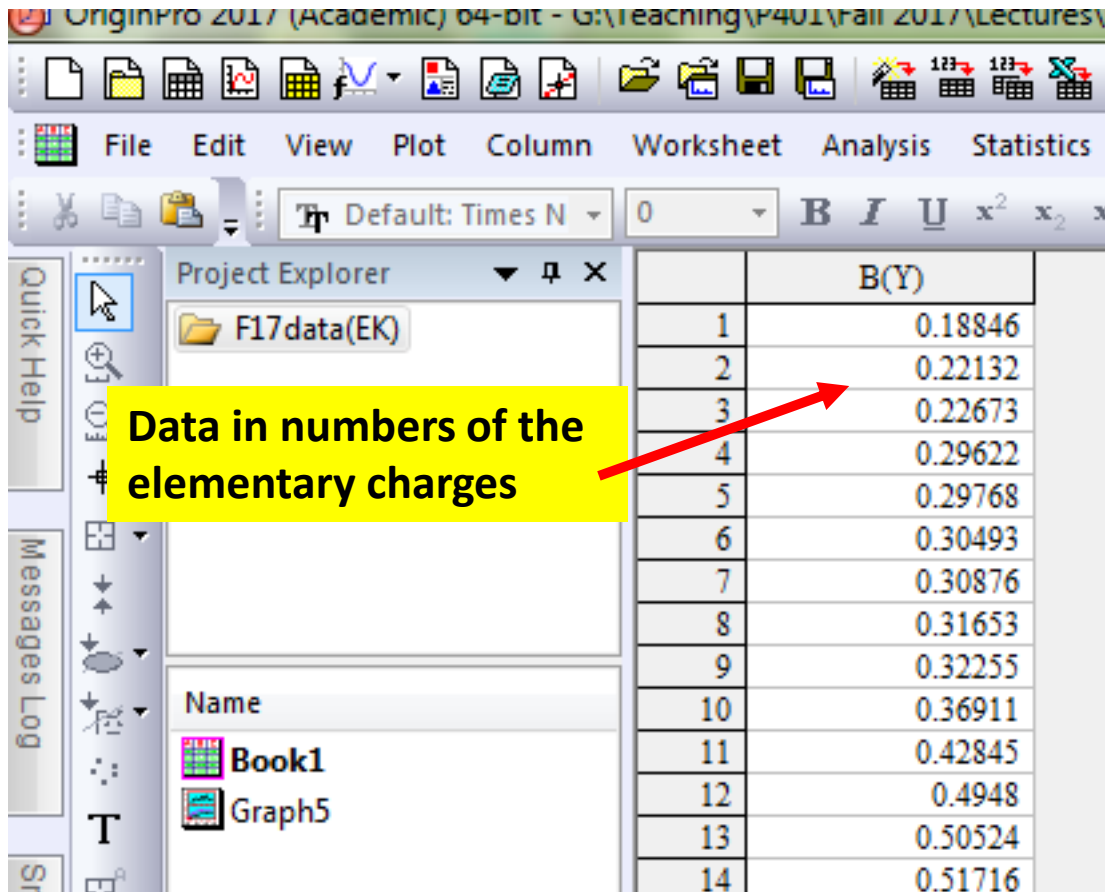
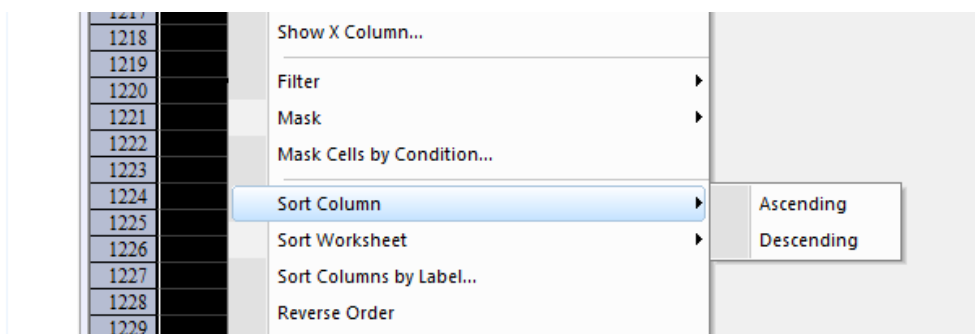


Working with Histogram Graph. Millikan Oil Drop Experiment.

