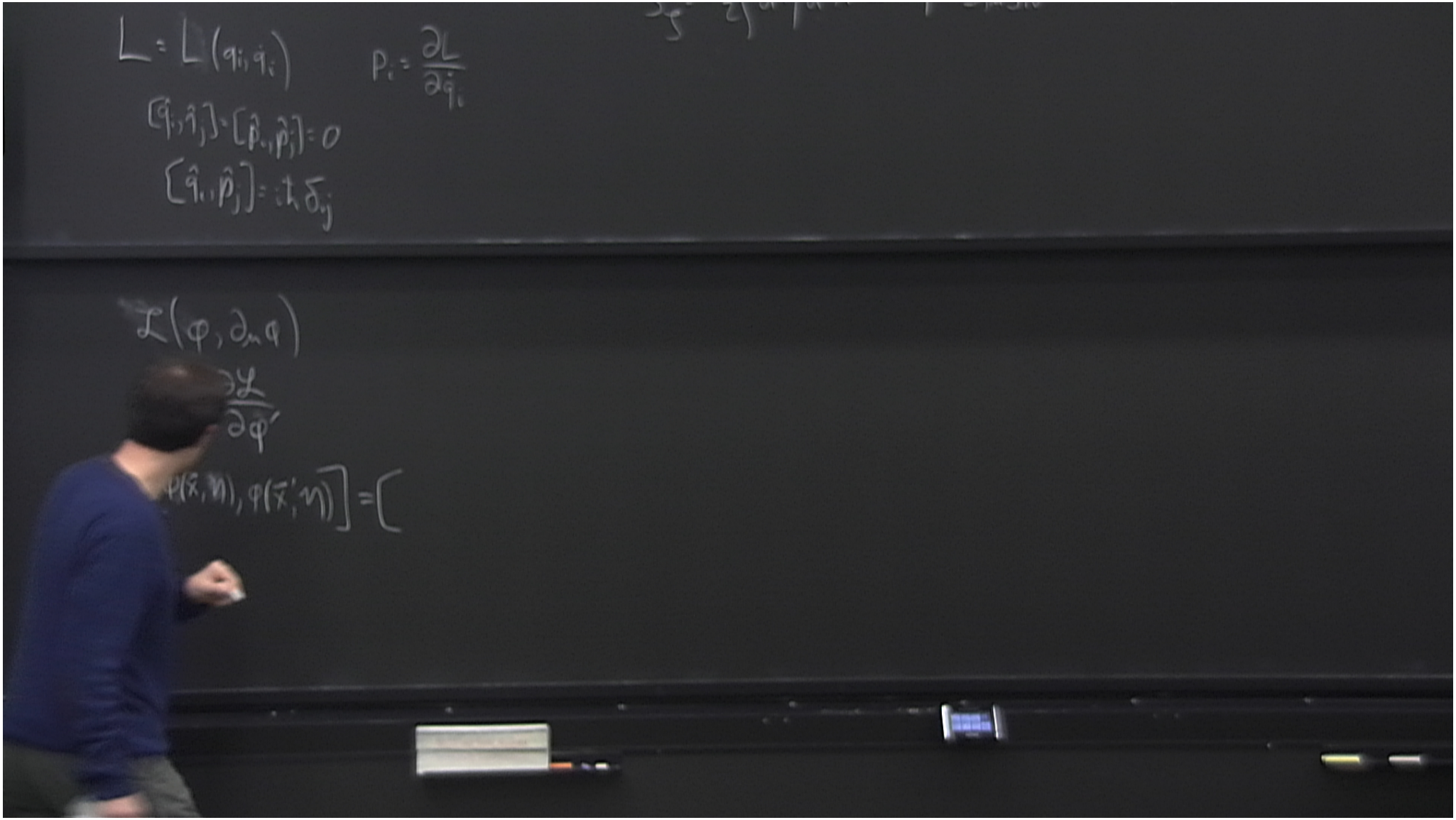
$x^m \to x^m + \xi^m(x) = x'^m$ $\quad G_{\mu\nu} = 0$

$g_{\mu\nu} \to g'_{\mu\nu} = \frac{\partial x^\alpha}{\partial x'^\mu}\frac{\partial x^\beta}{\partial x'^\nu} g_{\alpha\beta} = g_{\mu\nu} + \xi_{\mu,\nu} + \xi_{\nu,\mu}$


$\delta\varphi = 0, \quad \gamma_{ij} = a^2(t)\, e^{\zeta(\vec{x},\eta)}\, e^{h_{ij}(\vec{x},\eta)}$
$\partial_{ij} h_{ij} + \frac{1}{2} h_{ik} h_{kj}$
$h_{ij}\delta^{ij} = 0, \quad h_{ij,ik}\delta^{ik} = 0$
$h_{ij}\hat{k}^j = 0$


