Presentation

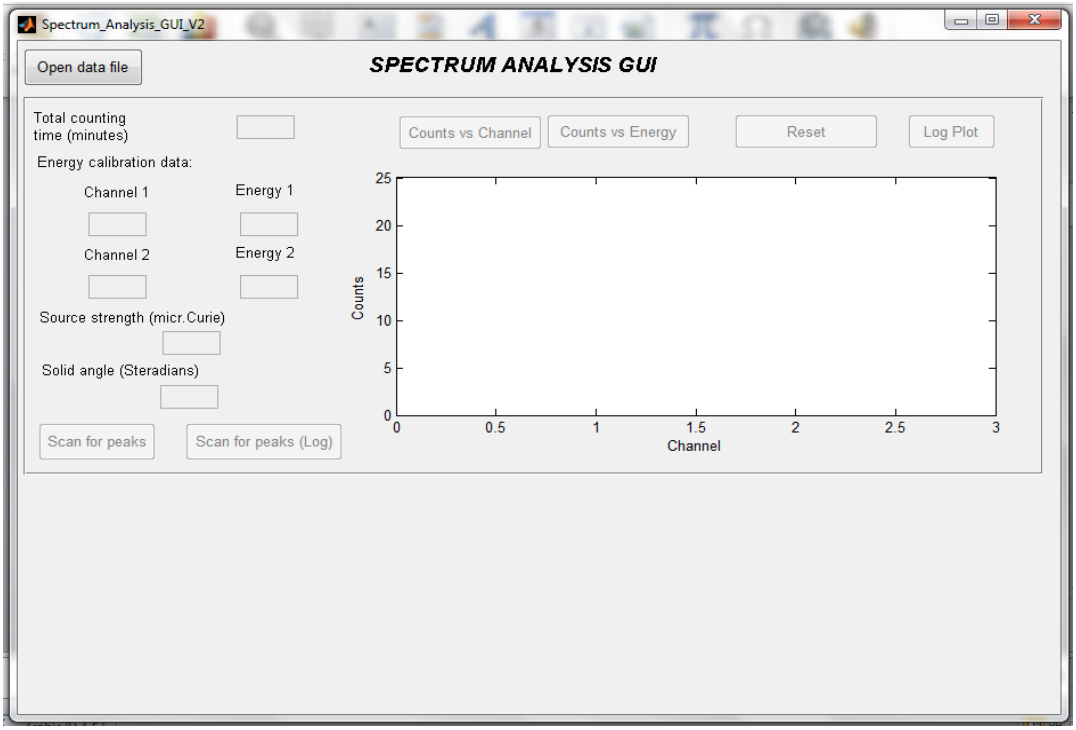


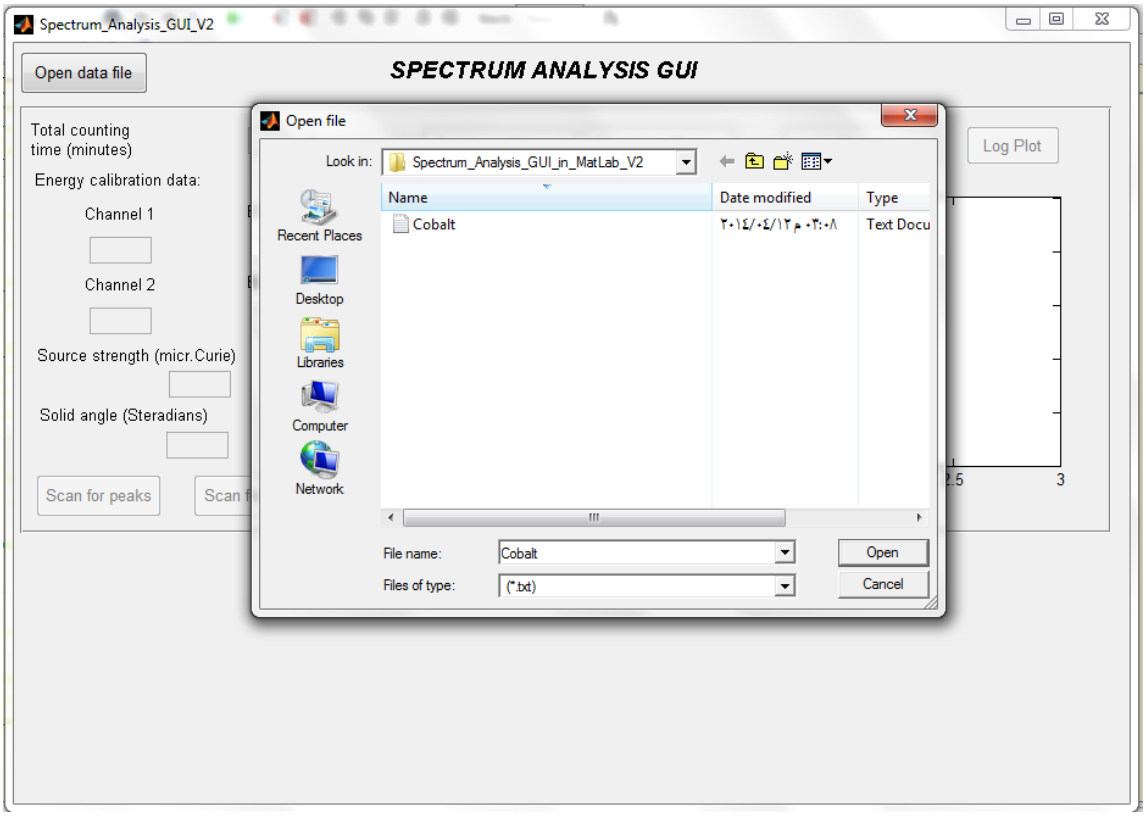
Figure 1

Key points

1. As shown buttons for plotting count vs channel, counts vs energy
2. Reset button
3. Log plot button (energy vs Log - (Count/Sec))
4. If in the input fields of GUI negative number is typed corresponding error dialog box will appear.
5. Load a Data file using the open data button.
6. The following parameters are calculated after pressing scan for peaks button: Counts/Sec, Energy, FWHM, Resolution, Peak Efficiency and STD Peak Efficiency.
7. The following file formats for input file are allowed: ".txt", ".dat", ".xls", "xlsx".

