ROOT basic tutorial

1. Setup your environment (assuming you are already inside the LIP machines that can be accessed using `ssh -XY username@summer.ncg.ingrid.pt`. If for some reason you cannot access the LIP machines check this section for instructions on how to proceed):

   a) Type `module avail` to check which software is already available in the machines. You will see that ROOT is already there!

   b) Type `module load root/6.18.04` to get the latest version of ROOT.

   c) Check if everything is working by typing `root`. The ROOT logo should appear and after that you will be inside the ROOT prompt. In the following times you can use `root -l` to suppress the graphical output.

2. Open a terminal and use ROOT to open the file zjet.root that is located in `/lstore/calo/aluisa/Tutorial_ROOT_basic/` (do `root /lstore/calo/aluisa/Tutorial_ROOT_basic/zjet.root`)

   a) Use `.ls` to check the content of the file.

   b) Print the content of the tree Tdata: `Tdata->Print()`. Check the number of branches and the names of the variables in each branch.

   c) Check the number of entries in the tree: `Tdata->GetEntries()`.

   d) Draw the p_x variable: `Tdata->Draw("px")`.

   e) Take a look at the different variables that exist in the tree and draw a couple of them. Try to understand their shape.

   f) Draw the mass of the particles. Which particles can you identify from this plot?

3. In the directory `/lstore/calo/aluisa/Tutorial_ROOT_basic/` there two macros: `RootTutorial1.C` (written in C++) and `RootTutorial1.py` (written in python). You can choose which one you want to start from and copy it to you working directory. The C++ macro is run using `root RootTutorial.C` while the python macro is run using `python RootTutorial.py`.

   a) Draw p_x, p_y and p_z.

   b) Draw a 2D histogram of p_y *versus* p_x.

   c) Draw the mass of the particles with id=0.

   d) Set the title of the histogram, change the line color, rebin it and scale it to unit area.

   e) Fit the histogram with a Gaussian function.

4. Copy and open the macro `RootTutorial2.C` (written in C++) or `RootTutorial2.py` (written in python) located in the same directory as in the previous exercise. It shows you how to loop over the events of a TTree and fill a histogram.

   a) Create a TCanvas and divide it in two pads side by side. Use the method Divide(2).

   b) In the left pad draw the mass of the particles with id=10. What objects are responsible for this mass peak?

   c) In the right pad draw the mass of Z boson.

   d) Fit the mass peak of the Z boson with a Gaussian function (as you did in the previous exercise) and the mass of the jet with an exponential function.

If you do not have access to the LIP machines

1. You can still follow the tutorial but it will require a bit more work since you will need to install ROOT on your computer.

2. In the agenda, you will find a file called `install_root.sh`. Download it to your computer.

3. Make it executable by typing `chmod +x install_root.sh`

4. Run the executable by typing `./install_root.sh`. This will download and compile ROOT. It can take a while.

5. After it is complete check if everything went well by typing `root`. The ROOT logo should appear and after that you will be inside the ROOT prompt.

6. You also need to download the data file that will be needed for this tutorial. Go to this page and download the file (click on "Download" in the right upper corner)