

Exercise Sheet 1 (String Theory, LVA Nr. 136.005) due 14th of march

Exercise 1: Relativistic Point particles

Consider the action of a relativistic point particle moving in space-time with background metric $g_{\mu\nu}$

$$S_{NG} = -m \int ds = -m \int dt \sqrt{g_{\mu\nu} \frac{\partial X^\mu}{\partial t} \frac{\partial X^\nu}{\partial t}} \quad (1)$$

- a) Show that the action does not depend on the parametrization of the worldline !
- b) What is the non-relativistic limit of this action ?

Exercise 2: The 'Polyakov' action

Consider the action,

$$S_P = \frac{m}{2} \int dt \sqrt{h_{tt}} \left(h_{tt}^{-1} g_{\mu\nu} \frac{\partial X^\mu}{\partial t} \frac{\partial X^\nu}{\partial t} - 1 \right), \quad (2)$$

where $h_{tt}(t)$ is a metric on the worldline. As this action contains no derivatives of h_{tt} , h_{tt} is not a dynamical field and we can integrate it out, i.e. solve its equations of motion and reinsert the solution back into the action.

- a) Show that this reproduces the action S_{NG} in eq. (1) !