Toy Discovery: Nuclear and Particle Physics

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1 Read and Rebinning

In order to make easier the management of the histograms we store the histograms of the file .root into a *TList** class. This allow us to iterate over objects that we can declare as histograms. The function is called rebinHist and take as input the name of the root file and the rebin number. The function read the file if the file contain *TH1* class it convert the object in the root file into a histogram TH1. Then, a new histogram is created where the rebin is performed. Finally, the new rebined histograms are stored in a *TList** and it is returned.

2 Cumulative Technique

To prepare a cumulative histogram, the function *cumulativeList* was created. It is a function that take a *TList* as input with rebinned histograms. Then, an iterator is created to take our parameter *hists*. Later we create a new list called *auxList*, that will be our auxiliary list. We create *obj*, that is going to be our object to iterate. We create a buckle that has *obj* as parameter, it will take the histograms from our list and will create a new histogram with the cumulative. Then it will put the new created histogram inside the auxiliary list, *auxList*. Finally the buckle returns the list, auxList, with all the cumulative histograms.

3 Find N Events

In this section we are going to construct a function(*integrateFits*) that receive a input (*TList and histolist* that are "rebinned" histograms) and then extract the events such as signal(peak), background(flat) and the data. In the code, to start we open a file(*Events*) in which we will print the events. Then, a loop is created. It is a while loop, which will work until the next element of the TList is zero. In each iteration, for each histogram we obtain a fit function for the signal, a fit function for the background and then we integrate the signal fit function and the background fit function in a range of 50 to 500, and 0 to 800 respectively. The number of events in each iteration is given by the value of the integral of the histogram. Finally, we print the results in the file. This process is repeated for each iteration to obtain a file for each event in the histogram.

4 Plotting

In order to plot the data, the function showHist was made. This function takes as an input a TList, and the output is the plot of the analyzing data. The elements of the TList are histograms, for the specific case of the project these are the cumulativeList and fitPeaksList. Thus, the function uses an iterative method to go through each histrogram in the TList's. First, an iterator is created using TIter. Then, the object to iterate is defined. Next, an iteration condition is used to create a number of objects equal to the number of histograms in the list. Later the environment of the plot is created employing TCanvas. In addition, the object created previously is used to take a histogram from the TList and put it into the canvas. Finally, at the end of each loop, the canvas is updated to obtain different plots in different canvas.

5 Fitting

Here we create a function *fitPeak* in order to fit the obtained histograms. Once it takes a histogram, the function return a fitted histogram. Most of the histograms are fitted using polynomial,Gaussian, and Landau functions. Then we obtain the parameters for the made fittings and the function return the histogram fitted, stored parameters for the fit in a declared list, are used to set the parameters for Signal and Full spectrum.*firPeakList* receives a Tlist of histograms and fit each one making use of *fitPeak*. All the fitted histograms are returned as Tlist. Finally in order to obtain and show the statistical parameters of each one of the fits, chi square, NDF, we created a function *showParameterFits* wich take a TList and print into a file all the mentioned statistical values coming from the fits.

6 Hypotesis Testing

7 Measurement and Discussion

The file *toydiscovery.root* contain data of four histograms. Each histogram and the fits corresponding to signal, background and signal+background are shown in Figures 2, 3, 4, 5. The function used to fit the background is a polynomial of 2nd degree. The signal was fitted with the sum of four gaussians places strategically in the range from 70 to 233 and a landau function in the range from 250 to 500. Figure 2 shows the signal is located around 125 which should correspond to Higgs boson in Giga electron Voltz.

The same argument for figure 3, the peak is placed around 200 then the signal should correspond to a top quark in Giga electron Voltz. Nevertheless, the signal from quark top exactly is placed around 175 possibly this signal comes from an unknown source. In figure 4 we can appreciate the two mentioned signals and other around 80 or 90 which probably is one or both kind of weak bosons. In the next section, we have explored the statistics from the measurements and some unexpected results.

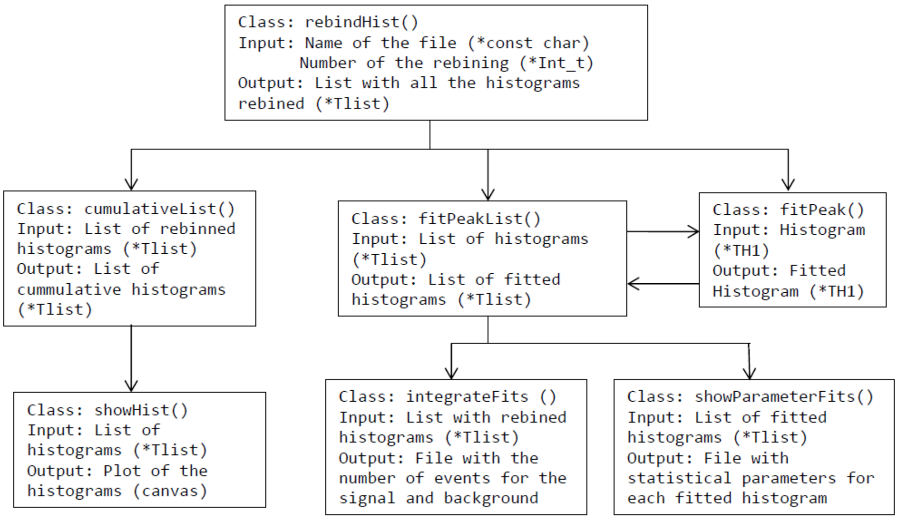

Figure 1: Flowchart of the code toydiscovery.c

From Table 1 we can see that the best fit is for the fourth histogram since the ratio between the χ^2 and NDF is the closest to best goodness of the fit. The other histograms have a lower ratio value suggesting the used fits are not the best one. In the column of Nevents signal and Nevents background, we can see two negative values for the histograms 2 and 4 respectively. In conclusion, we need a better fit of the data for the histograms. We analyze the results obtained and find that the signal received corresponds to boson $W^{\pm}$, boson Z^0, H Higgs boson and a quark top t probably.

