

Introduction to MadGraph

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Initializing

- 1) 'HEP_TOOLS -> MG5_aMC ->bin'
- 2) Launch MadGraph

./mg5_aMC

[illegible]

Figure 1: This is a caption

Calculating $e e \rightarrow \mu \mu$ scattering cross section

(note) When you type

help

you can easily find the commands you need.

- 4) Begin 'tutorial'

tutorial

```

MG5_aMC>tutorial
tutorial:
    You have entered tutorial mode. This will introduce you to the main
    syntax options of MadGraph5_aMC@NLO.

    To learn more about the different options for a command, you can use
    MG5_aMC>help A_CMD
    To see a list of all commands, use
    MG5_aMC>help

    The goal of this tutorial is to learn how to generate a process and to
    produce the output for MadEvent. In this part we will learn
    a) How to generate a process
    b) How to create output for MadEvent
    c) How to run the MadEvent output

    Let's start with the first point, how to generate a process:
    MG5_aMC>generate p p > t t~
    Note that a space is mandatory between the particle names.

MG5_aMC>

```

Figure 2: This is a caption

5) Generate a process.

Here we will generate the process given in the tutorial first. ('~' symbol after the particle stands for 'anti'particle)

generate p p > t t~

```

INFO: Process has 1 diagrams
INFO: Trying process: d d~ > t t~ WEIGHTED<=2 @1
INFO: Process has 1 diagrams
INFO: Trying process: d s~ > t t~ WEIGHTED<=2 @1
INFO: Trying process: s d~ > t t~ WEIGHTED<=2 @1
INFO: Trying process: s s~ > t t~ WEIGHTED<=2 @1
INFO: Process has 1 diagrams
INFO: Process u~ u > t t~ added to mirror process u u~ > t t~
INFO: Process c~ c > t t~ added to mirror process c c~ > t t~
INFO: Process d~ d > t t~ added to mirror process d d~ > t t~
INFO: Process s~ s > t t~ added to mirror process s s~ > t t~
5 processes with 7 diagrams generated in 0.068 s
Total: 5 processes with 7 diagrams
tutorial:
    You have just generated a new process.
    Note that the coupling order "QED=0" was automatically added by MG5
    to avoid non-QCD diagrams which have negligible contribution.
    You can find more information on supported syntax by using:
    MG5_aMC>help generate
    To list all defined processes, type
    MG5_aMC>display processes

    If you want to know more about particles and multiparticles present,
    write
    MG5_aMC>display particles
    MG5_aMC>display multiparticles

    If you want to add a second process, use the add process command:
    MG5_aMC>add process p p > W+ j, W+ > l+ vl @2
    This adds a decay chain process, with the W+ decaying
    leptonically.

    At this stage you can export your processes to different formats. In
    this tutorial, we will explain how to create output for MadEvent.
    This is done simply by typing:
    MG5_aMC>output MY_FIRST_MG5_RUN

MG5_aMC>

```

Figure 3: This is a caption

6) Export the process.

The format is output for MadEvent. We will give the name 'test'

