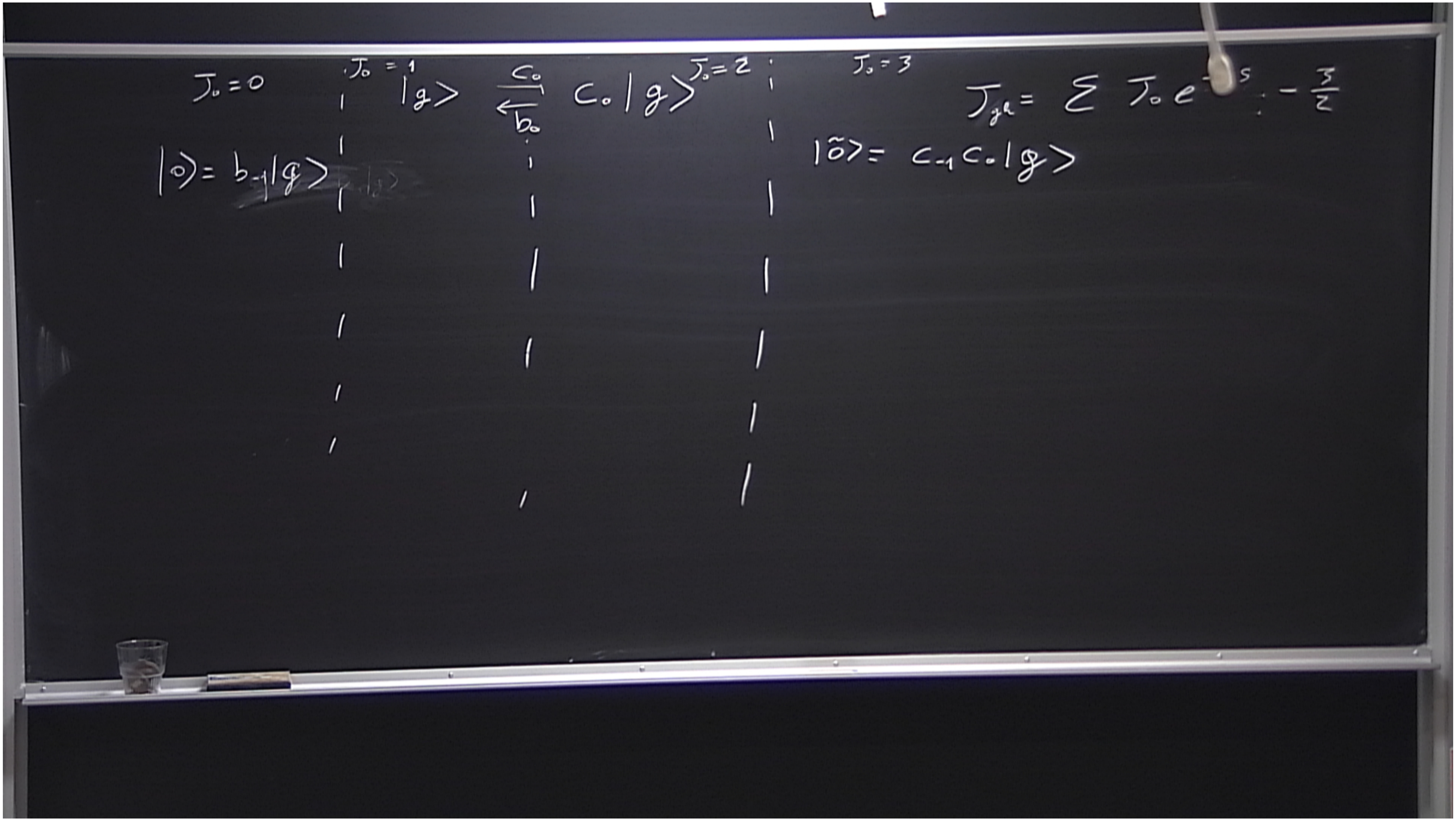
Title: String Theory Review-7

Date: Feb 03, 2015 10:15 AM

URL: http://pirsa.org/15020015

Abstract:



$J_0 = 0$

$|0\rangle = b_{-1}|g\rangle$

$J_0 = 1$

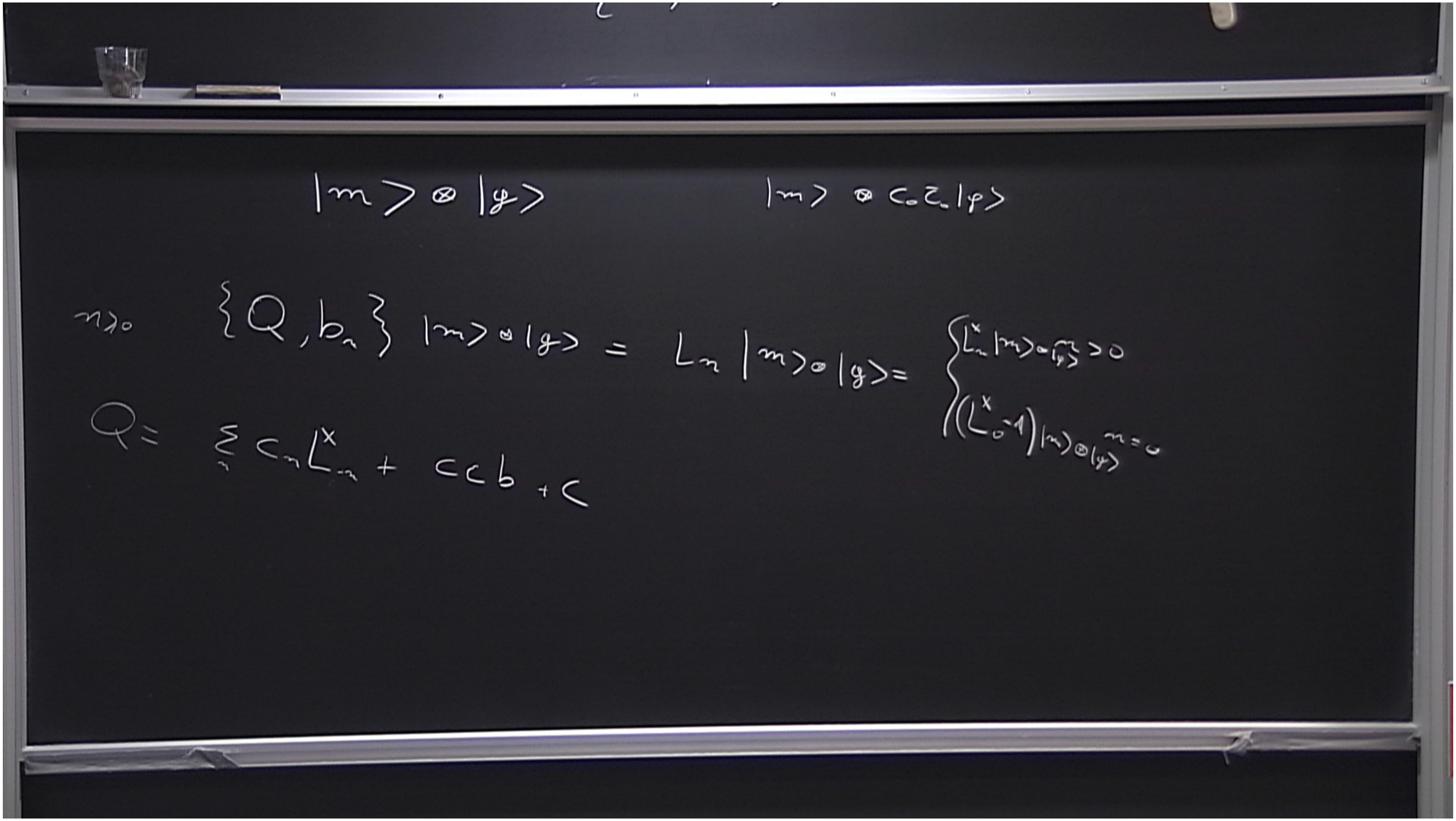
$|g\rangle \underset{b_0}{\overset{c_0}{\rightleftarrows}} c_0|g\rangle$

$J_0 = 2$

$J_0 = 3$

$|\tilde{0}\rangle = c_{-1}c_0|g\rangle$

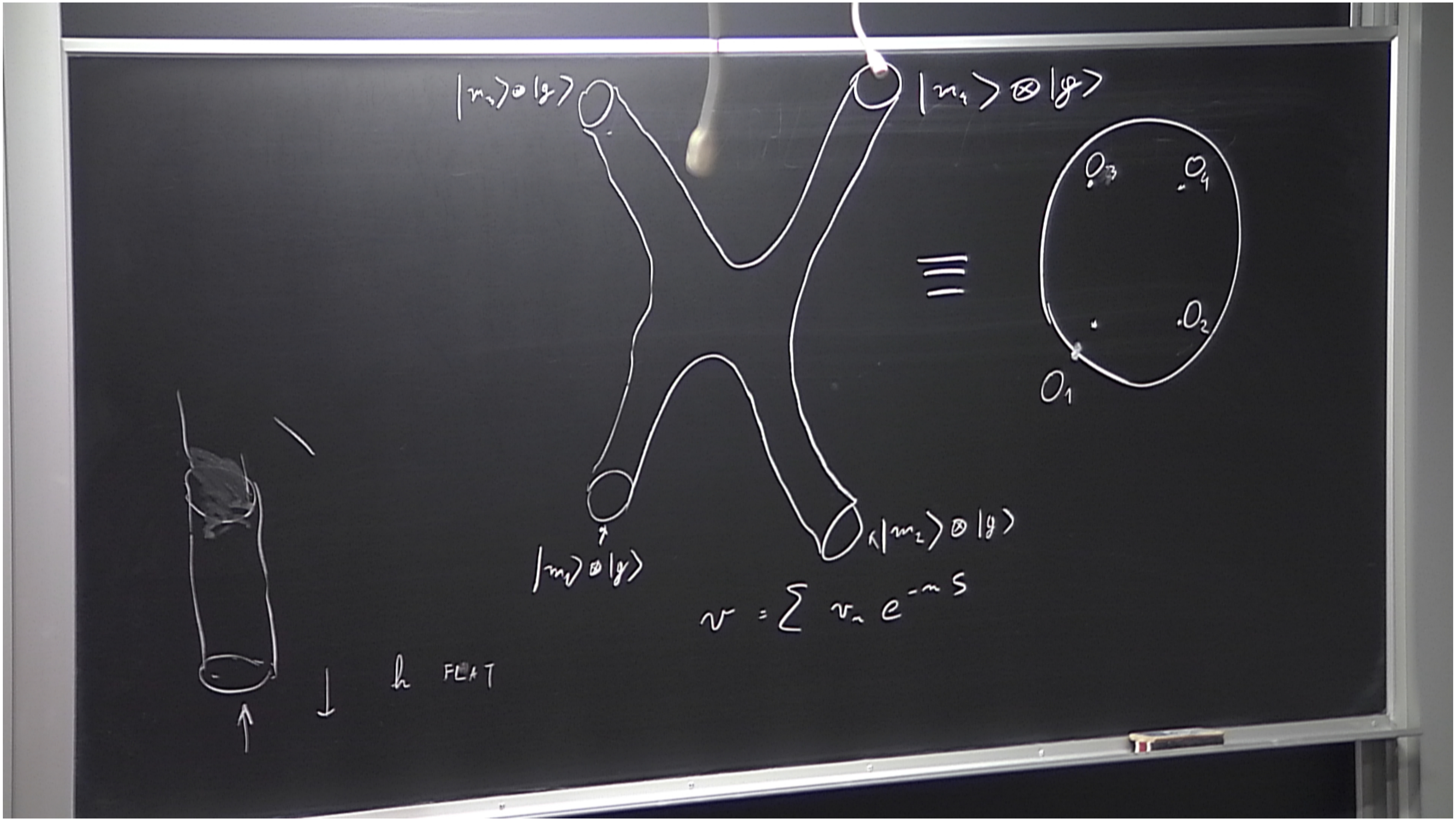
$J_{gh} = \sum J_0 e^{\ s}$ $: -\frac{3}{2}$



