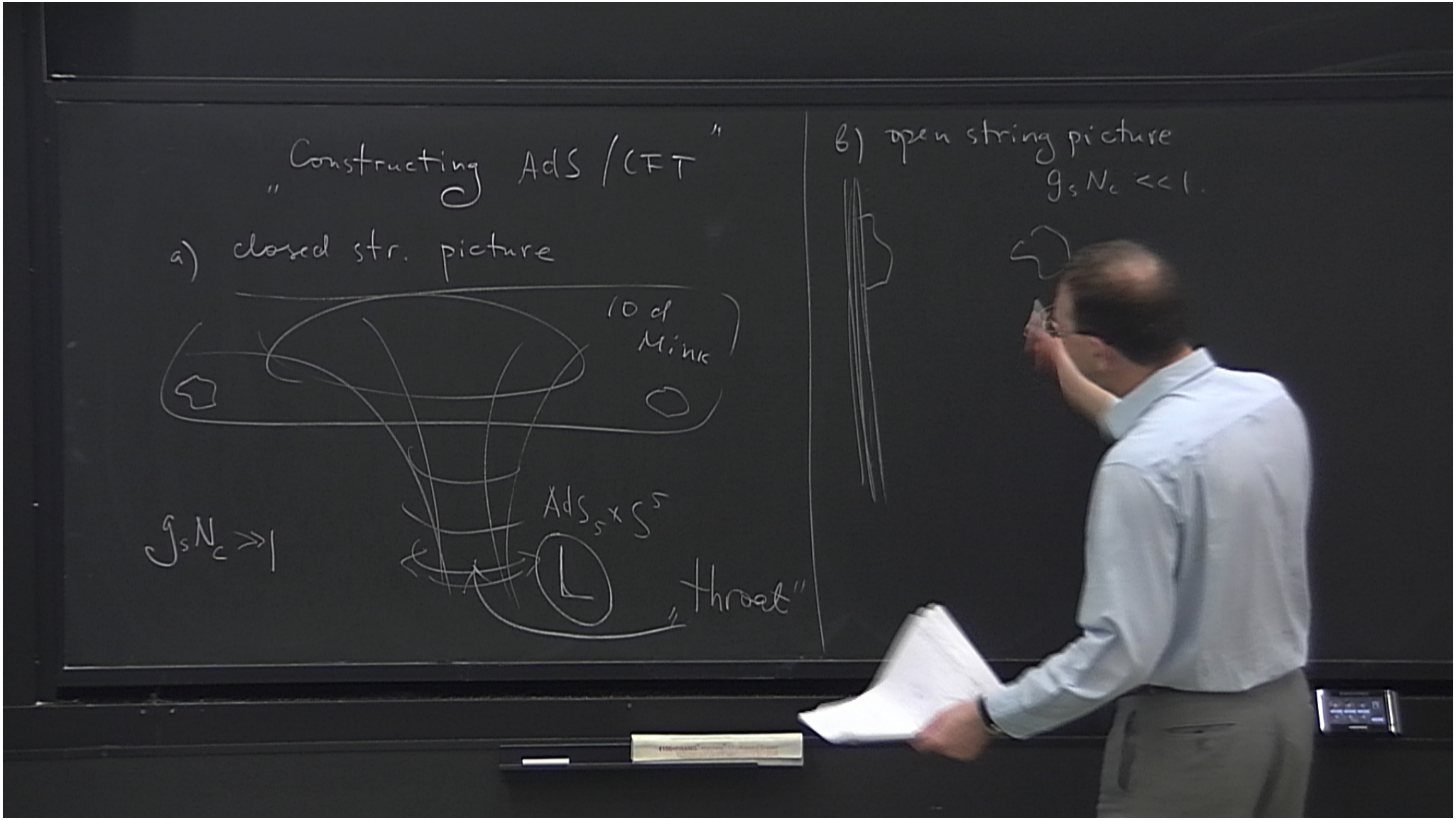
Title: 13/14 PSI - Explorations in String Theory - Lecture 9

Date: Mar 27, 2014 11:30 AM

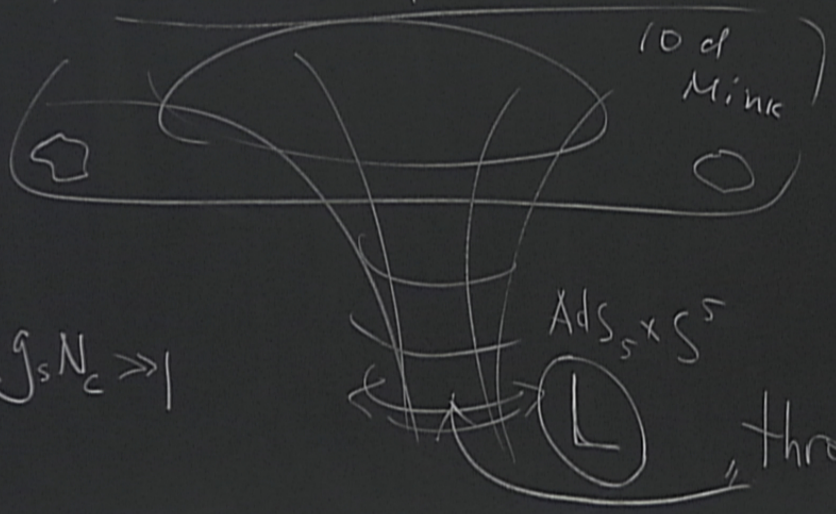
URL: http://pirsa.org/14030069

Abstract:


"Constructing AdS/CFT"
a) closed str. picture
10 of Mink
$AdS_5 \times S^5$
L
"throat"
$g_s N_c \gg 1$
b) open string picture
$g_s N_c \ll 1$.

