

Title: PSI 2015/2016 String Theory - Lecture 13

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Abstract:

$$\frac{1}{P^2} \Rightarrow \int_0^{\infty} e^{-TP^2} dt \rightarrow \int dt \int Dx e^{S[x,t]} = \int \frac{DeDx}{\text{DIFF}} e^{S[x,e]}$$

$x(t) \rightarrow$ POSITION IN SPACETIME
 $U \rightarrow U(x)$

$$\frac{P \cdot \gamma^{\mu}}{P^2} \longrightarrow \int \frac{DeDx D\psi D\bar{\psi}}{\text{SDIFF}} e^{S(x,\psi,e,X)}$$

$$d\tau \rightarrow \int d\tau \int D\alpha e^{S[x,\tau]} = \int \frac{D\alpha D\alpha}{\text{DIFF}} e^{S[x,\alpha]}$$

$x(u)$:= POSITION IN SPACETIME
 $u \rightarrow U(u)$

$$\rightarrow \int \frac{D\alpha D\alpha}{\text{DIFF}} e^{S(x,\tau,\alpha,\chi)}$$

$$\frac{P_{\mu\nu}}{P} = \int d\tau d\zeta e^{-P^2\tau - P\mu\zeta}$$

$$[x^\mu, p_\nu] = i\delta^\mu_\nu$$

$$\dot{x}^2$$

$$\hat{H} = p^2$$

$$\hat{Q} = p_\mu \dot{x}^\mu$$

$$\{\psi^\mu, \psi^\nu\} = 2\delta^{\mu\nu}$$

$$\psi \dot{\psi}$$

$$\{\hat{Q}, \hat{Q}\} = 2\hat{H}$$

$$\partial_\tau \rightarrow \hat{H}$$

$$\dot{Q} = P_n \psi^n$$

$$\hat{Q} \} = -2\hat{H}$$

$$\partial_3 [e^{-\tau \hat{H}} (1 - 3\hat{Q})] = -\hat{Q} e^{-\tau \hat{H}}$$

$$3\partial_4 [\quad] = 3 \hat{H} e^{-\tau \hat{H}} = \hat{Q} (3\hat{Q} e^{-\tau \hat{H}})$$

$$\hat{Q} = P_n \psi^n$$

$$\partial_3 [e^{-\tau \hat{H}} (1 - 3\hat{Q})] = -\hat{Q} e^{-\tau \hat{H}}$$

$$3\partial_4 [\quad] = 3 \hat{H} e^{-\tau \hat{H}} = \hat{Q} (3\hat{Q} e^{-\tau \hat{H}})$$

$$\frac{1}{P^2} \Rightarrow \int_0^\infty e^{-\tau P^2} d\tau \rightarrow \int d\tau \int Dx e^{S[x,\tau]} = \int \frac{DeDx}{\text{DIFF}} e^{S[x,e]}$$

$$\frac{P_n \gamma^4}{P^2} \longrightarrow \int \frac{DeDX D\chi D\psi}{\text{SDIFF}} e^{S(x,\chi,e,\psi)}$$

$$\frac{P_n \gamma^4}{P} = \int d\tau$$

$$= \langle P | \int d\tau d^3x$$

$$G(x_0, \tau, y, \tau, S) =$$

$$\frac{D e^{Dx}}{\text{DIFF}} e^{S[x, e]}$$

$x(u) \rightarrow$ POSITION IN SPACETIME
 $u \rightarrow U(u)$

(t, e, X)

$$\frac{P_{\mu} \gamma^{\mu}}{P} = \int d\tau d\zeta e^{-P^2 \tau - P_{\mu} \gamma^{\mu} \zeta} \quad \begin{matrix} \tau \\ \zeta \end{matrix} \quad \begin{matrix} \text{"PROPER TIME"} \\ \text{"PROPER SUPER-TIME"} \end{matrix}$$

$$= \langle P | \int d\tau d\zeta e^{-\tau \hat{H} - \zeta \hat{Q}} | P \rangle$$

$$G(x_i, x_f, \tau, \zeta) = \langle x_f | e^{-\tau \hat{H} - \zeta \hat{Q}} | x_i \rangle$$

u, θ

$$D_\theta = \partial_\theta + \theta \partial_u$$

$$D_u^2 = \partial_u$$

$$\{v_f, D_\theta\} = f \circ D_\theta$$

$$v_f = f(u) (\partial_\theta - \theta \partial_u)$$

$$\{f(u) (\partial_\theta - \theta \partial_u), \partial_\theta + \theta \partial_u\}$$

$$D_0^c = \partial_v$$

$$\{v_+, D_0\} = f \circ D_0$$

$$\{f(v)(\partial_v - 0\partial_v), \partial_v + 0\partial_v\} = \cancel{f(v)\partial_v} + 0 \cancel{f(\partial_v + 0\partial_v)} - \cancel{f\partial_v}$$