$\delta\varphi = 0, \quad \gamma_{ij} = a^2(t)\, e^{\zeta(\vec{x},\eta)}\, e^{h_{ij}(\vec{x},\eta)}$
$\delta_{ij} + h_{ij} + \frac{1}{2} h_{ik} h_{kj}$
$h_{ij}\delta^{ij} = 0, \quad h_{ij,k}\delta^{ik} = 0$
$h_{ij}\hat{k}^j = 0$


Inflation parts
Regularization transforms
Horizons Temp
$\left(\frac{R}{16\pi G_N} - \frac{1}{2}(\partial\phi)^2 - \frac{1}{2}m^2\phi^2\right)\sqrt{-g}\,d^4x$
A^μ = 2 polarizations
$ds^2 = -N^2dt^2 + \gamma_{ij}(dx^i + N^i dt)(dx^j + N^j dt)$
$\phi = \bar{\phi}(\eta) + \delta\phi(\vec{x},\eta)$
$g_{\mu\nu} = \bar{g}_{\mu\nu}(\eta) + \delta g_{\mu\nu}(\vec{x},\eta)$
$x^\mu \to x^\mu + \xi^\mu(x) = x'^\mu$
$G_{\mu\nu} = 0$
$g_{\mu\nu} \to g'_{\mu\nu} = \frac{\partial x^\alpha}{\partial x'^\mu}\frac{\partial x^\beta}{\partial x'^\nu} g_{\alpha\beta} = g_{\mu\nu} + S_{\mu\nu} + S_{\nu\mu}$
$\int d^4x\sqrt{-g}\left\{R - \frac{1}{2}(\partial\phi)^2 - V(\phi)\right\} \to \delta S_S + \delta S_V$
$S_S = -\frac{1}{2}\left(d\eta\, d^3\vec{x}\, z^2\, \eta^{\mu\nu} S_{\mu\nu} S_{\nu\mu}\right)$
$z^2(\eta) = \frac{a^2(\eta)\,\phi(\eta)}{a'(\eta)}$
$\delta\phi = 0$, $\gamma_{ij} = \frac{a^2(t)}{a(t_i)}$


$L = L(q_i, \dot{q}_i)$
$p_i = \frac{\partial L}{\partial \dot{q}_i}$
$[\hat{q}_i, \hat{q}_j] = [\hat{p}_i, \hat{p}_j] = 0$
$[\hat{q}_i, \hat{p}_j] = i\hbar\delta_{ij}$
$\mathcal{L}(\varphi, \partial_\mu \varphi)$
$\frac{\partial \mathcal{L}}{\partial \dot{\varphi}}$
$\varphi(\vec{x}, \eta), \varphi(\vec{x}', \eta)] = [$

