Physics 539 Fall 2018

Problem Set 4

Due on November 19

1. Using the constraints of conformal invariance, determine the coordinate dependence of the 3-point function of primary fields A_i with dimensions $(h_i, \tilde{h}_i)$:

$$\langle A_1(z_1, \bar{z}_1) A_2(z_2, \bar{z}_2) A_3(z_2, \bar{z}_2) \rangle \ .$$

2. The dilaton vertex operator corresponds to setting the polarization tensor

$$\epsilon^{\mu\nu} = \eta^{\mu\nu} - k^\mu \bar{k}^\nu - k^\nu \bar{k}^\mu$$

Calculate the 3-point function for two on-shell tachyons and one dilaton. Show that it has no dependence on the auxiliary vector $\bar{k}$ provided it satisfies $k \cdot \bar{k} = 1$.

3. Calculate the 3-point function for two dilatons and a graviton. Which term in the space-time effective action reproduces it? What is the 3-point function of three dilatons?

4. Calculate the 3-point amplitude for two massless closed string states and a closed string tachyon. Express it in terms of the massless state polarizations $\epsilon^1_{\mu\nu}$ and $\epsilon^2_{\mu\nu}$, and momenta k^1 and k^2.

5. Calculate the 4-point amplitude for two massless closed strings, of polarizations $\epsilon^1_{\mu\nu}$ and $\epsilon^2_{\mu\nu}$, and momenta k^1 and k^2; and two closed string tachyons, of momenta k^3 and k^4.

What is the leading pole in the s-channel? How is its residue related to the result from Problem 4?