Title: Twisted Holography Mini-Course - Lecture 20231123

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Collection: Twisted Holography Mini-Course

Date: November 23, 2023 - 9:00 AM

URL: https://pirsa.org/23110041

2d CHIRAL GAUGED $\beta\gamma$ SYSTEM

$\wr$ SYMPLECTIC BOSONS

$\Cap$

2d CHIRAL ALGEBRA

$$S_{SB} = \frac{1}{\hbar} \int \omega_{\alpha\beta} Z^\alpha \bar{\partial} Z^\beta$$

FREE!

SYMPLECTIC BOSONS

$$\Delta_{Z^\alpha} = \frac{1}{2}$$

$$Z^\alpha(z) Z^\beta(w) \sim \hbar \frac{\omega^{\alpha\beta}}{z-w}$$

$$:P(Z, \partial Z, \partial^2 Z \cdots):(z)$$

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$$\langle :Z^\alpha Z^\beta:(z) \; :Z^\gamma Z^\delta:(w) \rangle = \langle Z\, Z\, Z\, Z \rangle + \langle Z\, Z\, Z\, Z \rangle$$

"GAUGED"

$$\bar{A}_{\alpha\beta} = \bar{A}_I \, t^I_{\alpha\beta} \qquad I \cdot \mathrm{Adj} \qquad G$$

$$S_{SB+GAUGE} = \frac{1}{\hbar}\int \bar{Z}^\alpha \left(\omega_{\alpha\beta}\bar{\partial} + \bar{A}_{\alpha\beta}\right) Z^\beta + \mathrm{Tr}\, B_z^{\alpha\beta}\bar{A}_{\alpha\beta} + \mathrm{Tr}\, b(\bar{\partial} + \bar{A})c$$

$$\bar{A} = g^{-1}\bar{\partial} g \qquad g$$

$$\bar{A} = 0 \qquad c_I \qquad b^I$$

$$= Q\left(b_z^{\alpha\beta}\bar{A}_{\alpha\beta}\right)$$

$$\Downarrow$$

$$S_{SB+GHOSTS} \quad \frac{1}{\hbar}\int \omega_{\alpha\beta} Z^\alpha \bar{\partial} Z^\beta + \mathrm{Tr}\, b\,\bar{\partial} c$$

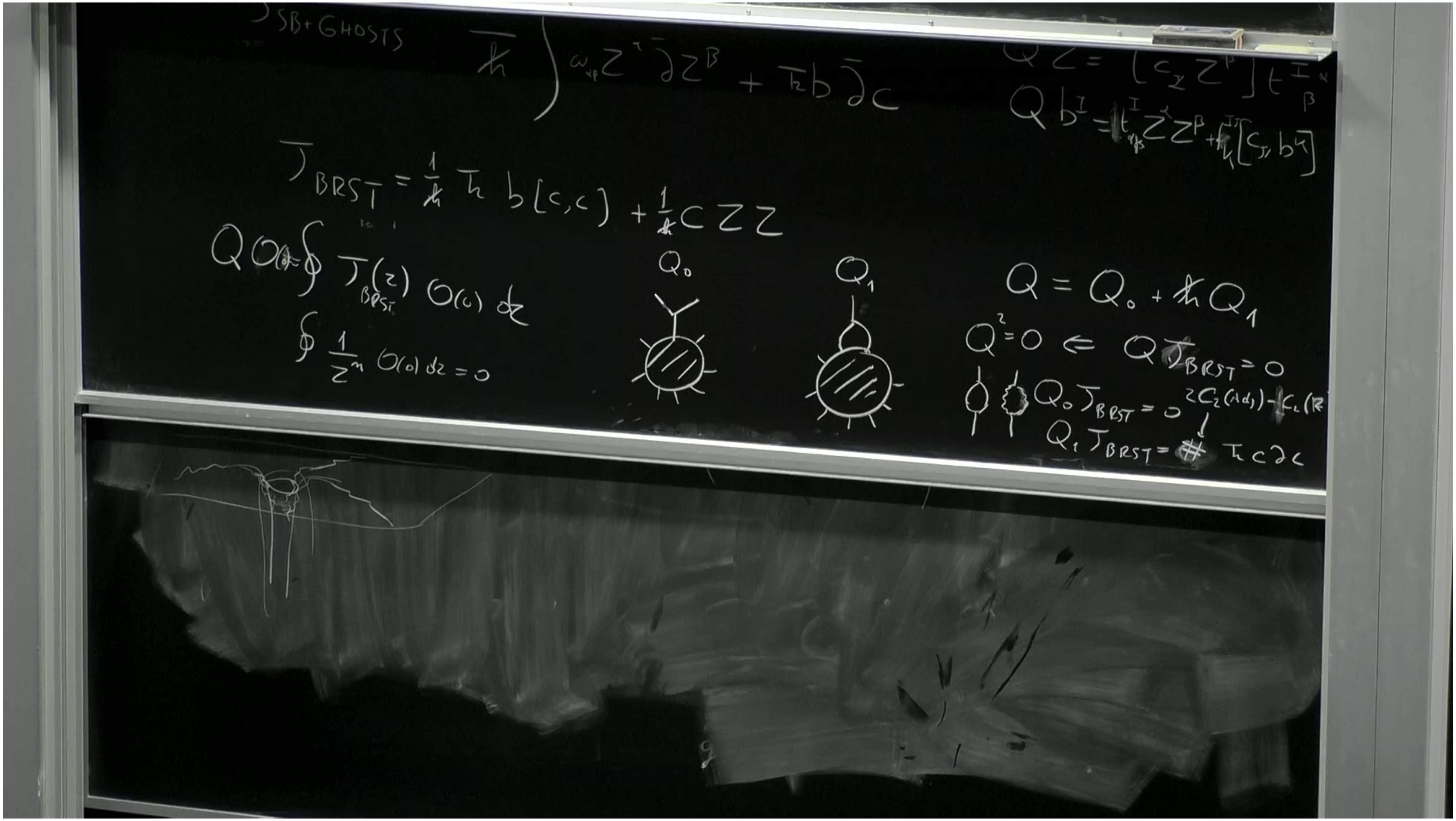
$$Q c_I = \frac{1}{2}[c_J, c_K] f_I^{JK}$$

