Title: Lecture - Twisted Holography a

Speakers:

Collection: Celestial Holography Summer School 2024

Date: July 26, 2024 - 10:00 AM

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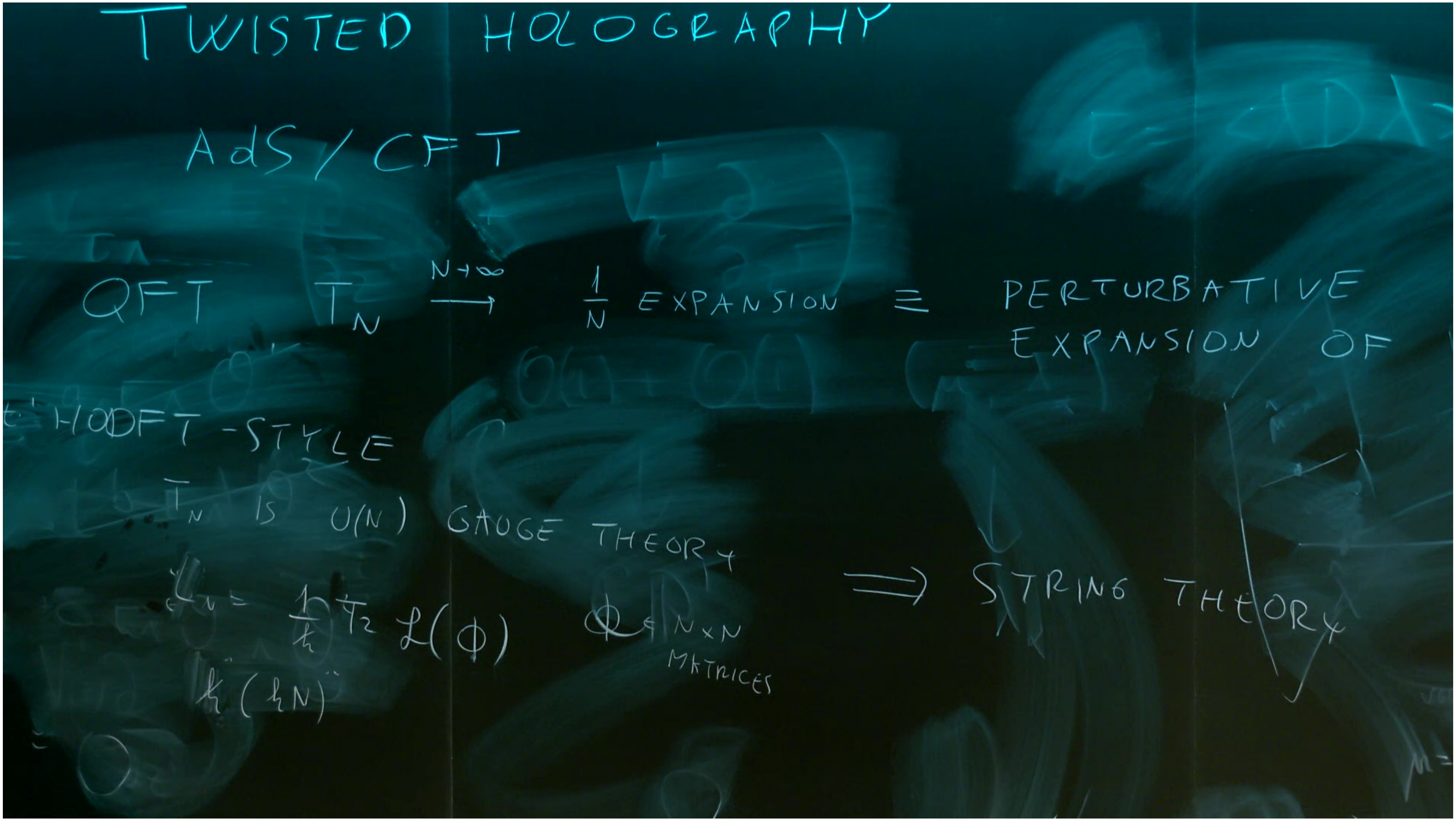
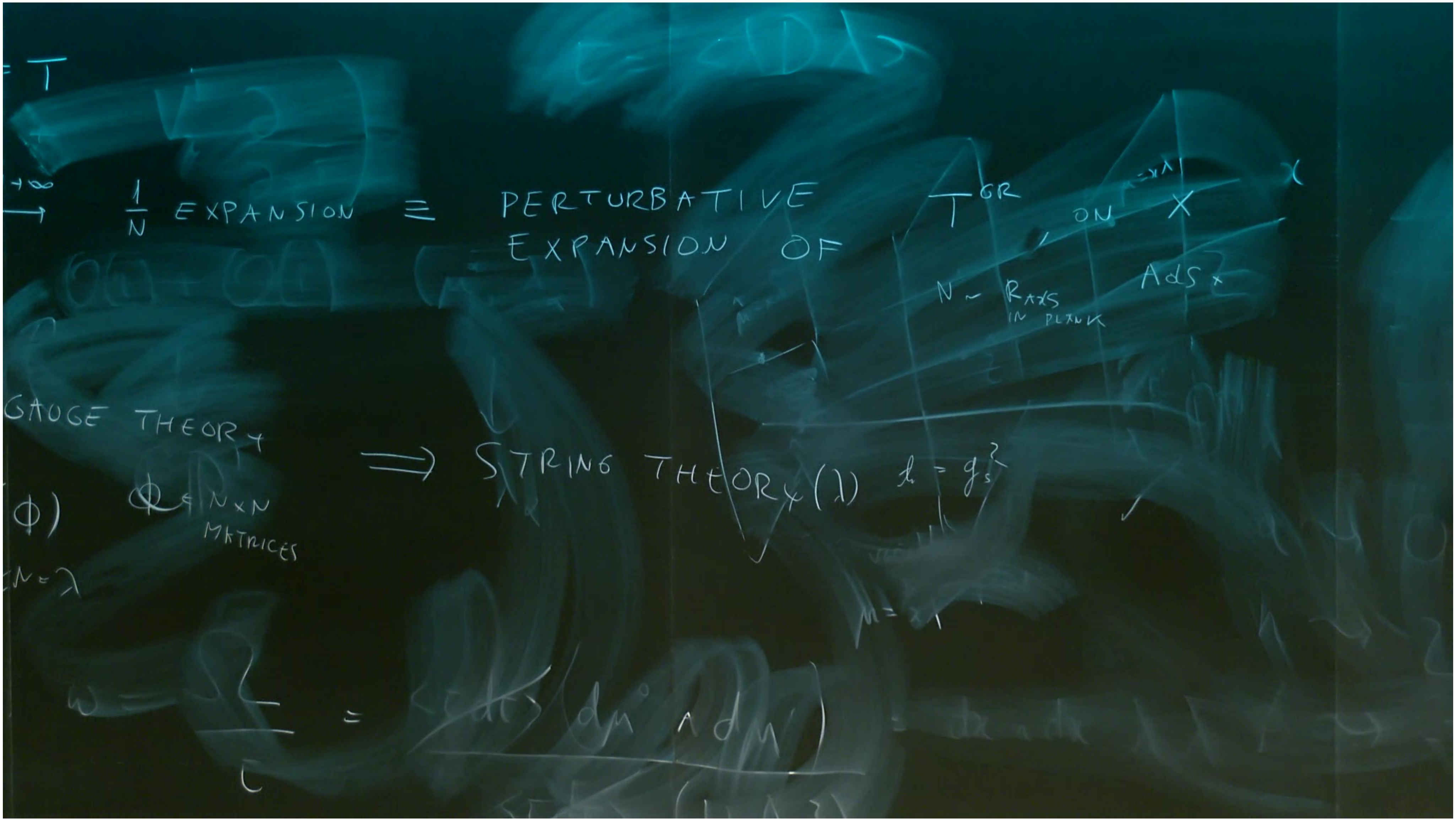
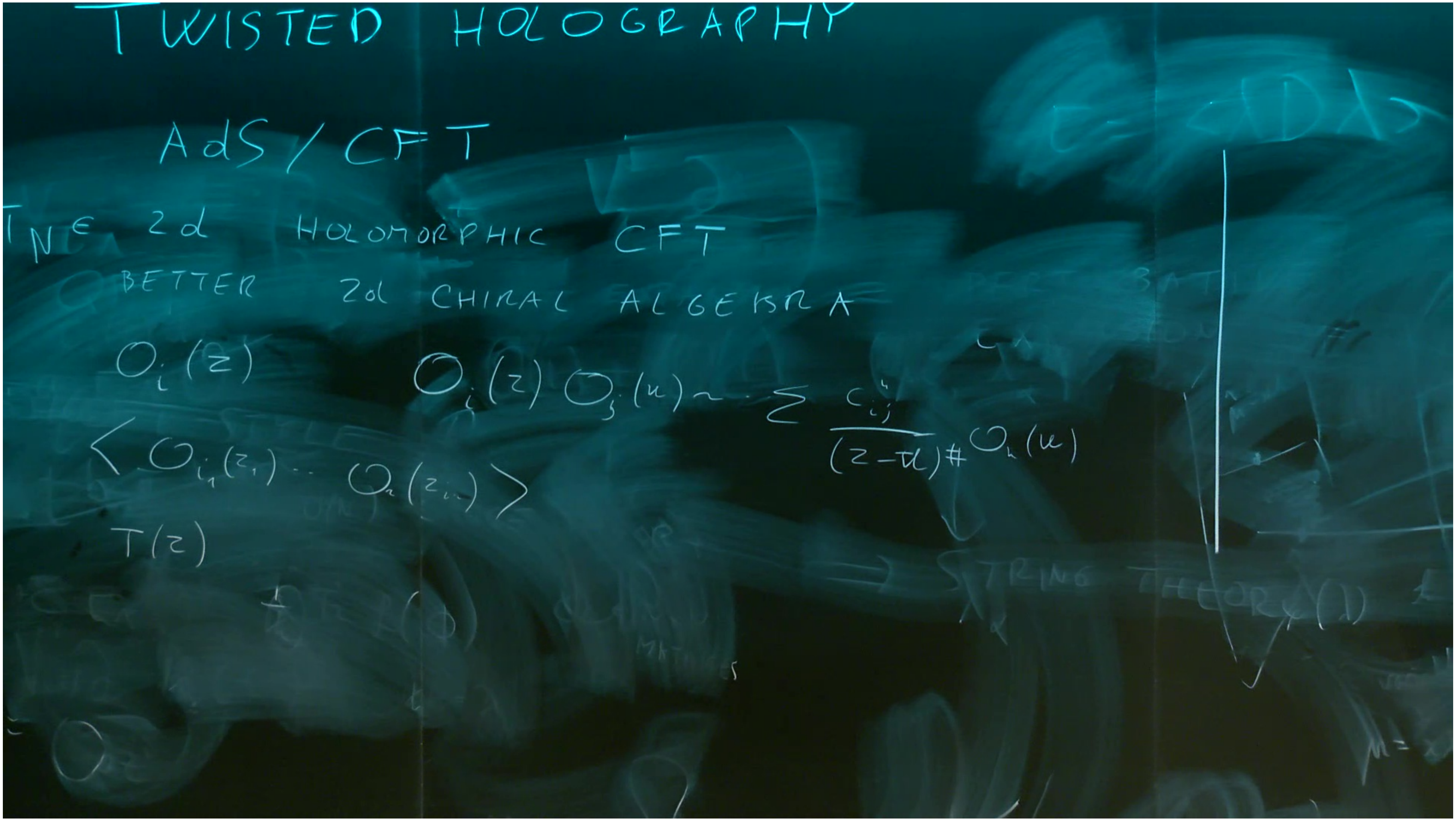
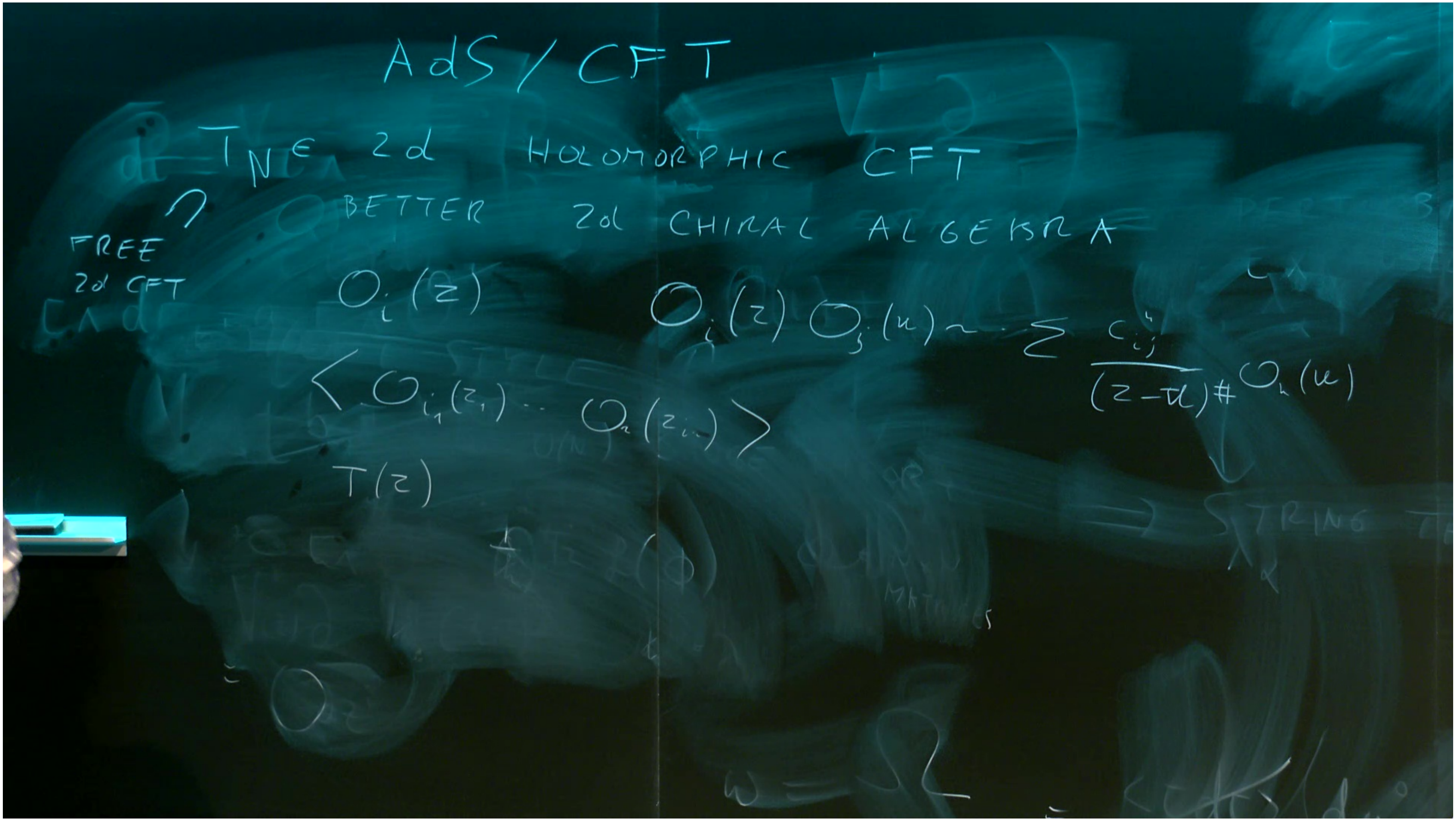