$L = L(q_i, \dot{q}_i)$ $\quad p_i = \frac{\partial L}{\partial \dot{q}_i}$

$[\hat{q}_i, \hat{q}_j] = [\hat{p}_i, \hat{p}_j] = 0$

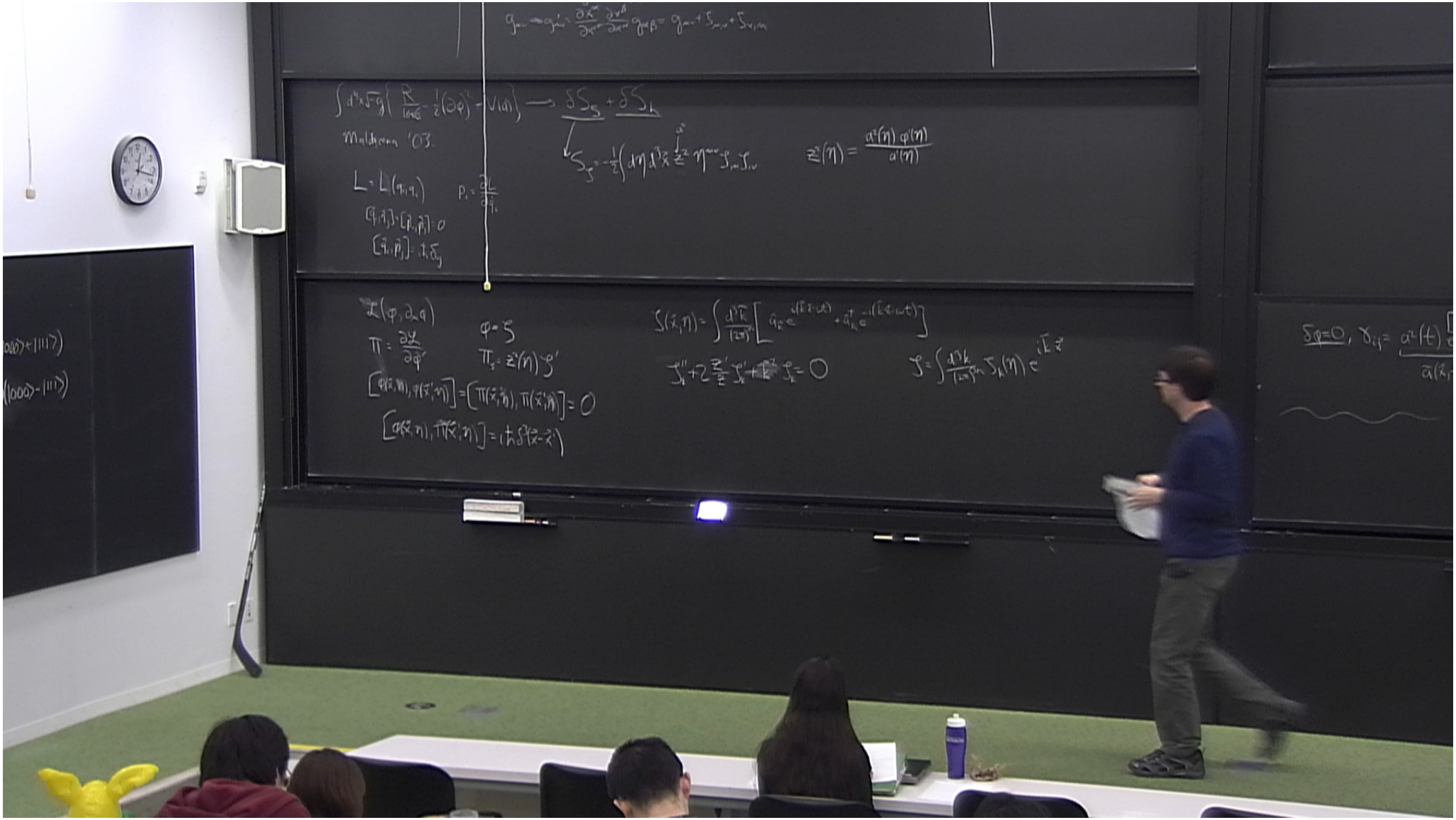
$[\hat{q}_i, \hat{p}_j] = i\hbar\,\delta_{ij}$

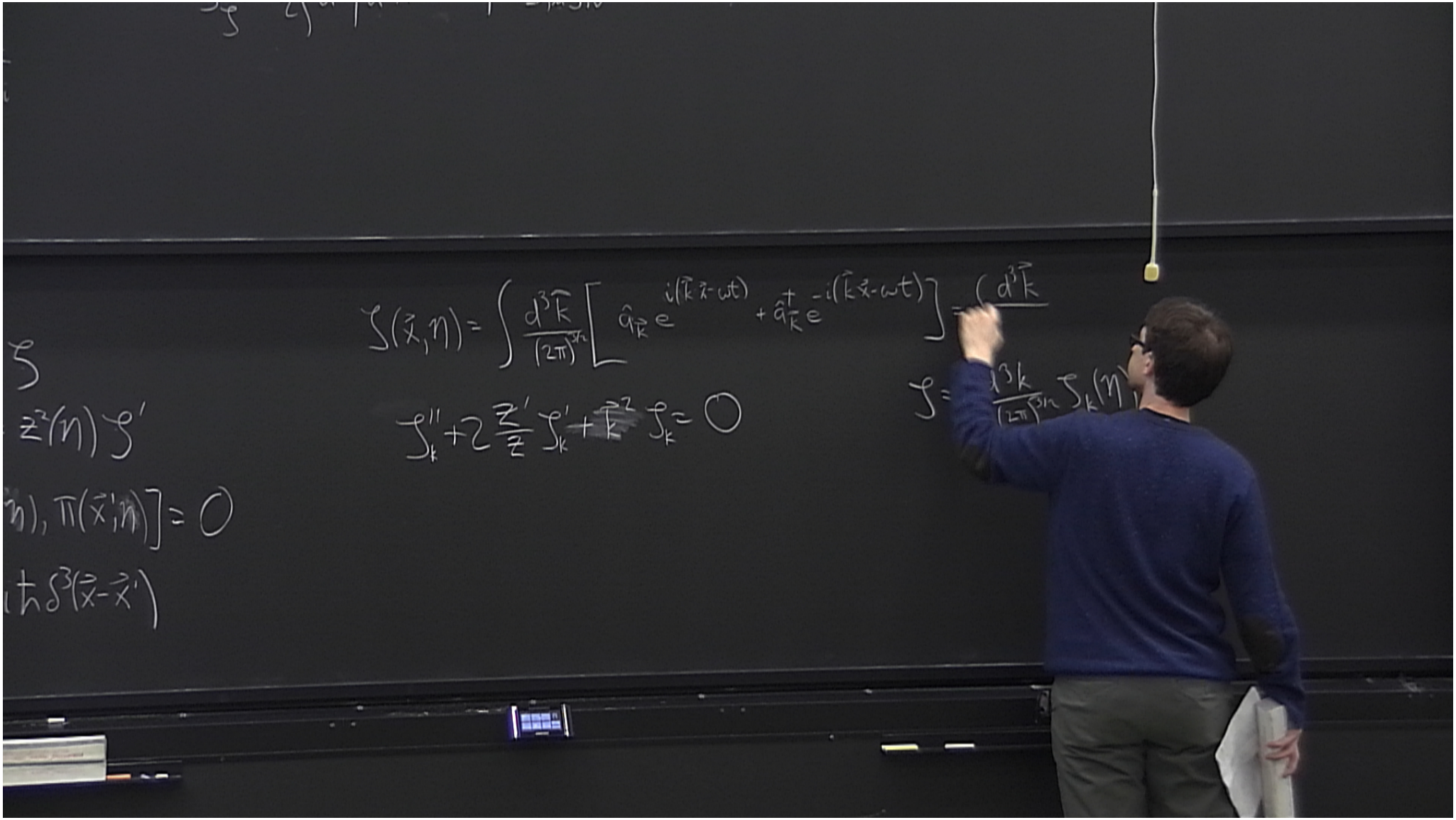
$\mathcal{L}(\varphi, \partial_\mu \varphi)$

