C++ AND ROOT

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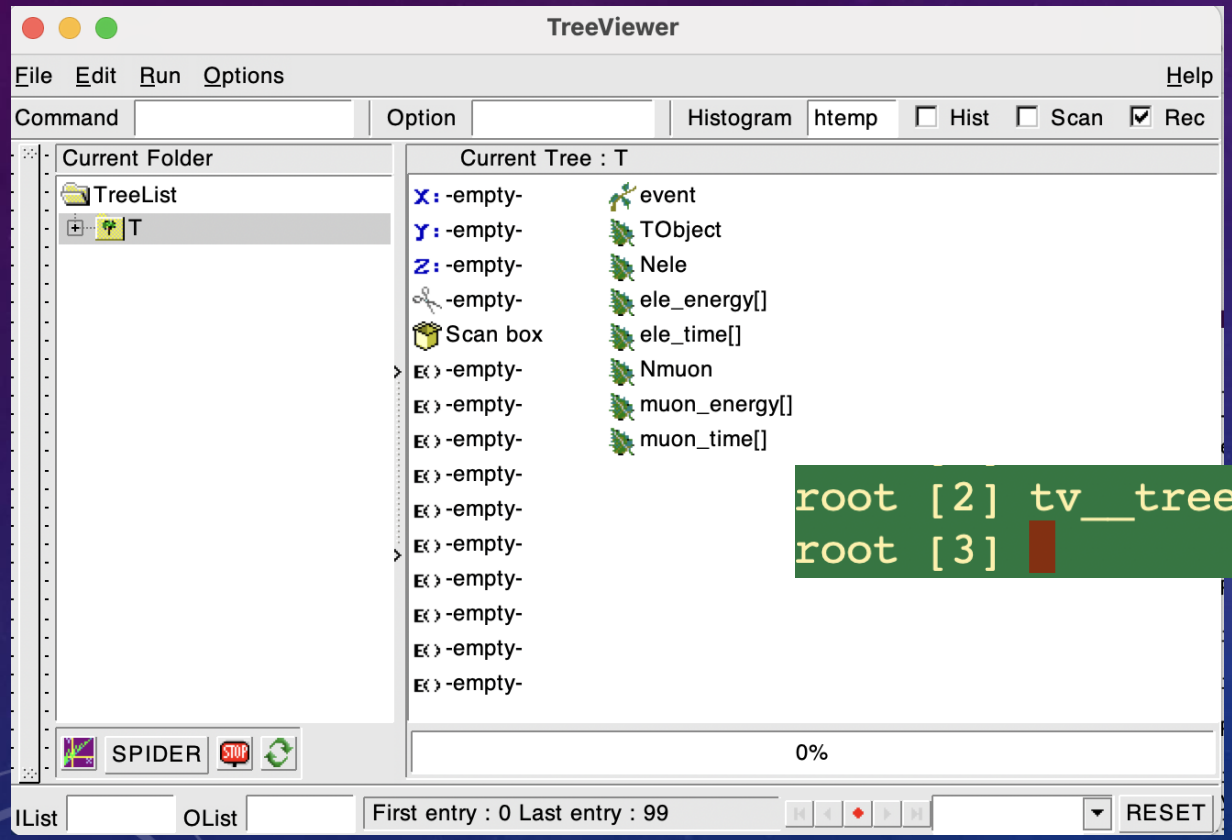
TODAY'S TASK

- See a class method for looping over TTree events
- Analysis task 1: Extract signal by removing the background and fitting
- Analysis task 2: Extract signal by cutting on TTree variables

PLOTTING TTREE VARIABLES WITH TREEVIEWER

- The easiest way to plot a variable is to open the tree viewer



Quantity to plot

Selection (cut)

First event

```
root [2] tv__tree->Draw("ele_energy[4]","Nele>=5","", 100, 0);
root [3]
```

