Exercises for the Lecture

Supersymmetry

Summer Semester 2016

Sheet 8

Exercise 1: Effective Superpotential

Starting from the superpotential

$$W = \frac{1}{2}M\phi_H^2 + \frac{\lambda}{2}\phi_H\phi^2 + \frac{y}{6}\phi_H^3\,,$$

show that the exact effective superpotential after integrating out ϕ_H is

$$W_{\text{eff}} = \frac{m^3}{3y^2}\Big(1 - \frac{3\lambda y\phi^2}{2M^2} \mp \Big(1 - \frac{\lambda y\phi^2}{M^2}\Big)\sqrt{1 - \frac{\lambda y\phi^2}{M^2}}\Big)\,.$$

Exercise 2: Holomorphy and Non-renormalization

Using holomorphy and symmetries show that the superpotential

$$W = \mu_1\phi + \mu_2\phi^2 + \ldots + \mu_n\phi^n + \ldots$$

is not renormalized.

Exercise 3: Using R-symmetry

Using holomorphy and the anomalous $U(1)_R$ symmetry show that the holomorphic gauge coupling of pure SUSY Yang-Mills is only renormalized at one-loop.

Exercises taken from "Terning - Modern Supersymmetry" chapter 8.
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