output test

```
INFO: Generating Helas calls for process: g g > t t~ WEIGHTED<=2 @1
INFO: Processing color information for process: g g > t t~ @1
INFO: Generating Helas calls for process: u u~ > t t~ WEIGHTED<=2 @1
INFO: Processing color information for process: u u~ > t t~ @1
INFO: Combined process c c~ > t t~ WEIGHTED<=2 @1 with process u u~ > t t~ WEIGHTED<=2 @1
INFO: Combined process d d~ > t t~ WEIGHTED<=2 @1 with process u u~ > t t~ WEIGHTED<=2 @1
INFO: Combined process s s~ > t t~ WEIGHTED<=2 @1 with process u u~ > t t~ WEIGHTED<=2 @1
INFO: Creating files in directory P1_gg_ttx
INFO: Generating Feynman diagrams for Process: g g > t t~ WEIGHTED<=2 @1
INFO: Finding symmetric diagrams for subprocess group gg_ttx
INFO: Creating files in directory P1_qq_ttx
INFO: Generating Feynman diagrams for Process: u u~ > t t~ WEIGHTED<=2 @1
INFO: Finding symmetric diagrams for subprocess group qq_ttx
Generated helas calls for 2 subprocesses (4 diagrams) in 0.025 s
Wrote files for 16 helas calls in 0.080 s
ALOHA: aloha creates FFV1 routines
ALOHA: aloha creates VVV1 set of routines with options: P0
save configuration file to /home/smllee/HEP_Tools/MG5_aMC/bin/TEST/Cards/me5_configuration.txt
INFO: Use Fortran compiler gfortran
INFO: Use c++ compiler g++
INFO: Generate jpeg diagrams
INFO: Generate web pages
Output to directory /home/smllee/HEP_Tools/MG5_aMC/bin/TEST done.
Type "launch" to generate events from this process, or see
/home/smllee/HEP_Tools/MG5_aMC/bin/TEST/README
Run "open index.html" to see more information about this process.
tutorial:
  If you are following the tutorial, a directory MY_FIRST_MG5_RUN has
  been created which can be used in order to run MadEvent exactly as if
  it was coming from MG4.

  Additionally to the MG4 command (see MY_FIRST_MG5_RUN/README), you can also
  generate your events/compute the cross-section from this interface:
  Please Enter:
  MG5_aMC> launch MY_FIRST_MG5_RUN
  (you can interrupt the computation to continue the tutorial by pressing Ctrl-C)

MG5_aMC>
```

Figure 4: This is a caption

7) Launch the process.

launch test

Then, you will be asked whether you want to change options for parameters and running.

Now, we do not want to change the options.

When you want to change, see Appendix.

Therefore, type 'Enter'.

You will be asked something again. Also type 'Enter' without changing.

8) See the result

Then the firefox browser pops up and gives the result of the simulation.

9) Escape from MadGraph

quit

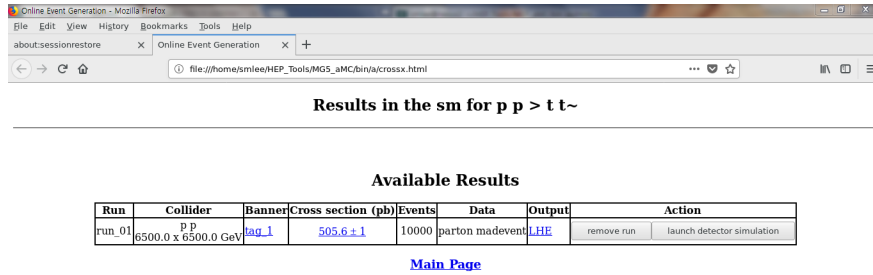


Figure 5: This is a caption

Loading the previous results

You might need the result of the previous simulation.

10) Go to /HEP_Tools/MG5_aMC/bin

There are several directories including your output ones. Go to the directory which you want to load.