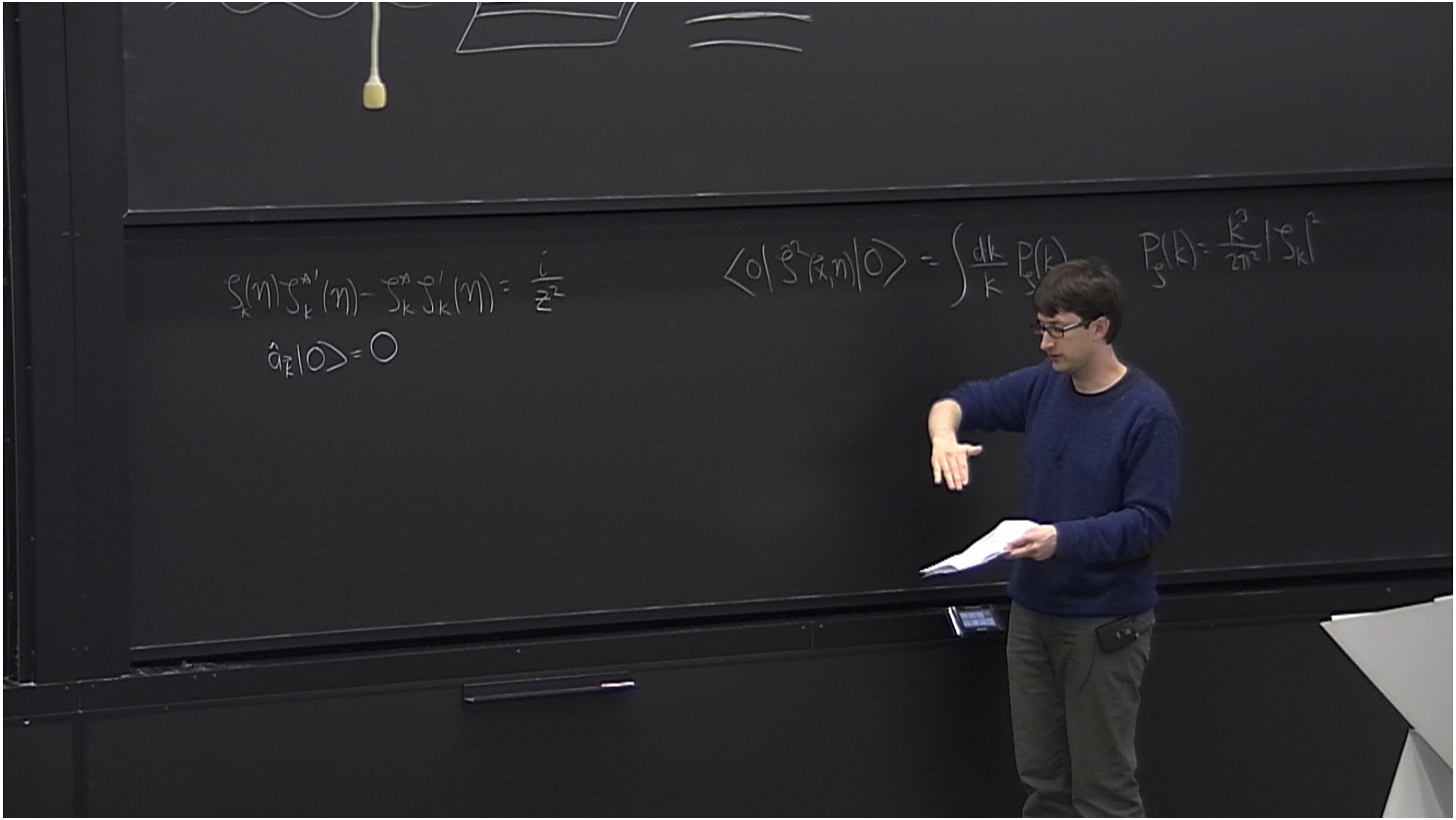
$\pi = \frac{\partial \mathcal{L}}{\partial \dot{\varphi}}$

