MadGraph/MadEvent v4

Hands-on session, YETI 2008

Exercise 1.a

- Draw all Feynman diagrams associated with the process $e^+e^- \rightarrow e^+e^-b\bar{b}$ below :

- Browse to http://madgraph.phys.ucl.ac.be
- Register (preferably with a spam filter free mail address, like gmail) or use the username "Angels" and guess the password (6 letters)
- Use MadGraph to check your answer (hint: this process is written e+e->e+e-bb~, QCD=0, QED=4)

Exercise 1.b

- Generate events for the previous process using the web interface for a e+e- collider running at 500 GeV and for default parameters / cuts. (hint: click on “On-line Event Generation” on the main page, in the “Colliders and cuts” section, select the “Use the form below” option and switch the collider to “e+e- @ 500 GeV”. Then click twice on “Send” and wait.)

- Look at the results page, how can you interpret them ? In particular, what is the number associated with each diagram ?

- Give a look at the plot page. Download the LHE event file & open it with a text editor. What do you see ?

Exercise 2

- Create the following process online : $pp \to Z, h^0 \to l^+l^-b\bar{b} \quad \text{with} \quad l^\pm = e^\pm, \mu^\pm$ (hint: this is written pp>Z h>l+l-bb~, QED=4, QCD=0, with the right assignment for p and l+/l-)
- Download the code (by clicking on “Code Download” on the process main page), expand it take (hint: tar xzvf madevent.tar.gz) a look at the files, especially :
  - particles.dat, interactions.dat, couplings.f in ./Source/MODEL
  - proc_card.dat, param_card.dat, run_card.dat in ./Cards
  - cuts.f, matrix.f in ./SubProcesses/P_*_*

Describe what you see in one sentence for each file:

- Generate 20k events for a Higgs mass of 140 GeV, using the command line (hint: modify the param_card.dat and the run_card.dat, then run ./bin/generate_events)
- What is the integrated luminosity needed to see 10 such events at Tevatron ? (hint: remember that the number of events equal the cross section times times the integrated luminosity)

Exercise 3

- Download the full MG/ME v4 package from the download page and untar it
- Use the USRMOD template to create a spin-1 “Higgs” model (hint: read the README file in Models/usrmod and take the SM Higgs as an example)
- Generate 20k events with this new model (hint: copy the MadEvent template to create a new directory, modify the proc_card.dat, run ./bin/newprocess, modify the param_card.dat and the run_card.dat, run ./bin/generate_events)
- Use MadAnalysis (with the online plotting interface) to create plots to discriminate between this model and the usual SM (hint: upload the generated unweigthed events file, run with the default card (take a look at it), and look at the plots especially the angular distributions. Re-do the same for the usual spin-0 Higgs events generated in Exercise 2). Write down all your observations.

Exercise 4

- Generate the Higgs signal in Exercise 2 online, up to the detector simulation with PGS. (hint: upload the proc_card.dat to create the process, switch to default non empty cards in the Pythia and PGS sections of the “Generate events” page)

- Browse to the MG wiki page : http://cp3wks05.fynu.ucl.ac.be/twiki/bin/view/Physics/YETI08 and follow instructions in handout notes to understand how the inclusive Z+jets sample has been generated. Write down all your questions if needed.

- Homework: Investigate signal and background PGS files with MadAnalysis to understand why b-tagging is essential (hint: read the MadAnalysis manual to create distributions for both files on the same plot without distinguishing b jets and non-b jets)