

Title: PSI 2015/2016 String Theory - Lecture 10

Date: Feb 12, 2016 10:15 AM

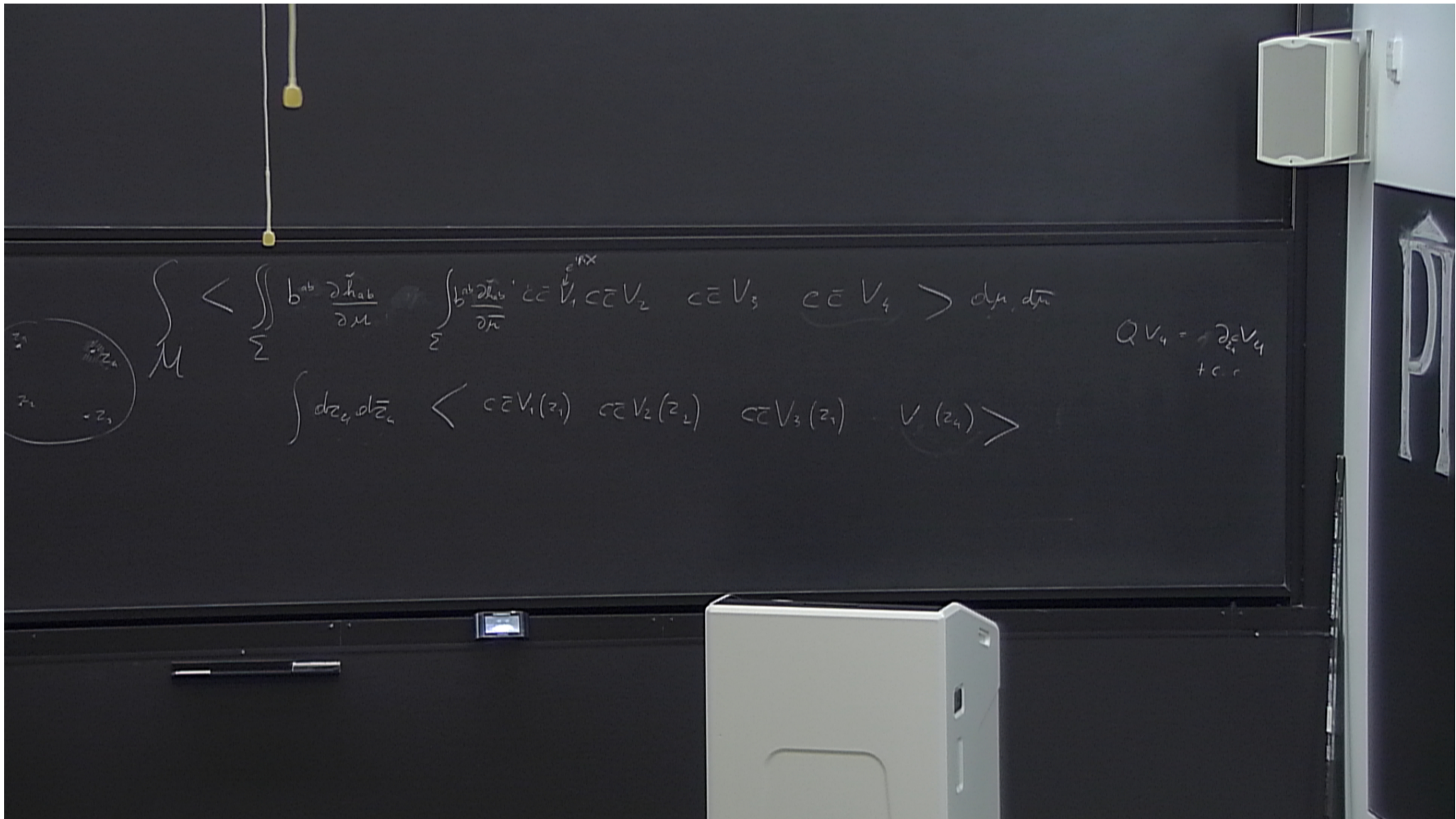
URL: <http://pirsa.org/16020044>

Abstract:

$$ds^2 = dz d\bar{z} + \delta\beta d\bar{z}^2 + \delta\bar{\beta} dz^2$$

$$\int_{\Sigma} b \frac{\delta\beta}{\delta\mu} \quad \int_{\Sigma} \bar{b} \frac{\delta\bar{\beta}}{\delta\bar{\mu}}$$