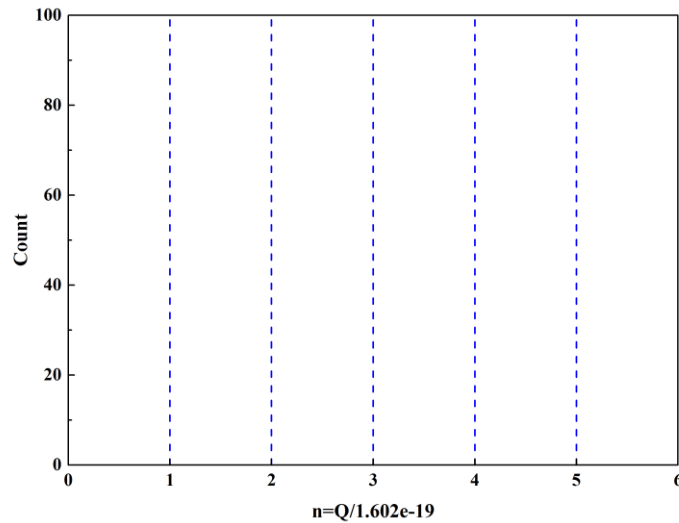
1. After calculating the charges plug in the data in Origin worksheet. Data could be in electrical charge units or as a numbers of elementary charges. Try to use maximum of available data points.



2. I would recommend you to check if the your data set contains some “nonrealistic” numbers of elementary charges ($n > 10$) and remove them from worksheet. In Origin you can sort data in column and then remove the “bad” data



3. For plotting your data you can use the prepared template: **HIST.otp**, located in: <\\engr-file-03\PHYINST\APL Courses\PHYCS401\Common\Origin templates\Oil drop experiment>



4. Plot your data as a histogram

Plot Setup: Configure Data Plots in Layer

Available Data:

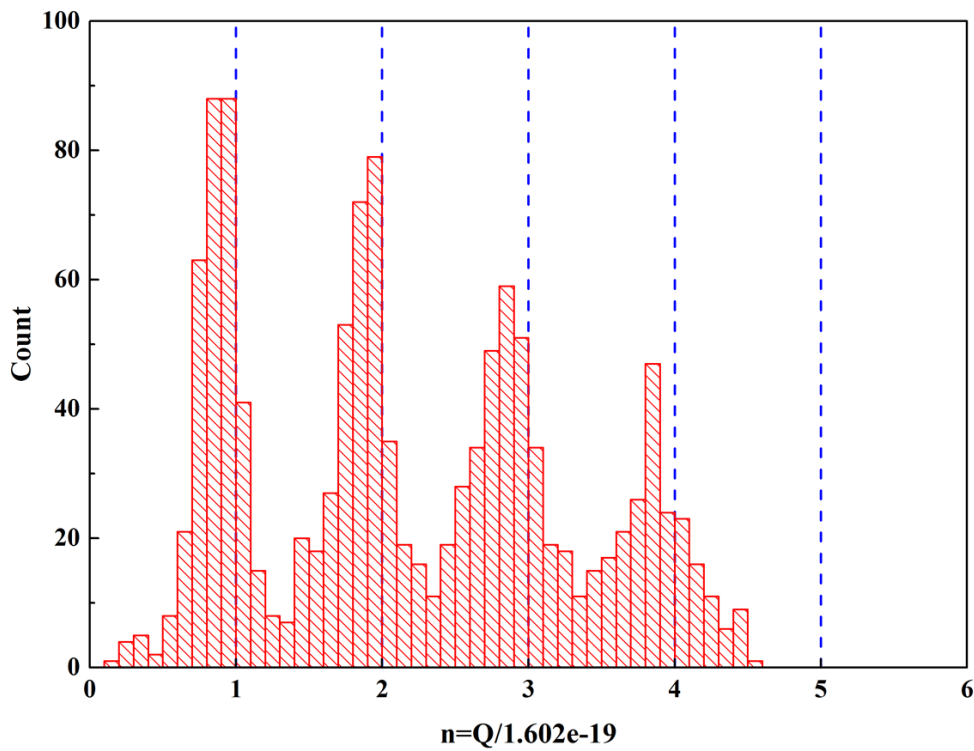
Long Name	Sheet	Cols	Rows	File Name	File C
Book1	Sheet1	1	1260		
Book1	Book1_B Bins	15	1000		