Histograms	Nevents Signal	Nevents Background	χ^2	NDF	χ^2/NDF
1	13.647779	8.398944	0.343553	25	0.014
2	89.373280	1554.505707	0.606136	52	0.012
3	668.566704	100.535887	12.660913	393	0.032
4	2628.504519	912.013767	97	121	0.802

Table 1: Events number ans statistical parameters for each histogram

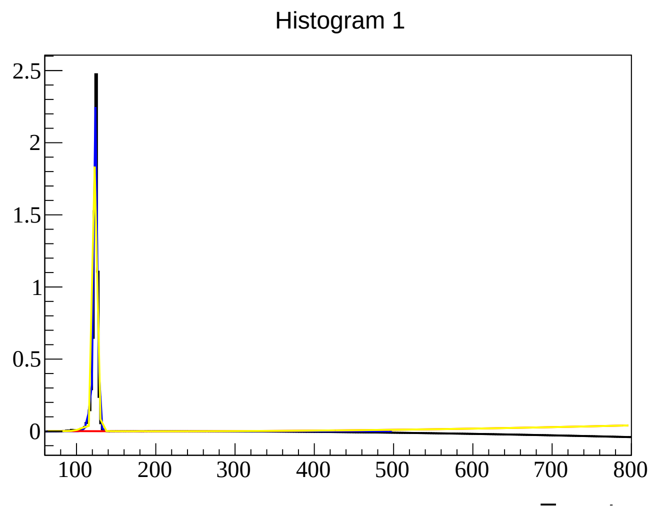

Figure 2: Histogram 1 and its corresponding fits for signal (blue), background (red) and signal+background (yellow)

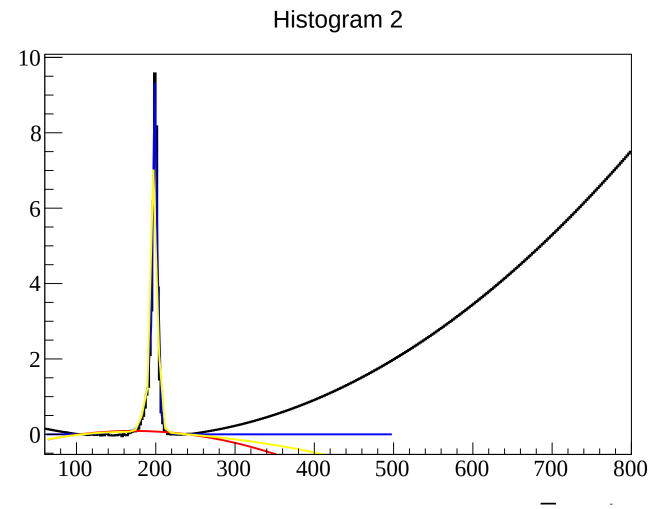

Figure 3: Histogram 2 and its corresponding fits for signal (blue), background (red and signal+background (yellow)

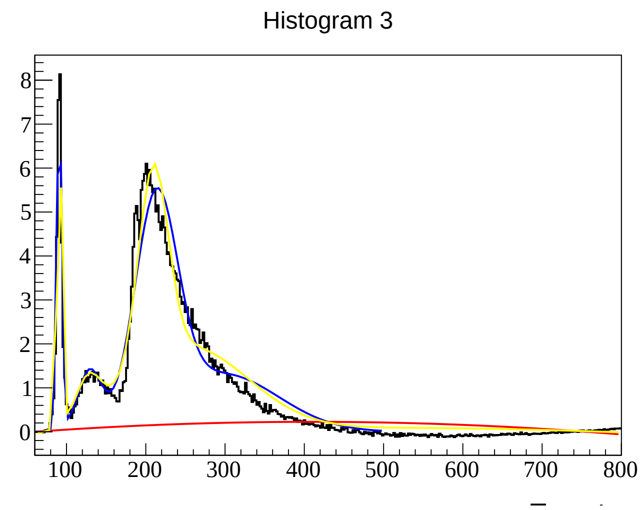

Figure 4: Histogram 3 and its corresponding fits for signal (blue), background (red) and signal+background (yellow)

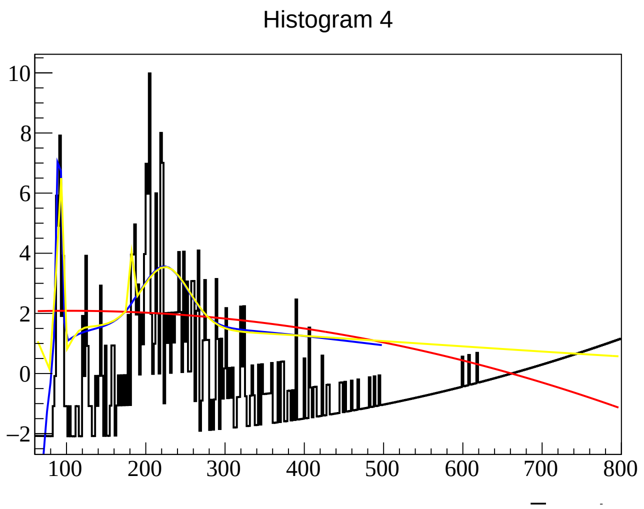

Figure 5: Histogram 4 and its fits for signal (blue), background (red) and signal+background (yellow)