Starting

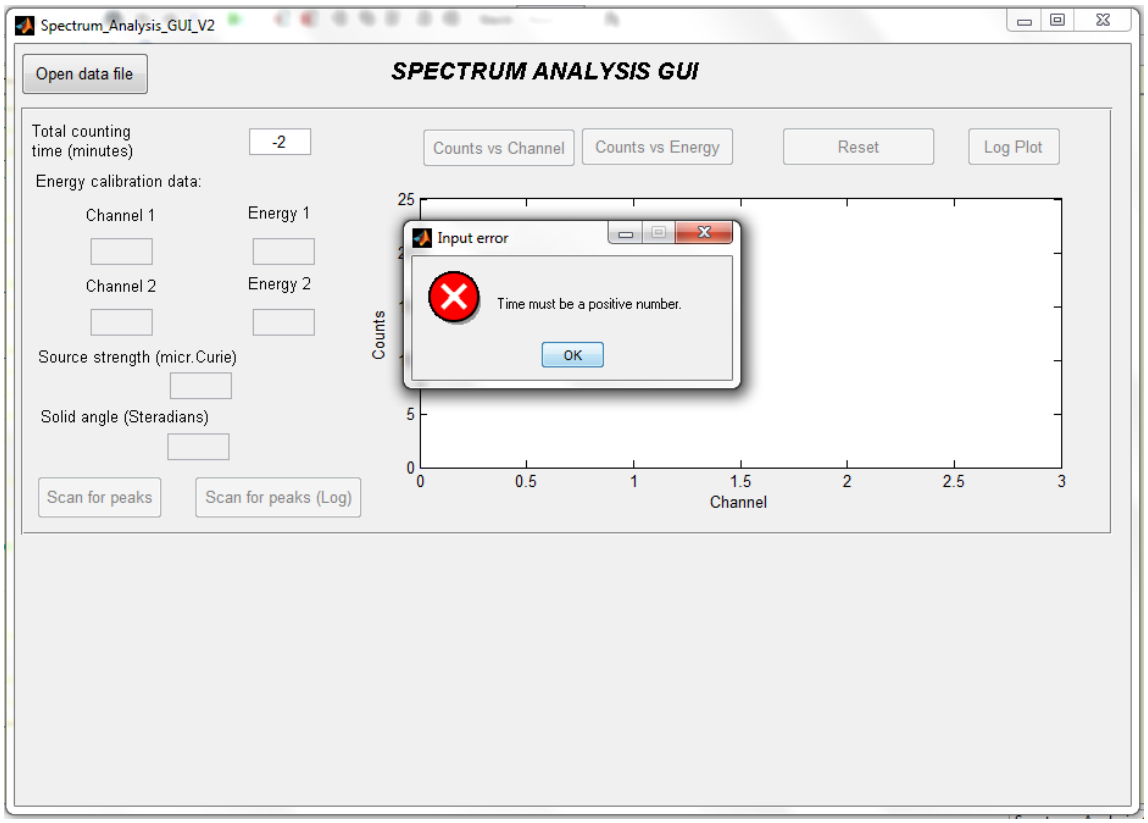
Pressing the button “Open data file” dialog box appears, which allows to choose input file from any location inside your PC (Fig.2). The following file formats for input file are allowed: “.txt”, “.dat”, “.xls”, “xlsx”. The input data must be formatted in two columns, the first column is channel number and the second column is total counts per channel and without any column names in the input file.



After loading the input file. The user can input the total time of the measurement, two data points of channel and corresponding energy (I.e. E1, ch1 and E2, ch2) for energy calibration. The default values for these parameters (Data given for Cobalt) are set as follows:

