MadGraph Tutorial

Katie Leonard
(Dated: April 20, 2012)

1) Installing MadGraph

- Installation proceedure on `https://server06.fynu.ucl.ac.be/projects/madgraph/wiki/MC4BSM#no1` can be followed.
- Check version of python

  $ python −−version

  (Should be version 2.6 or 2.7)
- Download madgraph5 package from `https://launchpad.net/madgraph5` into /MS4BSM directory
- Untar package

  $ tar -xvf MadGraph5_v1.4.4.tar.gz
- Check if mg5 is installed correctly by trying to run it

  $ ./bin/mg5

  mg5> exit

2) Installing MadAnalysis/MadEvent and Pythia-pgs

- Run mg5 and install desired packages

  $ ./bin/mg5

  mg5> install MadAnalysis

  mg5> install pythia-pgs

  mg5> exit
- These steps might take a while (∼10min for my slow computer)
- After MadAnalysis is installed you can launch MadEvent from mg5, and if Pythia-pgs is installed you can choose to run Pythia in MadEvent to hadronize your events.

3) Pre-workshop exercise

- Follow mg5 tutorial

  $ ./bin/mg5

  mg5> tutorial
- The tutorial is very easy and straight forward, it does not take long and we can probably go over it in class.

4) On-site exercise

- Instructions and solutions for the on-site tutorial can be found in the first link above
- Goals of exercise:
  1) Use the model generated by Feyrules
  2) Generate $pp \to u\bar{u}$
  3) Generate events
  4) Pass the events to Pythia
  5) Repeat exercise including decay chain

1) Use the model generated by Feyrules
   - download MC4BSM UFO files files into mg5_main_directory/models (`http://feynrules.irmp.ucl.ac.be/attachment/wiki/WikiStart/MC4BSM_2012_UFO.tgz`)
   - untar files
   - Import model into mg5

     $ ./bin/mg5 (in mg5 main directory)
     mg5> import model MC4BSM_2012_UFO –MC4BSM_2012_UFO

2-4) Generate $pp \to u\bar{u}$
   - First the correct widths and branching ratios need to be computed

     mg5> generate uv > u p1
     mg5> add process uv > u p2
     mg5> add process p2 > ev e+
     mg5> add process p2 > ev~ e-
     mg5> add process ev > e- p1
     mg5> output (This will create a directory for this process with events, param_card.dat, and run_card.dat)
     mg5> launch (This will launch MadEvent which will hadronize your events)
     After launching MadEvent it will ask you what programs you want to run, enter 2 for pythia (tab to stop the timer)
   - Now there should be a /PROC_MC4BSM_UFO_0 dircectory created in the main mg5 dicectory.
   - /PROC_MC4BSM_UFO_0/Cards contains the param_card.dat and run_card.dat
   - We can now gererate the desired process with the correct widths and branching ratios by calling this card in MadEvent.
   - Exit MadEvent and restart mg5; then enter the desired process

     $ ./bin/mg5
     mg5> generate p p > uv uv~
     mg5> output
     mg5> launch
     Again, it will ask you what program to run, 2 for pythia
     It will also ask if you would like to edit a card; here you can enter the path to param_card.dat generated above
       path_to_main_mg5_directory/PROC_MC4BSM_UFO_0/Cards/param_card.dat
   - Now you have created a /PROC_MC4BSM_UFO_1 directory
   - Open the index.html within the /PROC_MC4BSM_UFO_1 directory in a browser to view results, Feynman diagrams, plots, etc.

5) Repeat exercise with decay chain
   - Restart mg5 and enter the following to take full spin-correlation into account

```
$ ./bin/mg5
mg5> import model MC4BSM_2012_UFO
mg5> generate p p > uv uv~, uv > u p1, uv~ > u~ p1
mg5> add process p p > uv uv~, uv > u p1, uv~ > u~ p2
mg5> define l e+ e-
mg5> define lv ev ev~
mg5> add process p p > uv uv~, uv > u p1, (uv~ > u~ p2, (p2 > l lv, lv > l p2))
mg5> add process p p > uv uv~, uv~ > u~ p1, (uv > u p2, (p2 > l lv, lv > l p2))
mg5> add process p p > uv uv~, (uv > u p2, (p2 > l lv, lv > l p2)), (uv~ > u~ p2, (p2 > l lv, lv > l p2))
mg5> output
mg5> launch
```

  - Again, hadronize in pythia and refer to original param_card.dat
  - This step might take a while (~15min)

- Hooray! You are done!