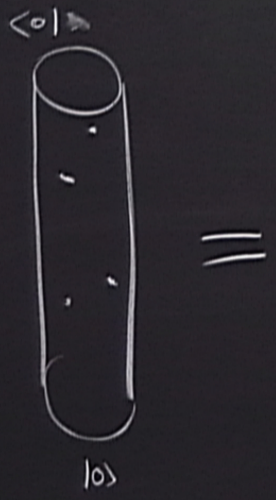
$|m\rangle \otimes |g\rangle$ $\qquad$ $|m\rangle \otimes c_0 \tilde{c}_0 |\varphi\rangle$

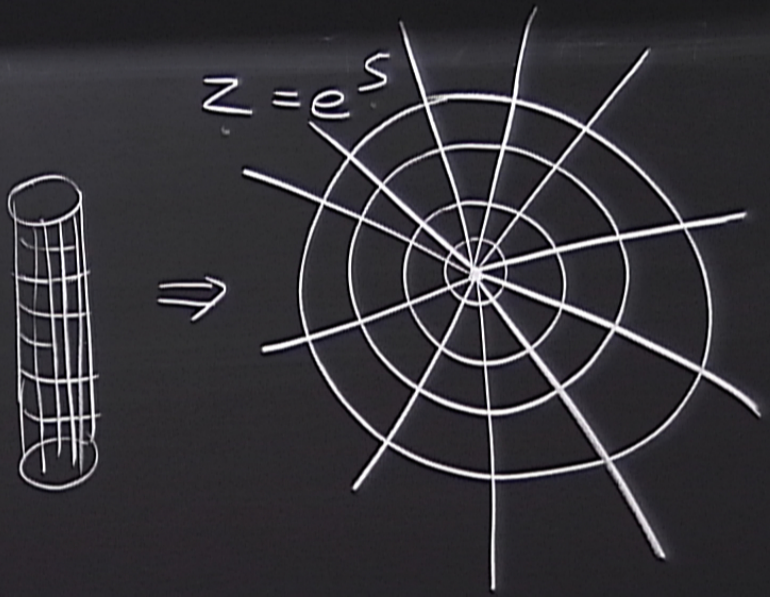
$$n \geq 0 \quad \{Q, b_n\} |m\rangle \otimes |g\rangle = L_n |m\rangle \otimes |g\rangle = \begin{cases} L^X_n |m\rangle \otimes |\varphi\rangle & n > 0 \\ (L^X_0 - 1) |m\rangle \otimes |\varphi\rangle & n = 0 \end{cases}$$