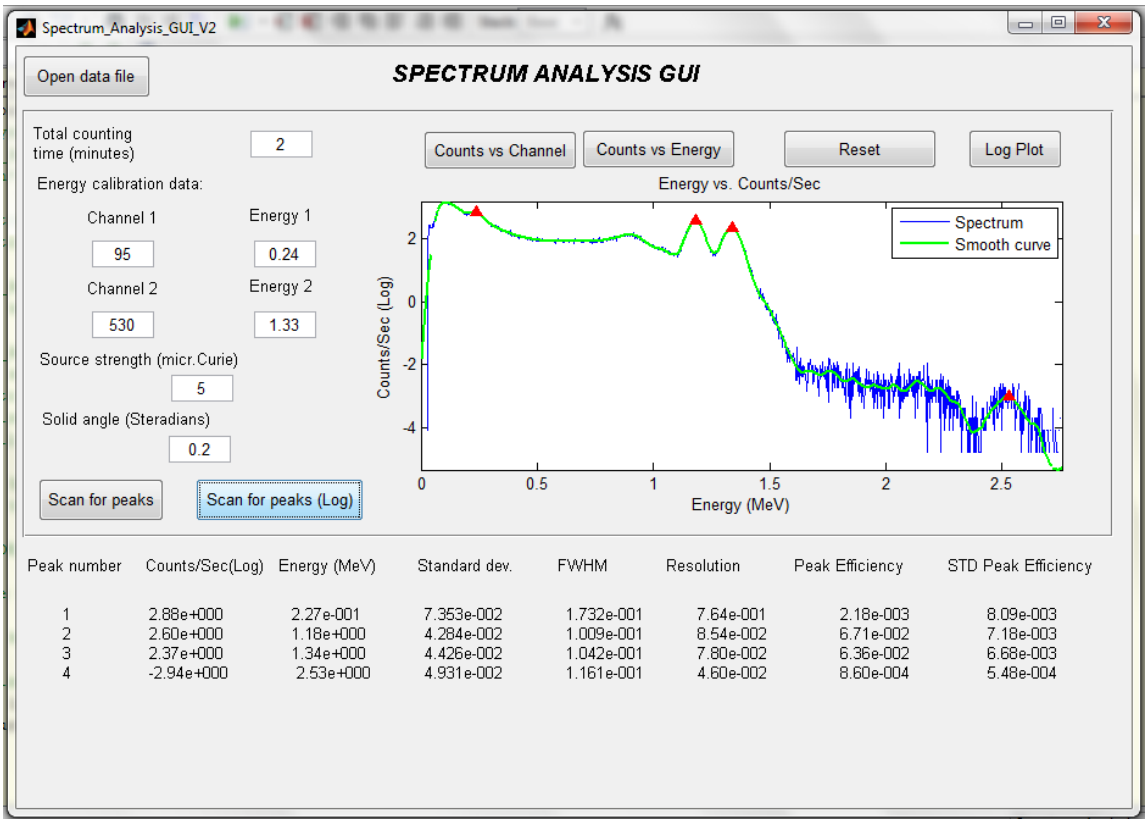
Total time	2 minutes
Channel 1	95
Channel 2	530
Energy 1	0.24 MeV
Energy 2	1.33 MeV
Source strength	5 $\mu Curie$
Solid angle	0.2 steradians

These parameters can be changed. In case of inputting negative values for these parameters, an error dialog box appears and all buttons and fields become disabled. User must input positive values for these parameters.



When the correct input parameters are set, all buttons become enabled. By pressing scan for peaks the spectrum analysis is performed and in the figure the counts/Sec vs energy is plotted. The

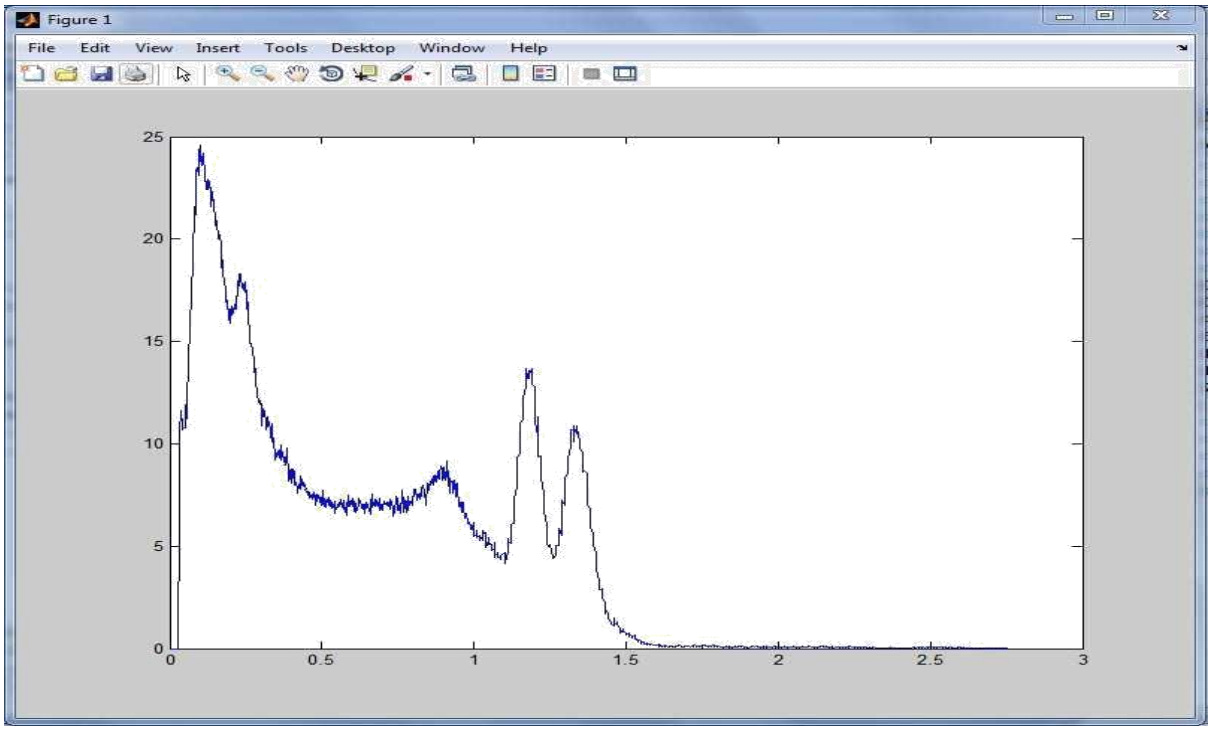
positions of peaks are marked in the plot. When the peaks are found, in the bottom part of GUI, information about these peaks will appear. Also this information is automatically saved in separate file ("Results.txt") in the same directory where the input file is located.