Q

∂_u, ∂_v

$$L_{F(u)} = F(u)\partial_u + \frac{1}{2}\partial_u F \otimes \partial_u$$

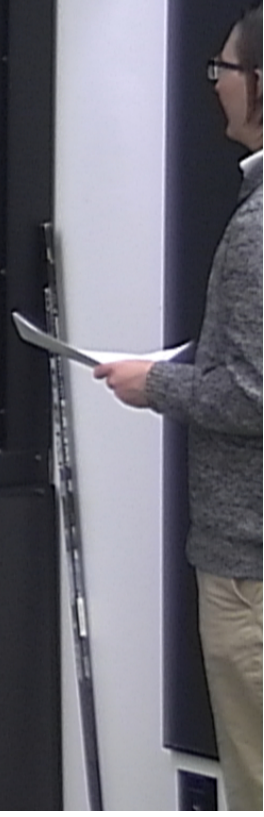
$$D_0^z = \partial_u$$

$$\{v_f, D_0\} = f \otimes D_0 \quad [L_{f_j}, D_0] = [\{v_f, v_0\}, D_0] = [\{v_f, D_0\}, v_f] + [D_0, v_f]v_f \\ = [j \otimes D_0, v_f] + [f \otimes D_0, v_f]$$

$$\{f(u)(\partial_u - \partial_v), \partial_u + \partial_v\} = f(u)\partial_u + \partial f(\partial_u + \partial_v) - 1 - v$$

$$\{v_f, v_g\} = -2fg\partial_u - (fg + gf)\partial_v = L_{fg}$$

$$\} = a\partial_u + b\partial_v + (\)D_0$$



Q

∂_u, ∂_v

$$L_{F(t)} = F(t)\partial_u + \frac{1}{2}\partial_v F \circ \partial_v$$

$$D_0^z = \partial_u$$

$$\{v_f, D_0\} = f \circ D_0 \quad [L_{f_g}, D_0] = [\{v_f, v_g\}, D_0] = [\{v_f, D_0\}, v_g] + [D_0, v_f]\{v_g\}$$
$$= [f \circ D_0, v_g] + [f \circ D_0, v_g]$$

$$\{f(u)(\partial_u - \partial_v), \partial_u + \partial_v\} = f(u)\partial_u + \partial_v f(\partial_u + \partial_v) - \dots = (\dots) D_0$$

$$\{v_f, v_g\} = -2fg\partial_u - (fg + gf)\partial_v = L_{fg}$$

$$\} = a\partial_u + b\partial_v + (\dots) D_0$$

∂_u, ∂_0 $\int ds ds$

$$L_{F(u)} = F(u)\partial_u + \frac{1}{2}\partial_u F \otimes \partial_0$$

$$\{v_f, D_0\} = f \otimes D_0 \quad [L_{f_g}, D_0] = [\{v_f, v_g\}, D_0] = [\{v_g, D_0\}, v_f] + [\{D_0, v_f\}, v_g] \\ = [g \otimes D_0, v_f] + [f \otimes D_0, v_g]$$

$$\{f(u)(\partial_u - \partial_0), \partial_u + \partial_0\} = \cancel{f(u)\partial_u} + \partial_0 f(\partial_u + \partial_0) + \dots = (\dots) D_0$$

$$\{v_f, v_g\} = -2fg\partial_u - (fg + fg)\partial_0 = L_{fg}$$

$$\{a(u)\partial_u + b(u)\partial_v, D_0\} = a\partial_u + b\partial_v + (1)D_0$$

$$\{v_f, v_g\} = -2fg\partial_u - (f_g + f_g)\partial_v = d_{fg}$$

$$y(u, 0) = z(u) + \theta \psi(u)$$

$$v_f y = f(u) \psi(u) - f(u) \dot{x} \theta$$

$$v_f x = f(u) \psi(u)$$

$$v_f \psi = f(u) \dot{x}(u)$$

$$v_f \chi = e^{-z} (f \dot{e})$$

$$v_f e^{-z} = -f \chi$$

$$S = \int du dv \mathcal{L}(y(u, 0))$$

$$S_x = \int du e^{-z} \dot{x}^2$$

$$S_\psi = \int du e^{-z} \psi \dot{\psi}$$

$$S_\chi = \int du$$

$$v_f S_x = \int du 2e^{-z} \dot{x} (f \dot{\psi} + f \dot{\psi}) + [v_f e^{-z}] \dot{x}^2$$

$$v_f S_\psi = \int du 2e^{-z} \dot{x} (-f \dot{\psi} - \frac{1}{2} f \dot{\psi}) - f \dot{x} \psi \partial_u e^{-z} + (v_f e^{-z}) \psi \dot{\psi}$$

$$v_f S_\chi = \int du f \chi \dot{\psi} + f \dot{x} \chi + [v_f \chi] \psi$$

$$\begin{array}{l}
 v^1, v^2, v^i, \theta^i \\
 Y = X + \theta_i \psi^i \\
 \int_{\text{SPOUVAKOU}} [X, \psi, h_{ab}, X]
 \end{array}$$

SUPER

$$\begin{array}{l}
 c \\
 -26 \\
 +11
 \end{array}$$

$$G(\alpha, \beta, \gamma, \tau, \beta) = \langle x_f | e^{-\tau H - \beta Q} | x_i \rangle$$

SUPER-HOLOMORPHIC

$$(z, \theta) \rightarrow (z', \theta')$$

$$v_f = f(z) (\partial_{\theta} - \theta \partial_z)$$

$$(\bar{z}, \bar{\theta})$$

$$v_{\bar{f}} = \bar{f}(\bar{z}) (\partial_{\bar{\theta}} - \bar{\theta} \partial_{\bar{z}})$$

26

b, c	1	X
β, γ	$\frac{1}{2}$	ψ

$$\frac{3}{2}D - 15 = 0 \Rightarrow D = 10$$

T

G