"Constructing AdS/CFT"

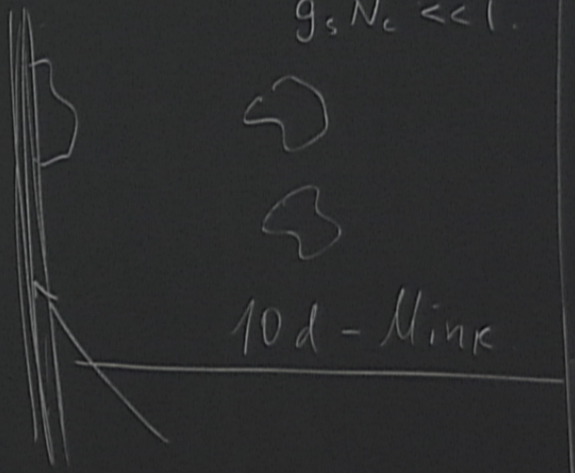
a) closed str. picture

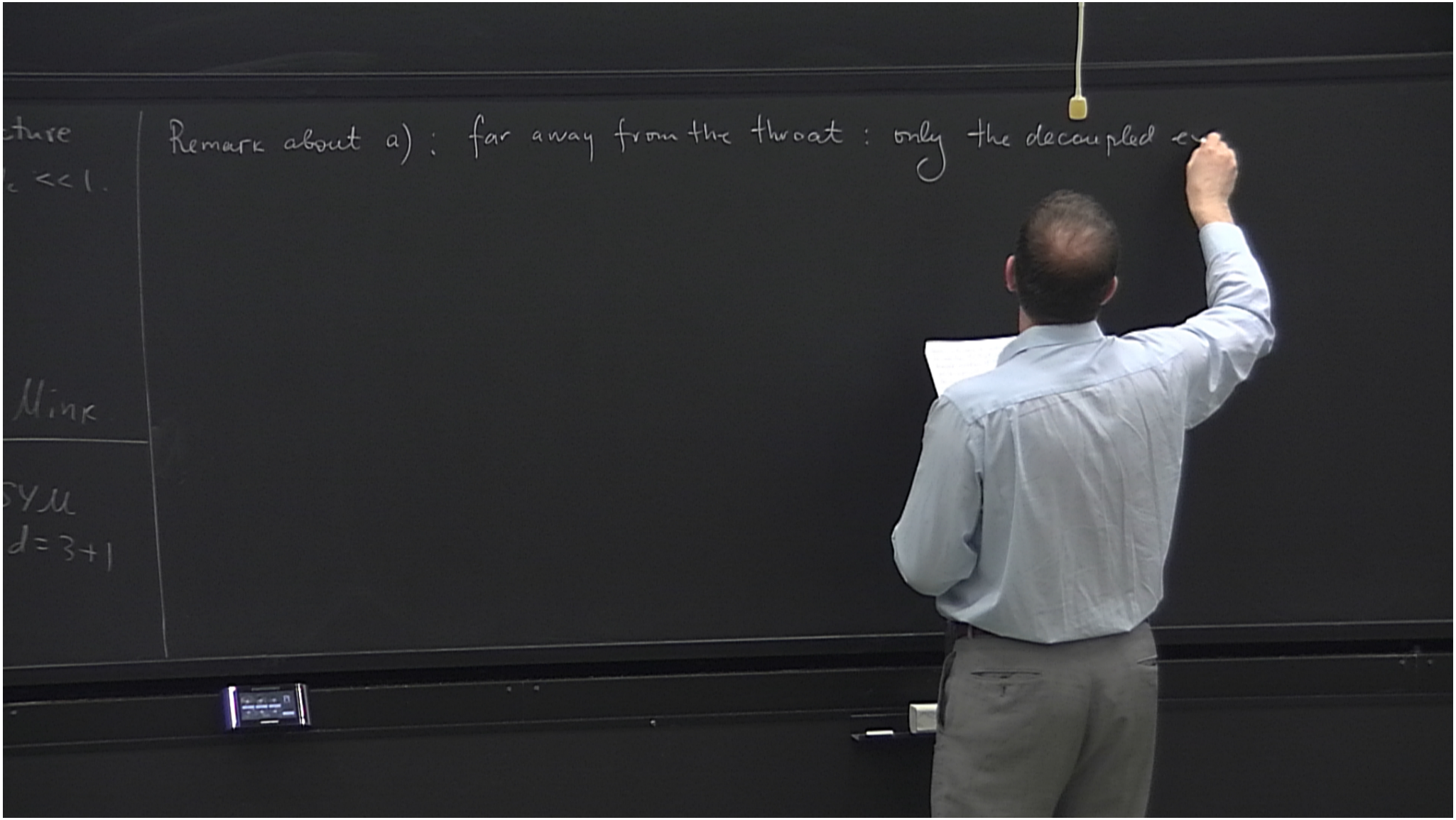


$g_s N_c \gg 1$

b) open string picture

$g_s N_c \ll 1$.




