Goal of these exercises

Basic informations: you will work on a set of events coming out from a PAMELA experiment simulation. The given file

```
/home/mocchiut/pamela/data/pamelasimu.root
```

contains the TTree pamcalotree, storing data with the PamCalo class, header file:

```
/home/mocchiut/pamela/PamCalo/inc/PamCalo.h
```

so library:

```
/home/mocchiut/pamela/PamCalo/lib/Linux/libPamCalo.so .
```

The ROOT file contains about 5.700.000 events: protons, electrons and positrons mixed together in an energy range from 10 to 300 GeV.

Positrons to electrons ratio in this file is about 0.1 . Electrons to protons ratio in this file is about 0.007 .

Exercise 1

Write an an executable compiled program which reads the input file

```
/home/mocchiut/pamela/data/pamelasimu.root
```

and gives as output a new ROOT file containing a TTree with three variables (a TBranch for each one):

- pID
- qtot
- nstrip

Save into the new file events which satisfy the following condition:

1. the event lays in the energy range 25 – 30 GeV (hint: pay attention to the sign of "energy", use "fabs"!).

Hints:

- to compile, remember to add also the compilation flags:

```
-I/home/mocchiut/pamela/PamCalo/inc
-L/home/mocchiut/pamela/PamCalo/lib/Linux/
-lPamCalo
```

- to run, remember to export LD_LIBRARY_PATH:

```
export LD_LIBRARY_PATH=/home/mocchiut/pamela/PamCalo/lib/Linux/:$LD_LIBRARY_PATH
```

- the output file should have a size of about 1.2M, if you have quota problem you can write the output on the linux temporary directory "/tmp/".

Exercise 2

Write a ROOT-CINT script which reads the output file of exercise 1 (should be similar to this one: `/home/mocchiut/scripts/EM_output_280313.root` use this file if you are not able to complete or run exercise 1) and gives as output on the screen and on the disk (pdf format) a TCanvas divided into two pads (one column, two rows – hint: `TCanvas::Divide`) which contains from top to bottom:

1. a scatter plot (`TH2D`) of `qtot` vs `nstrip` with black dots for background-like events (`pID==0`) and red dots for the signal-like events (`pID==1`) (hints: qtot range [0-12000] and nstrip range [0-1200], use method "SetMarkerColor" and the "same" option when drawing the second scatter plot);
2. the event distribution histogram (`TH1D`) for `qtot` for the signal-like events (`pID==1`) fitted with a Gaussian function G1(N1, $\mu1$,$\sigma1$).

Exercise 3

Update the script of exercise 2 in order to draw a new TCanvas divided into three pads (one columns, three rows – hint: `TCanvas::Divide`) which contains the `nstrip` distributions (`TH1D` same binning for all histograms, range [200,1000]) for events selected with `qtot` > ($\mu 1$ - 2 * $\sigma 1$) (wit $\mu 1$ and $\sigma 1$ obtained in exercise 2, use $\mu 1$=6600 and $\sigma 1$=800 if not able to complete ex. 2) where:

- first row plot contains events for which pID==1;
- second row plot contains the events for which pID==0;
- third row plot contains the events for which pID==0 or pID==1.

Preparing the output

- create a directory named with the following format:

  YourInitials_C++2012

  (for example in my case it would be: EM_C++2012)

  put inside this directory ALL the files you want me to correct and look at.
- ALL files names format (but Makefile, if any) must be like:

  YourInitials_something.extension

  (for example in my case I would create files: EM_main.cpp, EM_myscript.C, EM_OutputHistogram1.pdf, etc. etc.)
- create a README text file (named like EM_README.txt), inside the file write:
  - **your name and surname**
  - a list of the files you are submitting
  - **in details** how to compile and run the programs
  - any other comment and answer to question(s) rised in the exercise description
- create a compressed tarfile containing the directory:

```
bash> ls
EM_C++2012
bash> tar zcf EM_C++2012.tar.gz EM_C++2012/
```

- copy the tarzipped file on the USB key I will circulate

Timing and rules

- You have four hours time to do your work.
- You can search the web, look at manuals, look at any note you wrote during the course, etc.
- We will discuss what you have written at the oral examination on XXXX/XX/XX, until that (if needed) you can change and improve your programs. In that case prepare an electronic version we can look at during the oral examination, we will compare it to the one handed in today and we will discuss any change and/or correction.