Summer CERN stage Logbook

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1 Week 01

1.1 20/07/2015

Access to Cern

The first day we did a lot of bureaucracy. It's not necessary to register the car, our badge permits us to pass. During the afternoon we have attended to a conference during which our tutors have presented the projects.

1.2 21/07/2015

First use of Castor and Marlin

Kinematics

The first process we analyze is the $e^+e^- \to t\bar{t}$ with energy $\sqrt{s} = 365$ Gev, where one top decays as $t \to bW \quad W \to l\nu$, and the other top in three jets. This process with two leptons are more rare, while, on the other and, the process with 6 jets are really difficult to study.

By analyzing the kinematics of the process we have found that the lepton has to cut in energy: the configuration with the minimum energy is when the W has the maximum energy (emitted in the top direction) and the lepton is emitted back respect to the W fly direction; the configuration with the maximum energy is when the W has the maximum energy (emitted in the top direction) and the lepton is emitted front respect to the W fly direction.

With the top energy of 182.5 Gev we obtain a minimum energy of 13.45 Gev and a maximum energy of 120.16 Gev.

Anyway there will be a lot of background to this process (also with high energy) due to the lepton produced by gamma pair production or pions decays.

1.3 22/07/2015

PyROOT and Git

Installing PyRoot and Git, and created a Git repository. You can find some useful files in the utilities folder.

1.4 23/07/2015

Tree Root

Thanks to Maurizio we understood a lot about Root trees. They are like tables: the rows represent the events, the columns are the branches and contain the information of the events.

Trees are contained in a ROOT file, to see the content we could use ROOT as follow: root -l myfile.root _file0-¿ls()

To see a tree we can use the command: mytree-¿Scan() and it permits to see it as a table.

To loop on a tree using C++ we have to create the class associated to the tree by using: mytree-¿MakeClass("myclass") This command creates the file myclass.h that contains the definition of the class with the basic methods. The class contains some variables and the pointers to the branches. The file myclass.C is a ROOT macro, with the function loop, which loops on the events of the tree: you can add your code in this function and make the loop by executing this macro.

In python it's more simple, because one can open the ROOT file and load the tree by using

myfile = TFile("myfile.root","READ") mytree = file.Get("mytree")

and then, to loop on the events of the tree

for event in mytree: my code

Grow space in Lxplus

Thanks to Maurizio we have also increased our free space on Lxplus and adopted the CMSSW_7_4_7 environment to use Root macro on Lxplus. See the file configurazioneLXPlus.txt in utilities to find some useful commands.

1.5 24/07/2015

Using Pyroot scripts

We have started writing python scripts. At the end of the script, all the canvas opened are automatically closed, so, to save the histograms and plots the best way is to save them into a Root file. Here is an example.

file_to_save1 = TFile("./file_to_save1.root","CREATE") Part_ID.Write()

where PartID is a TCanvas variable.

We can also launch Python script using

python -i myscript.py

which don't close the prompt at the end of the macro.

Glob

A useful command in Python is Glob, which gives an array of the files in one folder; we could then loop on this array.

It's also useful to keep the bash library on Python by importin os library.

SLCIO Marlin ntuples

We understood something more about the ntuple produced by Marlin.

mcpdg contains the ID of the simulated particles.

mcgst contains the status of the particles. There are 4 status possible: 0, 1, 2, 102 we have understood that the particles in final state (which are revealed by the detectors) have status 1, while particles which decay have status 2. bottom quarks have status 0 and we will check later which particles have status 102.

mcmox,y,z are the three components of the momentum of the particle mcvtx,y,z are the vertex coordinates where the particle is produced

We understood that there are lot of muons and electrons (also reconstructed) which are not produced in the W decay. They are produced, for instance, by the electrons which radiate. This effect creates a background to the leptons we want to study. In addition the leptons we want to study can radiate and it's difficult to reconstruct these leptons. Maybe, during the study of the montecarlo events, we could analyze the vertex in which the leptons are produced.

We need to ask Patrick and Patrizia if they prefer to import all ROOT library (like import ROOT as RT) or only the functions we need in that macro.

We need also to ask them if they prefer to write a logbook with us or by themselves.

We produced a few plots of the electrons and muons energy in both reconstructed and simulated events. We need to talk about them with Patrick and Patrizia. We need also to understand how the events were smiulated (for instance if each event is only one collision or a collision between two bunches).

