

Problem 3.1

Consider a theory with superpotential

$$W = \lambda A_0 + mA_1A_2 + YA_0A_1^2, \quad m^2 > 2\lambda Y.$$

- a) Determine the minimum of the scalar potential V .
- b) Compute the mass spectrum for all bosons and all fermions for $\langle A_0 \rangle = 0$.
- c) Verify the sum rule $\text{Str} M^2 = 0$.

Problem 3.2

Consider a supersymmetric $U(1)$ gauge theory with gauge coupling g and two massive chiral multiplets $\Phi_{\pm}$ of opposite $U(1)$ charge and with a non-vanishing FI-term ξ_{FI} .

- a) Compute the scalar potential for $W = m\Phi_+\Phi_-$ (cf. problem 2.3).
- b) Determine the minimum of V for $|m|^2 > \xi_{\text{FI}}g$. Is the $U(1)$ spontaneously broken?
Is supersymmetry spontaneously broken?
- c) Determine the minimum of V for $|m|^2 < \xi_{\text{FI}}g$. Which symmetries are spontaneously broken? Is there a choice of parameters where supersymmetry is unbroken and the $U(1)$ is broken?

Problem 3.3

Compute the mass matrix of the stops.

Problem 3.4

Compute the mass matrix of the charginos $\tilde{W}^{\pm} = \frac{1}{\sqrt{2}}(\lambda^1 \mp i\lambda^2), \tilde{h}_u^+, \tilde{h}_d^-$.