TWISTED HOLOGRAPHY
AdS / CFT
QFT T_N N→∞ 1/N EXPANSION ≡ PERTURBATIVE EXPANSION OF
t'HOOFT-STYLE
T_N IS U(N) GAUGE THEORY
L_N = 1/ħ Tr L(Φ) Φ ∈ N×N MATRICES
ħ (ħN)
⟹ STRING THEORY


1/N EXPANSION ≡ PERTURBATIVE EXPANSION OF T^GR ON X
N ~ R_AdS IN PLANK
AdS ×
GAUGE THEORY
Φ ∈ N×N MATRICES
⟹ STRING THEORY (λ)


TWISTED HOLOGRAPHY
AdS / CFT
2d HOLOMORPHIC CFT
BETTER 2d CHIRAL ALGEBRA
$\mathcal{O}_i(z)$
$\mathcal{O}_i(z)\,\mathcal{O}_j(w) \sim \sum \frac{c_{ij}^{k}}{(z-w)^{\#}}\,\mathcal{O}_k(w)$
$\langle \mathcal{O}_{i_1}(z_1) \cdots \mathcal{O}_{i_n}(z_n) \rangle$
$T(z)$
STRING THEORY


AdS / CFT
THE 2d HOLOMORPHIC CFT
? BETTER 2d CHIRAL ALGEBRA
FREE 2d CFT
$O_i(z)$
$O_i(z)\, O_j(w) \sim \sum \frac{c_{ij}^{k}}{(z-w)^{\#}} O_k(w)$
$\langle O_{i_1}(z_1) \ldots O_{i_n}(z_{n}) \rangle$
$T(z)$