2 Week 02

2.1 27/07/2015

Stage and copy file from CERN servers

Patrick have copied all the .slcio files in his directory and processed them with Marlin using two bash scripts. We have copied the ntuples from eos (see the glossary) to our folder, and now we can loop among them.

He used two files: jobCopy.sh and jobMarlin.sh to process the files.

jobCopy first stage the files from the tape (Castor) to the disk, and then copies the files into EOS folder. jobMarlin loops above all the files writing the correct steering.xml file and create all the ntuple.

More about the slcio ntuples

We have found out something else about our ntuples:

We discovered that all the top quark have status 3, and the bottoms have sometimes status 2 and sometimes status 3.

By using the parent information (mcpa0 e mcpa1, for daughters mcda0,1,2,3,4) we managed to select only the leptons which come from the W decay. Then, with a pyroot macro we filled the 2-D histograms of the number of leptons versus the energy and the angle.

2.2 28/07/2015

Lepton vs energy-angle histogram

We managed to loop above all the .root files. We use 256 bins (16 for the angle and 16 for the energy), that are quite similar to the square root of the entries (they are about 40k, the 40% of 100k events).
We have also used the reduced energy defined as

$$x = \frac{2E}{m_t}\sqrt{\frac{1-\beta}{1+\beta}}$$

$$\beta = \sqrt{1 - 4m_t^2/s}$$

We plotted the histo of the number of lepton in function of the $cos(\theta)$ and of the reduced energy. We expected a curve distribution in both the variables, and, to do this, we have to plot only the positive leptons (or the negative); otherwise there can't be any asymmetry in the angular distribution.

The result can be seen in figure 2.1, 2.2, 2.3

Unfortunately the angular distribution is flat: this implies that Pythia simulation don't consider the top polarization. So we cannot use these simulation to perform our analysis, and we need to proceed with different data.

Writing Root Tree using PyROOT

We have also learn how to write a Tree Root using PyROOT. We need first to define a TTree variable, then define the branches, and then fill the branches with a 0-D array (this is important), by looping on the events. Further information in the glossary folder.

2.3 29/07/2015

Copy and Marlin new simulation files

We decided to use other simulation files made with Wizard (instead that Pythia), we could find them at this site clicca qui These simulations are made at 365 GeV and would consider the polarization of the top quarks (we hope so).

By using some scripts bash we have staged all the files, copied and Marlin them.