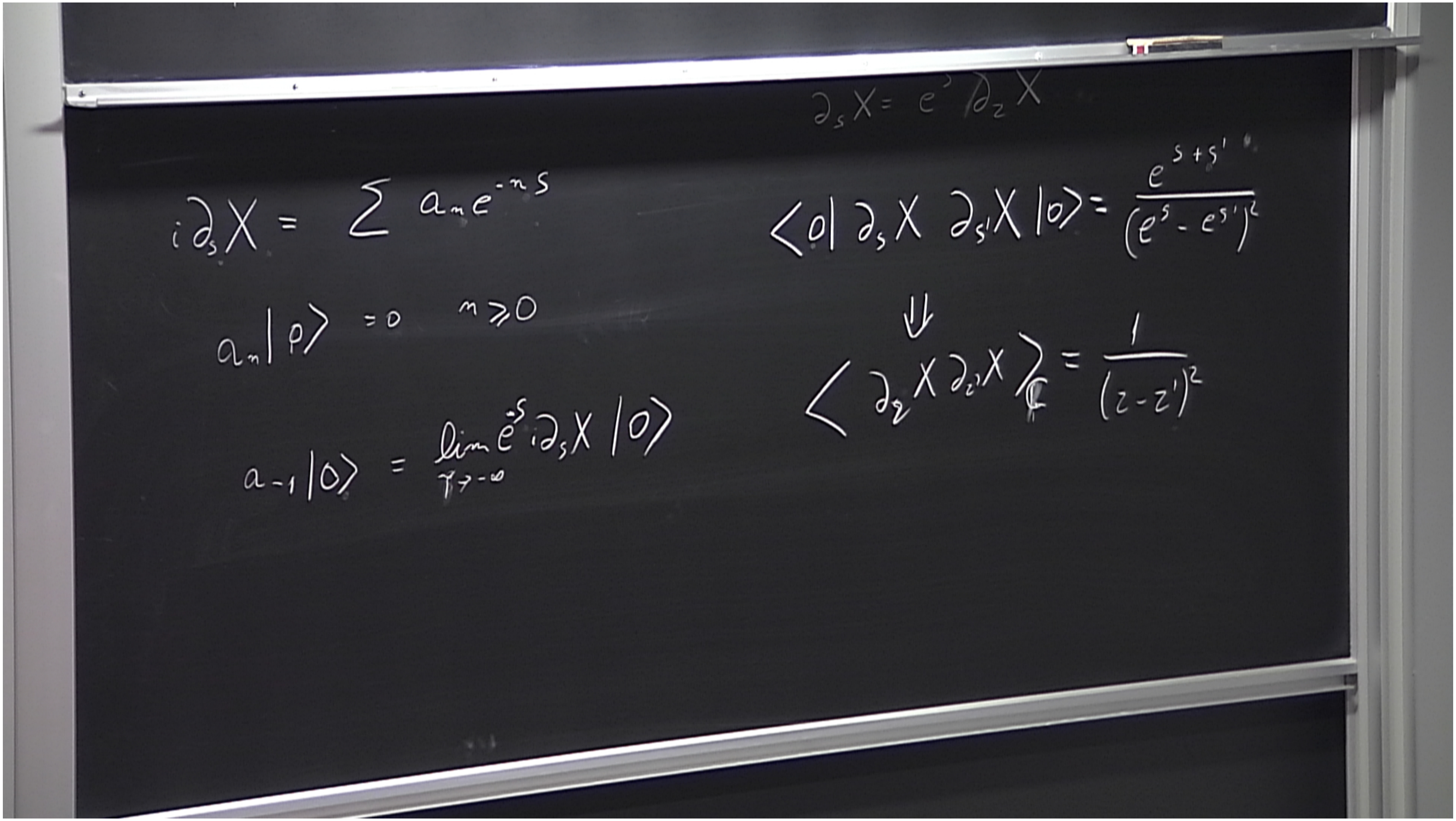
$$Q = \sum_n c_n L^X_{-n} + c c b + c$$


$|m_3\rangle \otimes |g\rangle$
$|m_4\rangle \otimes |g\rangle$
$\equiv$
O_3
O_4
O_2
O_1
$|m_1\rangle \otimes |g\rangle$
$|m_2\rangle \otimes |g\rangle$
$v = \sum v_n e^{-nS}$
h
FLAT

$$\int \partial_z X \, \bar{\partial}_{\bar{z}} X \, dz \, d\bar{z}$$







$$i\partial_s X = \sum a_n e^{-ns}$$

$$a_n|\rho\rangle = 0 \qquad n \geqslant 0$$

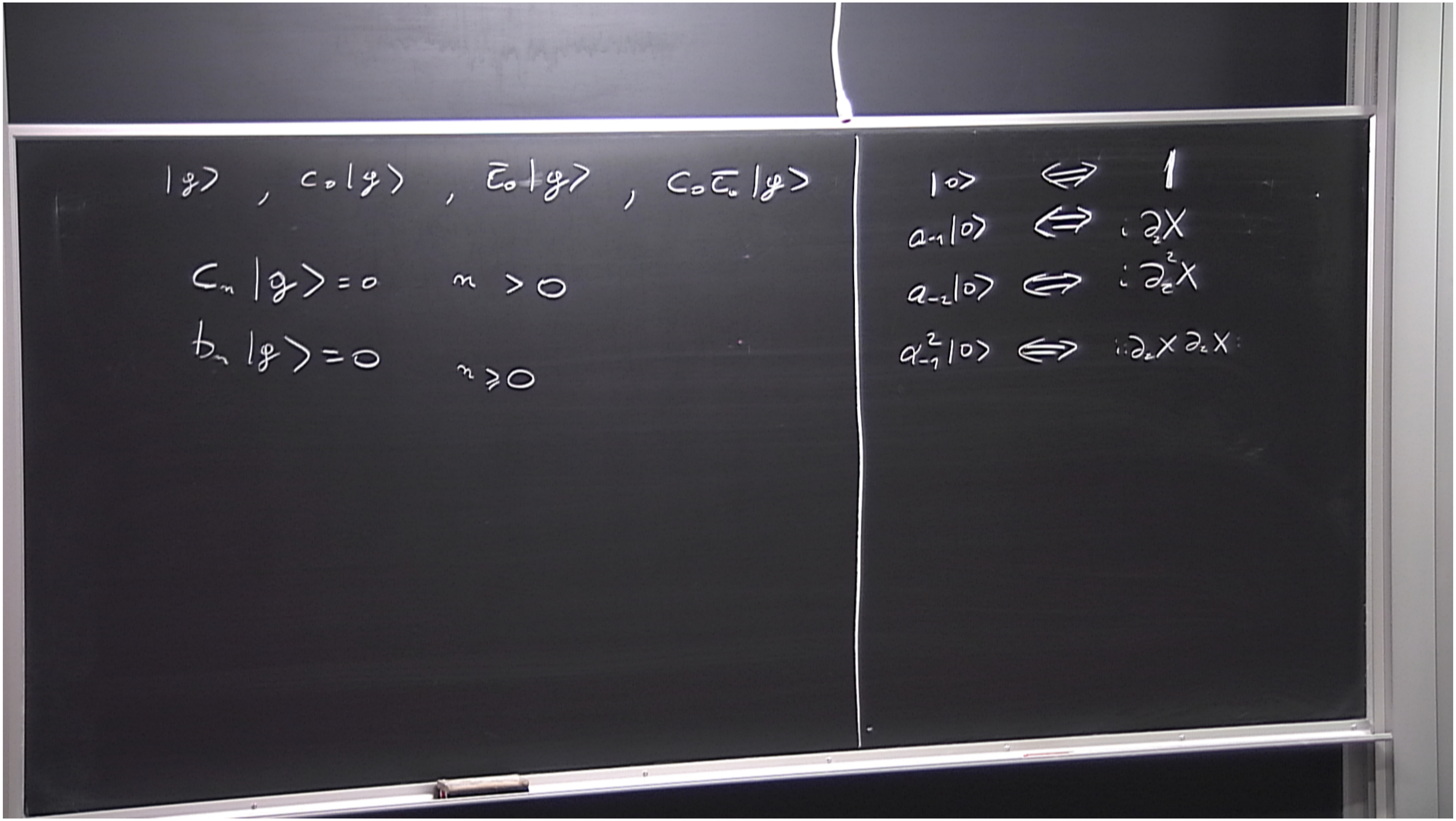
$$a_{-1}|0\rangle = \lim_{\tau\to-\infty} e^{-s} i\partial_s X|0\rangle$$

$$\partial_s X = e^{s}\partial_z X$$

$$\langle 0|\partial_s X\,\partial_{s'} X|0\rangle = \frac{e^{s+s'}}{(e^s - e^{s'})^2}$$

$$\Downarrow$$

$$\langle \partial_z X\,\partial_{z'} X\rangle_{\mathbb{C}} = \frac{1}{(z-z')^2}$$



