Physics 731 Homework 4

Due Monday 12 February 2007

1 Using only spinor indices

Determine the actual relationship between x^μ and $x^{\alpha\dot{\alpha}}$ (at the component level). That is, express each component of $x^{\alpha\dot{\alpha}}$ in terms of the components of x^μ and each component of x^μ in terms of the $x^{\alpha\dot{\alpha}}$. What is the Lorentz invariant x^2 in terms of $x^{\alpha\dot{\alpha}}$?

2 Component transformations

Derive the SUSY component transformations (found in Anke's lectures) for a general superfield $\Psi(x, \theta, \bar{\theta})$ from the fact that Ψ is a superfield, *i.e.* $\Psi'(Z') = \Psi(Z)$.

(This may be a bit painful if you write the superfield out completely, but do at least 3 components. There is, of course, a better way.)

3 Chirality transformations

Solve the chirality differential constraint $\bar{D}_{\dot{\alpha}}\Phi = 0$ in terms of an arbitrary $\phi(x, \theta)$. Then work out the "standard" SUSY transformations of the components (A, ψ, F) of ϕ.

4 Linear superfields

A complex linear superfield L satisfies the constraint $\bar{D}^2 L = 0$. Determine its component expansion. How many independent components are there?

One can impose the additional "reality" constraint $L = \bar{L}$ so that now we have $D^2 L = \bar{D}^2 L = 0$. What is the superfield expansion of such an object?

(This is also a bit painful, but doing it will help you learn the arithmetic and also make you realize the need for more sophisticated methods.)