Event generation with MadGraph 5

Tutorial

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Lectures and exercises found at
https://server06.fynu.ucl.ac.be/projects/madgraph/wiki/SchoolNTU

The basics

- Please make sure that you have MG5, Pythia-PGS, MadAnalysis, td, and ROOT installed on your laptop

- Please divide into groups of 4 students per group.

- Work on your own, but compare and discuss together.

- Don't hesitate to ask us when you have questions!

1. Launch madgraph and start the tutorial
   - ./bin/mg5
   - mg5> tutorial

and follow the instructions

Diagram generation

2. Draw the diagrams for the following processes, and compare with MG5:

- u u~ > t t~

- u u~ > t t~ QED=2

- p p > w+, w+ > l+ vl (before and after "output")

Is the result what you expected?

Different models

3. Generate diagrams for the following processes:

- c c~ > h > b b~ in the SM

- p p > h in SM and HEFT

- Gluino pair production in the MSSM at the LHC

Compute decay widths and cross sections

4. Generate MadEvent output for the following processes:

   - p p > t t~

   - p p > w+/-

   - p p > w+/- j

   - p p > go go

   - go decay to all squarks + quarks (not collider)

5. Understand the cards (param_card, run_card, etc)

6. Generate and compare cross sections for the processes at Tevatron and the LHC. Discuss.
   LHC: lpp1=lpp2=1, ebeam1=ebeam2=7000
   Tevatron: lpp1=1, lpp2=-1, ebeam1=ebeam2=980

Complete collider analysis

7. Perform a complete collider analysis:

- Generate MadEvent output for the process
  p p > h, h > l+ l- vl vl~ in the HEFT model

- Using the default Higgs mass of 120 GeV, generate events at the LHC, through Pythia and PGS or Delphes. Same for 180 GeV Higgs.

- Study plots at parton level, Pythia level and detector level. What are the differences?

- Extra: Generate also the background process
  p p > w+ w-, w+ > l+ vl, w- > l- vl~ (in the SM) and compare plots.

- Where are the main differences? Discuss!