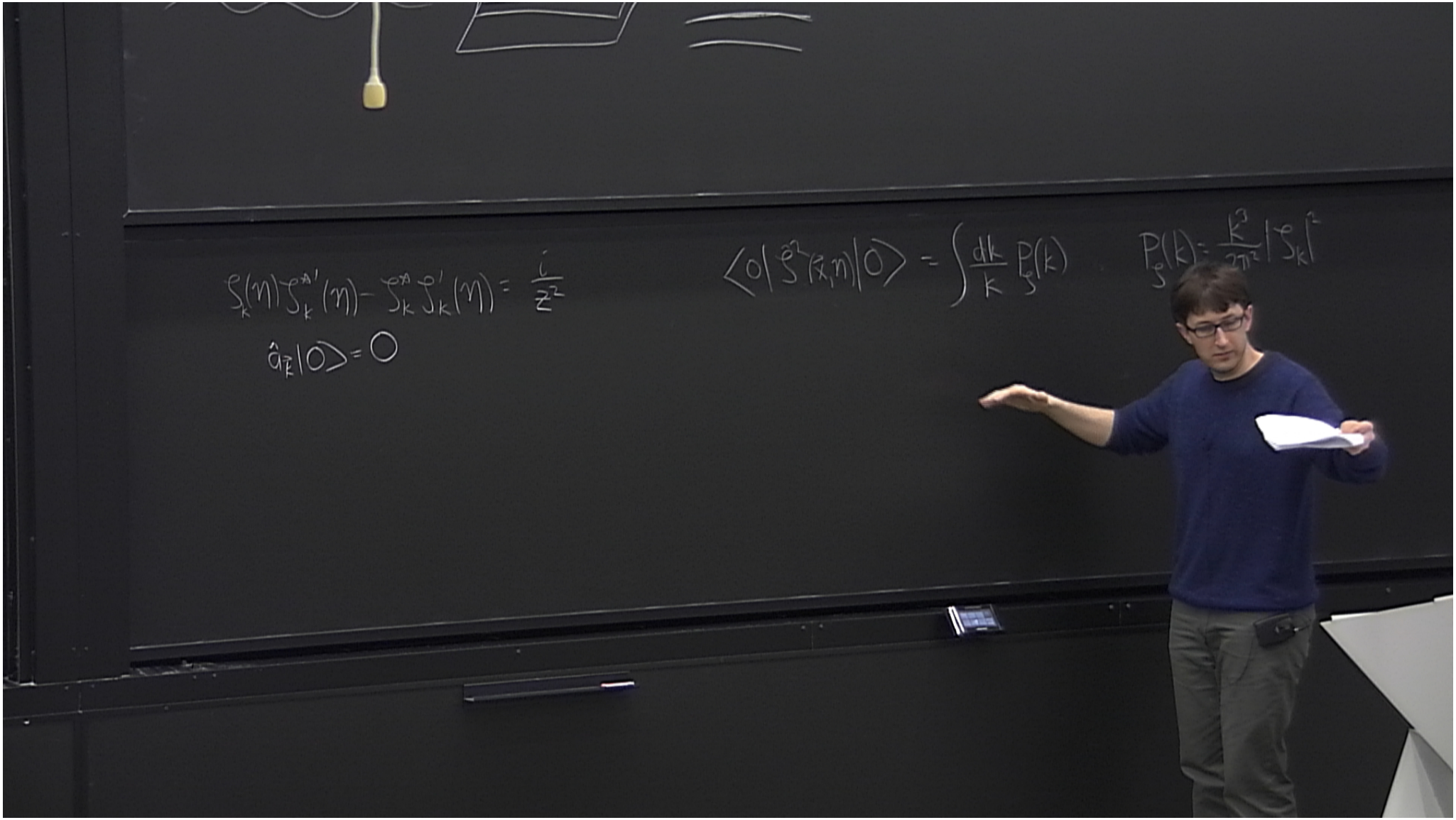
$[\varphi(\vec{x}, \eta), \varphi(\vec{x}', \eta)] = [\pi(\vec{x}, \eta), \pi(\vec{x}', \eta)] = 0$

$= i\hbar\,\delta^3(\vec{x} - \vec{x}')$


Maldacena '03.