Plot Type:

Color Mapped
Bubble + Color Mapped
Pie
Bar
Stacked Column / Bar
Stacked Bar
XYZ Contour
Japanese Candlestick
OHLC Bar Chart
Box
Histogram

Plot List: Drag entries in 1st column to reorder or to move between layers. Right click for other opt

Plot	Range	Show	Plot Type	Legend
Layer 1	Re	<input checked="" type="checkbox"/>		



5. Template is saved with bin size as 0.1 but you can change it by clicking on the graph

Plot Details - Plot Properties

Graph6

- Layer1
 - [Book1]Sheet1! B(Y) [1*:1241*]

Pattern Spacing Data

Type: Dots

Jitter Points

Single Block Barplot

Snap Points To Bin

Automatic Binning

Bin Size: 0.1

Number of Bins: 50

Begin: 0

End: 5

Bin Height (0-100): 100

Bin Worksheet

Add Distribution Curves

Go

Distribution Curve

Type: None

Bins Alignment

Center

Right

Left

Data Width (%): Auto

Preview: [No Title]

The Counts column in the Bin Worksheet can be used for fitting.

Plot Type: Histogram

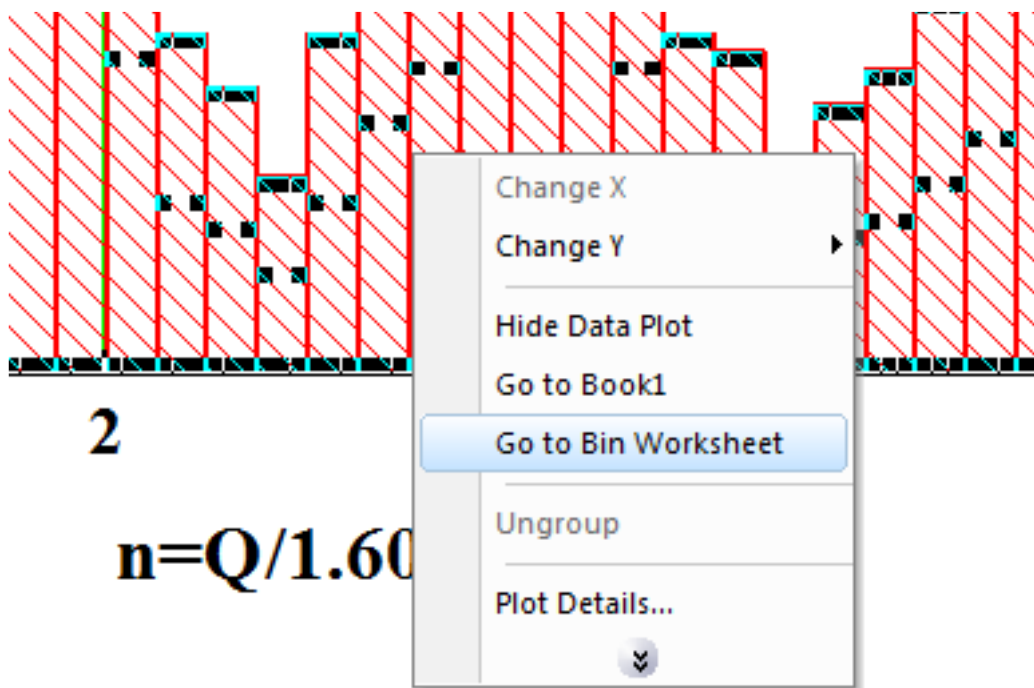
>> Workbook OK Cancel Apply

80

3