$|g\rangle$, $c_0|g\rangle$, $\bar{c}_0|g\rangle$, $c_0\bar{c}_0|g\rangle$

$c_n|g\rangle = 0 \qquad n > 0$

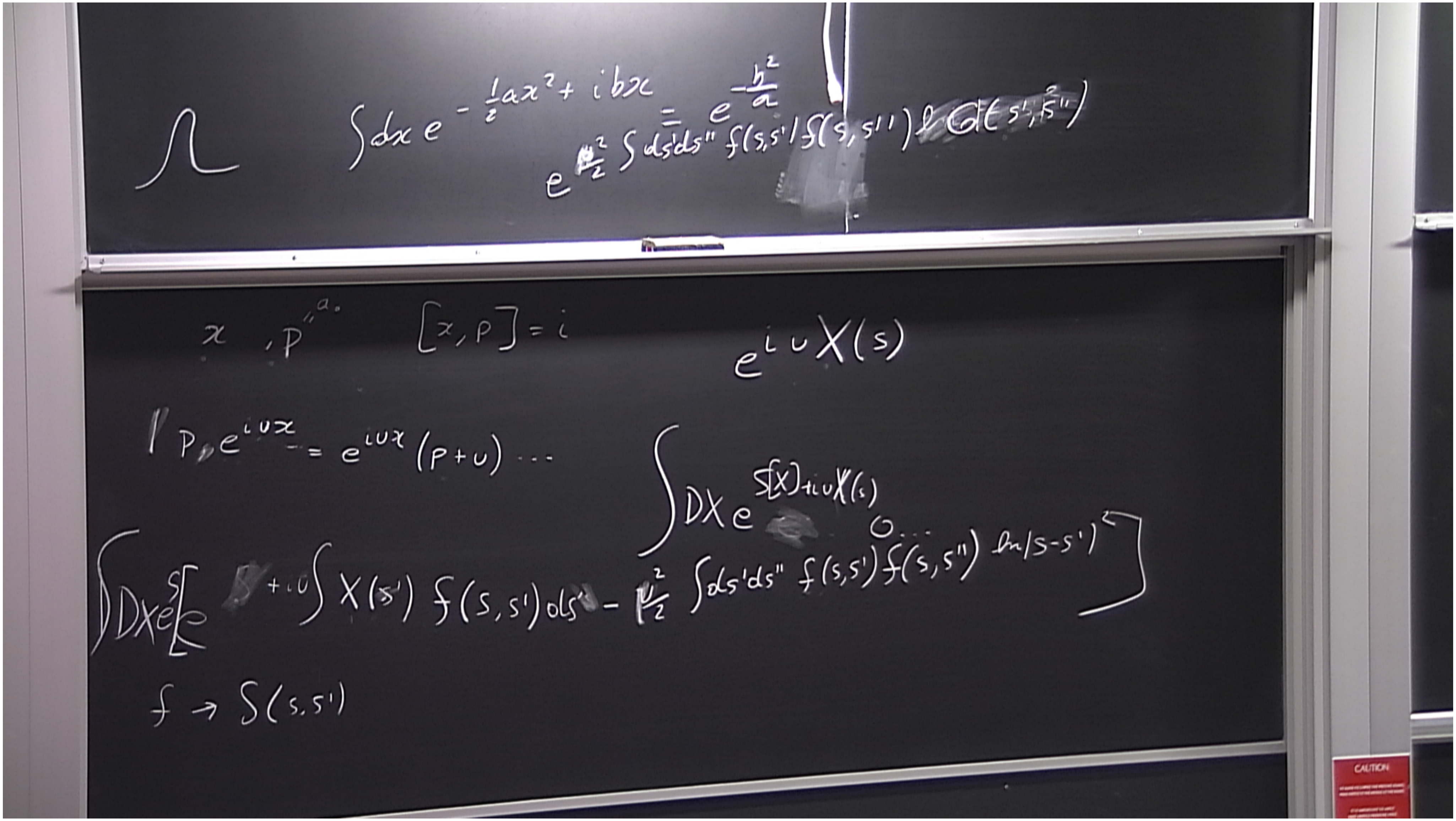
$b_n|g\rangle = 0 \qquad n \geq 0$

$|0\rangle \Longleftrightarrow 1$

$a_{-1}|0\rangle \Longleftrightarrow i\partial_z X$

$a_{-2}|0\rangle \Longleftrightarrow i\partial_z^2 X$

$a_{-1}^2|0\rangle \Longleftrightarrow :\partial_z X \partial_z X:$



$$\int dx\, e^{-\frac{1}{2}ax^2 + ibx} = e^{-\frac{b^2}{a}}$$