Remark about a) : far away from the throat : only the decoupled
Mink
d=3+1

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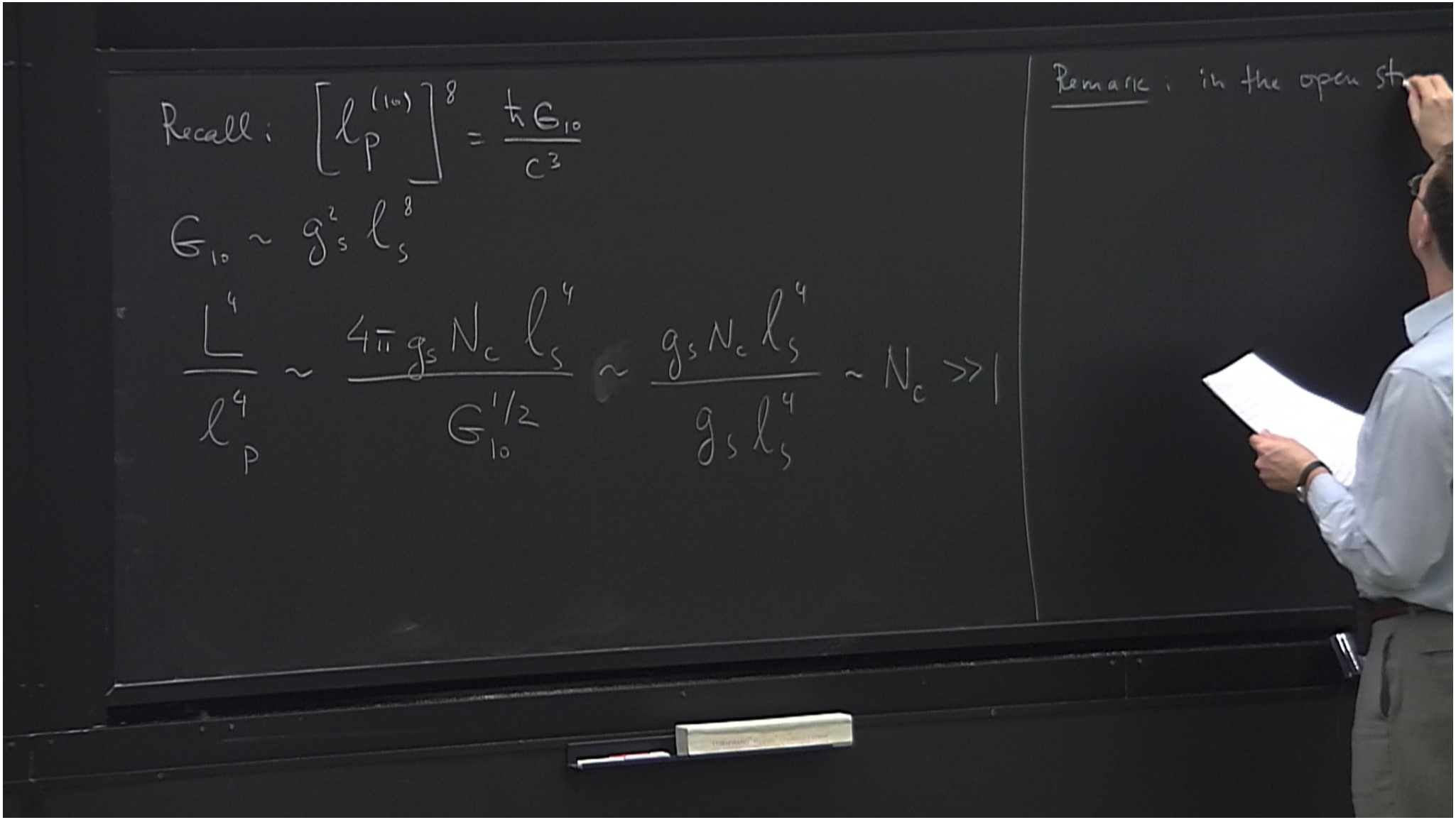
Remark about a): far away from the throat: only the decoupled excitations of the $d=10$ graviton supermultiplet are relevant at low energy ($E \ll 1/\ell_s$) but arbitrarily large excitations of type IIB strings are relevant deep down the throat since they are redshifted from the point of view of an asympt. obser

Remark: computing curvature invar. (e.g. Kretschmann – exercise) for $p=3$ brane sol. $\Rightarrow$ they are OK for $g_s N_c \gg 1$

Absence of quantum grav. corr.: $L \gg \ell_p \Rightarrow L^4 \gg \ell_p^4$


Recall: $\left[\ell_p^{(10)}\right]^8 = \frac{\hbar G_{10}}{c^3}$
$G_{10} \sim g_s^2 \ell_s^8$
$\frac{L^4}{\ell_p^4} \sim \frac{4\pi g_s N_c \ell_s^4}{G_{10}^{1/2}} \sim \frac{g_s N_c \ell_s^4}{g_s \ell_s^4} \sim N_c \gg 1$
Remark: in the open st

Conjecture (Maldacena, 1997): $\underline{\mathrm{I}}$ and $\overline{\underline{\mathrm{II}}}$ describe the same object.

$\mathcal{N}=4$ $SU(N_c)$ SYM in $d=3+1$ = type IIB superstr. th. on $AdS_5 \times S^5$

Remark: $\mathcal{N}=4$ SYM is a highly constrained theory, some quantities are the same for weak and strong coupling (e.g. scaling dim of some operators). One may expect that computing these quantities in pictures $\underline{\mathrm{I}}$, $\overline{\underline{\mathrm{II}}}$, one gets the same result. This is indeed the case (see I. Klebanov hep-th/9702076)

