Physikalisches Institut, Albert-Ludwigs-Universität Freiburg

Übungen zur Vorlesung

Supersymmetrie

WS 07/08

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Blatt 11

Hausaufgabe 10 Sfermion Mass Squared Matrices

Derive all terms that contribute to the mass squared matrices of the sfermions. We use the notation

$$\tilde{f}_\uparrow = \tilde{u}, \tilde{\nu} \quad \text{and} \quad \tilde{f}_\downarrow = \tilde{d}, \tilde{e}$$

for the up and down-type sfermions respectively.

Hint:

There are soft-breaking mass- and A-terms, as well as D- and F-terms.

Let us introduce the following notation:

$$\chi_{f_\uparrow} = A_{f_\uparrow} - \mu \cot\beta, \quad \chi_{f_\downarrow} = A_{f_\downarrow} - \mu \tan\beta,$$
$$\text{with} \quad M_Z^2 = \frac{g^2 + g'^2}{4} \left(v_u^2 + v_d^2 \right).$$

Write the mass squared matrix in the basis $(\tilde{f}_L, \tilde{f}_R)$. The off-diagonal elements generate a mixing between the superpartners of the left- and right-handed SM fermions. For which of them is this important?

Diagonalize the mass squared matrix.

Präsenz-Aufgabe 12 Structure of MSSM Feynman Rules

Consider the structure of the Feynman rules in the MSSM. First, recall what general Lorenz structures are possible.

Find

- Gauge self-couplings
- Fermion gauge interactions
- Sfermion gauge interactions
- all sorts of Yukawa couplings
- triple and quartic scalar couplings
- never try to count!