TWISTED HOLOGRAPHY

4d $N=4$ SYM

AdS / CFT

THE 2d HOLOMORPHIC CFT

BETTER 2d CHIRAL ALGEBRA

FREE 2d CFT

$O_i(z)$

$$O_i(z)\, O_j(u) \sim \sum \frac{C_{ij}^{k}}{(z-u)^{\#}}\, O_k(u)$$

$$\langle O_{i_1}(z_1) \cdots O_{i_n}(z_n) \rangle$$

$T(z)$

IIB ON $AdS_5 \times S_5$

$\cup$

HOLOMORPHIC GRAVITY ON 3d CY

KODAIRA SPENCER / BCOV

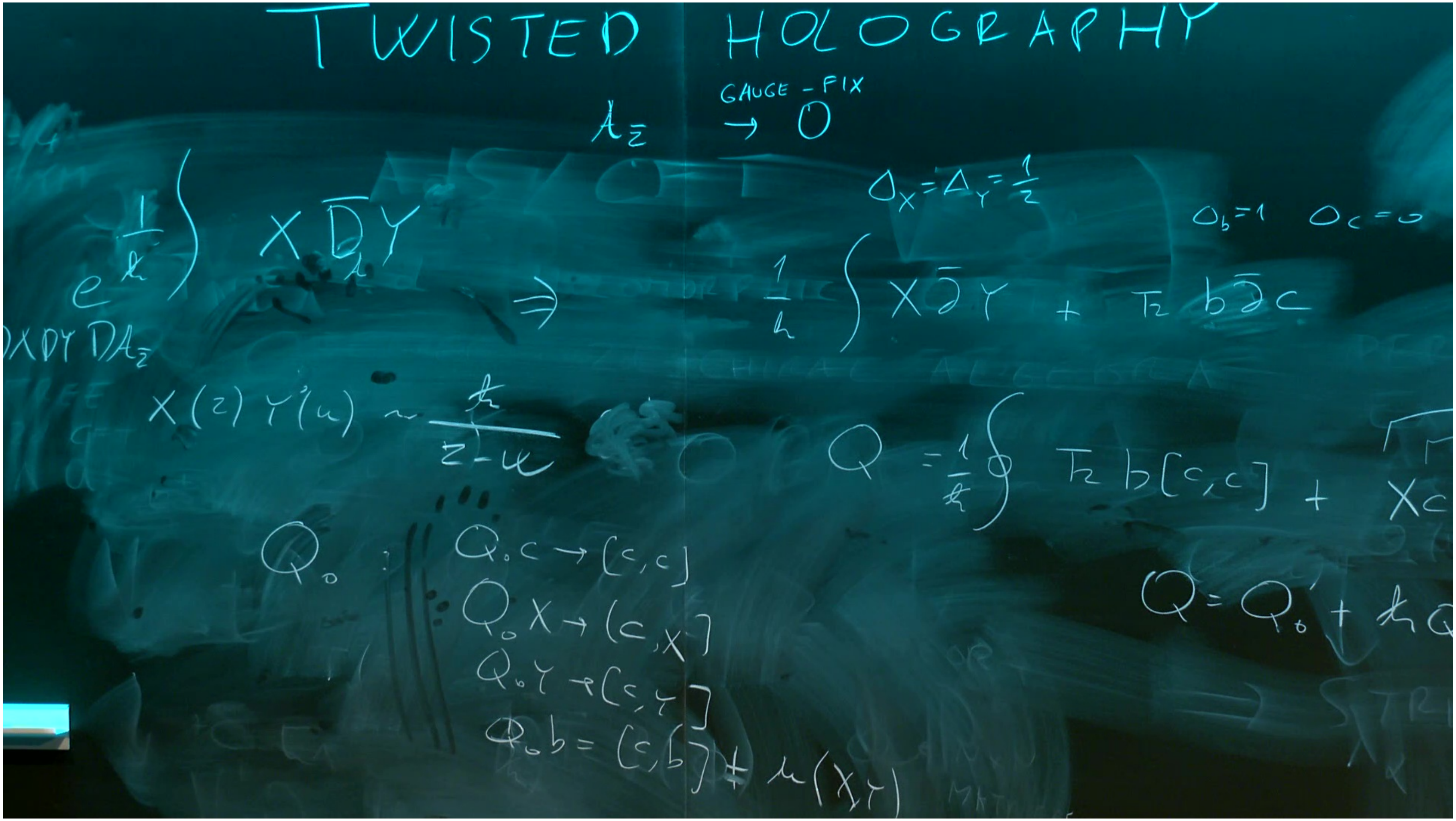
NON-RENORMALIZA

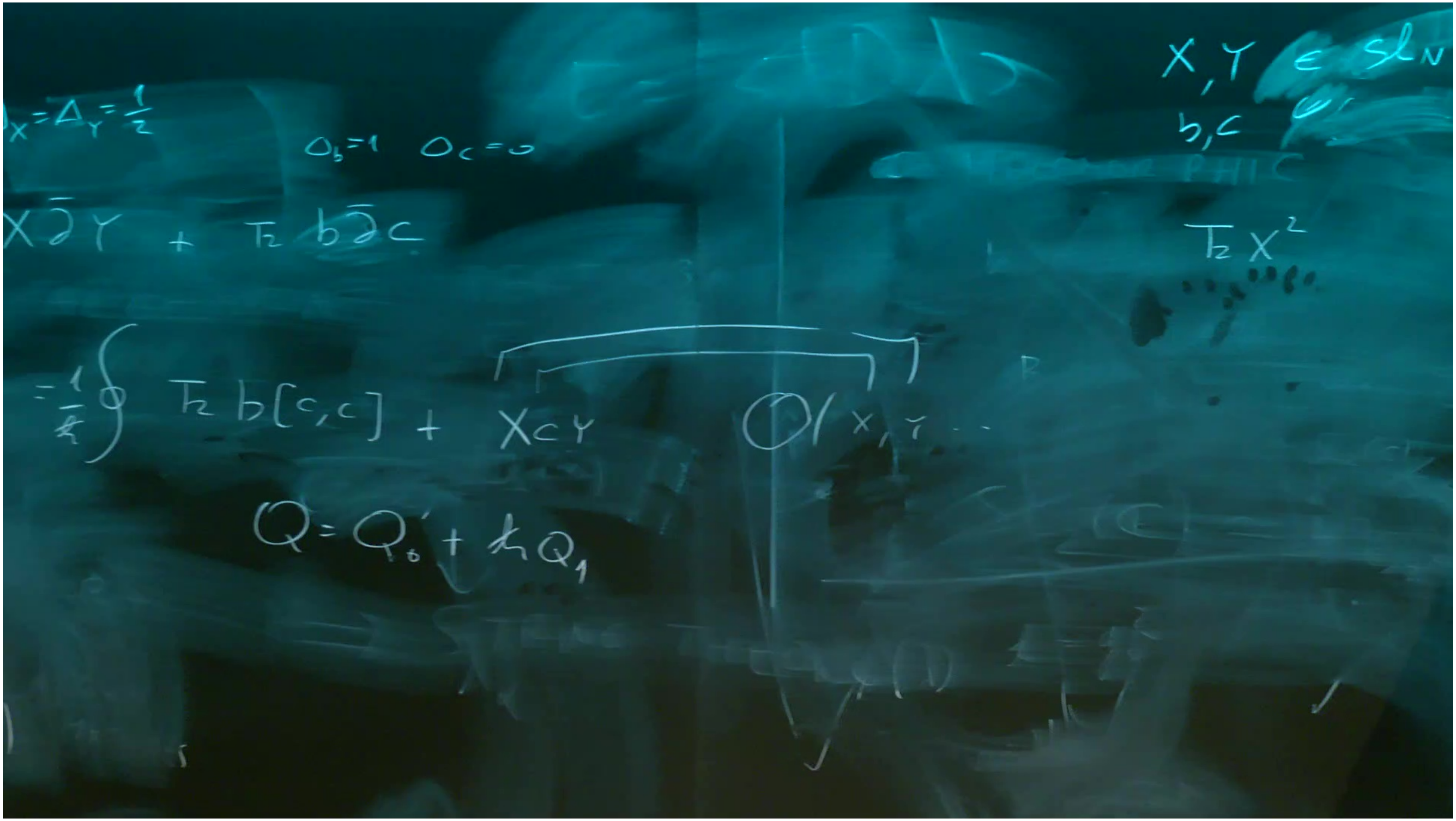
B-MODEL TOP STRINGS

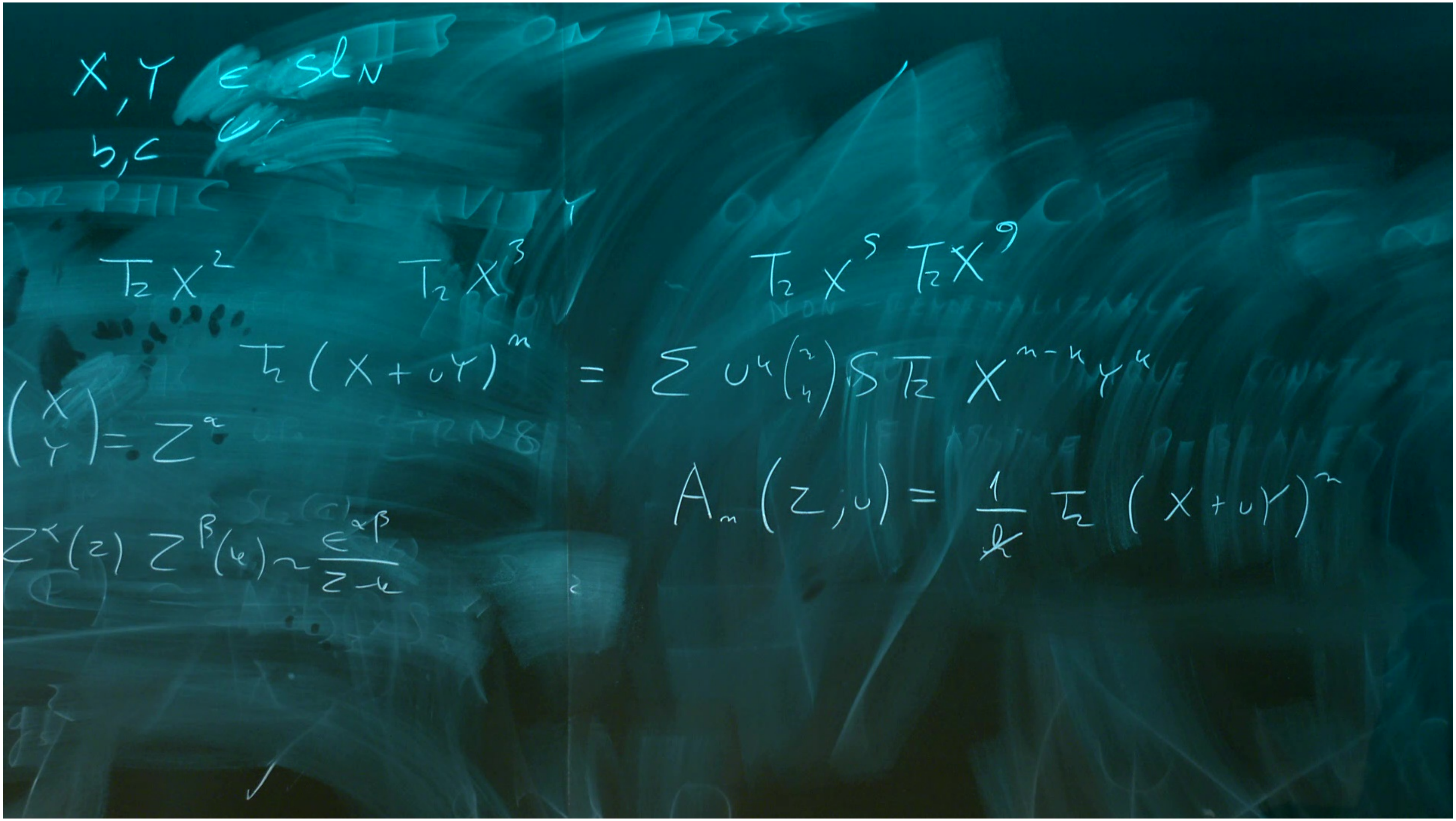
BUT UNI

IF ASSUME

$$SL_2(\mathbb{C}) \simeq \underbrace{AdS_3}_{SL_2(\mathbb{C})/SU(2)} \times \underbrace{S_3}_{SU(2)}$$


TWISTED HOLOGRAPHY
GAUGE-FIX
$A_{\bar z} \to 0$
$\Delta_X = \Delta_Y = \frac{1}{2}$
$\Delta_b = 1 \quad \Delta_c = 0$