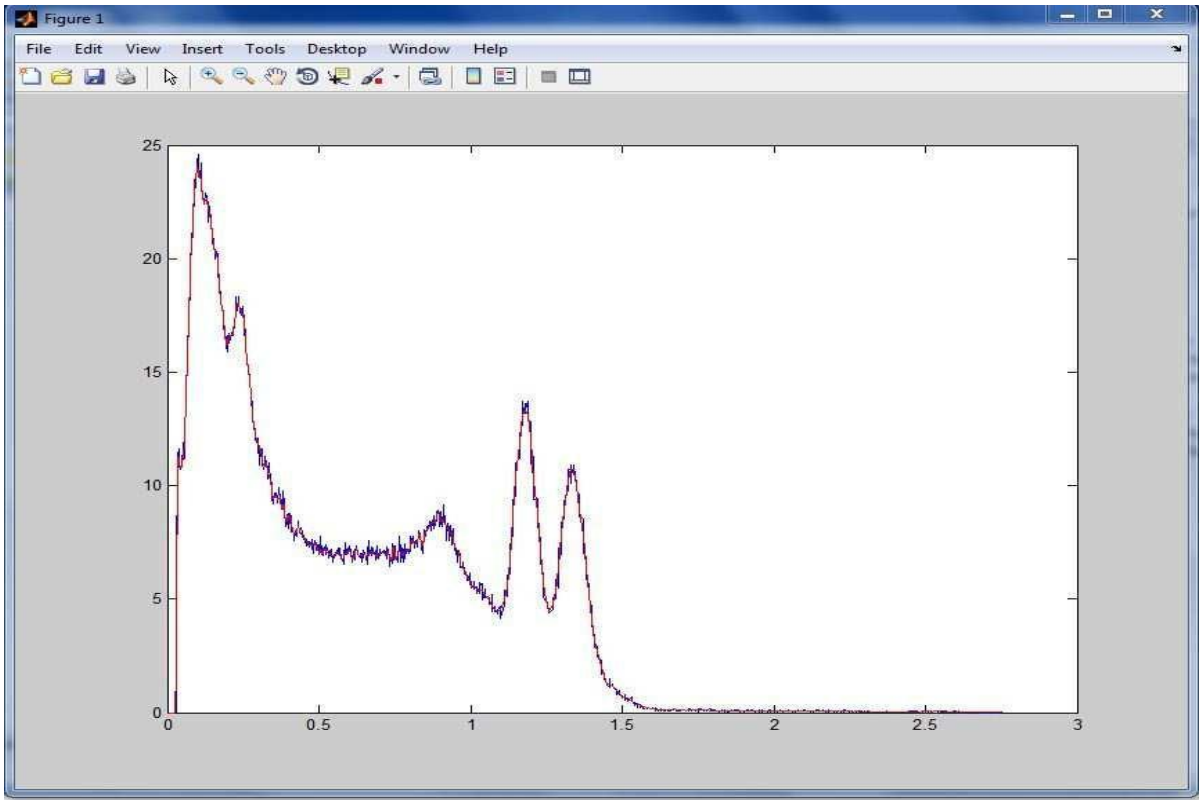
Peaks finding algorithm

The hardest part of this project was to develop algorithm which will find the correct peaks. It is not as easy as it looks. we have tried many different filters in matlab to get acceptable solution. And finally we found the following solution.

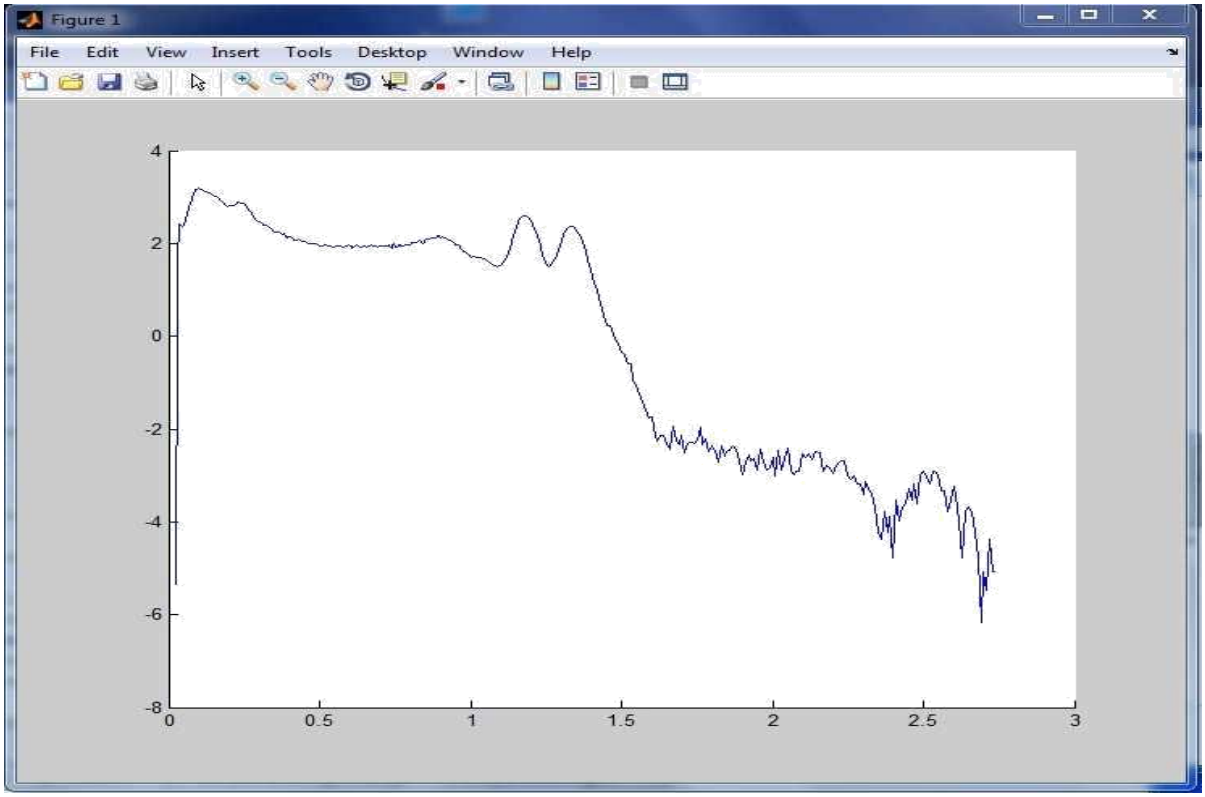
As the initial data are noisy at first step we are doing median filter (in Matlab type *help medfilt1* to get information about this). After that the spectrum will be



