

Übungen zu Physik an Hadron-Collider SS 2011
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Übungsblatt Nr. 5

Die Lösungen müssen bis 11 Uhr am Donnerstag den 9.6.2011 in die Briefkästen im Erdgeschoss des Gustav-Mie-Hauses eingeworfen werden!

1. Inclusive jet cross section

Download the ntuple named JetJet_det_7TeV.root from

http://wwwhep.physik.uni-freiburg.de/~ivivarel/col_phys/

They contain proton-proton collisions simulated with Pythia 8. The process simulated is “hard” QCD interactions, resulting in jet production. The \hat{p}_T cut used in generation is $\hat{p}_T > 25$ GeV (\hat{p}_T is the transverse momentum produced in $2 \rightarrow 2$ process computed at matrix element by Pythia).

The final state has been reconstructed using a jet reconstruction algorithm (anti- k_t with a $R = 0.4$, but this is irrelevant for this exercise). Jets with a transverse momentum larger than 20 GeV have been written in the ntuple. The variables referring to them are named truejet_(pt,eta,phi,e).

A given, gaussian, smearing to the jet energy is applied (in order to emulate some sort of calorimeter response). The variables referring to the smeared jets are names recojet_(pt,eta,phi,e). The average jet response is kept at 1 (that is, effects from calorimeter non compensation and dead material are not simulated).

- Plot the jet resolution curve (that is: $\sigma(E)/E$ as a function of E) [**3 points**]. To do this:
 - Fill histograms of E_{reco} for jets corresponding to a very narrow bin of E_{true} (ideally one should do this for one specific value of E_{true} . Find a compromise between having a very narrow bin and having a reasonable statistics in the bin).
 - Fit each histogram with a gaussian function and therefore find $\sigma(E)$ for a given E_{true} .
 - Finally plot $\sigma(E)/E$ as a function of E_{true} .
- Fit the jet resolution curve with a suitable parametrization. [**2 points**]

Now we want to focus a bit more on the measurement of the inclusive jet cross section. It is known that the data contained in the ntuple correspond to about 620 nb^{-1} of integrated luminosity.

- Plot the inclusive jet cross section $d\sigma/dp_T$ for reco jets with $|\eta| < 2.5$ and $p_T > 40$ GeV. Be careful with the normalisation. [**2 points**]
- How would the result at $p_T = 70$ GeV change if the actual jet energy scale is 3% lower (that is, if the jet energy measurement is overestimated by 3%)? [**2 points**]
- Plot again the inclusive cross section but this time for true jets. Compare with the result obtained using reco jets and comment the result. Are the two plots expected to be identical? Why? [**3 points**]