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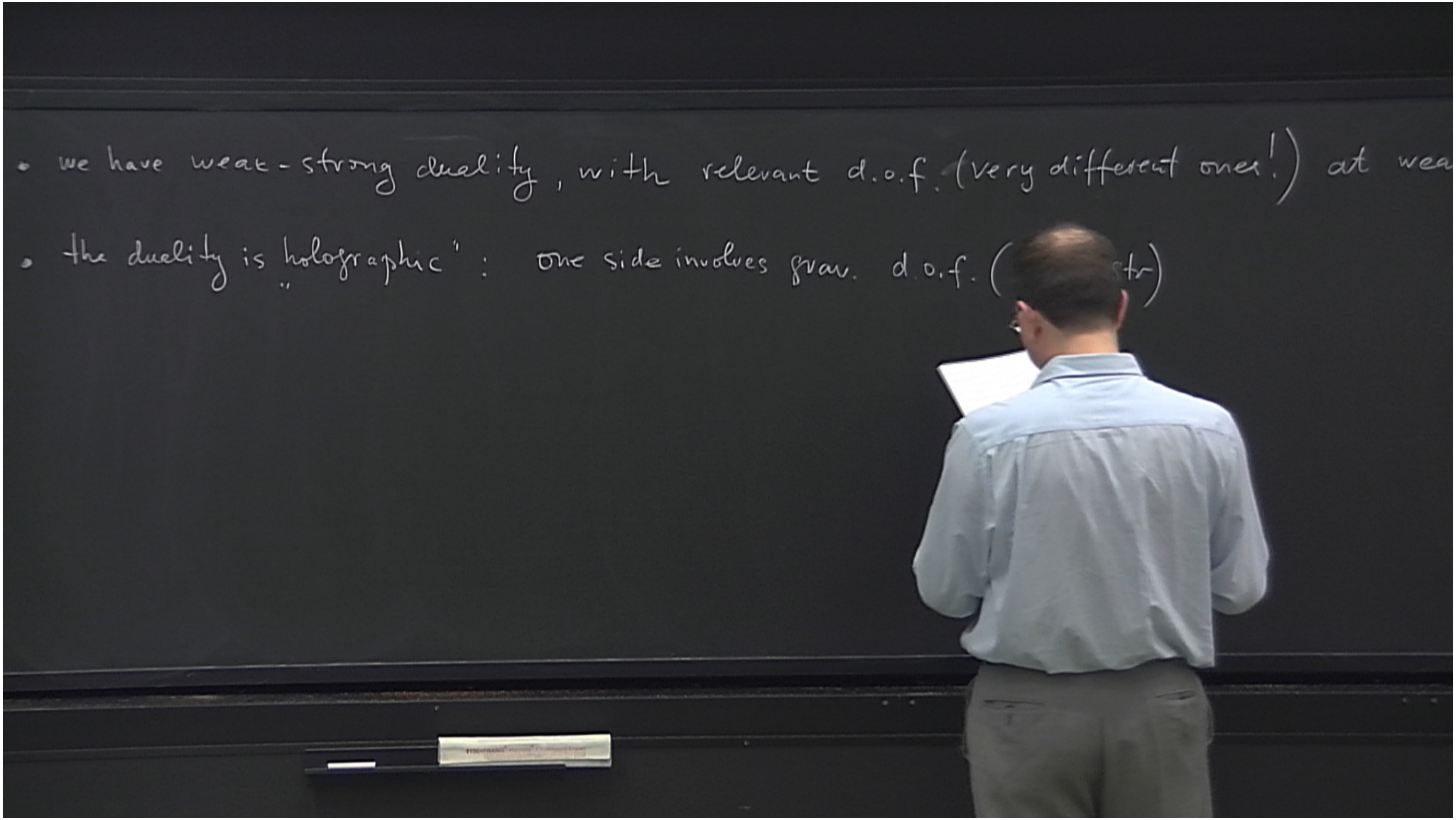
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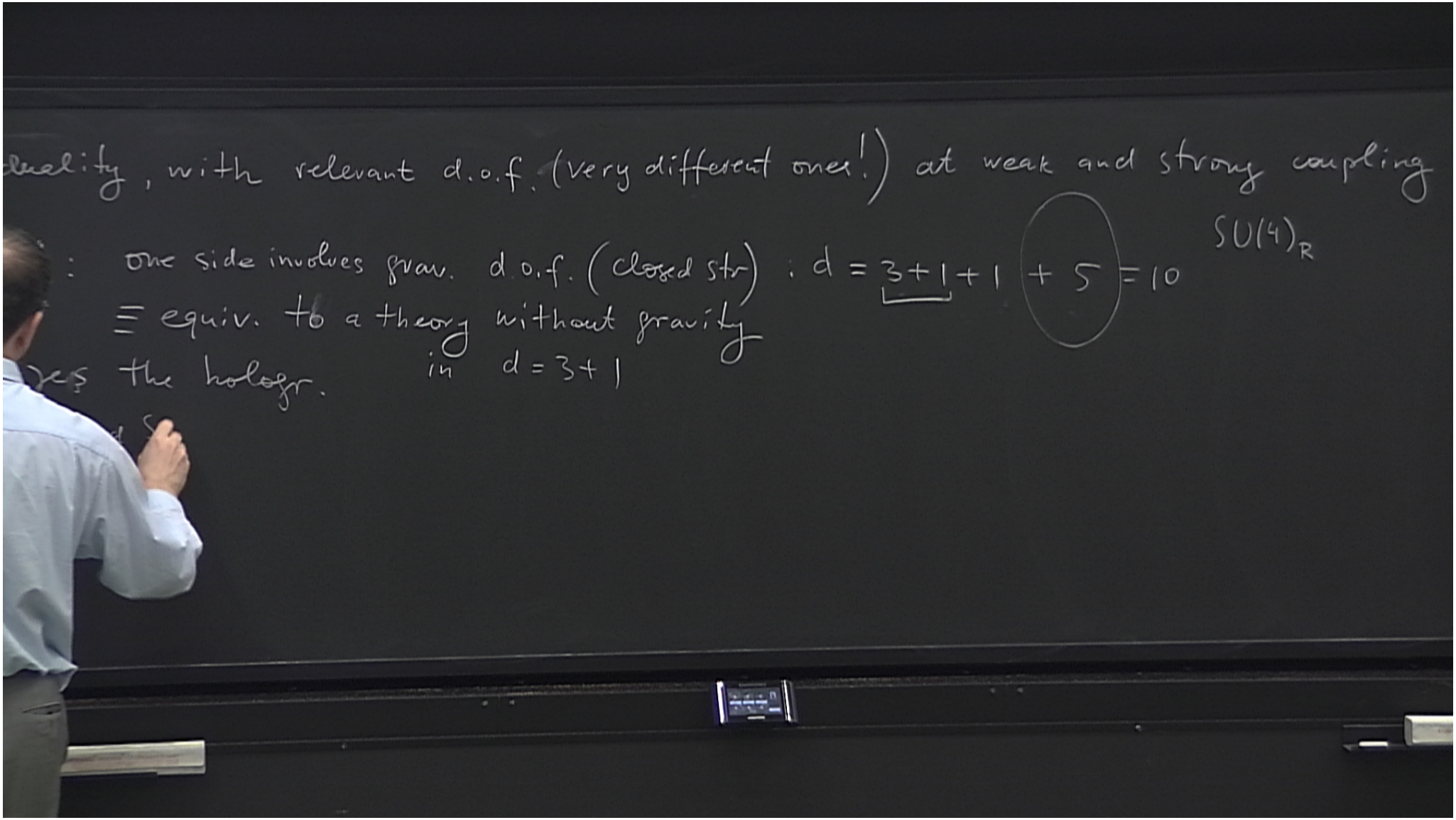

duality, with relevant d.o.f. (very different ones!) at weak and strong coupling
: one side involves grav. d.o.f. (closed str) : d = 3+1 + 1 + 5 = 10
SU(4)R
≡ equiv. to a theory without gravity
es the hologr.
in d = 3+1

