ROOT Basic Tutorial

1. Setup your environment (assuming you are already inside the LIP machines that can be accessed using `ssh -XY USERNAME@pauli.ncg.ingrid.pt`)
   (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 gcc63/root/6.24.06` 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, 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 your 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.