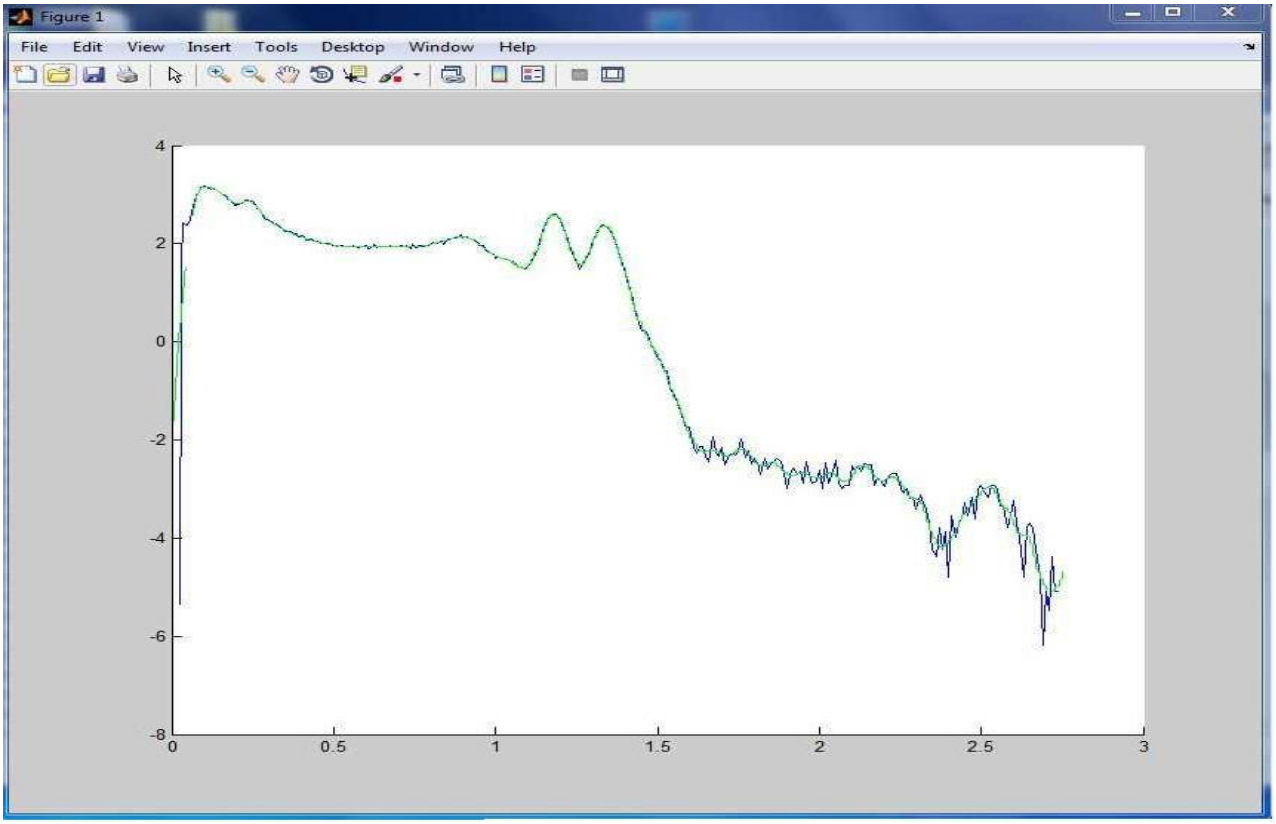
After this, do smoothing for this data. Using smooth function in matlab the smooth curve will be (red line).



