

# MadGraph Tutorial at KIAS

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**Olivier Mattelaer** <sup>a,b</sup>

<sup>a</sup> *Centre for Cosmology, Particle Physics and Phenomenology (CP3)*

*Université Catholique de Louvain*

*Chemin du Cyclotron 2, B-1348 Louvain-la-Neuve, Belgium*

<sup>b</sup> *Fond national de la Recherche Scientifique (FNRS),*

*Rue D'egmont 2*

*100 Bruxelles, Belgium*

*E-mails:* [olivier.mattelaer@uclouvain.be](mailto:olivier.mattelaer@uclouvain.be)

ABSTRACT:

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## 1. Initiation to MadGraph

The purpose of this section is that you learn the basic command of the mg5 interface. In order to do so. Go to the directory when you install mg5, launch it, type "tutorial" and follow instructions.

```
$ ./bin/mg5
mg5> tutorial
```

## 2. Masterize the Madgraph generation

The purpose of this section, is to masterize the creation of diagram. For this exercise, first draw (BY HAND) the diagram and then compare with MadGraph5.

- $u\bar{u} > t\bar{t}$
- $gg > t\bar{t}$  with the semi-leptonic decay.
- $gg > t\bar{t}h$  use sm model and heft model.

For this process, answer the following questions:

- What's the differences between this model and the sm one.
  - What's the motivation for such model? What is the validity for such model?
- $uu > t\bar{t}b\bar{b}$

## 3. Competition

The first to finish a generation wins some chocolate. The process will be given on the board.

## 4. How to Compute cross-section

The purpose of this section is to understand what are the different parameters used by MadGraph/Madevent in order to compute a cross-sections/generate events.

- create a process for madevent (for example):

- $mg5 > generate pp > e^+vej$
- $mg5 > output KIAS_EXAMPLE$

and read the following files:

- KIAS\_EXAMPLE/Cards/param\_card.dat
- KIAS\_EXAMPLE/Cards/run\_card.dat
- KIAS\_EXAMPLE/Cards/pythia\_card\_default.dat
- KIAS\_EXAMPLE/Cards/pgs\_card\_default.dat

Note all your questions, and after we will discuss together the meaning of all those parameters.

## 5. Compute your first cross-section

The purpose of this part is to make a first generation and to start to do physics with it. The idea is to make a generation and understand the various behavior presented in the various distributions.

For this, by group, take one process and compute the cross-section for the LHC and for the Tevatron.

- Compare the two results, explain why you have such result.
- Look at the various distributions. Why looking at such variable?
- Do you expect such results?
- How this is different of the bkg? (which background?)
- All the question that you will have.

The proposed processes are the following

- $pp > tt$  with a given decay.
- $pp > l + vl$
- $pp > l + l-$
- $pp > H$  Higgs decaying in two W and the W in lepton.

## 6. Signal + Background Phenomenology

The purpose of this study is to make a full chain analysis including shower/ hadronization/ basic detector reconstruction. And search how such process can be observed.

Generate one of the two following process

- $pp > H$  Higgs decaying in two W and the W in lepton.
- $pp > t\bar{t}h$  with semi leptonic decay of the top.
- $pp > sl\bar{s}l$  decaying in lepton neutralino.

Some of the questions that you should ask yourself

- How do I distinguish the signal from the background? (at parton level and reconstructed level)
- How do I measure the mass of the new particles?
- How do I measure the spin of the new particles?
- How do I treat the background?
- For which spectrum in mass, this might be interesting to discover the particles?

## 7. Analyzing some unknown sample

At the LHC, we don't know the theory in advance. So finding the correct theory is not trivial. In this exercise, you will receive distributions for  $pp > X$  with full decay. Your job is to find what is  $X$ , what is the mass of  $X$ , the properties of  $X$ , ...

You will find the sample here:

- <http://cp3wks05.fynu.ucl.ac.be/twiki/pub/Physics/CernSummerSchool08/A.pdf>
- <http://cp3wks05.fynu.ucl.ac.be/twiki/pub/Physics/CernSummerSchool08/B.pdf>
- <http://cp3wks05.fynu.ucl.ac.be/twiki/pub/Physics/CernSummerSchool08/C.pdf>

In order to make the exercise more easy, this is the three scenarios:

- Higgs
- $W'$
- $Z'$

If you need some help, the same process at parton level are more easy to distinguish and more easy to analyze:

- <http://cp3wks05.fynu.ucl.ac.be/twiki/pub/Physics/CernSummerSchool08/A-lhe.pdf>
- <http://cp3wks05.fynu.ucl.ac.be/twiki/pub/Physics/CernSummerSchool08/B-lhe.pdf>
- <http://cp3wks05.fynu.ucl.ac.be/twiki/pub/Physics/CernSummerSchool08/C-lhe.pdf>