firefox index.html

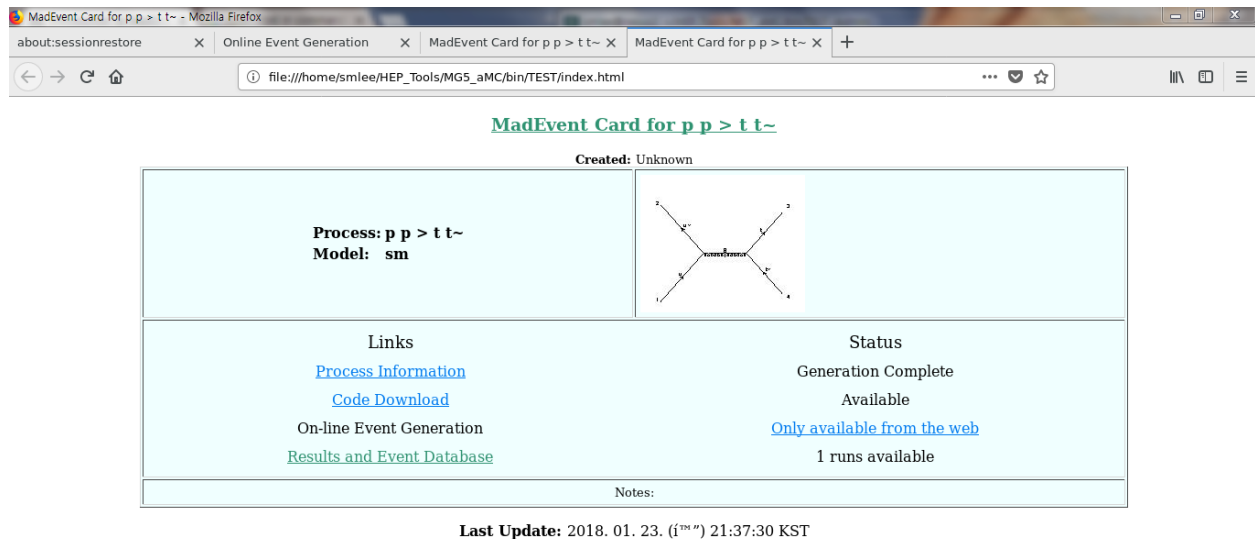


Figure 6: This is a caption

When you click 'Results and Event Database', you can see the previous results.

Appendix) How to change the options

Simulation contains a lot of options to change. Here, you can see how to change the momenta of colliding particles, as an simple example.

The previous processes are identical. We are right after the ‘launch’

1) Launch the process.

After this you will be asked like this:

```
MG5_aMC>launch TEST
*****
*                                     *
*           W E L C O M E to         *
*       M A D G R A P H 5 _ a M C @ N L O  *
*           M A D E V E N T           *
*                                     *
*           *       *       *         *
*         *   *   *   *   *         *
*           *       *       *         *
*                                     *
*       VERSION 2.6.1                2017-12-12  *
*                                     *
*   The MadGraph5_aMC@NLO Development Team - Find us at  *
*   https://server06.fynu.ucl.ac.be/projects/madgraph    *
*                                     *
*           Type 'help' for in-line help.               *
*                                     *
*****
INFO: load configuration from /home/smllee/HEP_Tools/MG5_aMC/bin/TEST/Cards/me5_configuratio
n.txt
INFO: load configuration from /home/smllee/HEP_Tools/MG5_aMC/input/mg5_configuration.txt
INFO: load configuration from /home/smllee/HEP_Tools/MG5_aMC/bin/TEST/Cards/me5_configuratio
n.txt
Using default text editor "vi". Set another one in ./input/mg5_configuration.txt
generate_events run_02
The following switches determine which programs are run:
/=====\
| 1. Choose the shower/hadronization program      shower = OFF      |
| 2. Choose the detector simulation program        detector = OFF    |
| 3. Choose an analysis package (plot/convert)    analysis = ExRoot  |
| 4. Decay onshell particles                      madspin = OFF      |
| 5. Add weights to events for new hypp.          reweight = OFF     |
\=====/
Either type the switch number (1 to 5) to change its setting,
Set any switch explicitly (e.g. type 'shower=Pythia8' at the prompt)
Type 'help' for the list of all valid option
Type '0', 'auto', 'done' or just press enter when you are done.[60s to answer]
```

Figure 7: This is a caption

2) Determine whether programs are run or not.

For example, When you want to make the shower ‘on’, type ‘1’. You may check the shower options changes as ‘shower = Pythia8’

You might want to off the shower again. Then type ‘1’, once again.

When you are done, press ‘Enter’.