$e^{\frac{1}{\hbar}\int X \bar D_A Y}$
$\Rightarrow \frac{1}{\hbar}\int X\bar\partial Y + \mathrm{Tr}\, b\bar\partial c$
$DX\,DY\,DA_{\bar z}$
$X(z)\,Y(w) \sim \frac{\hbar}{z-w}$
$Q = \frac{1}{\hbar}\int \mathrm{Tr}\, b[c,c] + Xc$
$Q_0 :$
$Q_0 c \to [c,c]$
$Q_0 X \to [c,X]$
$Q_0 Y \to [c,Y]$
$Q_0 b = [c,b] + \mu(X,Y)$
$Q = Q_0 + \hbar Q$


X, Y ∈ sl_N
b, c
Δ_X = Δ_Y = 1/2
Δ_b = 1 Δ_c = 0
X ∂̄ Y + Tr b ∂̄ c
Tr X^2
Tr b[c, c] + XcY
Q = Q_0 + ħ Q_1


$X, Y \in sl_N$
b, c
$Tr\, X^2$
$Tr\, X^3$
$Tr\, X^5$ $Tr\, X^9$
$Tr\,(X+uY)^n = \sum u^k \binom{n}{k} S\, Tr\, X^{n-k} Y^k$
$\begin{pmatrix} X \\ Y \end{pmatrix} = Z^a$
$A_n(z,u) = \frac{1}{k} Tr\,(X+uY)^n$
$Z^\alpha(z)\, Z^\beta(w) \sim \frac{\epsilon^{\alpha\beta}}{z-w}$