$n=Q/1.602e-19$

- Now you need to add an X-Y plot of Counts vs Bin center. Right click on the graph and “Go to Bin Worksheet”



- Now the Bin worksheet is unhidden and you can use for adding the plot on the graph

017\Lectures\Lecture#6. Error analysis. Data fitting\F17data(EK) * - [Book1 *]

is Statistics Image Tools Format Window Help

100%

	A(X)	B(Y)	C(Y)	D(Y)
Long Name	Bin Centers	Counts	Cumulative Sum	Cumulative Percent
Units				
Comments	Bins	Bins	Bins	Bins
F(x)=				
1	0.05	0	0	0
2	0.15	1	1	0.08071
3	0.25	4	5	0.40355
4	0.35	5	10	0.8071
5	0.45	2	12	0.96852
6	0.55	8	20	1.61421
7	0.65	21	41	3.30912
8	0.75	62	103	6.30287

Plot Setup: Configure Data Plots in Layer

Available Data:

Long Name	Sheet	Cols	Rows	File Name	File Date	Created	Modified
Book1	Sheet1	1	1260		10/6/2008 12:43:53	10/4/2017 13:49:32	
Book1	Book1_B Bins	4	60		10/6/2008 12:43:53	10/4/2017 13:49:32	

Right-click on various panels to bring up context menus.

Plot Type:

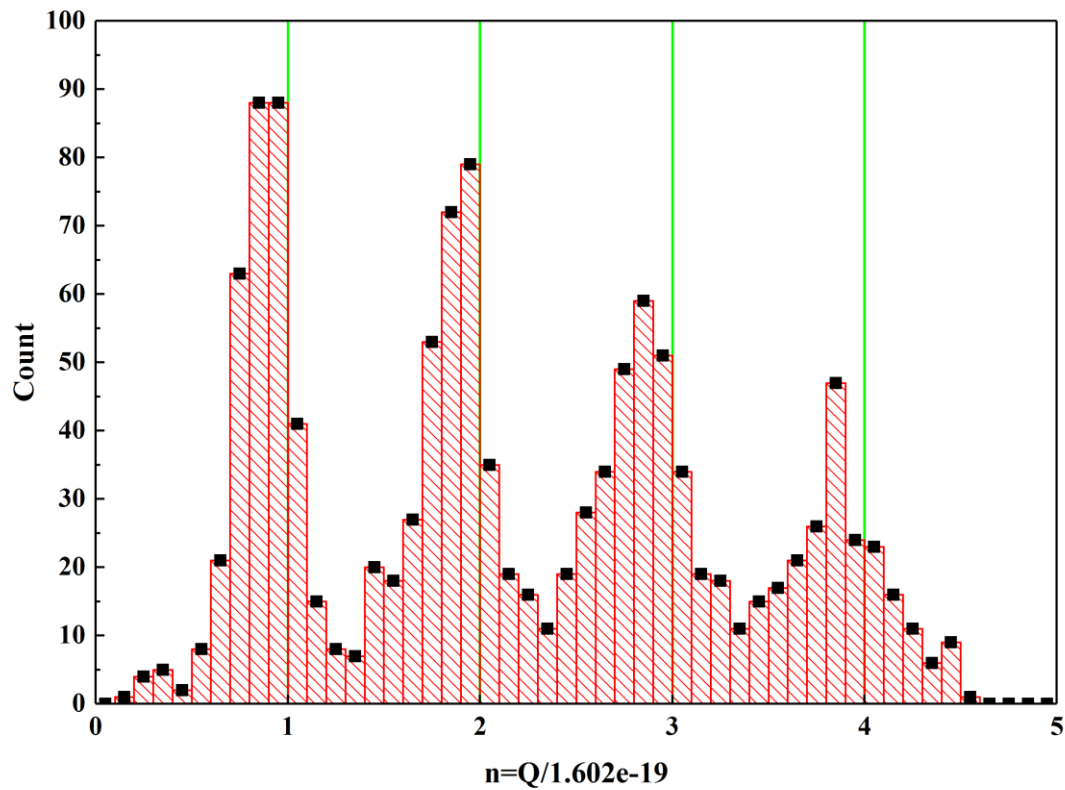
Show(S) [Book1]"Book1_B Bins"