Here, we will not change this options.

```

>1
The following switches determine which programs are run:
/=====\
| 1. Choose the shower/hadronization program      shower = Pythia8 |
| 2. Choose the detector simulation program        detector = OFF   |
| 3. Choose an analysis package (plot/convert)    analysis = ExRoot |
| 4. Decay onshell particles                      madspin = OFF    |
| 5. Add weights to events for new hypp.          reweight = OFF   |
\=====/
Either type the switch number (1 to 5) to change its setting,
Set any switch explicitly (e.g. type 'shower=OFF' at the prompt)
Type 'help' for the list of all valid option
Type '0', 'auto', 'done' or just press enter when you are done.
>

```

Figure 8: This is a caption

3) Edit a card

You will be asked once again as follows.

```

Do you want to edit a card (press enter to bypass editing)?
/-----\
| 1. param : param_card.dat |
| 2. run   : run_card.dat   |
\-----/
you can also
- enter the path to a valid card or banner.
- use the 'set' command to modify a parameter directly.
  The set option works only for param_card and run_card.
  Type 'help set' for more information on this command.
- call an external program (ASperGE/MadWidth/...).
  Type 'help' for the list of available command
[_0, done, 1, param, 2, run, enter path][90s to answer]
>2

```

Figure 9: This is a caption

To change energies of colliding particles, type '2'

To go to insert mode, type 'i'. Then you can change the script. Let us change 6500.0->1000.0.

When you are done, type 'esc->:wq'

Now you have changed the script, press 'Enter' to run.

4) Result

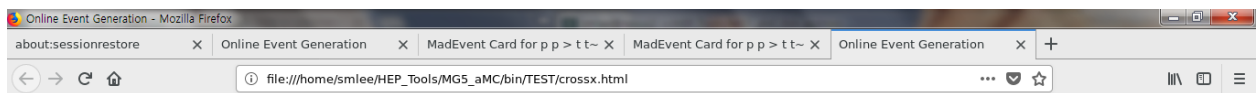
You can get another line for new results. Note that the cross section increased, as expected.

```

open /home/smllee/HEP_Tools/MG5_aMC/bin/TEST/Cards/run_card.dat
#
# This file is used to set the parameters of the run.
#
# Some notation/conventions:
#
# Lines starting with a '#' are info or comments
#
# mind the format:  value      = variable      ! comment
# *****
#
# *****
# Running parameters
# *****
#
# *****
# Tag name for the run (one word)
# *****
tag_1      = run_tag ! name of the run
# *****
# Number of events and rnd seed
# Warning: Do not generate more than 1M events in a single run
# If you want to run Pythia, avoid more than 50k events in a run.
# *****
10000 = nevents ! Number of unweighted events requested
0      = iseed   ! rnd seed (0=assigned automatically=default))
# *****
# Collider type and energy
# lpp: 0=No PDF, 1=proton, -1=antiproton, 2=photon from proton,
#      3=photon from electron
# *****
1       = lpp1    ! beam 1 type
1       = lpp2    ! beam 2 type
6500.0  = ebeam1   ! beam 1 total energy in GeV
6500.0  = ebeam2   ! beam 2 total energy in GeV
# *****
# Beam polarization from -100 (left-handed) to 100 (right-handed)
# *****
0.0     = polbeam1 ! beam polarization for beam 1
0.0     = polbeam2 ! beam polarization for beam 2

```

Figure 10: This is a caption



Results in the sm for $p p > t \bar{t}$

Available Results

Run	Collider	Banner	Cross section (pb)	Events	Data	Output	Action
run_01	$p p$ 6500.0 x 6500.0 GeV	tag_1	505.6 ± 1	10000	parton madevent	LHE	remove run launch detector simulation
run_02	$p p$ 1000.0 x 1000.0 GeV	tag_1	1.549 ± 0.0032	10000	parton madevent	LHE	remove run launch detector simulation

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Figure 11: This is a caption