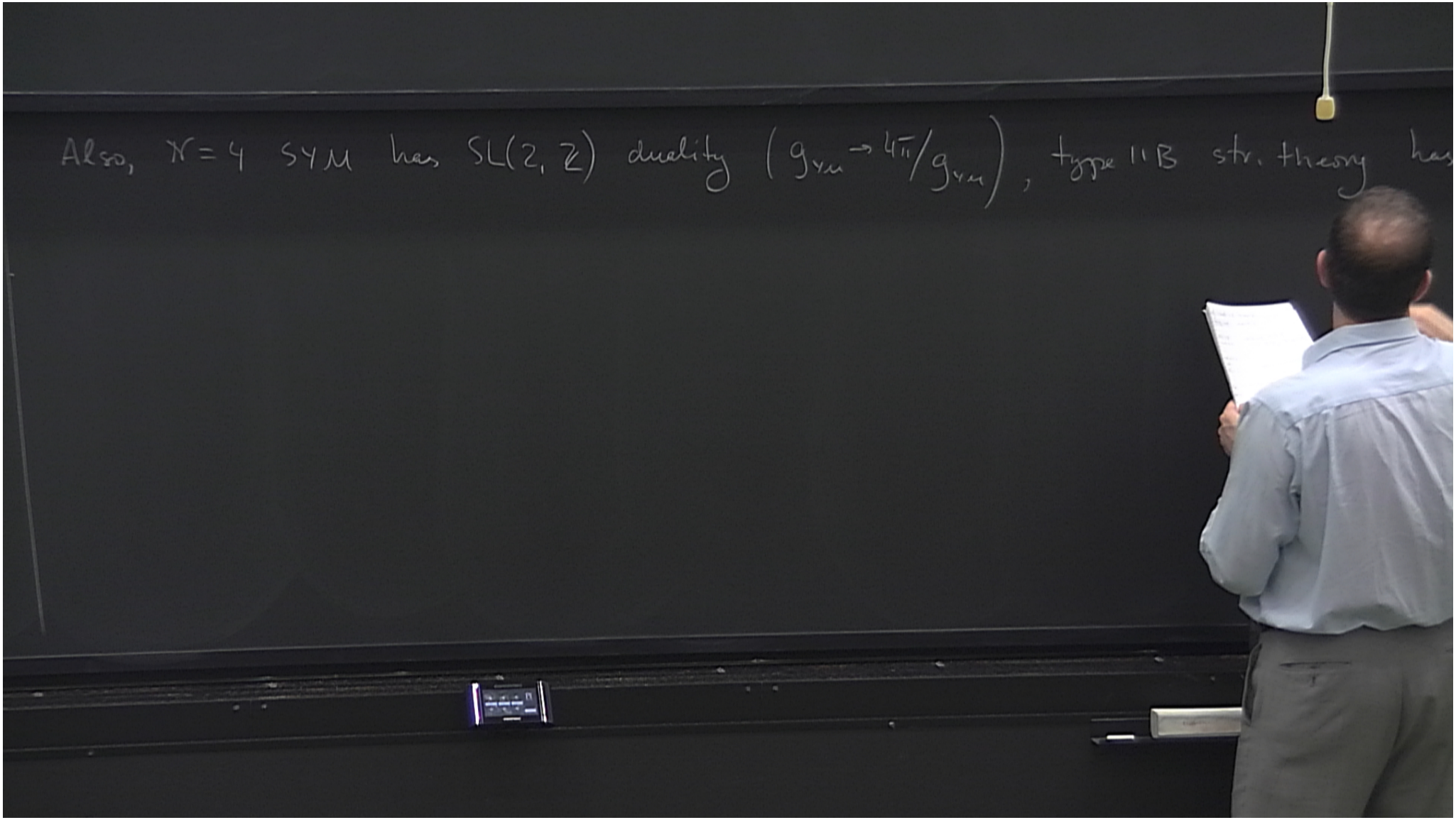
Symmetries.

$\mathcal{N}=4$ SYM : conformal $SO(4,2)$ + $SO(6)_R$ R-symm.

