Übungen zu Physik an Hadron-Collider SS 2013
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Übungsblatt Nr. 10

**Die Lösungen müssen bis 11 Uhr am Mittwoch den 10.7.2013 in die
Briefkästen im Erdgeschoss des Gustav-Mie-Hauses eingeworfen werden!**

1. **Supersymmetry at the LHC**

   The following exercise is aimed to gain some feeling with SUSY kinematics and decay vertices. Some of the hypothesis made are not necessarily the favourite assumptions typically made in SUSY analysis.

   - Given the fact that the LHC is a hadron collider, what are the supersymmetric particles that are expected to be produced (if their masses are accessible given the energy in the centre-of-mass of the machine)? [**2 points**]

   Assume a SUSY particle spectrum such that only one (first or second) squark generation is produced, with a cross section of 1 pb. The squark mass is 400 GeV, the lightest neutralino mass is 50 GeV, all other SUSY particles have masses of few TeV.

   - The production mechanism is then $pp \rightarrow \tilde{q}\tilde{q}$. How does the $\tilde{q}$ decay? What is the final state? [**2 points**]

   - Assume that the two squarks are produced at rest in the transverse plane. A given selection is applied, which requires 2 jets of $p_T > 100$ GeV. Compute the acceptance on the signal of this cut (the signal acceptance being defined as the probability of a signal event to pass the selection). [**2 points**]

   - A further cut on the missing transverse momentum is required: $E_T^{miss} > 150$ GeV. What is the total acceptance of the selection, in the case in which the p_T of the jets is at threshold? [**2 points**]

   - Make a list of possible SM background processes, mentioning which are expected to be relevant. [**2 points**]

   - A total of 10 background events from SM processes are expected per pb^{-1}. According to the numbers given (or computed) above, does one expect to exclude the signal at 95% CL (that is, with a significance of 2σ) with 100 pb^{-1} of data? [**2 points**]