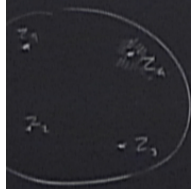


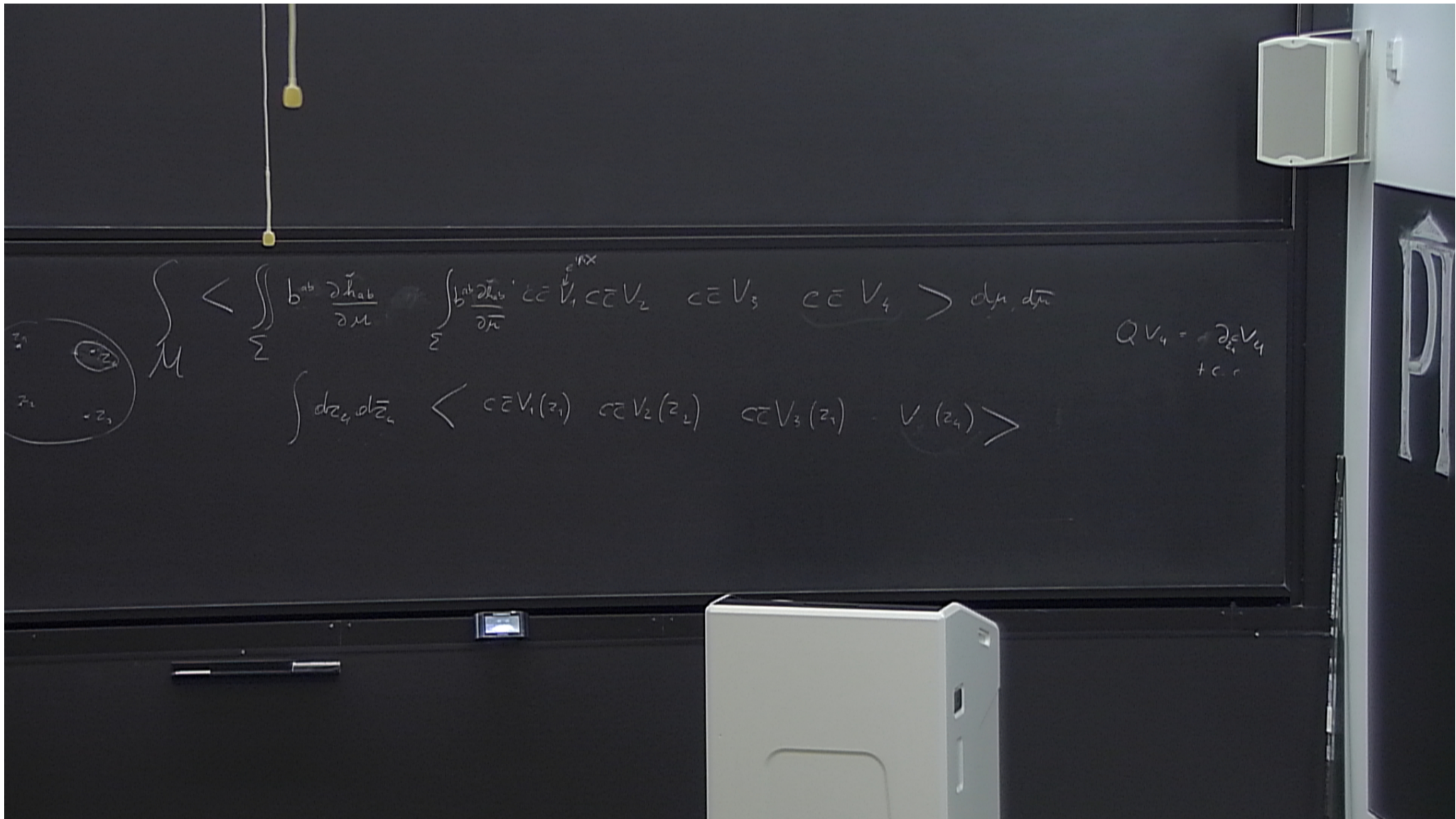


$$\int_M \left\langle \int_{\Sigma} b^{ab} \frac{\partial \tilde{h}_{ab}}{\partial \mu} \int_{\Sigma} b^{ab} \frac{\partial \tilde{h}_{ab}}{\partial \mu} c \bar{c} V_1 c \bar{c} V_2 c \bar{c} V_3 c \bar{c} V_4 \right\rangle d\mu d\bar{\mu}$$

$$\int dz_1 d\bar{z}_1 \left\langle c \bar{c} V_1(z_1) c \bar{c} V_2(z_2) c \bar{c} V_3(z_3) V(z_4) \right\rangle$$

$$QV_4 = -\partial_{\bar{z}_i} V_4 + c.c.$$





$$\int_M \left\langle \int_{\Sigma} b^{ab} \frac{\partial \tilde{h}_{ab}}{\partial \mu} \int_{\Sigma} b^{ab} \frac{\partial \tilde{h}_{ab}}{\partial \mu} c\bar{c} V_1 c\bar{c} V_2 c\bar{c} V_3 c\bar{c} V_4 \right\rangle d\mu, d\bar{\mu}$$

$$\int dz_4 d\bar{z}_4 \left\langle c\bar{c} V_1(z_1) c\bar{c} V_2(z_2) c\bar{c} V_3(z_3) V(z_4) \right\rangle$$

$$QV_4 = \partial_{z_i} V_4 + c.c.$$