$AdS_5 \times S^5$ isometries : $SO(4,2) \times SO(6)$

Also, $\mathcal{N}=4$ SYM has $SL(2,\mathbb{Z})$ duality

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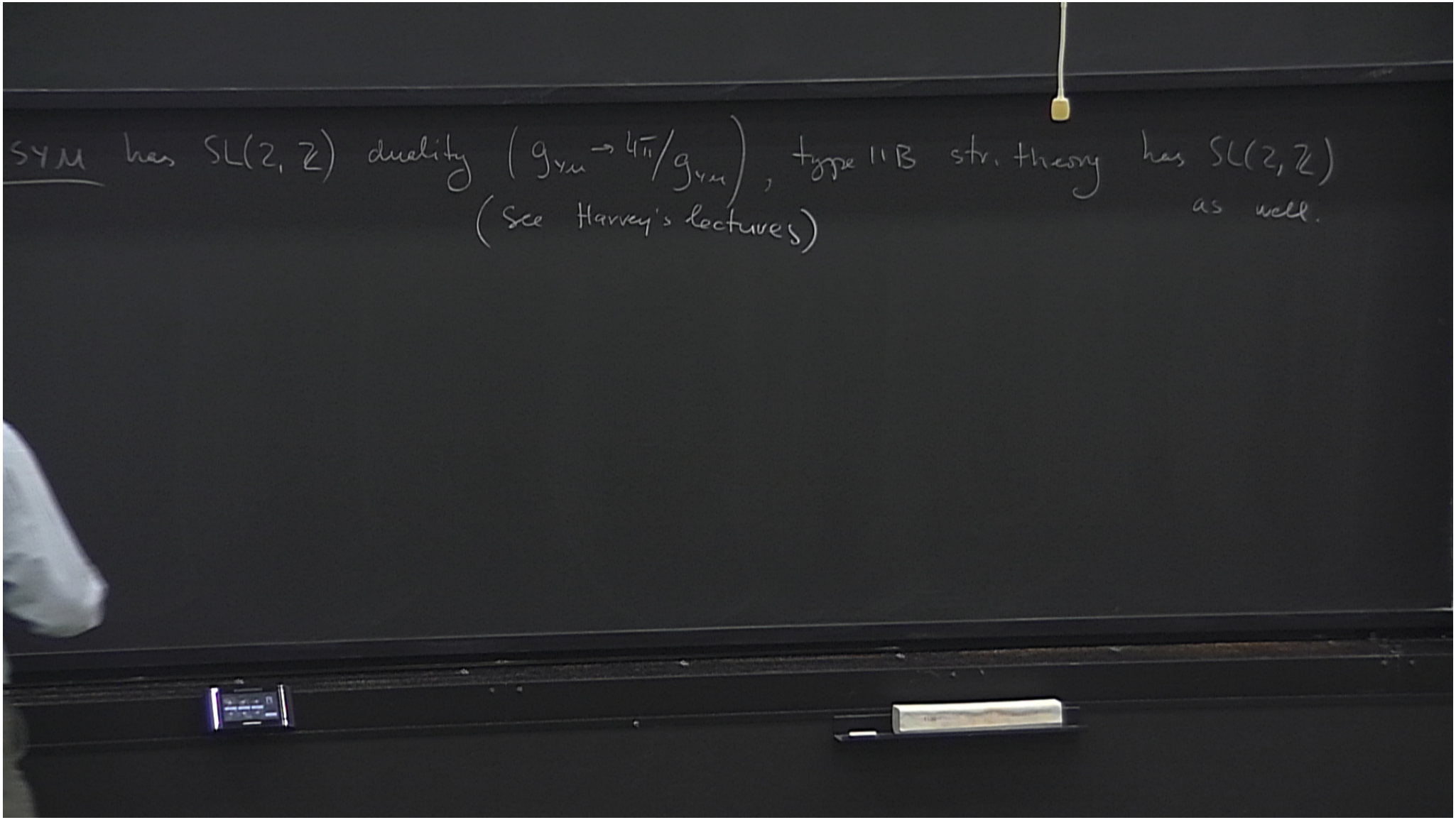
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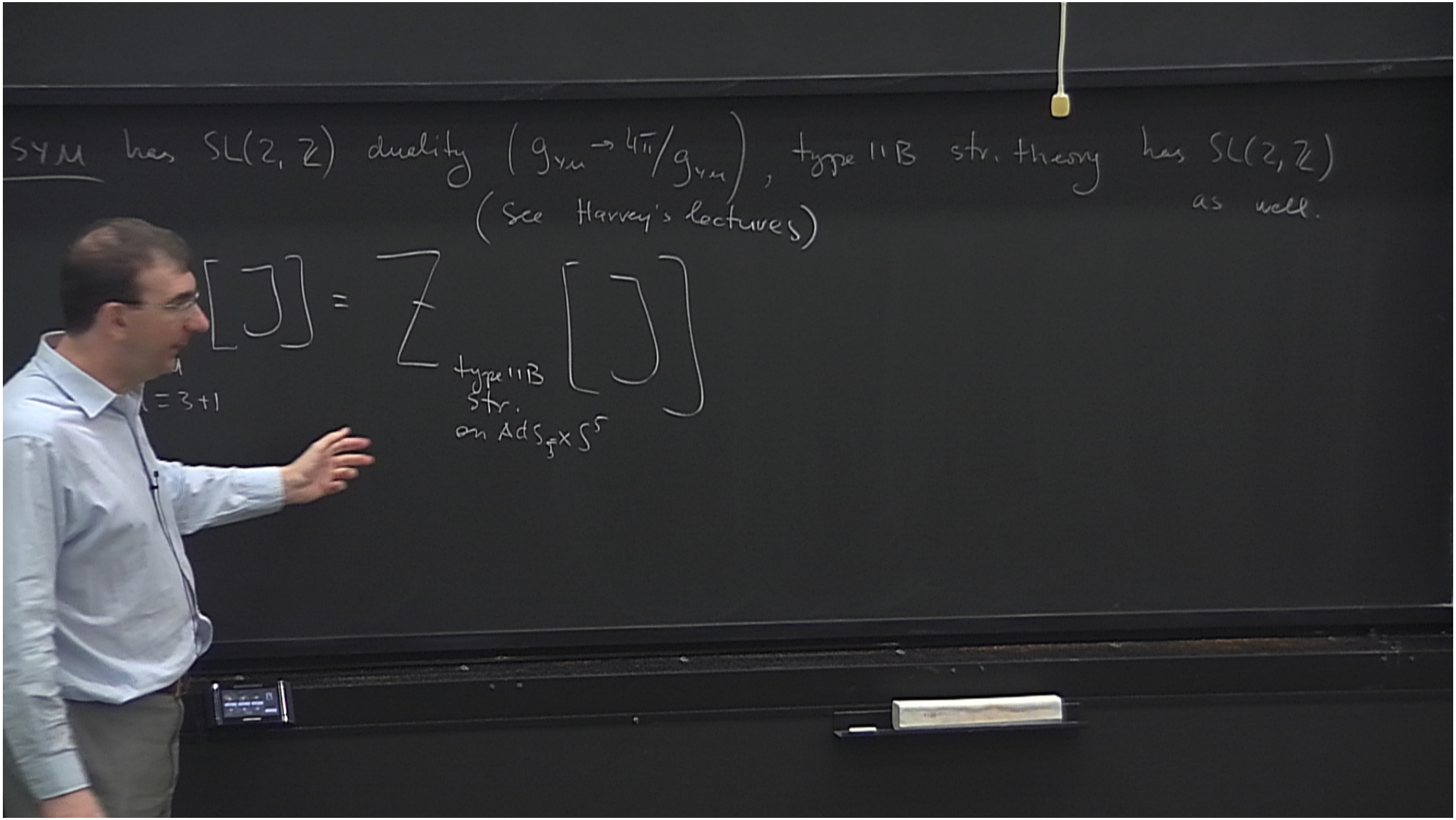
(See Harvey's lectures)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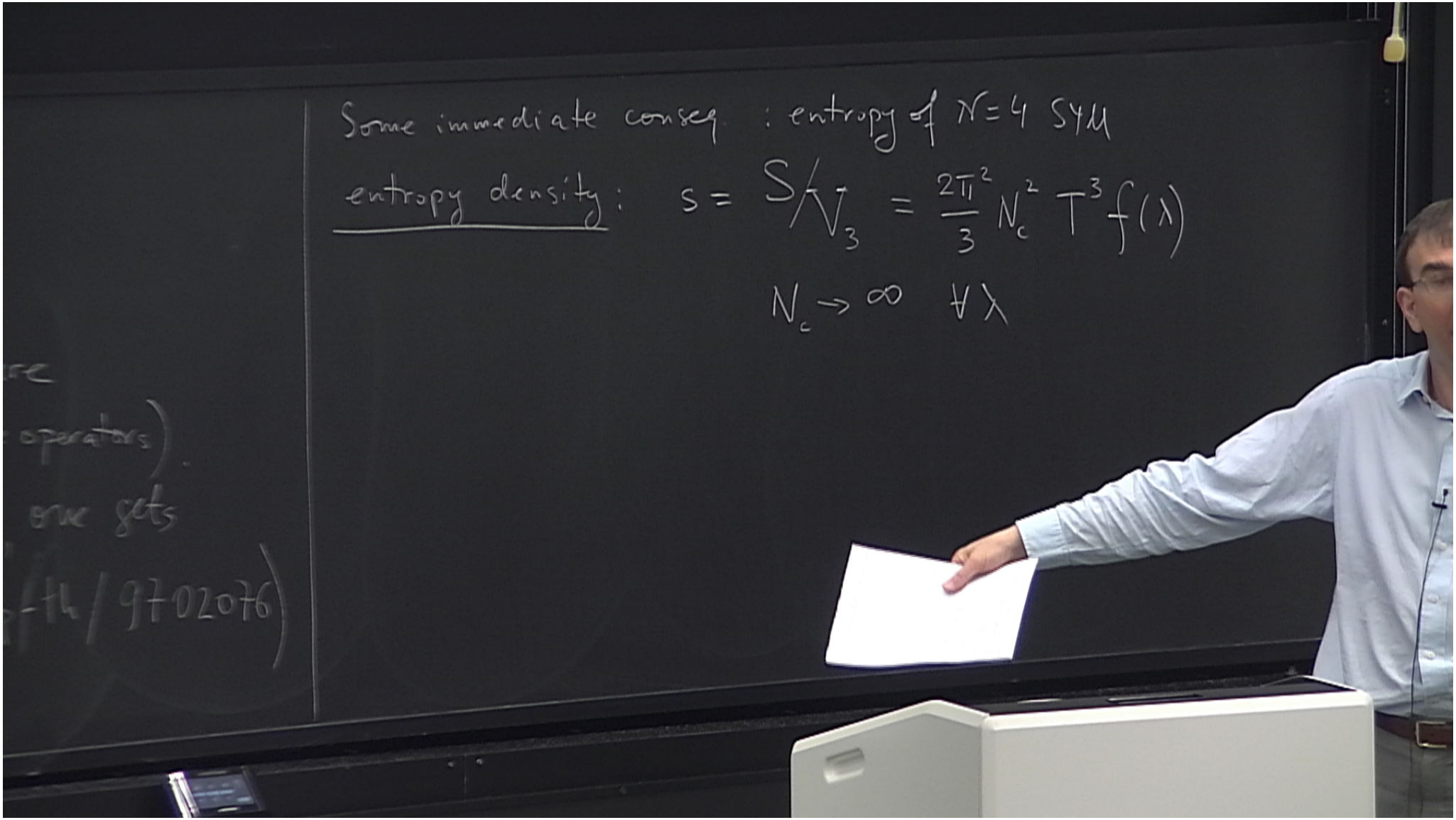
