Physikalisches Institut, Albert-Ludwigs-Universität Freiburg

Übungen zur Vorlesung

Supersymmetrie

WS 07/08

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Blatt 6

Präsenz-Aufgabe 7 Superpotential Rewritings

a) Consider a supersymmetric model with the superpotential

$$W = c_i\,\hat{\Phi}_i + \frac{1}{2} M_{ij}\,\hat{\Phi}_i\hat{\Phi}_j + \frac{1}{6} Y_{ijk}\,\hat{\Phi}_i\hat{\Phi}_j\hat{\Phi}_k.$$

Compare with the lecture to show that the mass and interaction terms can be written as

$$\mathcal{L}_{int} = -\frac{1}{2}\frac{\delta^2 W(\phi)}{\delta\phi_i\delta\phi_j}\,\psi_i\psi_j + F_i\,\frac{\delta W(\phi)}{\delta\phi_i} + c.c.,$$

where $W(\phi)$ has the same form as the superpotential, but is only a functional of the scalar components of the corresponding superfields.

b) Show that the equation of motion for F_i is

$$F_i = -\frac{\delta W}{\delta\phi_i^*}, \quad F_i^* = -\frac{\delta W}{\delta\phi_i}.$$

Präsenz-Aufgabe 8 Majorana Spinors

a) Show that the matrix

$$\mathcal{C} = \begin{pmatrix} \epsilon^{\alpha\beta} & 0 \\ 0 & \epsilon_{\dot\alpha\dot\beta} \end{pmatrix}$$

has the same components as $i\gamma^2\gamma^0$.

b) For

$$\Psi = \begin{pmatrix} \xi_\alpha \\ \bar\eta^{\dot\alpha} \end{pmatrix}, \quad \overline{\Psi} \equiv \Psi^\dagger\gamma^0 = \begin{pmatrix} \eta^\alpha & \bar\xi_{\dot\alpha} \end{pmatrix},$$

a Majorana spinor is defined by

$$\Psi_M = \mathcal{C}\,\overline{\Psi}_M^{\mathrm{T}} = \mathcal{C}\gamma^0\Psi_M^*.$$

What has to hold for ξ_α and $\bar\eta_{\dot\alpha}$?

c) Consider the chiral representation for gamma matrices. What is $(\gamma^\mu)^{\mathrm{T}}$? Show

$$\Gamma^{\mathrm{T}} = \begin{cases} +\mathcal{C}\,\Gamma\,\mathcal{C}^{-1}, & \Gamma = \mathbb{1},\ \gamma^5\gamma^\mu,\ \gamma^5 \\ -\mathcal{C}\,\Gamma\,\mathcal{C}^{-1}, & \Gamma = \gamma^\mu,\ [\gamma^\mu,\gamma^\nu]\,. \end{cases}$$