HW# 2 -Phys859-Fall 2002

Due Wednesday, October 9, 2002, by 1.30pm

Prof. Melanie Becker
Room 4125, (301)405-1774
melanieb@physics.umd.edu

Problem 1.

Deduce the Virasoro algebra from the operator product expansion of the world-sheet energy-momentum tensor

$$T(z)T(w) = \frac{c}{2(z-w)^2} + \frac{2T(w)}{(z-w)^2} + \frac{\partial T(w)}{z-w} + \text{regular},$$

[*10 points*].

Problem 2.

Identify the SO(25) irreducible representations that describe the particle spectrum at the N=3 level of the open bosonic string. Start by building the representations of SO(24). Show that under the reduction SO(25) $\to$ SO(24) the symmetric traceless rank 3 tensor of SO(25) gives rise to the symmetric traceless rank 3 and rank 2 tensor of SO(24). And also show that the antisymmetric rank 2 tensor and the vector of SO(24) originate from the SO(25) antisymmetric rank 2 tensor [*10 points*].

Problem 3.

a) Verify that the RNS superstring action

$$S = \frac{1}{2\pi\alpha'} \int d^2\sigma \left(\partial_\alpha X^\mu \partial^\alpha X_\mu - i\bar{\psi}^\mu \rho^\alpha \partial_\alpha \psi_\mu \right)$$

is invariant under the global supersymmetry transformations

$$\delta X^\mu = \bar{\epsilon},$$
$$\delta \psi^\mu = -i\rho^\alpha \partial_\alpha X^\mu \epsilon,$$

[*10 points*].

b) Due to this symmetry there is a conserved current J^α. What is the form of the conserved Noether current? [*10 points*].

c) Show that the equations of motion imply the conservation of the supercurrent

$$\partial_\alpha J^\alpha = 0,$$

[*10 points*].