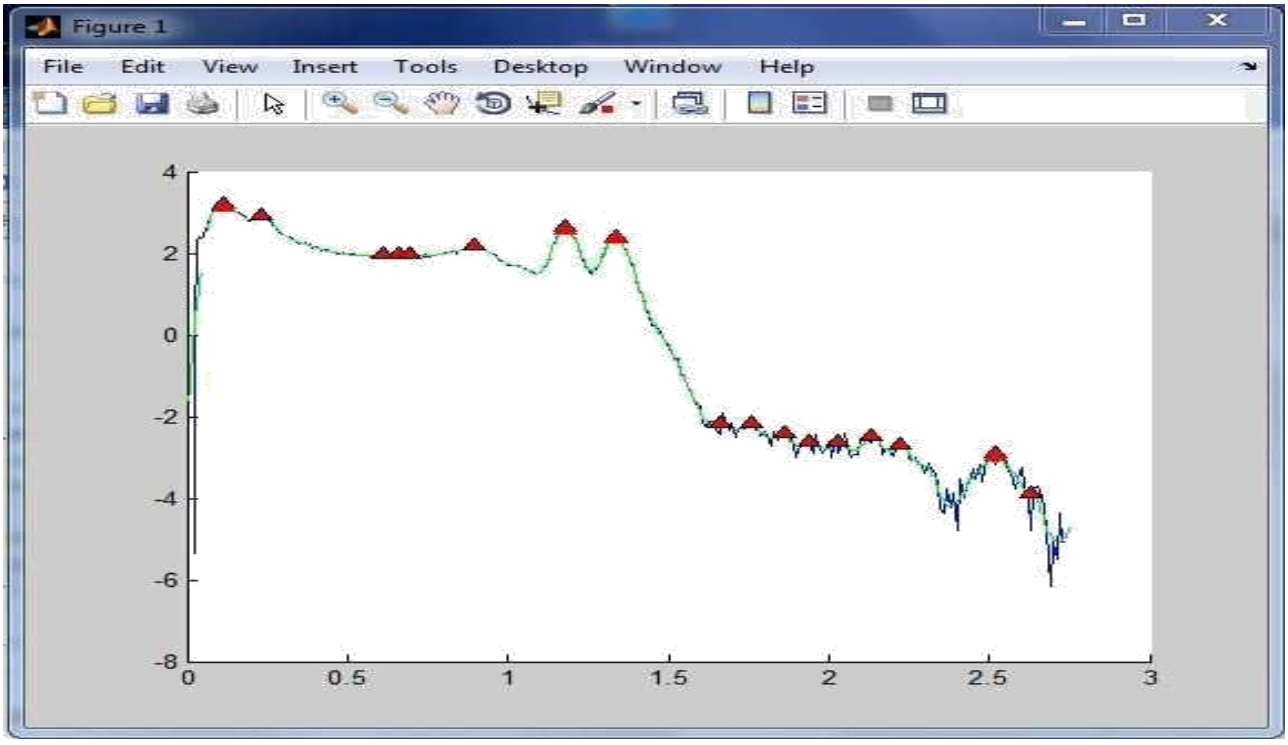
After this the log of this smoothing curve is calculated



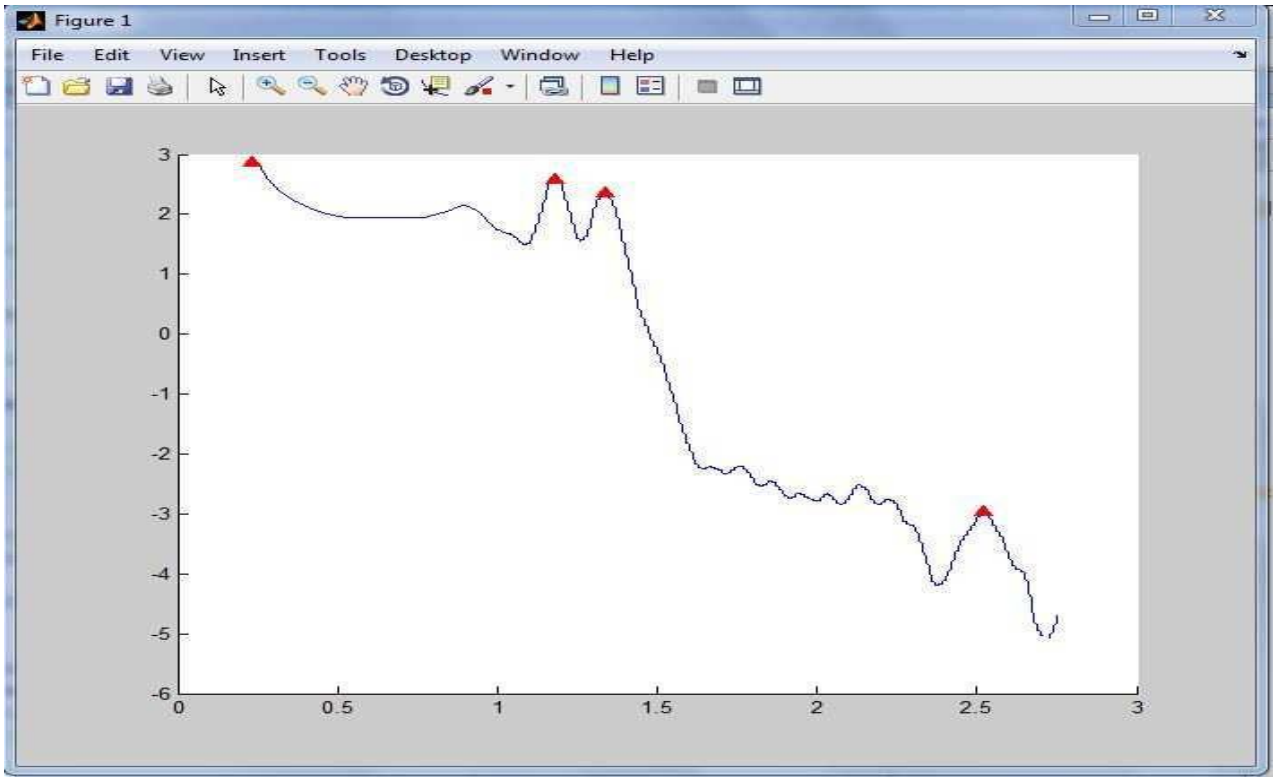
Now one can see the last peak, which appears at energy 2.5MeV. Smoothing one more times of this new curve we get (green lines).