$$\int_{\Sigma} \left\langle \int_{\mathcal{M}} b^{ab} \frac{\partial \tilde{h}_{ab}}{\partial \mu} \int_{\Sigma} b^{ab} \frac{\partial \tilde{h}_{ab}}{\partial \mu} c \bar{c} V_1 c \bar{c} V_2 c \bar{c} V_3 c \bar{c} V_4 \right\rangle d\mu d\bar{\mu}$$

$$\int dz_1 d\bar{z}_1 \left\langle c \bar{c} V_1(z_1) c \bar{c} V_2(z_2) c \bar{c} V_3(z_3) V(z_4) \right\rangle$$

$$Q \int dz_1 d\bar{z}_1 V_4 = 0$$

$$Q V_4 = \partial_{\bar{z}_1} V_4 + c.c.$$



$$dz_4 d\bar{z}_4 \langle c\bar{c}V_1(z_1) c\bar{c}V_2(z_2) c\bar{c}V_3(z_3) V(z_4) \rangle$$

$$\frac{1}{(p_1 + p_4)^2 + m^2} = \int_0^{\infty} e^{-\tau[(p_1 + p_4)^2 + m^2]}$$

$$\Gamma\Gamma\Gamma = \prod_{1 \leq i < j \leq 3} |z_i - z_j|^{2+2p_i \cdot p_j} \int dz_4^2 \prod_{1 \leq i \leq 3} |z_i - z_4|^{2p_i \cdot p_i}$$

$$|z_4|^{-4} \quad z_4 \rightarrow \infty$$

$$2p_4 \cdot p_i \geq -2$$

$dz_4 d\bar{z}_4 \langle c\bar{c}V_1(z_1) c\bar{c}V_2(z_2) c\bar{c}V_3(z_3) V(z_4) \rangle$