N of events

https://alpha.physics.uoi.gr/JStrologas/PSI/ myData_5.root

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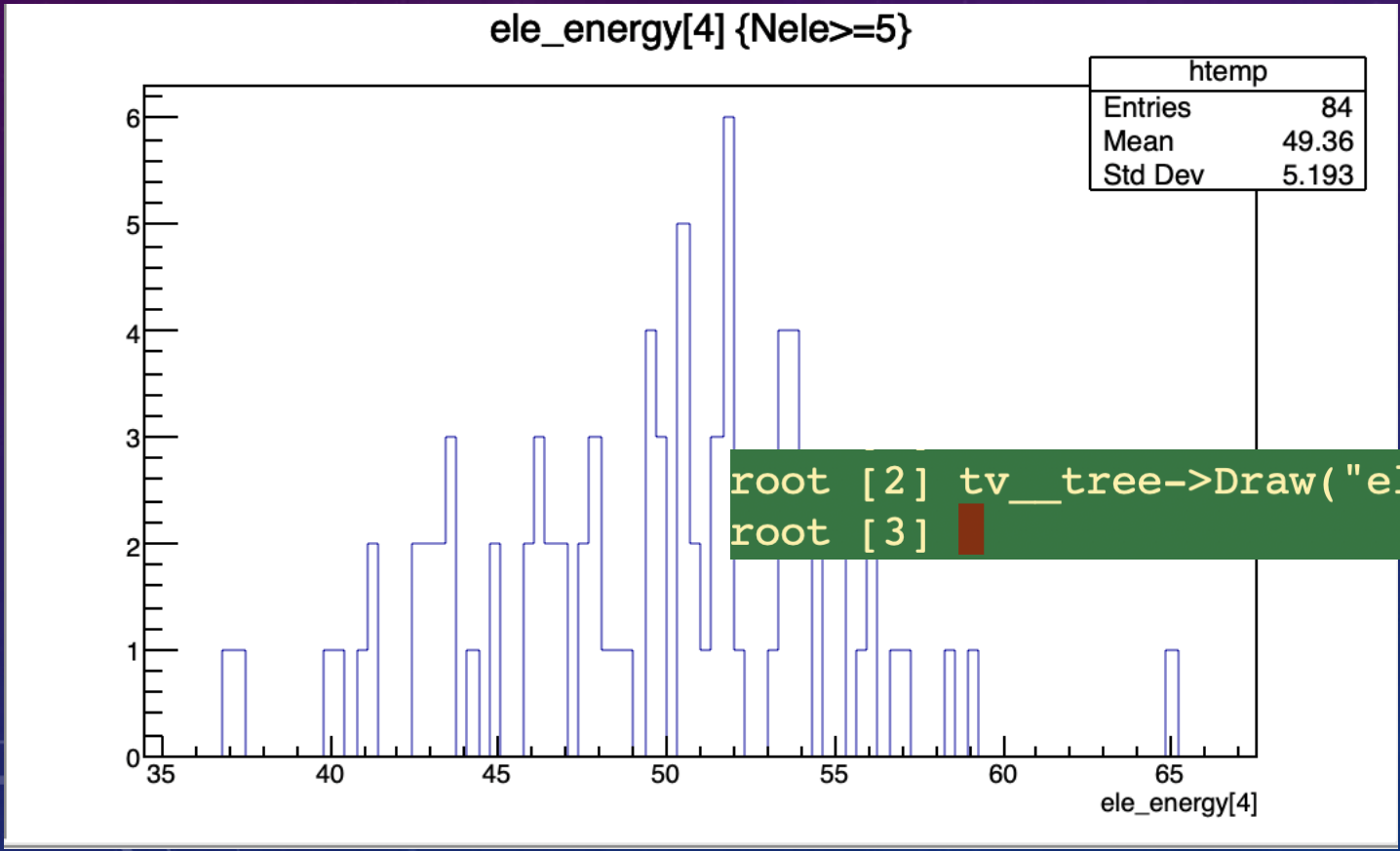


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FOR MORE COMPLICATED ANALYSIS TASKS

- If we have a more complicated task, we want to run a macro (.C) instead of typing commands
- The macro has to be extendable to include any ROOT object
  - E.g., we should be able to define and fill a histogram
- Solution: Create a class
  - One of the methods of the class will loop over the TTree events
- Good news: There is an automated way to do this
  - TTree method MakeClass()