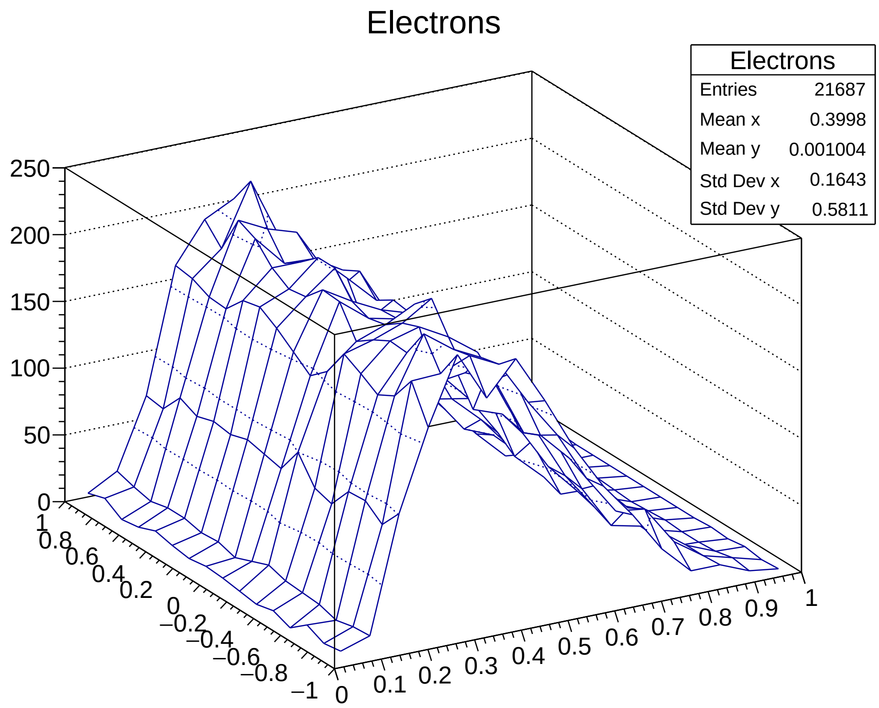

Figura 2.1: Energy-angle distribution of the electrons

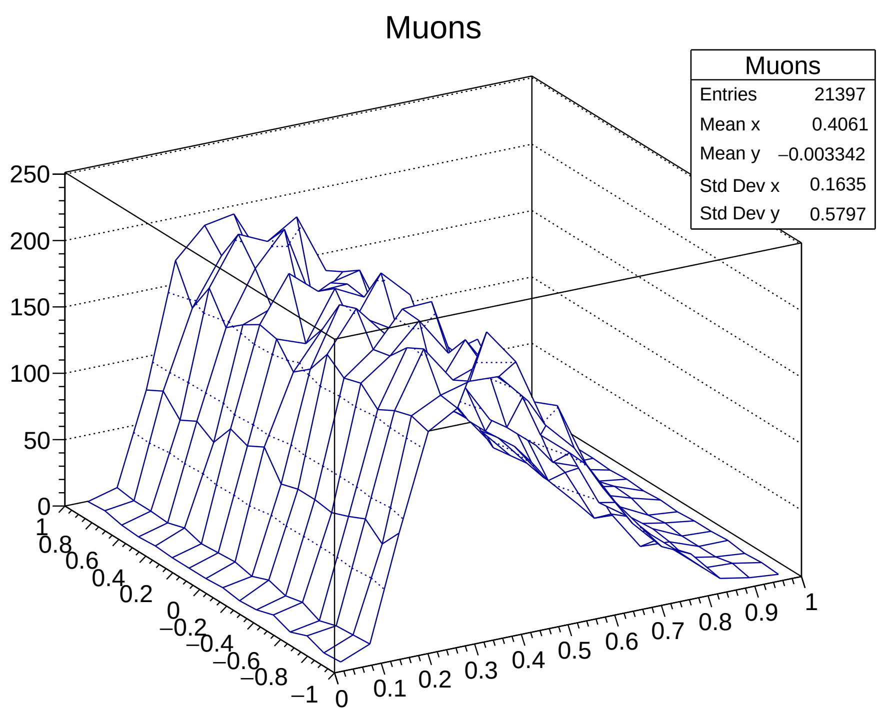

Figura 2.2: Energy-angle distribution of the negative muons

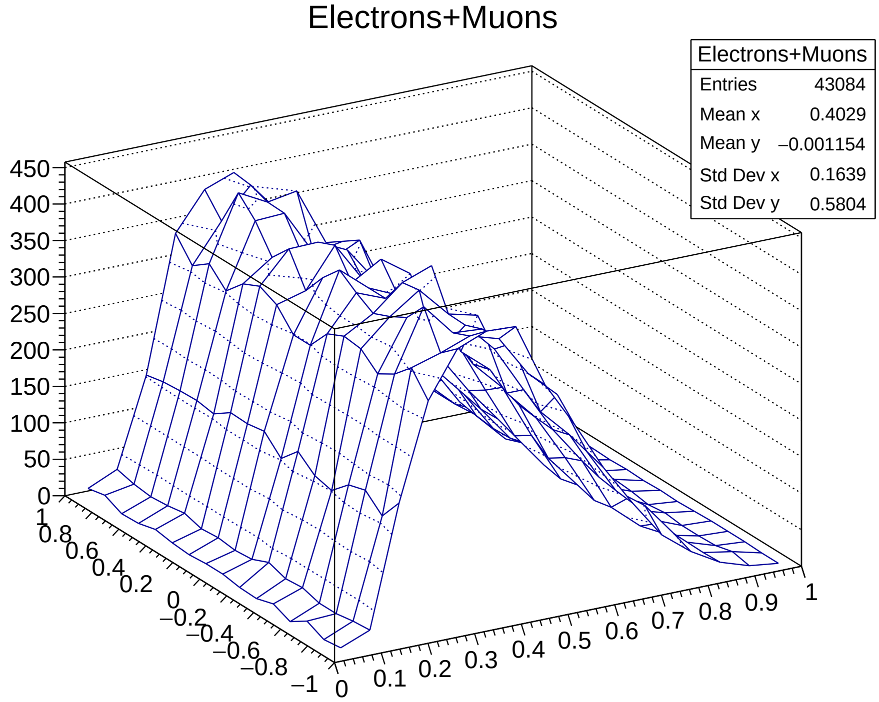

Figura 2.3: Energy-angle distribution of the electrons and negative muons