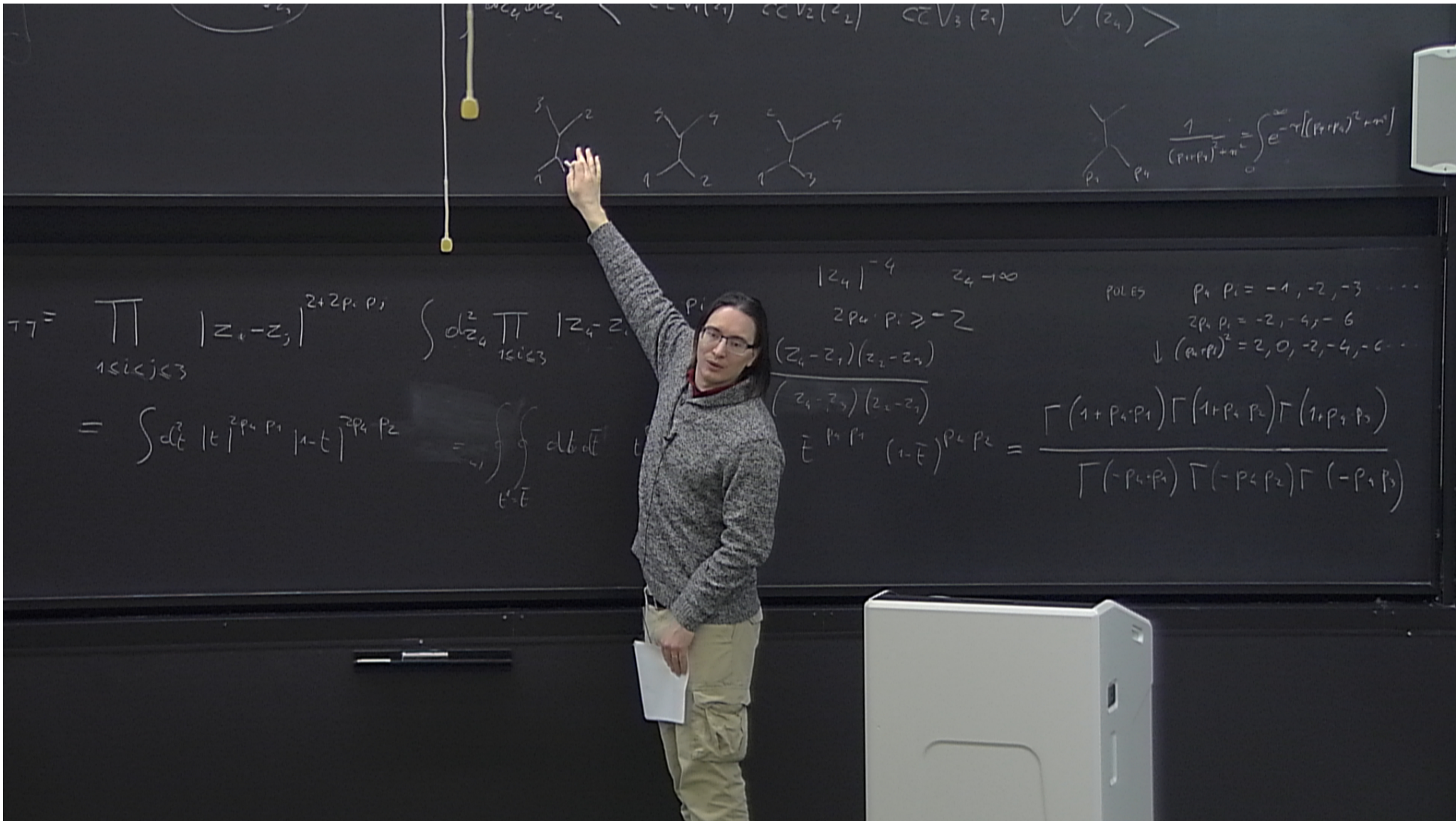
$\frac{1}{(p_1+p_2)^2+n^2} = \int_0^{\infty} e^{-\tau[(p_1+p_2)^2+n^2]}$

$$A_{TTTT} = \prod_{1 \leq i < j \leq 3} |z_i - z_j|^{2+2p_i p_j} \int d^2 z_4 \prod_{1 \leq i \leq 3} |z_4 - z_i|^{2p_i p_i}$$