Some immediate consequ. : entropy of $\mathcal{N}=4$ SYM
entropy density: $s = S/V_3 = \frac{2\pi^2}{3} N_c^2 T^3 f(\lambda)$
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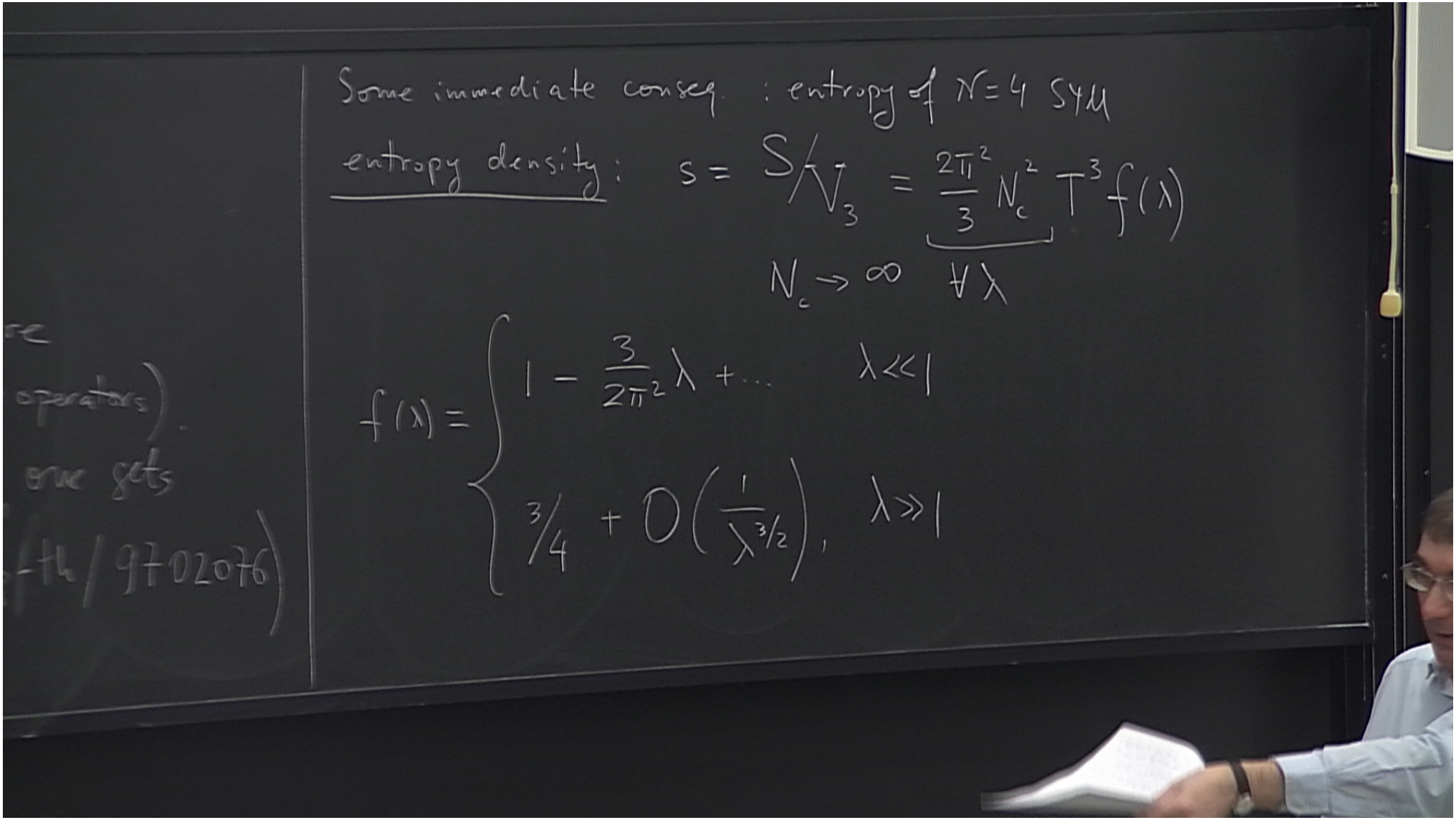
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$f(\lambda) = \begin{cases} 1 - \frac{3}{2\pi^2}\lambda + \dots & \lambda \ll 1 \\ 3/4 + O\left(\frac{1}{\lambda^{3/2}}\right), & \lambda \gg 1 \end{cases}$

