Introduction to the Terascale – DESY 2015

# Delphes Tutorial - Lisa Borgonovi

Login:

```
ssh schoolXX@naf-schoolXX.desy.de -Y
```
(pwd)

Main steps to start using Delphes in Desy devices.
In **BLUE**: steps you have to do only the first time that you follow these instructions
In **RED**: steps you have to repeat EVERY TIME you start a new session in your machine

Setup GCC and ROOT:

```
source /afs/cern.ch/sw/lcg/external/gcc/4.7/x86_64-slc6/setup.sh

cd /afs/cern.ch/sw/lcg/app/releases/ROOT/5.34.18/x86_64-slc6-gcc47-opt/root/

source bin/thisroot.sh

cd
```

Download Delphes and compile it:

```
wget http://cp3.irmp.ucl.ac.be/downloads/Delphes-3.2.0.tar.gz

tar -zxf Delphes-3.2.0.tar.gz

cd Delphes-3.2.0/

make
```

From inside the folder Delphes-3.2.0 (useful to use the macros to analyze the ROOT Tree):

```
export DELPHES_PATH=$(pwd)

export LD_LIBRARY_PATH=$LD_LIBRARY_PATH:$DELPHES_PATH
```

To run Delphes, you need:

1) a file with generated events, in .hepMC format (or other): **be sure to know its path (don't copy it!)**. The .hepMC files we are going to use for this exercise are in:

/afs/desy.de/project/school/Delphes_tutorial/hepMC/

h_ggH_ZZ_4mu_125_5k.hepmc (4-muon channel)
h_ggH_ZZ_4elec_125_5k.hepmc (4-electron channel)

2) a file in .tcl format (Delphes Card). For this exercise use the default cards inside the folder cards:

delphes_card_ATLAS_PileUp.tcl
or
delphes_card_CMS_PileUp.tcl

3) If you run with Pile Up (our case!) you need one file with a collection of Minimum Bias events (MinBias.pileup). Be sure to know its path: in the Delphes Card, you have to indicate the MinBias.pileup path. For this exercise, **copy it in your folder Delphes-3.2.0** from:
/afs/desy.de/project/school/Delphes_tutorial
so that the path indicated in the card is already correct.

After the production of the .root ntuples with Delphes, you will have to analyze them with some macros that I've prepared which perform a simple analysis: **copy** the folder macros from:

/afs/desy.de/project/school/Delphes_tutorial/

**Exercise: MUONS**

1) Run Delphes using the CMS or ATLAS card with Pile Up (default: PU=50).

The structure of the shell command line to run Delphes (if you are using a hepMC file) is:

```
./DulphesHepMC cards/cardname.tcl path/outputfile.root
path/hepmcfile.hepmc
```

In this case the command line is:

```
./DelphesHepMC cards/delphes_card_CMS_PileUp.tcl
test.root
/afs/desy.de/project/school/Delphes_tutorial/hepMC/h_ggH_
ZZ_4mu_125_5k.hepmc
```

When the .root file is produced, look at its structure with the ROOT TBrowser:

```
root -l
gSystem->Load("libDelphes")
TFile *_file0 = TFile::Open("name.root")
new TBrowser
```

Now you can analyze the .root file with the H ⟶ ZZ ⟶ 4mu macros:
DelphesMU_analysis.C
DelphesMU_distributions.C

To compile the macros:

```
source /compileDelphesMU_analysis
```
or
```
source /compileDelphesMU_distributions
```

To run the macros on one .root file:

```
./RunDelphesMU_analysis path/name.root
```
or
```
./RunDelphesMU_distributions path/name.root
```

Look at the .histo produced with the TBrowser

2) Produce three new cards starting from the one you just used:

In the first one change the value of "PTRatioMax" for muons (it is a cut on the particle isolation: with the default value, only particle with an "isolation value" less than 0.1 are saved. This cut is very tight, so try with no cut e.g. 9999).

In the second one maintain the value of "PTRatioMax" to 9999 and extend the muon reconstruction efficiency down to pT = 3 GeV.

In the third one maintain "PTRatioMax" at 9999 and the muon reconstruction efficiency down to pT = 3 GeV as before and then try to simulate an upgraded detector, with better muon tracking efficiency, muon reconstruction efficiency, muon pT resolution and eta coverage extension up to 3.5.

After producing these 3 new samples, use the macros to apply the $H \longrightarrow ZZ \longrightarrow$ 4mu analysis on each one of them. Then compare the three results using the macro Plots.C. To use it, open the macro and insert the correct name of the files you want to read, then:

```
root -l
```

```
.x Plots.C
```

Ex

**Exercise: ELECTRONS**

1) Run Delphes using the CMS or ATLAS card with Pile Up (default: PU=50), changing the electron "PTRatioMax" value to 9999 and extending the electron reconstruction efficiency down to pT = 3 GeV.

2) Produce a new card starting from the one just used, modifying the calorimeter granularity

3) Produce a new card with the original calorimeter granularity, but with better electron tracking efficiency, reconstruction efficiency, pT resolution and eta extension

After producing these three new samples, modify the macros used before to apply the $H \longrightarrow ZZ \longrightarrow$ 4ele analysis on each one of them.

Tips:

PID(ele) = 11
Mass(ele) = 0.00051 GeV
Remember to modify also the compiler and the .h!

Then use the macro Plots.C to compare the two results.