X	xEr	Y	yEr	L	Column	Long Name	Comments	Sampling Interval
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	< auto >	From/Step=		
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	A	Bin Centers	Bins	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	B	Counts	Bins	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	C	Cumulative Sum	Bins	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	D	Cumulative Percent	Bins	

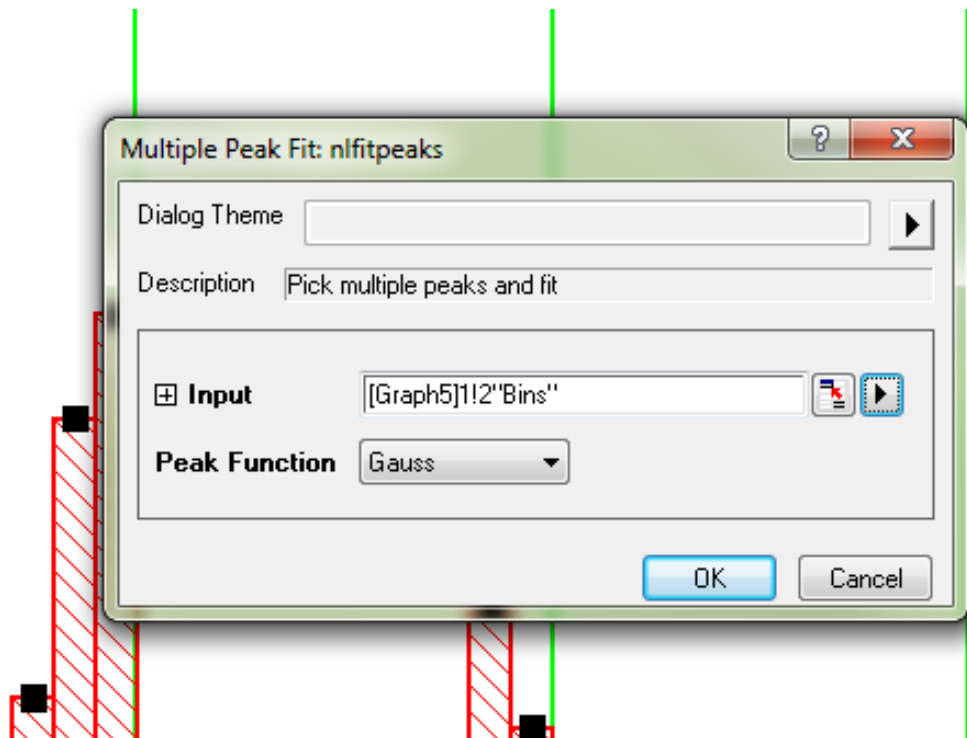
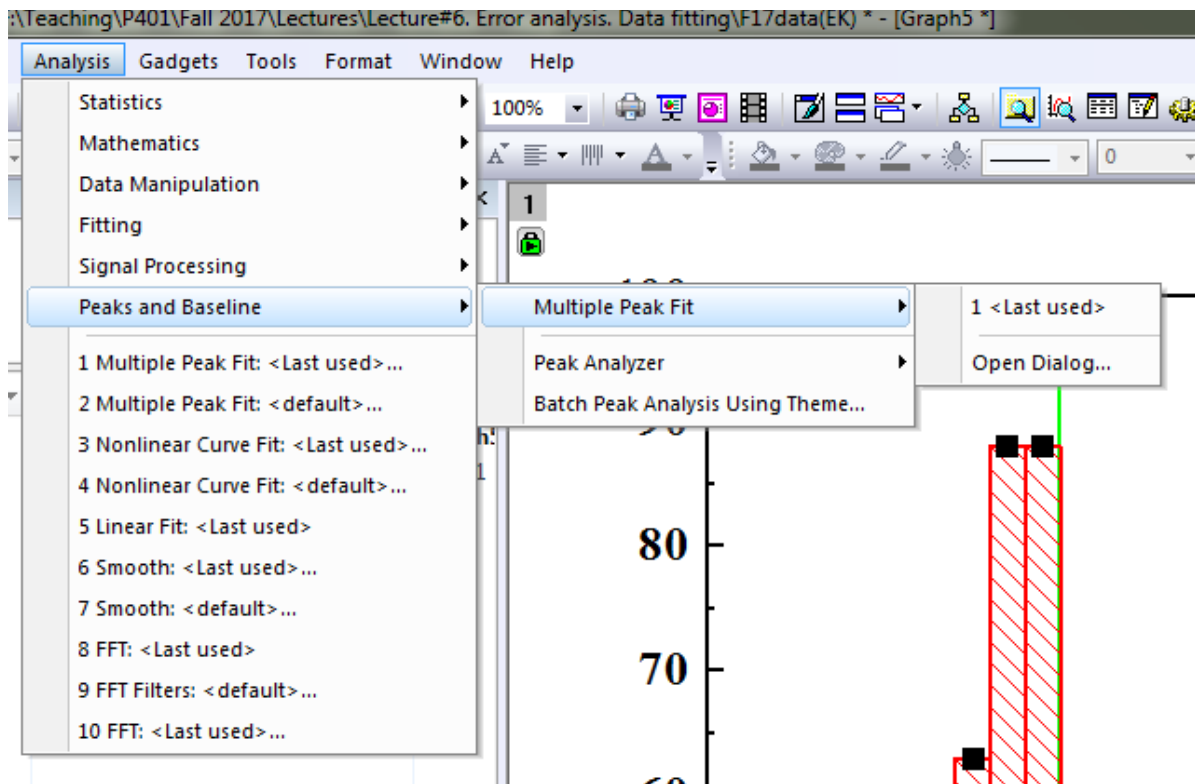
Plot List: Drag entries in 1st column to reorder or to move between layers. Right click for other options.