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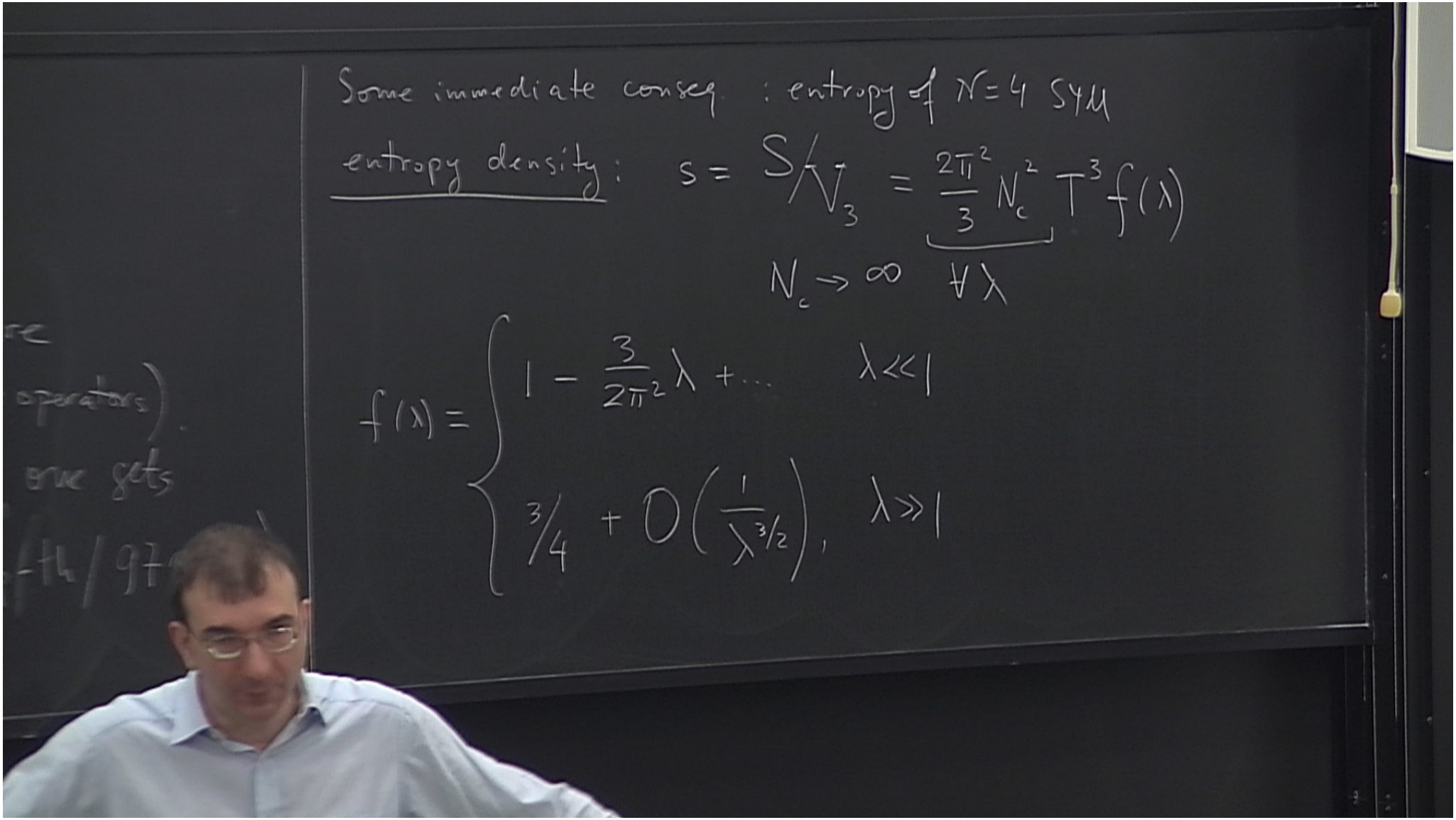
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