sl_N

$$T + \epsilon\, \partial \Sigma X Y$$

$$\mathrm{Tr}\, X^3 \qquad \mathrm{Tr}\, X^5 \quad \mathrm{Tr}\, X^9$$

$$(X+uY)^n = \sum u^k \binom{n}{k} S\, \mathrm{Tr}\, X^{n-k} Y^k$$

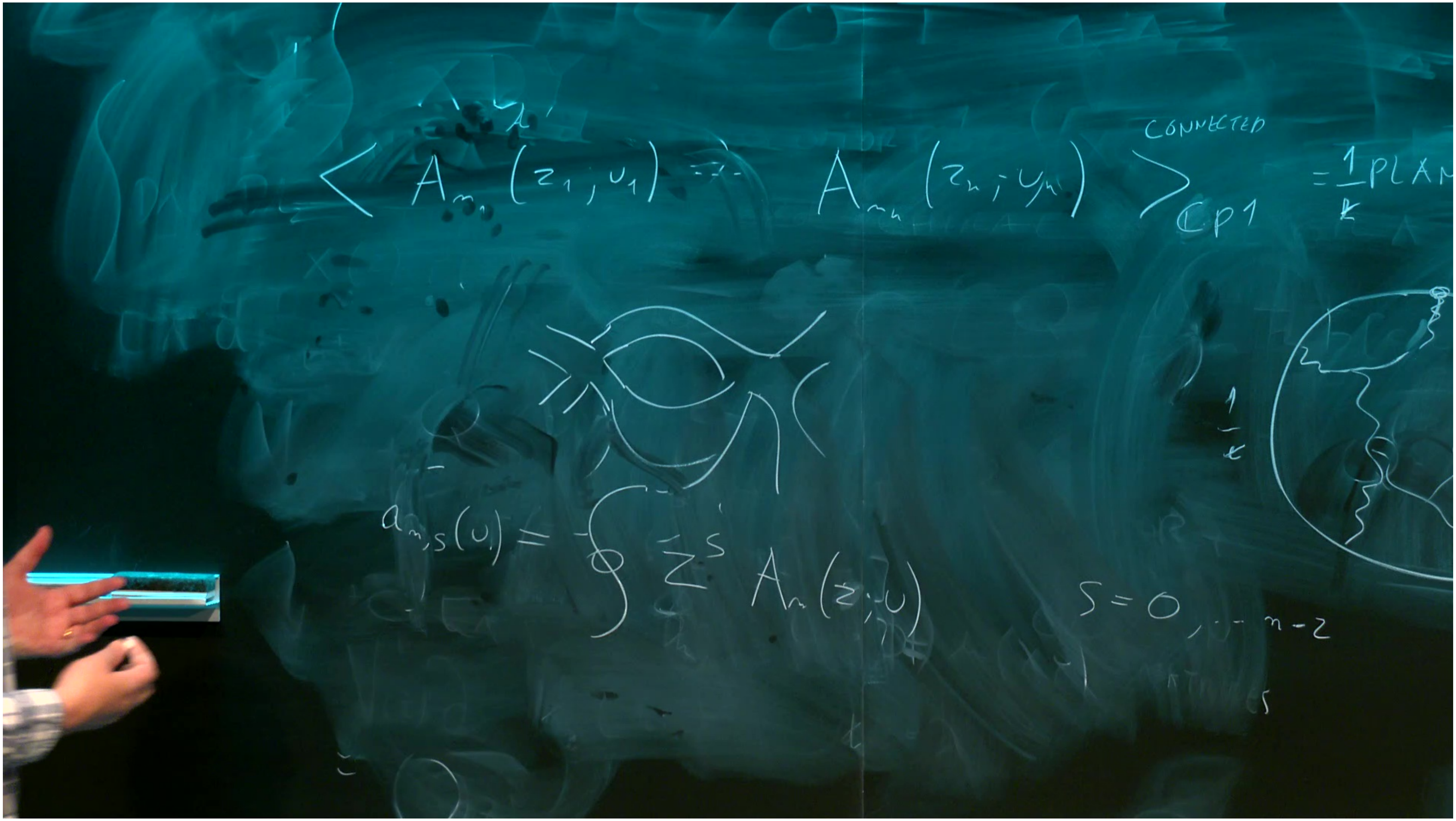
$$\frac{\epsilon^{\alpha\beta}}{z-w}$$

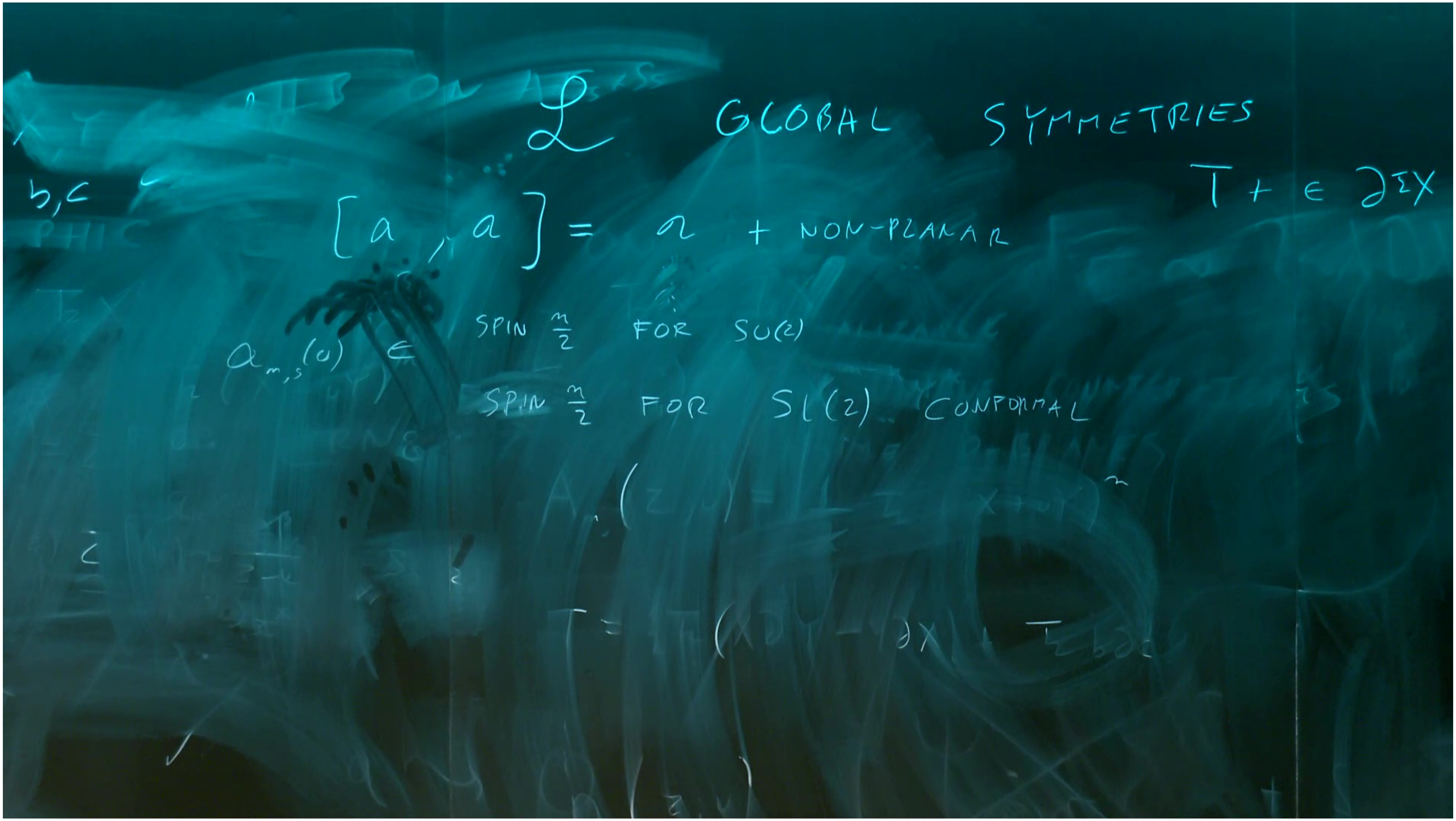
$$A_n(z;u) = \frac{1}{k}\, \mathrm{Tr}\, (X+uY)^n$$

$$T = \frac{1}{2}\mathrm{Tr}(X\partial Y - Y\partial X) + \mathrm{Tr}\, b\partial c$$

$$\vdots$$

$$D_n(z;u)$$


CONNECTED
$\langle A_{n_1}(z_1;u_1) \cdots A_{n_n}(z_n;u_n) \rangle_{\mathbb{C}P1} = \frac{1}{k}$ PLAN
$\frac{1}{k}$
$a_{n,s}(u) = \oint z^s A_n(z;u)$
$s = 0, \ldots n-2$