Plot	Range	Show	Plot Type	Legend
Layer 1		<input type="checkbox"/> Rescale	<input checked="" type="checkbox"/>	
[Book1]Sheet1! B[Y]	[1*:1241*]	<input checked="" type="checkbox"/>	Histogram	B
[Book1]Book1_B Bins! "Bin Centers"[X], "Counts"[Y]	[1*:50*] 0.05 < X < 4.95 , 0 < Y < 88	<input checked="" type="checkbox"/>	Scatter	Bins

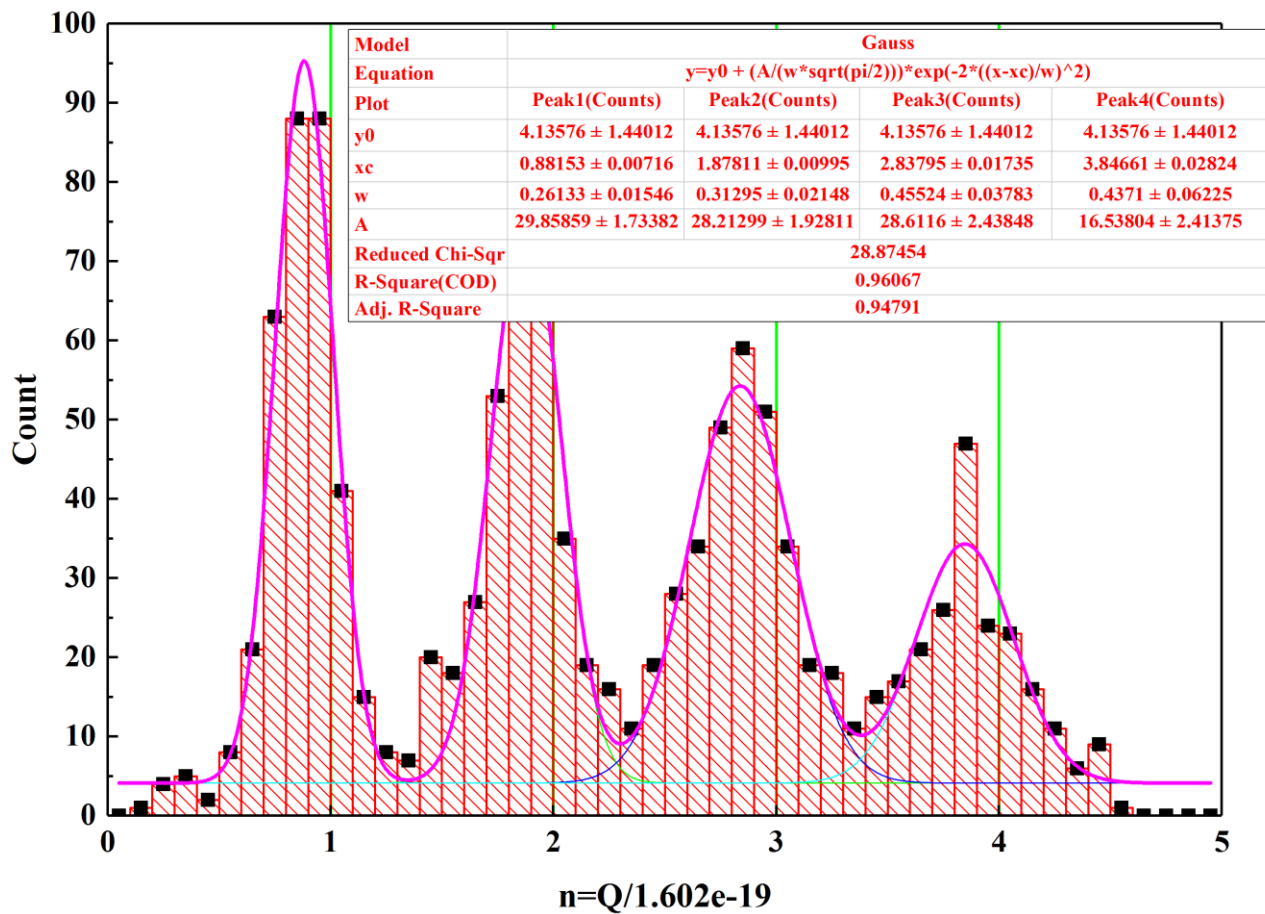
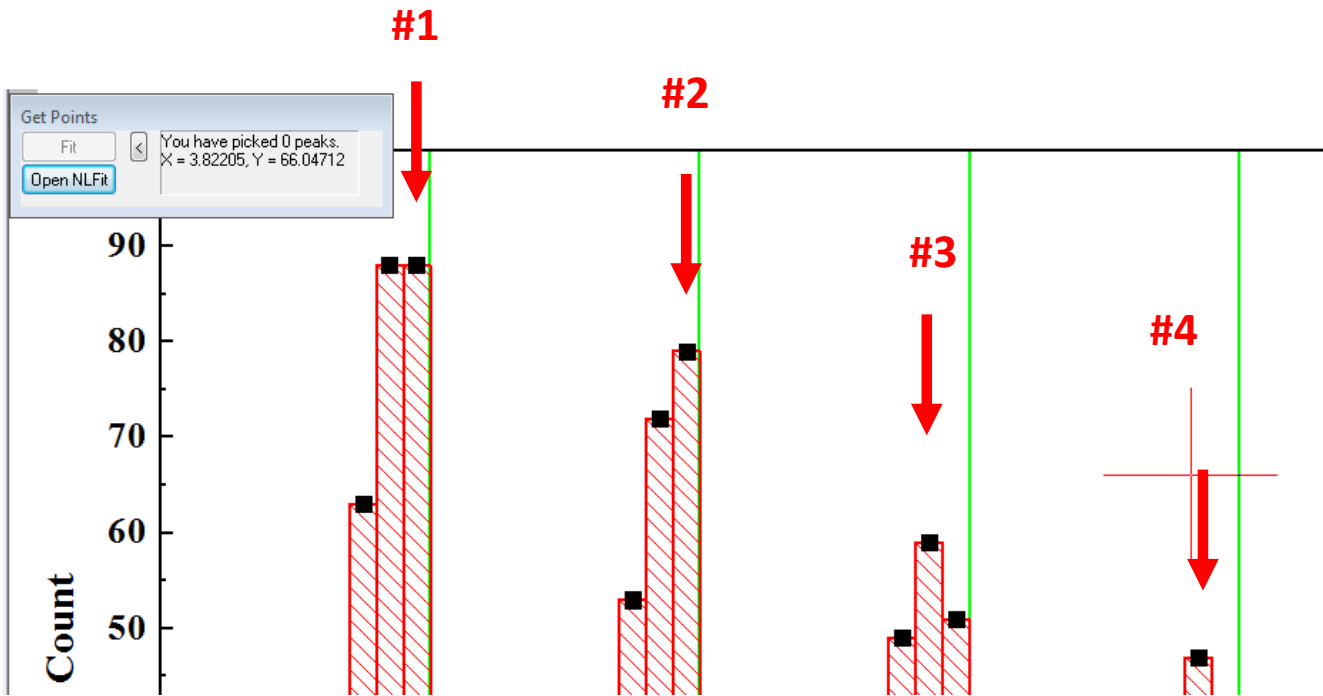
And new plot will appear on the graph