$$= e^{\frac{\mu^2}{2}\int ds' ds'' f(s,s') f(s,s'') \ell G(s',s'')}$$

$x \;, p^{''a.}$ $\qquad [x,p] = i$ $\qquad e^{iuX(s)}$

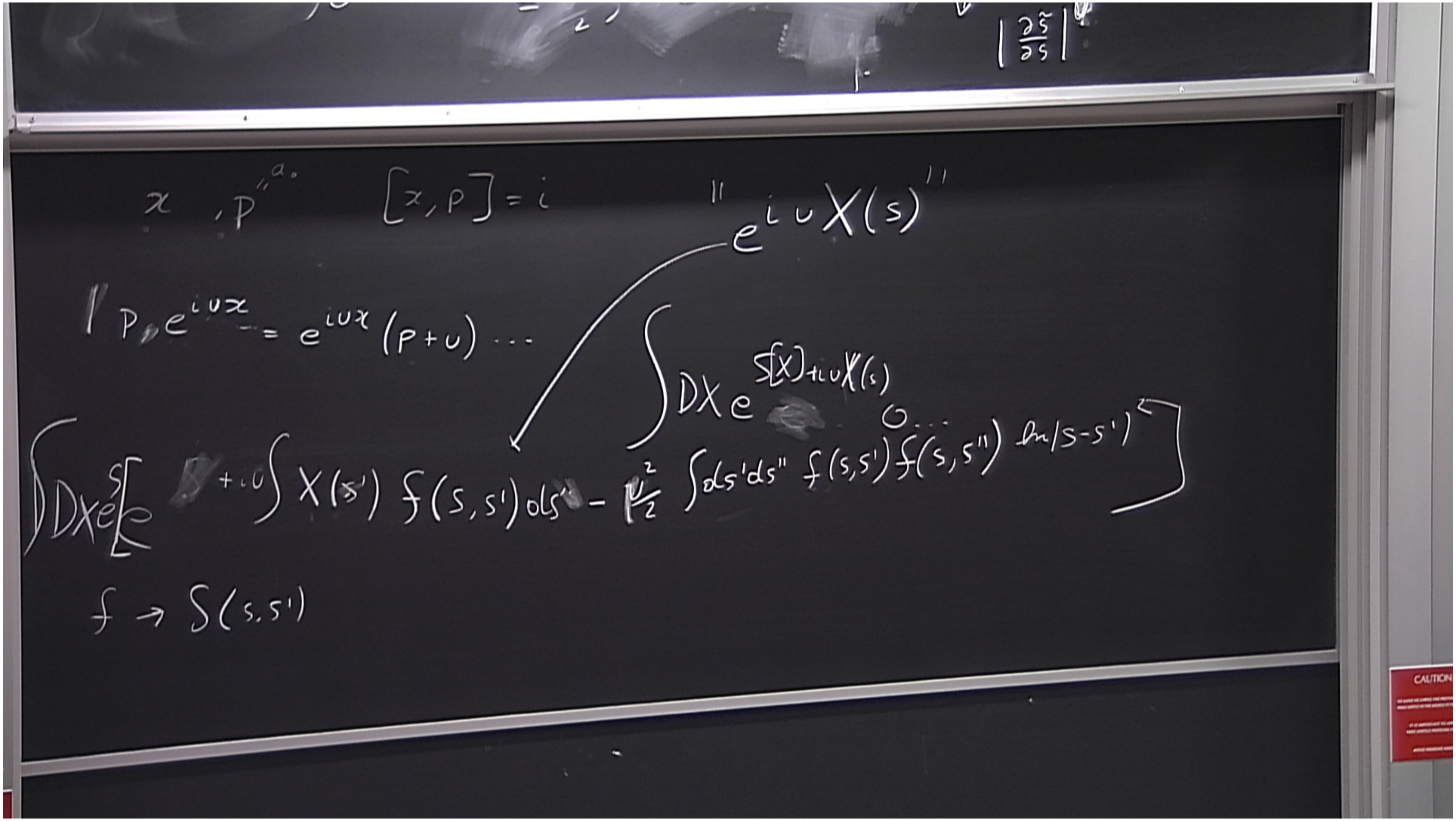
$$p\, e^{iux} = e^{iux}(p+u) \dots$$

$$\int DX\, e^{S[X] + iuX(s)}$$

$0 \dots$

$$\int DX e^{S[e + iu\int X(s') f(s,s') ds' - \frac{\mu^2}{2}\int ds' ds'' f(s,s') f(s,s'') \ln|s-s'|^2]}$$

$$f \to \delta(s,s')$$



$\left|\frac{\partial \tilde{s}}{\partial s}\right|$

$x \;, p$ "a."

$[x,p]=i$

"$e^{iuX(s)}$"