$\mathcal{L}$ GLOBAL SYMMETRIES
$T + \in \partial \Sigma X$
b,c
$[a, a] = a$ + NON-PLANAR
$a_{m,s}(u) \in$
SPIN $\frac{m}{2}$ FOR SU(2)
SPIN $\frac{m}{2}$ FOR SL(2) CONFORMAL

TWISTED HOLOGRAPHY

$$A_{\bar z} \xrightarrow{\text{GAUGE - FIX}} 0$$

$gl(n|n)$

$$Q^2 = 0$$

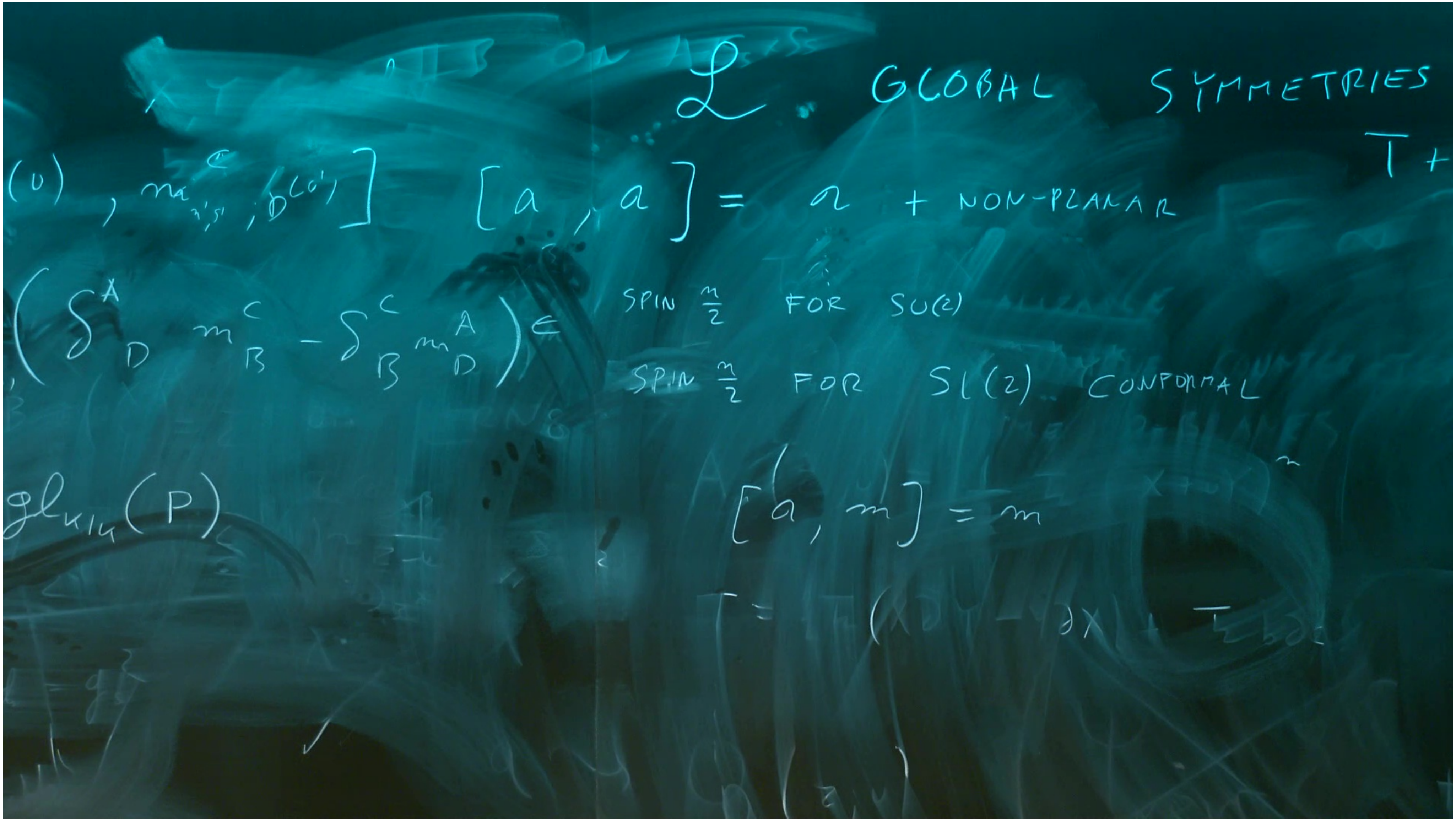
$$\frac{1}{\hbar}\int \mathrm{Tr}\, X \bar\partial Y + \mathrm{Tr}\, b \bar\partial c + I^A \bar\partial J_A$$

