Übungen zu Physik an Hadron-Collider SS 2011
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Übungsblatt Nr. 7

Die Lösungen müssen bis 11 Uhr am Donnerstag den 30.6.2011 in die Briefkästen im Erdgeschoss des Gustav-Mie-Hauses eingeworfen werden!

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1. **W cross section at the LHC**

   Consider the first W and Z cross section paper produced by the ATLAS collaboration:

   `http://arxiv.org/pdf/1010.2130v1`

   Without pretending the understanding of the full paper, here are a few questions that you are required to answer as quantitatively as possible.

   - Figure 1b shows the E_T spectrum of the electrons as measured in the data triggering on low p_T electrons. There is a huge contribution arising from jet production from QCD processes. Briefly discuss the different reasons why QCD enters into this plot with such a large contribution.
   - Focusing on Figure 2a: the QCD contributions dominates in a region at low missing transverse energy. Why? What are the possible sources of missing transverse energy in QCD jet events? **[2 points]**
   - Still on the same figure, why has $Z \to \tau\tau$ a harder contribution than $Z \to ee$ (that is, on average the missing transverse energy is larger)? **[2 points]**
   - On figure 3a and 3b: explain the shape of the m_T distribution for the $W \to e(\mu)\nu$ component. **[2 points]**
   - The selection for the electron channel is ${E_T}^{miss} > 25$ GeV, $m_T > 40$ GeV. What is the minimum allowed transverse momentum of the electron? To what angle between the electron and the missing transverse momentum does this correspond? **[2 points]**
   - In table 4: one estimates (after background subtraction) about 600 $W^+ \to e^+\nu$ and 400 $W^- \to e^-\bar{\nu}$ events. How significant is the excess of W^+ events if only statistical uncertainties are assumed (quote a probability that the two numbers actually correspond to equal production cross sections from $pp \to W^\pm + X$)? If the excess is significant, could you explain the difference qualitatively? **[3 points]**