PROCESS OF CREATING AND RUNNING THE TTREE ANALYSIS CODE

- First call the method MakeClass()
  - If the instance of TTree is T call T->MakeClass("myAnalysis")
    - This creates the myAnalysis.h header file and myAnalysis.C macro that describe your class MyAnalysis

- Some times these automatically created macros need editing
  - Most usual editing: Replace TTree with the TChain object, so that you can chain many trees together

- To run the macro start a new root session and issue the following commands
  - .L MyAnalysis.C ← Loads the macro
  - MyAnalysis t ← creates an instance of the class MyAnalysis
  - t.Loop() ← executes the method Loop() of the class (which loops over the events)

THE LOOP() METHOD OF YOUR NEW CLASS

- This method loops over events, so you put there all your tanalysis code

```
#define myAnalysis_cxx
#include "myAnalysis.h"
#include <TH2.h>
#include <TStyle.h>
#include <TCanvas.h>

void myAnalysis::Loop()
{
//   In a ROOT session, you can do:
//      root> .L myAnalysis.C
//      root> myAnalysis t
//      root> t.GetEntry(12); // Fill t data members with entry number 12
//      root> t.Show();       // Show values of entry 12
//      root> t.Show(16);     // Read and show values of entry 16
//      root> t.Loop();       // Loop on all entries
//

//     This is the loop skeleton where:
//    jentry is the global entry number in the chain
//    ientry is the entry number in the current Tree
//  Note that the argument to GetEntry must be:
//    jentry for TChain::GetEntry
//    ientry for TTree::GetEntry and TBranch::GetEntry
//
//       To read only selected branches, Insert statements like:
// METHOD1:
//    fChain->SetBranchStatus("*",0);  // disable all branches
//    fChain->SetBranchStatus("branchname",1);  // activate branchname
// METHOD2: replace line
//    fChain->GetEntry(jentry);       //read all branches
//by  b_branchname->GetEntry(ientry); //read only this branch
```

```
//by  b_branchname->GetEntry(ientry); //read only this branch
   if (fChain == 0) return;

   Long64_t nentries = fChain->GetEntriesFast();

   Long64_t nbytes = 0, nb = 0;
   for (Long64_t jentry=0; jentry<nentries;jentry++) {
      Long64_t ientry = LoadTree(jentry);
      if (ientry < 0) break;
      nb = fChain->GetEntry(jentry);   nbytes += nb;

      cout << Nele << " " << Nmuon << endl;

      // if (Cut(ientry) < 0) continue;
   }
}
```