$$Q_0 b = [X, Y] + J_A I^A$$

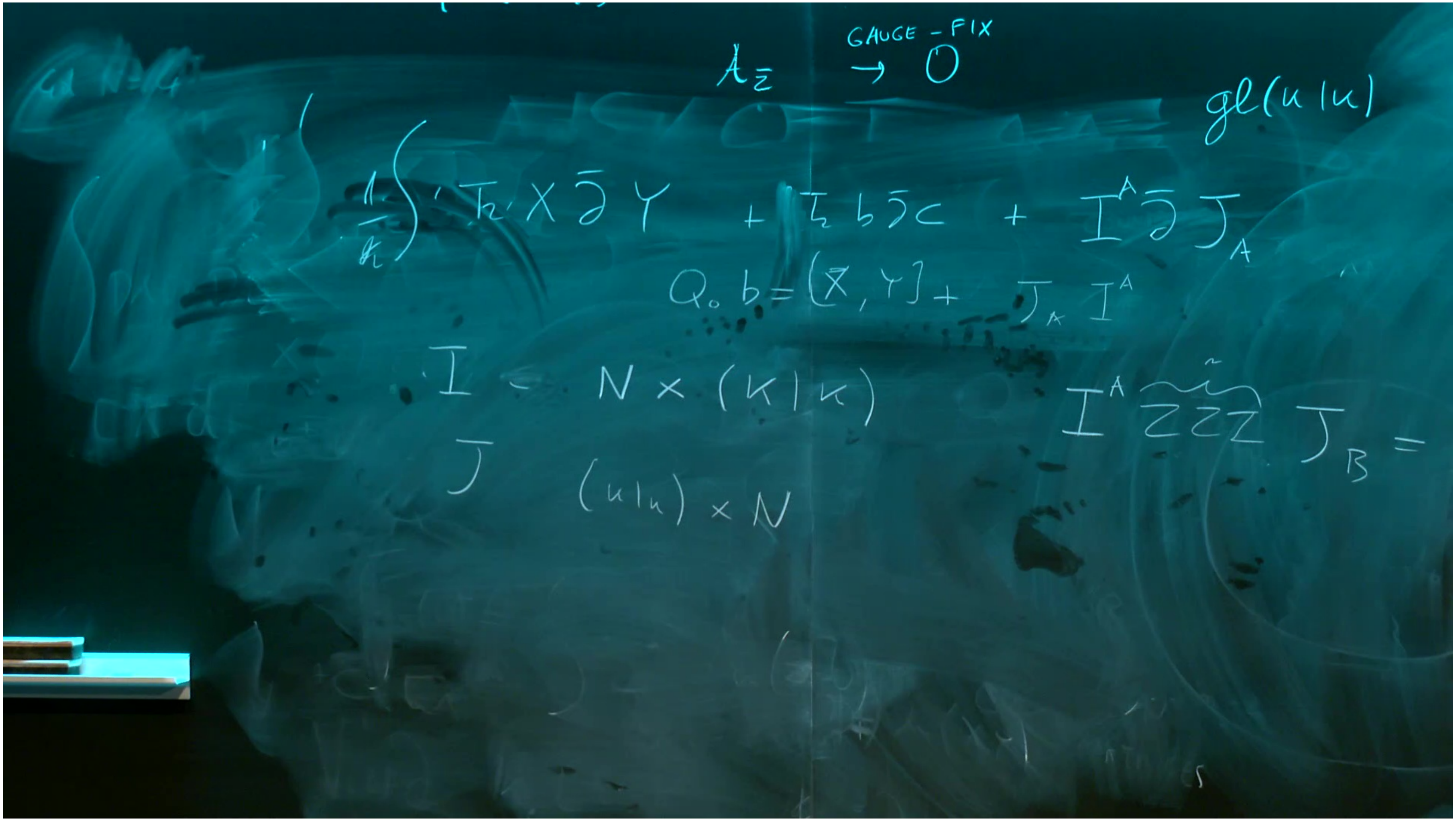
$$I \in N \times (K|K)$$

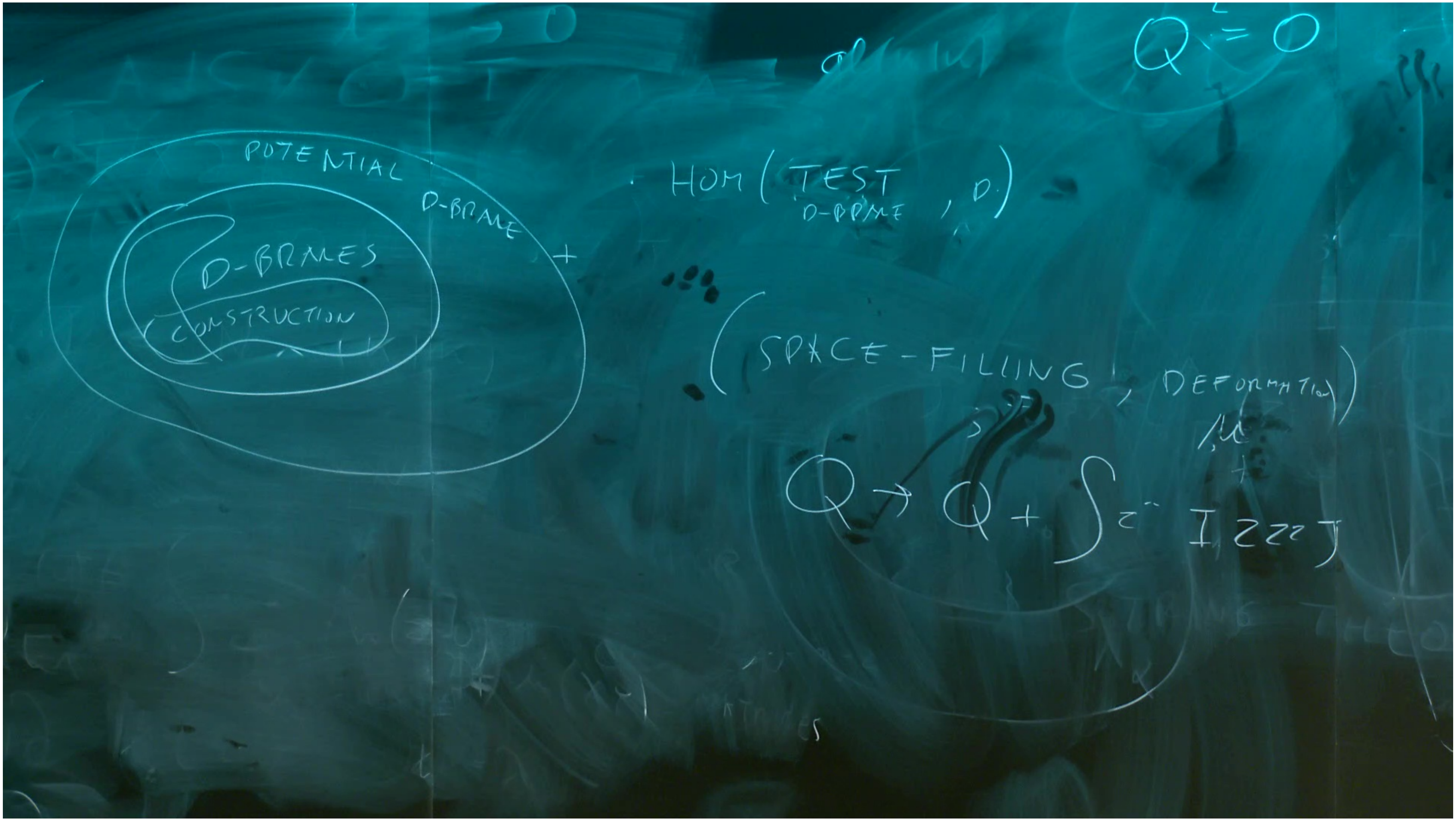
$$J \quad (n|n) \times N$$

$$I^A ZZZ J_B = M^A_B(z; u)$$



$\mathcal{L}$ GLOBAL SYMMETRIES
[a, a] = a + NON-PLANAR
$\left(\delta^A_D m^C_B - \delta^C_B m^A_D\right) \in$
SPIN $\frac{m}{2}$ FOR SU(2)
SPIN $\frac{m}{2}$ FOR SL(2) CONFORMAL
$gl_{4|4}(P)$
[a, m] = m


GAUGE-FIX
$A_{\bar z} \to 0$
$gl(n|n)$
$\frac{1}{\hbar}\int \mathrm{Tr}\, X \bar\partial Y + \mathrm{Tr}\, b \bar\partial c + I^A \bar\partial J_A$
$Q_0 b = [X, Y] + J_A I^A$
$I \quad N \times (K|K)$
$J \quad (n|n) \times N$
$I^A \, ZZZ \, J_B =$


Q = 0
POTENTIAL
D-BRANE
D-BRANES
CONSTRUCTION
HOM (TEST D-BRANE , D)
(SPACE-FILLING , DEFORMATION)
Q → Q + ∫