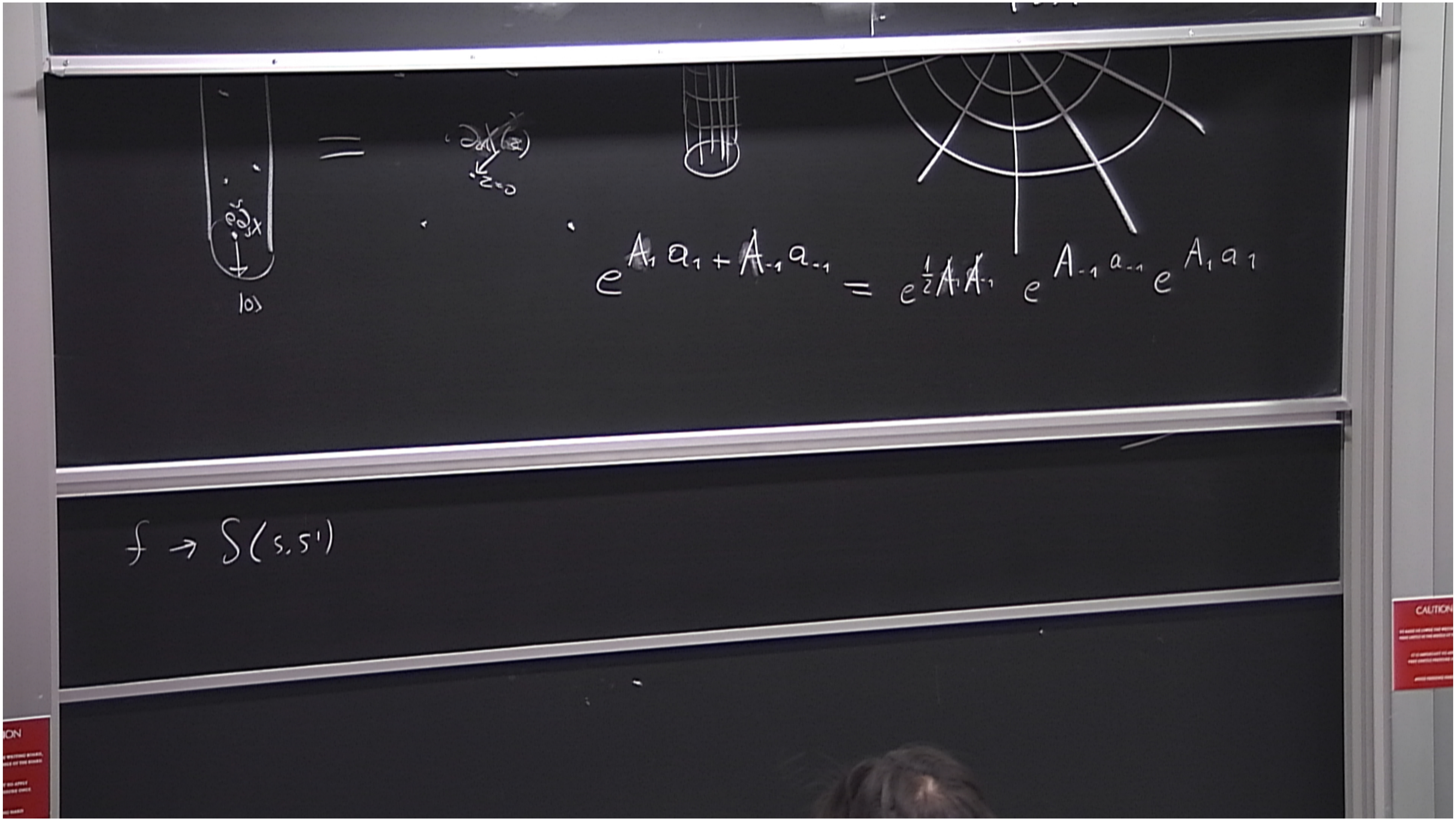
$p\, e^{iux} = e^{iux}(p+u)\dots$

$\int DX\, e^{S[X]+iuX(s)}$

$0\dots$

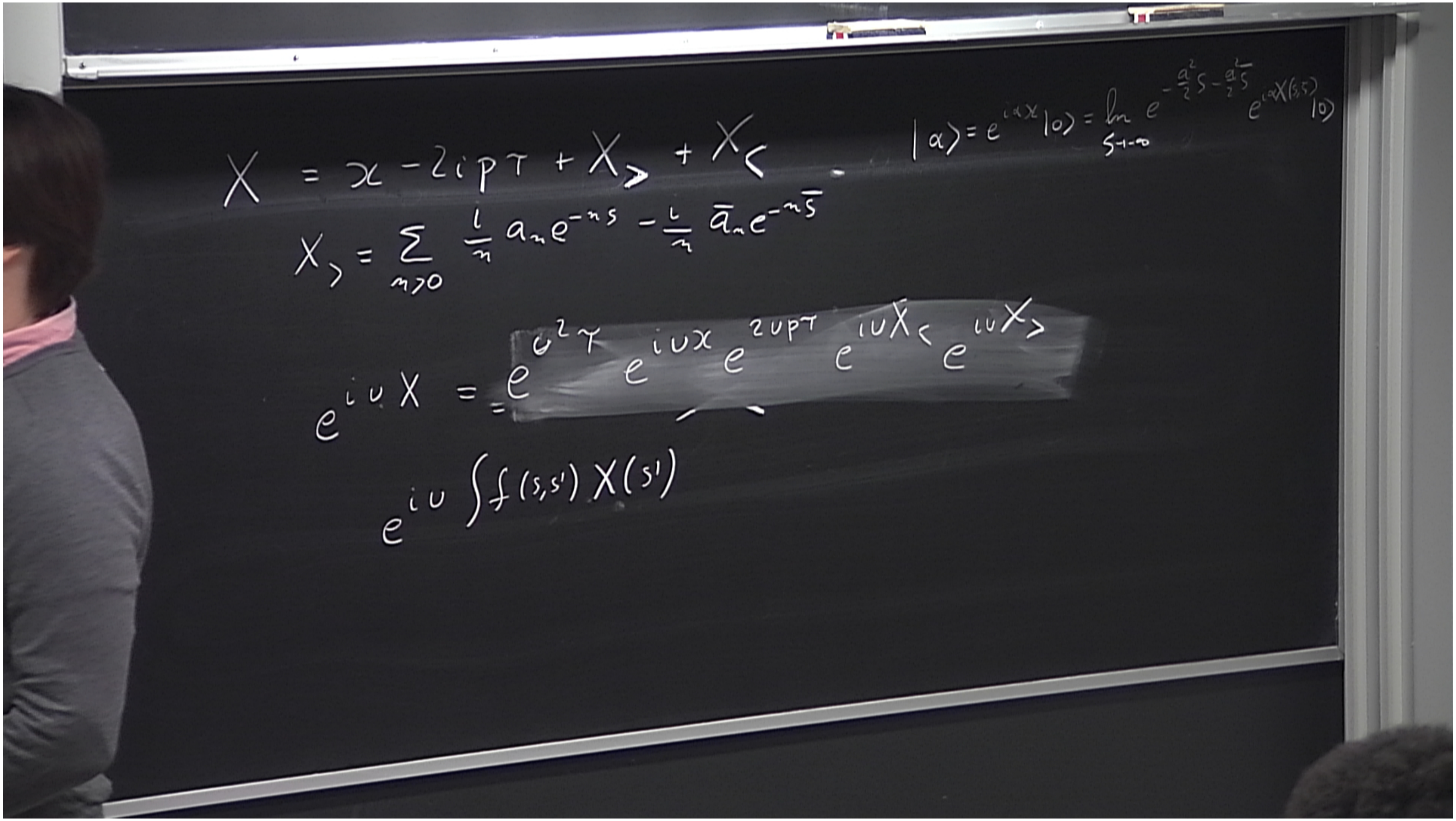
$\int DX\, e^{S}\left[e^{+iu\int X(s')f(s,s')ds' - \frac{u^2}{2}\int ds'ds''\, f(s,s')f(s,s'')\ln|s-s'|^2}\right]$

