Exercises for the Lecture

Supersymmetry

Summer Semester 2016

Sheet 6

Exercise 1: Non-Abelian Gauge Theory

Consider an $SU(2)$ vector V and chiral multiplet Φ both in the adjoint representation.

a) Write down the most general supersymmetric action for this field content which is at most first order in derivatives (up to partial integrations).
b) Discuss the constraints due to renormalizability.
c) For the renormalizable version, work out the F- and D-term potential.
d) Characterize the flat directions of these potentials if they exist.

Exercise 2: Super gauge covariant derivatives

Let Ψ be a generic superfield that transforms as

$$\Psi \quad \longrightarrow \quad e^{-2\Lambda}\Psi$$

under (non-Abelian) super gauge transformations. We define chiral super gauge covariant derivatives by

$$\mathcal{D}_\alpha \Psi = e^{-2V} D_\alpha (e^{2V}\Psi), \quad \bar{\mathcal{D}}_{\dot{\alpha}}\Psi = \bar{D}_{\dot{\alpha}}\Psi\,.$$

a) Show that these derivatives are indeed super gauge covariant.
b) Argue that one could write the Grassmann integrals in the superspace measure as differentiations with respect to these chiral super gauge covariant derivatives.
c) Let Φ be a chiral multiplet and $\Phi^\dagger$ its conjugate. Show that Φ is also chiral with respect to these chiral super gauge covariant derivatives.
d) Show that $\bar{\Phi} = \Phi^\dagger e^{-2V}$ is anti-chiral with respect to them.

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