$\zeta(\vec{x},\eta) = \int \frac{d^3\vec{k}}{(2\pi)^{3/2}} \left[\hat{a}_{\vec{k}} e^{i(\vec{k}\cdot\vec{x}-\omega t)} + \hat{a}^\dagger_{\vec{k}} e^{-i(\vec{k}\cdot\vec{x}-\omega t)} \right]$
$\zeta_k'' + 2\frac{z'}{z}\zeta_k' + k^2\zeta_k = 0$
$z^2(\eta)\,\zeta'$
$\pi(\vec{x},\eta)] = 0$
$i\hbar\,\delta^3(\vec{x}-\vec{x}')$


$f_k(\eta)\,\delta\pi_k^{*\prime}(\eta) - \delta\pi_k^{*}\,\delta\pi_k'(\eta) = \frac{i}{z^2}$
$\hat{a}_k|0\rangle = 0$
$\langle 0|\delta^2(x,\eta)|0\rangle = \int \frac{dk}{k} P_\delta(k)$
$P_\delta(k) = \frac{k^3}{2\pi^2}|f_k|^2$


$f_k(\eta)\,f_k^{*\prime}(\eta) - f_k^{*} f_k'(\eta) = \frac{i}{z^2}$
$\hat{a}_{\vec{k}}|0\rangle = 0$
$\langle 0|\hat{\delta}^2(\vec{x},\eta)|0\rangle = \int \frac{dk}{k} P_\delta(k)$
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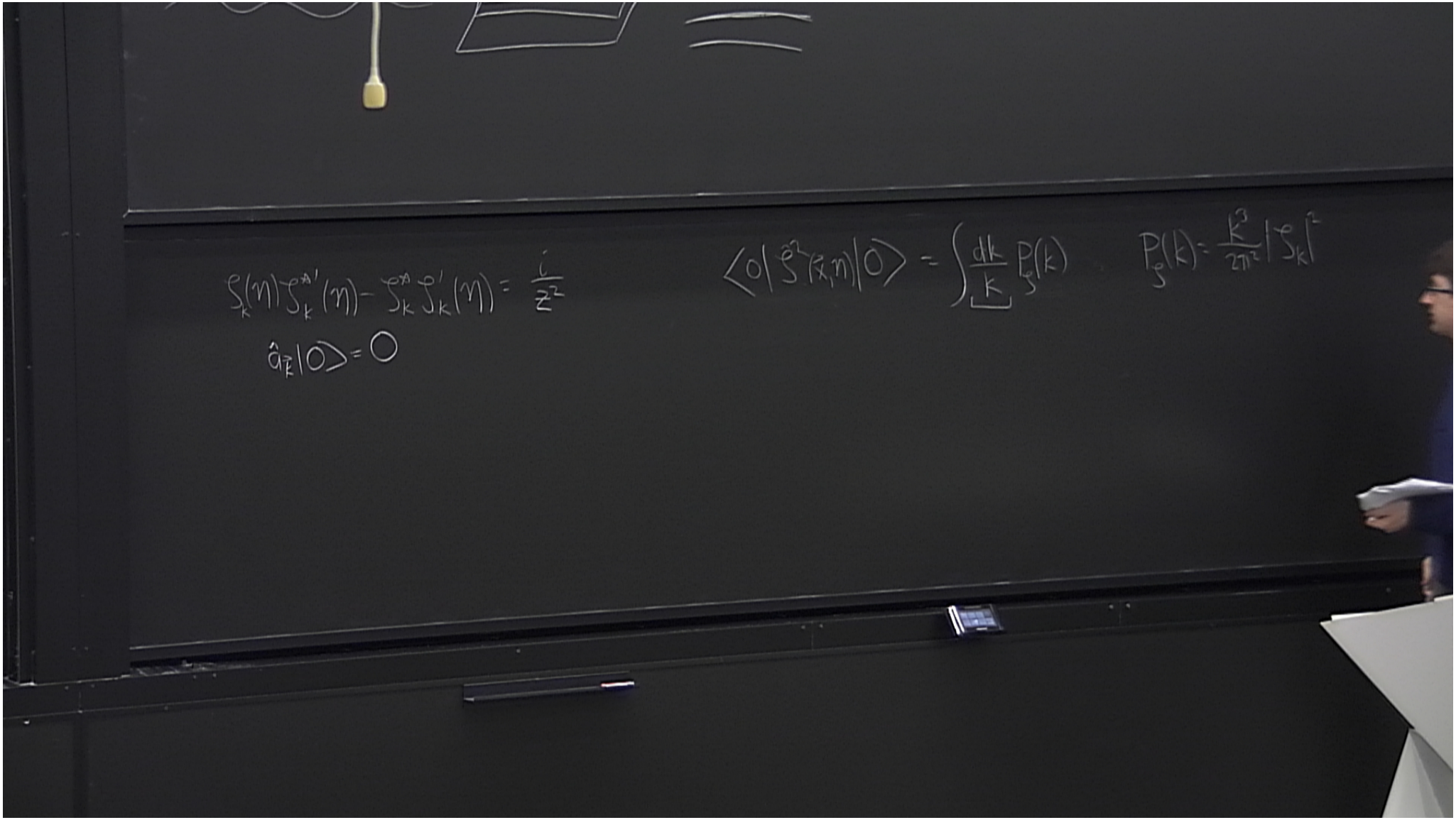
$f_k(\eta)\varphi_k^{*\prime}(\eta) - \varphi_k^{*} f_k'(\eta) = \frac{i}{z^2}$
$\hat{a}_{\vec{k}}|0\rangle = 0$
$\langle 0|\hat{\varphi}^2(\vec{x},\eta)|0\rangle = \int \frac{dk}{k} P_\varphi(k)$
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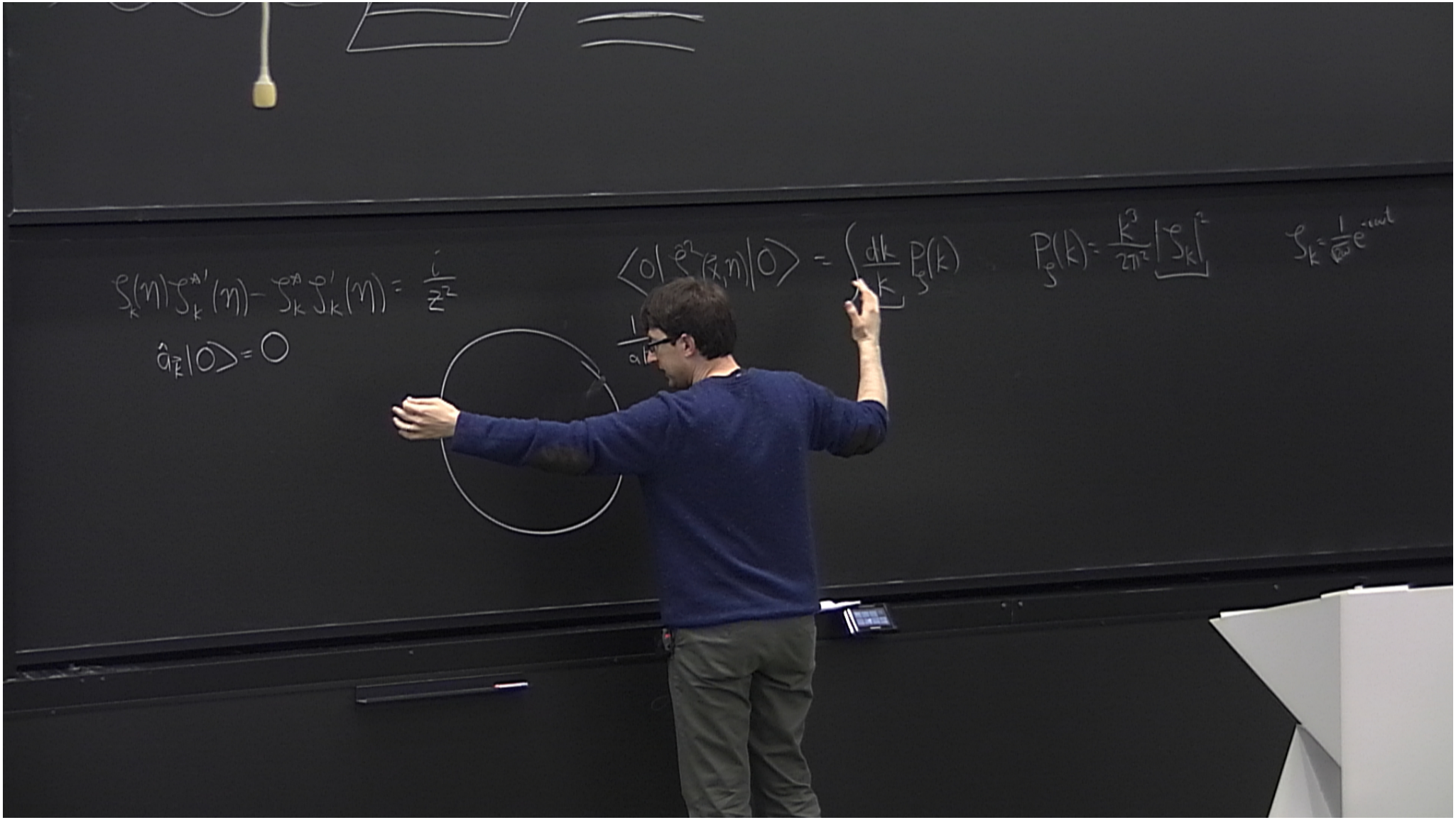
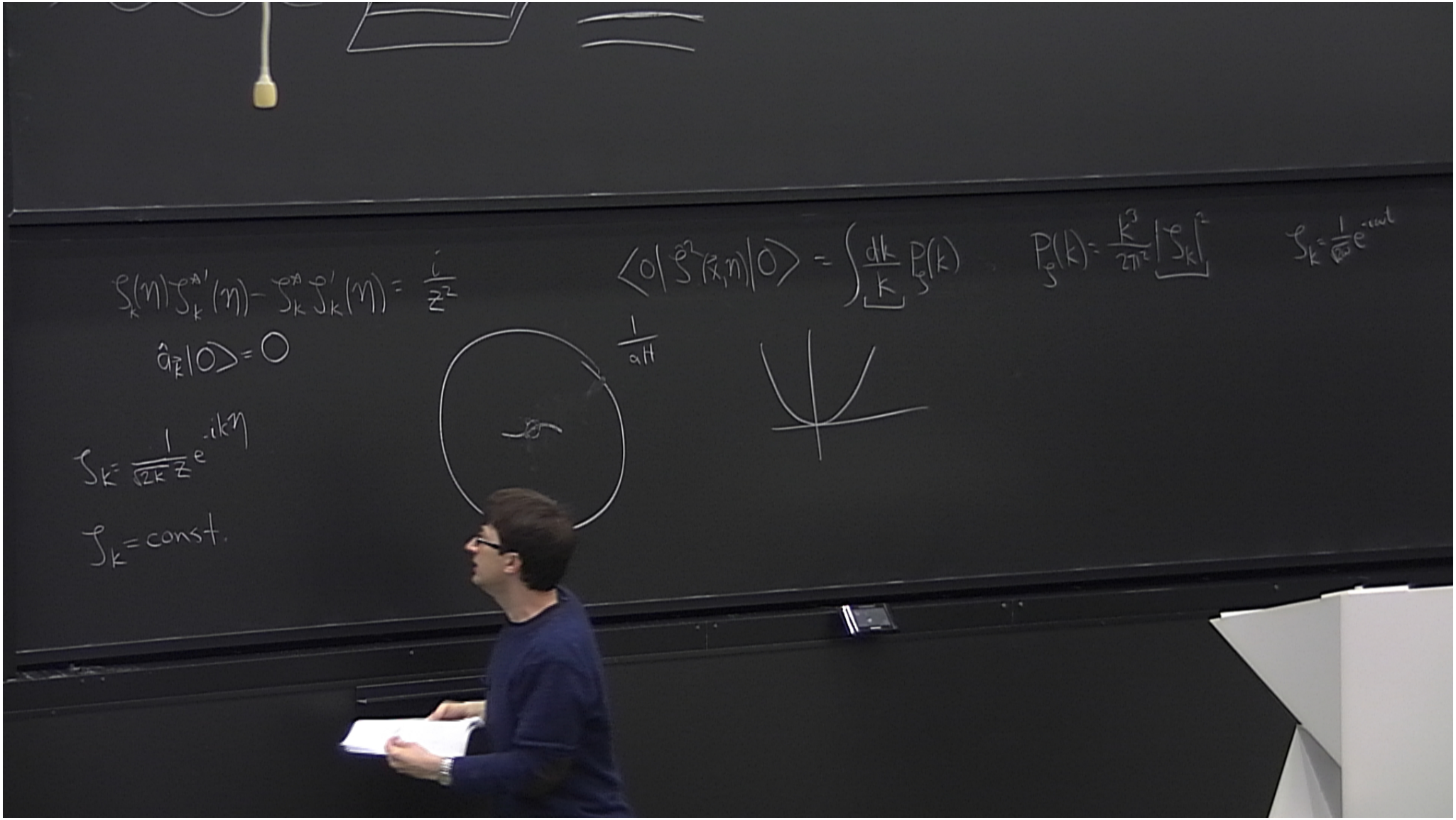

$f_k(\eta)\varphi_k^{*\prime}(\eta) - \varphi_k^{*} f_k'(\eta) = \frac{i}{z^2}$
$\hat{a}_{\vec{k}}|0\rangle = 0$
$\langle 0|\hat{\varphi}^2(\vec{x},\eta)|0\rangle = \int \frac{dk}{k} P_\varphi(k)$
$P_\varphi(k) = \frac{k^3}{2\pi^2}|f_k|^2$
$f_k = \frac{1}{\sqrt{2k}} e^{-ikt}$


$\zeta_k(\eta)\zeta_k^{*\prime}(\eta) - \zeta_k^{*}\zeta_k'(\eta) = \frac{i}{z^2}$
$\hat{a}_{\vec{k}}|0\rangle = 0$
$\zeta_k = \frac{1}{\sqrt{2k}z} e^{-ik\eta}$
$\zeta_k = \text{const.}$
$\langle 0|\zeta^2(\vec{x},\eta)|0\rangle = \int \frac{dk}{k} P_\zeta(k)$
$P_\zeta(k) = \frac{k^3}{2\pi^2}|\zeta_k|^2$
$\zeta_k = \frac{1}{\sqrt{2k}} e^{-ik\eta}$
$\frac{1}{aH}$