8. Now you need to do the multippeak fitting using Gaussian model as a peak shape



9. Click on all expected peaks and the on “Open NLFit” and preform the fitting



10. The positions of the peaks and uncertainties calculated by fitting procedure you can find from the Table of the fitting results. These uncertainties reflect only random errors and don't take in account the systematic errors. To calculate the systematic error you need to use the error propagation equation – see the Lecture notes.

	A	B1	B2	B3	B4
1	Model	Gauss			
2	Equation	$y=y_0 + (A/(w*\sqrt{\pi/2}))*\exp(-2*((x-xc)/w)^2)$			
3	Plot	Peak1(Counts)	Peak2(Counts)	Peak3(Counts)	Peak4(Counts)
4	y0	4.13576 ± 1.44012	4.13576 ± 1.44012	4.13576 ± 1.44012	4.13576 ± 1.44012
5	xc	0.88153 ± 0.00716	1.87811 ± 0.00995	2.83795 ± 0.01735	3.84661 ± 0.02824
6	w	0.26133 ± 0.01546	0.31295 ± 0.02148	0.45524 ± 0.03783	0.4371 ± 0.06225
7	A	29.85859 ± 1.73382	28.21299 ± 1.92811	28.6116 ± 2.43848	16.53804 ± 2.41375
8	Reduced Chi-Sq	28.87454			
9	R-Square(COD)	0.96067			
10	Adj. R-Square	0.94791			

11. For each peak to calculate the statistical error you need to take the standard deviation for corresponding peak (w_i) and divide it by the square root of the number of data points corresponding this peak ($\sqrt{N_i}$). N_i could be calculated from area parameters (A_i) for normal distribution assuming that $\sum_i A_i$ corresponds total number of points N and the fraction corresponding each peak will be proportional to A_i :

$$N_i \approx \frac{A_i}{\sum_i A_i}$$