$f \to \delta(s,s')$



$$e^{A_1 a_1 + A_{-1} a_{-1}} = e^{\frac{1}{2} A_1 A_{-1}} \, e^{A_{-1} a_{-1}} \, e^{A_1 a_1}$$

$f \to S(s, s')$



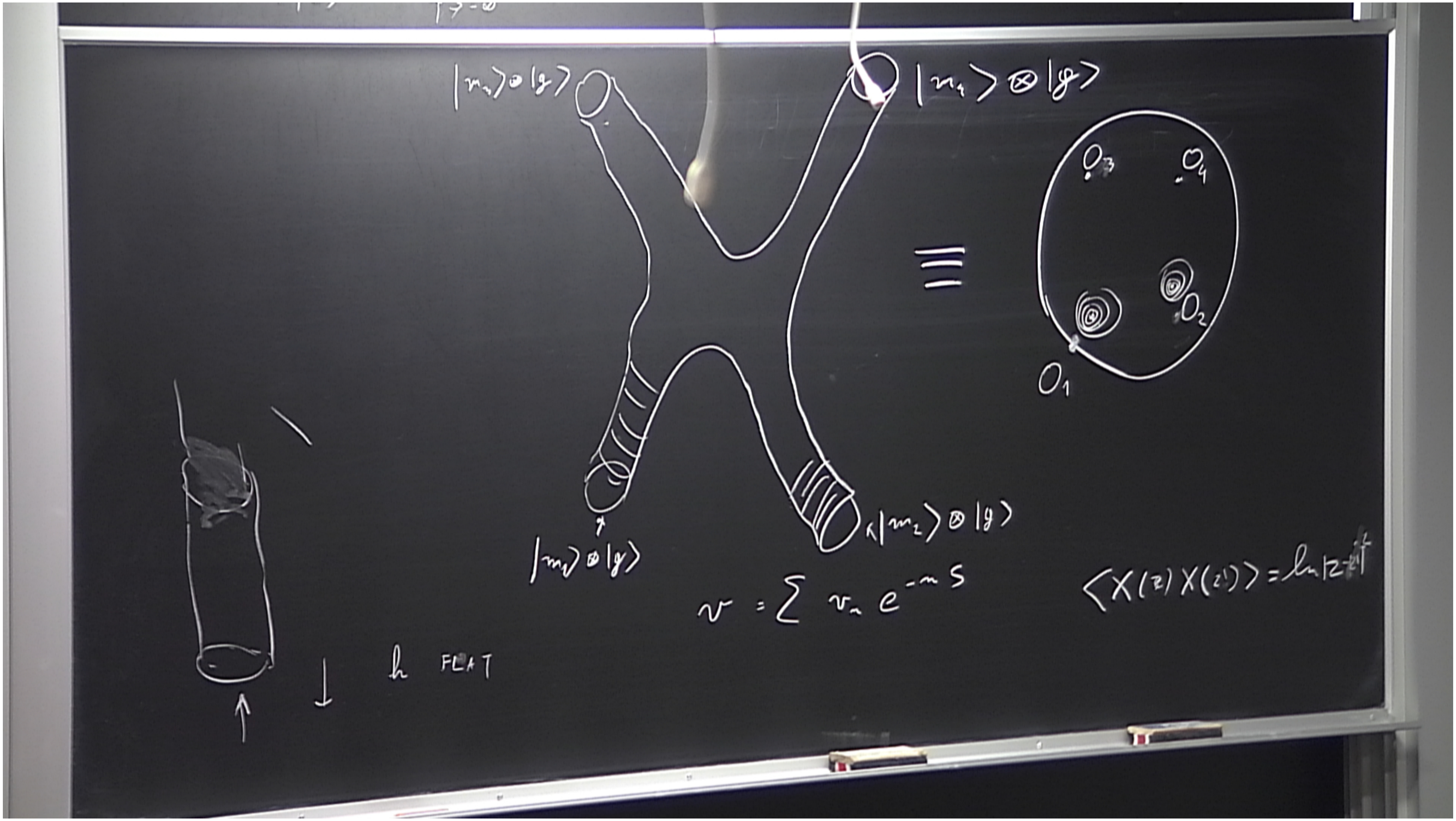
$$|\alpha\rangle = e^{i\alpha x}|0\rangle = \lim_{s\to-\infty} e^{-\frac{a^2}{2}s-\frac{a^2}{2}\bar{s}}\, e^{i\alpha X(s,\bar{s})}|0\rangle$$

$$X = x - 2ip\tau + X_> + X_<$$

$$X_> = \sum_{n>0} \frac{i}{n} a_n e^{-ns} - \frac{i}{n}\bar{a}_n e^{-n\bar{s}}$$

$$e^{iuX} = e^{u^2\tau}\, e^{iux}\, e^{2up\tau}\, e^{iuX_<}\, e^{iuX_>}$$

$$e^{iu\int f(s,s')X(s')}$$



$$v = \sum v_n e^{-nS}$$

$$\langle X(z) X(z') \rangle = \ln|z-z'|$$