$\int d^2 z_4 \int_{z_4 = (z_i)^*}$

$$|z_4|^{-4} \quad z_4 \rightarrow \infty$$

$$2p_i \cdot p_i \geq -2$$



$$\gamma \gamma = \prod_{1 \leq i < j \leq 3} |z_i - z_j|^{2+2p_i p_j} \int dz_4 \prod_{1 \leq i < 3} |z_4 - z_i|^{2p_i p_i}$$

$$= \int d\bar{t} |t|^{2p_1 p_1} |1-t|^{2p_2 p_2} = \int_{\bar{t}=\bar{t}} d\bar{t} \bar{t}^{p_1 p_1} (1-\bar{t})^{p_2 p_2}$$

$$|z_4|^{-4} \quad z_4 \rightarrow \infty$$

$$2p_4 p_i \geq -2$$

$$\frac{z_4 - z_1}{z_4 - z_2} (z_2 - z_1)$$

$$\frac{(z_4 - z_2)(z_1 - z_2)}{\bar{t}^{p_1 p_1} (1-\bar{t})^{p_2 p_2}} =$$

POLES $p_i p_i = -1, -2, -3, \dots$
 $z p_i p_i = -2, -4, -6, \dots$
 $\downarrow (p_i p_i)^2 = 2, 0, -2, -4, -6, \dots$

$$= \frac{\Gamma(1+p_1 p_1) \Gamma(1+p_2 p_2) \Gamma(1+p_3 p_3)}{\Gamma(-p_1 p_1) \Gamma(-p_2 p_2) \Gamma(-p_3 p_3)}$$

$$p_4 - p_1 = -n$$

$$\frac{\Gamma(1 + p_4 p_2) \Gamma(1 + p_4 p_3)}{\Gamma(2 - n + p_4 p_2) \Gamma(2 - n + p_4 p_3)} = \prod_{k=0}^{n-2} (p_4 p_2 - k) (p_4 p_3 - k)$$

$$p_4 - p_1 = -n$$

$$\frac{\Gamma(1+p_4 p_2) \Gamma(1+p_4 p_3)}{\Gamma(2-n+p_4 p_2) \Gamma(2-n+p_4 p_3)} = \prod_{k=0}^{n-2} (p_4 p_2 - k) (p_4 p_3 - k)$$

$$\int_0^1 t^{m-1} (1-t)^{n-1} dt = \frac{\Gamma(m)\Gamma(n)}{\Gamma(m+n)}$$

$$p_4 - p_1 = -n$$

$$\frac{\Gamma(1+p_4 p_2) \Gamma(1+p_4 p_3)}{\Gamma(2-n+p_4 p_1) \Gamma(2-n+p_4 p_3)} = \prod_{k=0}^{n-2} (p_4 p_2 - k) (p_4 p_3 - k)$$

$$A \approx \sum \dots \frac{1}{p_4 \cdot p_1 + m}$$

$$S = -(p_1 + p_2)^2 \quad t = -(p_1 + p_3)^2 \quad u = -(p_1 + p_4)^2$$

$$A_4 = \frac{\Gamma(-1 - \frac{S}{2}) \Gamma(-1 - \frac{t}{2}) \Gamma(-1 - \frac{u}{2})}{\Gamma(2 + \frac{S}{2}) \Gamma(2 + \frac{t}{2}) \Gamma(2 + \frac{u}{2})}$$

$$\int_0^1 t^{\alpha-1} (1-t)^{\beta-1} dt = \frac{\Gamma(\alpha)\Gamma(\beta)}{\Gamma(\alpha+\beta)}$$

$$p_4 - p_1 = -n$$

$$\frac{\Gamma(1+p_4 p_2) \Gamma(1+p_4 p_3)}{\Gamma(2-n+p_4 p_1) \Gamma(2-n+p_4 p_3)} = \prod_{k=0}^{n-2} (p_4 p_2 - k)(p_4 p_3 - k)$$

$$A \approx \sum \dots \frac{1}{p_4 \cdot p_1 + m}$$

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-s-t-u = 2

$s, t, u \rightarrow \infty \sim e$