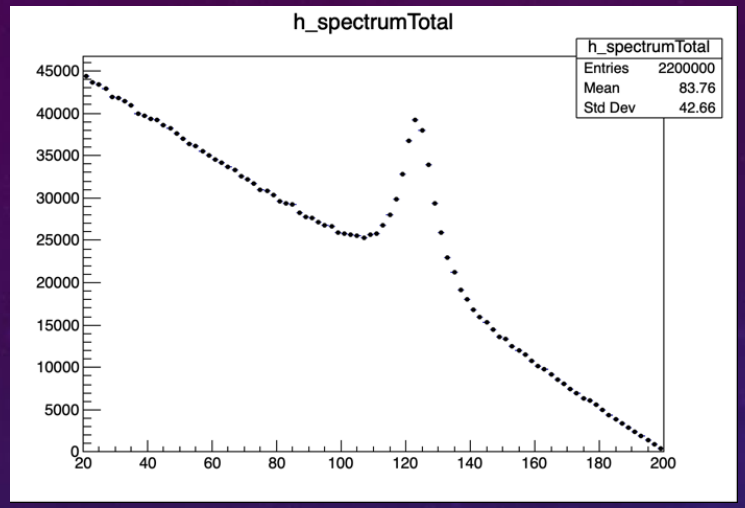
Added this

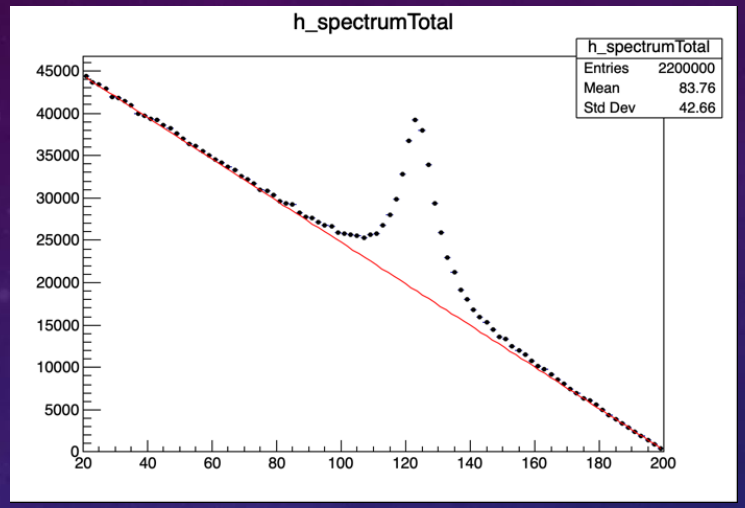
ANALYSIS TASK 1

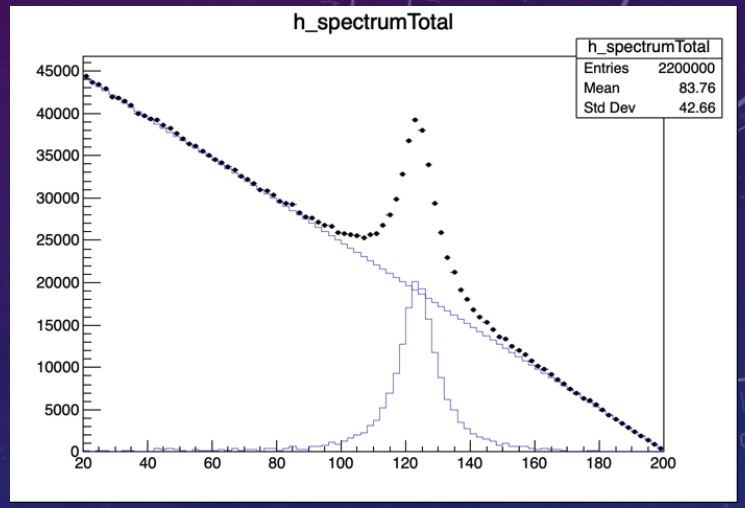
- You are given a distribution of mass reconstructed from an experiment. You are also given that the background follows a linear distribution
  - The file is https://alpha.physics.uoi.gr/JStrologas/PSI/file_1.root

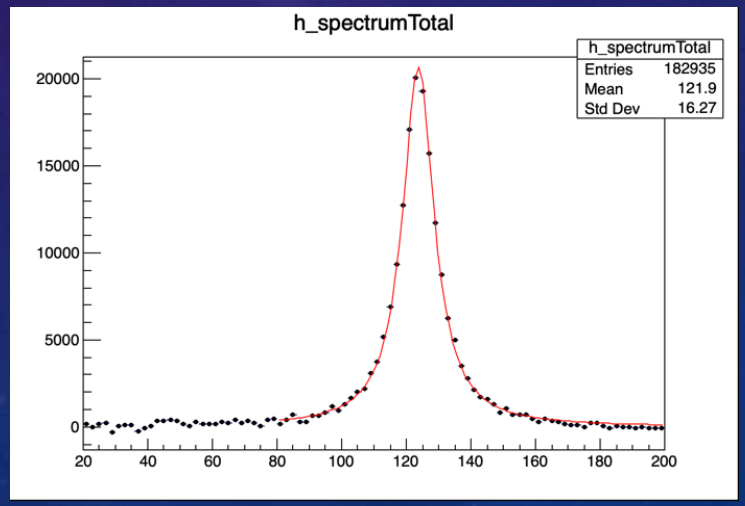
- Your goal is to extract the signal
  - Remove the background
  - Fit the signal with a Breit-Wigner distribution
    - Extract the pole mass and width of this newly discovered particle

THE STEPS OF SOLVING THE PROBLEM









We will solve it together, step by step

ANALYSIS TASK 2

- You are given a TTree that has the reconstructed mass, theta, and phi of particles
  - The location of the file is ..

- Can you discover the signal by setting proper cuts (selections) on the particles' properties

We will solve it together, step by step

REMEMBER TO TAKE THE CODE YOU WROTE WITH YOU