Now in this curve if we will compare five channels before and five after we will get many peaks (you can use `findpeaks` command for this). We also tried to increase this amount, but it is not right solution, because by increasing this value (from 5 to 10, 20, 30 or more) you will lose the right peaks. So after scanning for the peaks we will find all these peaks



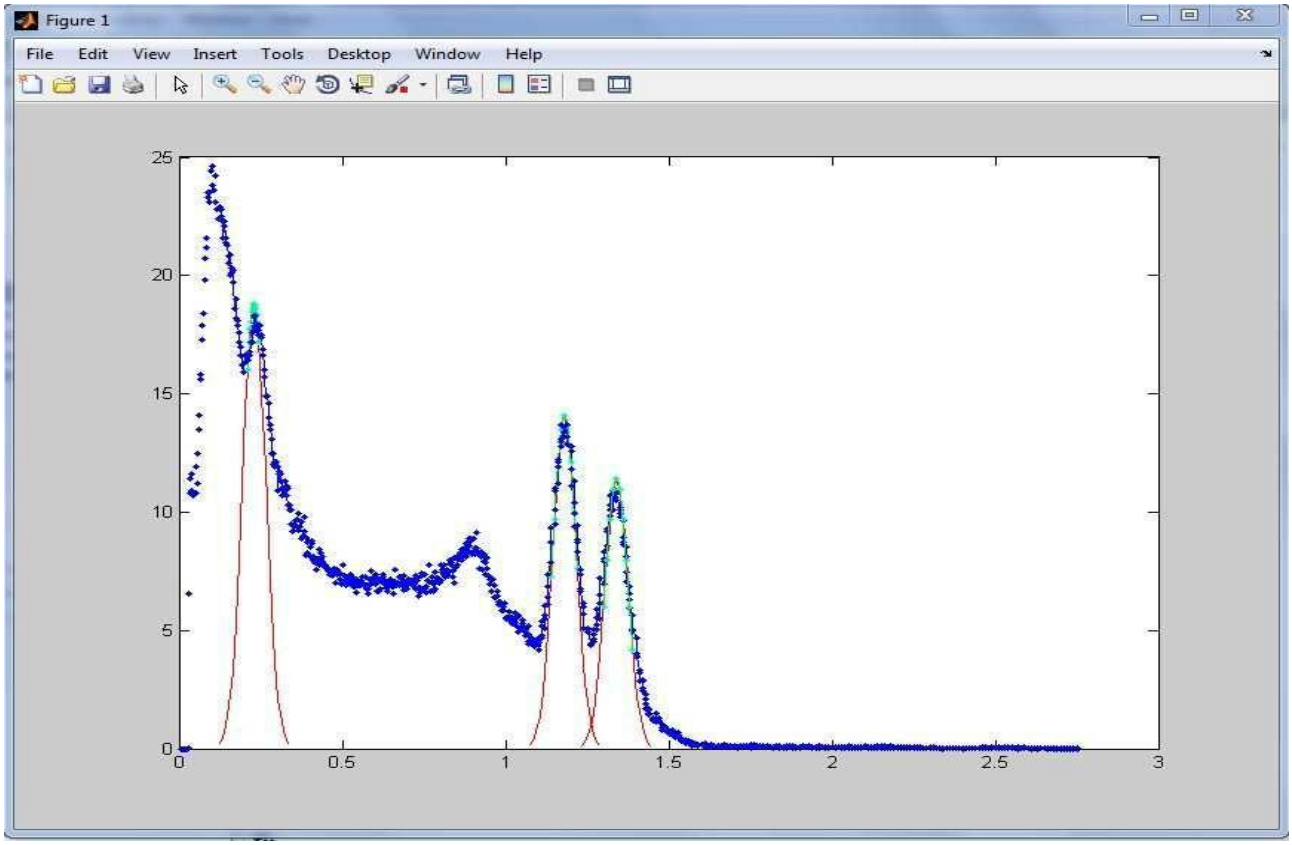
Now from this plot we see that unwonted peaks amplitudes are almost in the same level (this will be for any spectrum after taking log). So to exclude these peaks we add one more logical filter. We are comparing the amplitudes of these peaks. We put condition that the amplitude difference of neighbor peaks must be bigger than some value (for our data 0.5 is enough). Appling this filter we will get the right peaks.



So the algorithm which is used in this program is that and we think this is good solution.

Parameters calculation

After we find the positions and amplitudes of that peaks we apply Gaussian fit to that positions. Just to show that the fit is working correctly in the following plot the spectrum is shown with fitting curves to the positions of peak.



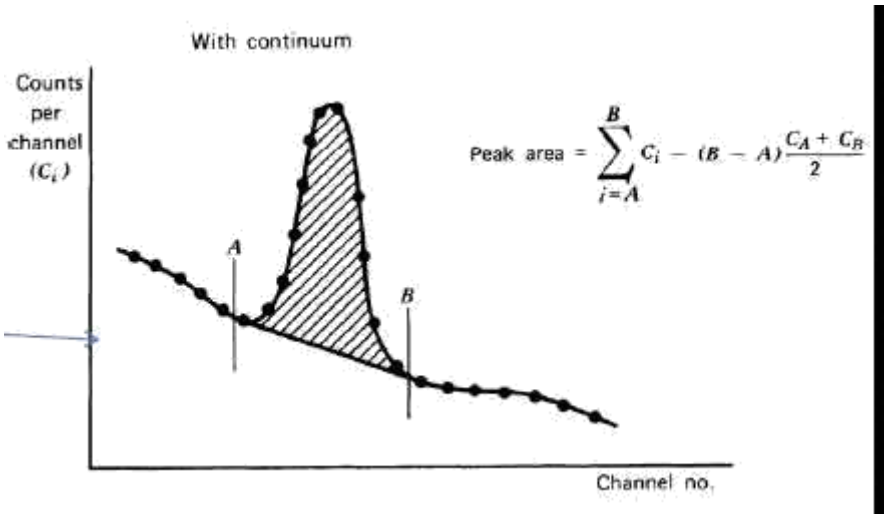
Applying Gaussian fit three parameters will be calculated. The first coefficient of Gaussian fit will be Counts/Sec (which is amplitude), second coefficient is energy of peak (this is mean value of Gaussian distribution) and the third coefficient is standard deviation σ.