$$Q Z^\alpha = [c_I Z^\beta]\, t^I{}_\beta{}^\alpha$$

$$Q b^I = t^I_{\alpha\beta} Z^\alpha Z^\beta + f^{IJ}_K [c_J, b^K]$$

$$J_{BRST} = \mathrm{Tr}\, b[c,c] + cZZ$$

$$Q\mathcal{O}(w) = \oint J_{BRST}(z)\, \mathcal{O}(w)\, dz$$


SB+GHOSTS
$J_{BRST} = \frac{1}{\hbar} \mathrm{Tr}\, b[c,c] + \frac{1}{\hbar} c Z Z$
$Q \mathcal{O} = \oint J_{BRST}(z)\, \mathcal{O}(0)\, dz$
$\oint \frac{1}{z^n} \mathcal{O}(0)\, dz = 0$
Q_0
Q_1
$Q = Q_0 + \hbar Q_1$
$Q^2 = 0 \Leftarrow Q J_{BRST} = 0$
$Q_0 J_{BRST} = 0$
$Q_1 J_{BRST} = \# \, \mathrm{Tr}\, c \partial c$

$$\int \Psi_1 \Psi_2 \Psi_3 \left(\langle O_1 O_2 O_3 \rangle_{\text{worldvolume}} \right)$$

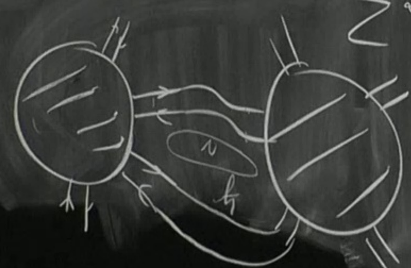
$$\boxed{\begin{array}{l} Z^\alpha \in \mathrm{Adj} \quad \alpha = 1,2 \\ b, c \in \mathrm{Adj} \end{array}}$$

$U(N)$

$$S = \frac{1}{\hbar}\int \epsilon_{\alpha\beta} \mathrm{Tr}\, Z^\alpha \bar\partial Z^\beta + \mathrm{Tr}\, b \bar\partial c$$

$$Z^\alpha_I Z^\beta_J \sim \frac{\epsilon^{\alpha\beta}}{z-w}\, \hbar\, \delta_{IJ} \qquad b^I c_J \sim \frac{1}{\hbar} \frac{\delta^I_J}{z-w}$$

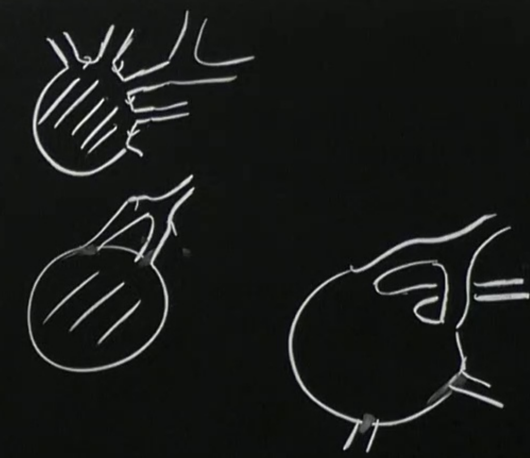
$$Z^{\alpha\, i}{}_j(z) Z^{\beta\, k}{}_t(w) \sim \hbar \frac{\epsilon^{\alpha\beta} \delta^i_t \delta^k_j}{z-w}$$



$$\hbar^\# N^\# \to \hbar^\# (\hbar N)^\#$$

SINGLE TRACE OP

$$\frac{1}{\hbar}\,\mathrm{Tr}\, W(\partial^m b, \partial^{m+1} c, \partial^n Z) = \mathcal{O}_W$$



$$Q_0 \mathcal{O}_W \equiv \mathcal{O}_{Q_0 W}$$

$$Q_1 \mathcal{O}_W = \overset{\hbar N}{g}\, \mathcal{O}_{Q_1 W} + \hbar \sum_i \mathcal{O}_i \mathcal{O}_j c_W^{ij}$$

$$\mathcal{O}_{W_1}(z_1)\, \mathcal{O}_{W_2}(z_2) \sim 1\, \mathcal{O}_{..} + g\, \mathcal{O}_{..} + g^2 \mathcal{O}_{..} \quad g^{\text{SIZE}}$$

$+\mathcal{O}(\hbar)$ NON-PLANAR

$$:\mathcal{O}^{(z)}_{W_1} \mathcal{O}^{(u)}_{W_2}:$$