## Exercises, part 8 - Xmas edition

Thursday 2003-12-04 - Thursday 2004-01-08 16:00 !

### 1. 'New physics' ?                                                    10 points

Pythia was used to generate in total 397272 'LHC' events, stored on file pythia.root (on CD). The sample includes standard model processes and - maybe - in addition events corresponding to other processes have been included. On the file only final state particles as deliverd by Pythia are stored, and only those with $|\eta| < 3$ and $|\vec{p}| > 1\,\mathrm{GeV}$, corresponding to the capabilities of a typical pp detector. Detector effects as inefficiencies, resolution, are NOT simulated.

In order to preselect 'hard scattering' processes only events with the following kinematical constraints are written to pythia.root:

- at least one high energy lepton (electron or muon) or photon with $p_\perp > 25\,\mathrm{GeV}$.
  
  **or**

- missing transverse energy $\mathrm{MET} \equiv |\sum \vec{p}_\perp^{\,i}| > 75\,\mathrm{GeV}$
  
  **or**

- scalar sum of transverse momenta plus missing transverse energy $\sum |\vec{p}_\perp^{\,i}| + \mathrm{MET} > 300\,\mathrm{GeV}$

These constraints simulate the trigger conditions of a real experiment.

The data set of $\sim 400000$ events corresponds to an effective run time (at full LHC luminosity of $10^{34}/\mathrm{cm}^2/\mathrm{s}$) of only 22 seconds !

The events are written to the file pythia.root in 'root tree' format. Example-program pythia_analysis.C (on CD) shows how to read the data. For each particle the following parameters are stored:

- $p_x$ in GeV

- $p_y$ in GeV

- $p_z$ in GeV (z = beam)

- $q \cdot m$ in GeV, where $q$ = charge in units of elementary charge

- $d_V$ in mm = distance collision point - particle creation

Task: Please analyse the simulated data set and check for deviations from the SM sample.

Try to look at the events in an unbiased way - dont rely on specific models, dont trust calculated cross sections and dont believe limits from other experiments.