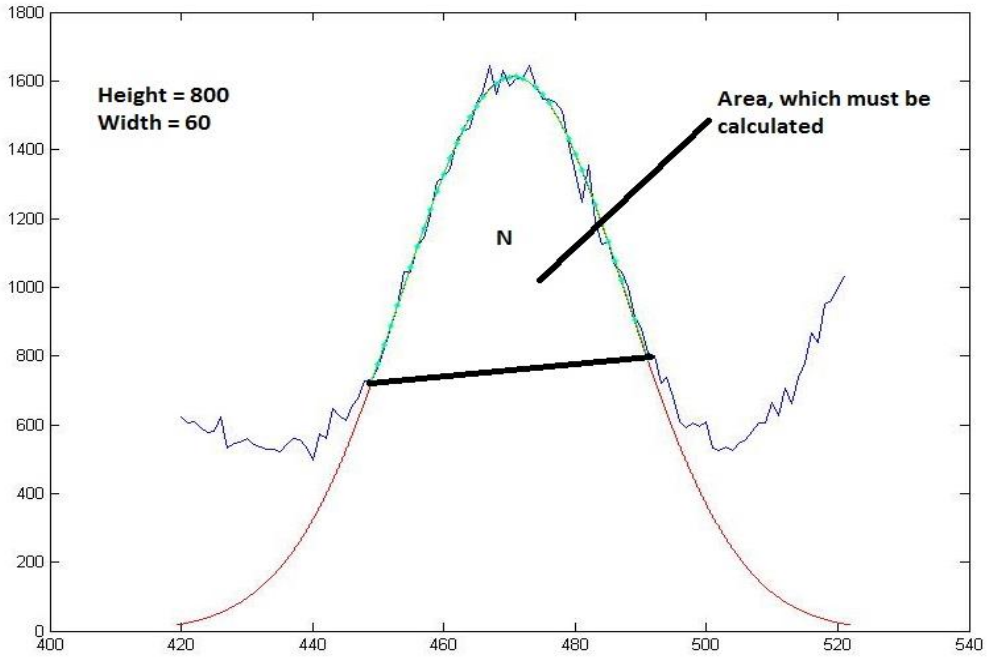
FWHM is calculated as $2.35 * \sigma$.

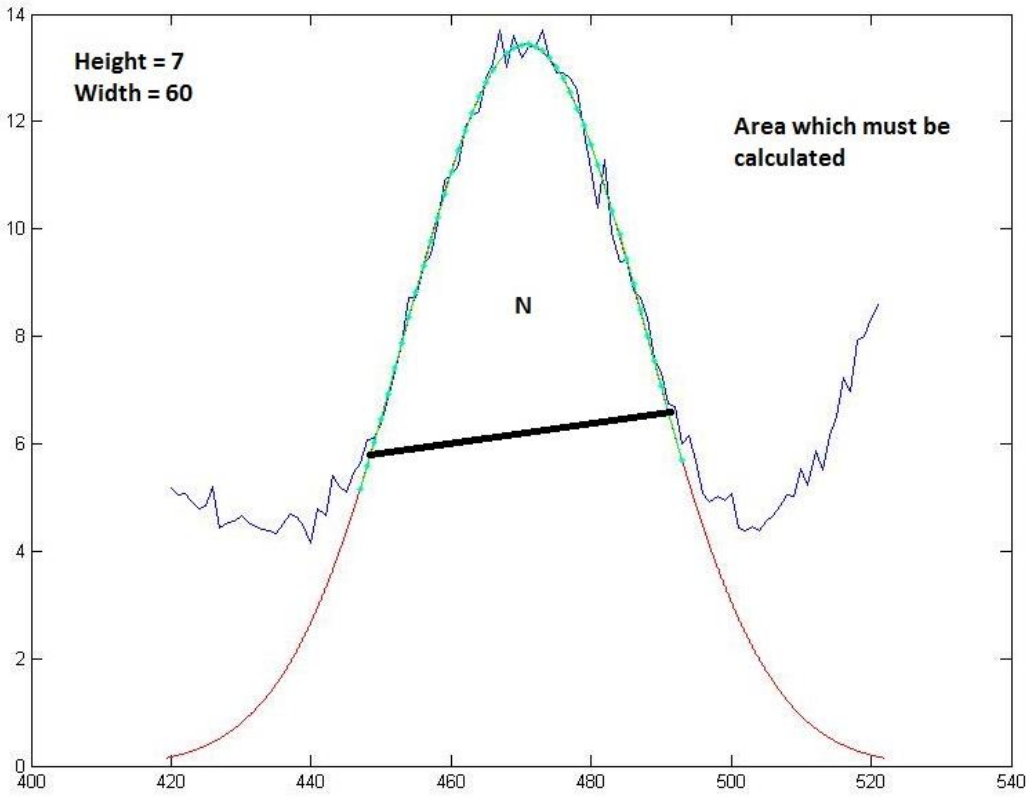
The peak efficiency is calculated as following (peak efficiency formula).

Where *N*-is the area of Gaussian fit for given peak, *S*- is the source strength (the value is taken from GUI corresponding input field) and Ω is the solid angle (also from input field).

Area Calculation







Here We make also unit conversation. For example source strength is 5, so the value for S will be

$$S = 5 * 10^{-6} * 3.7 * 10^{10}$$

And finally the STD peak efficiency is calculated via the formula that we derive from the error propagation of efficiency equation.

The final layout of our GUI is like this