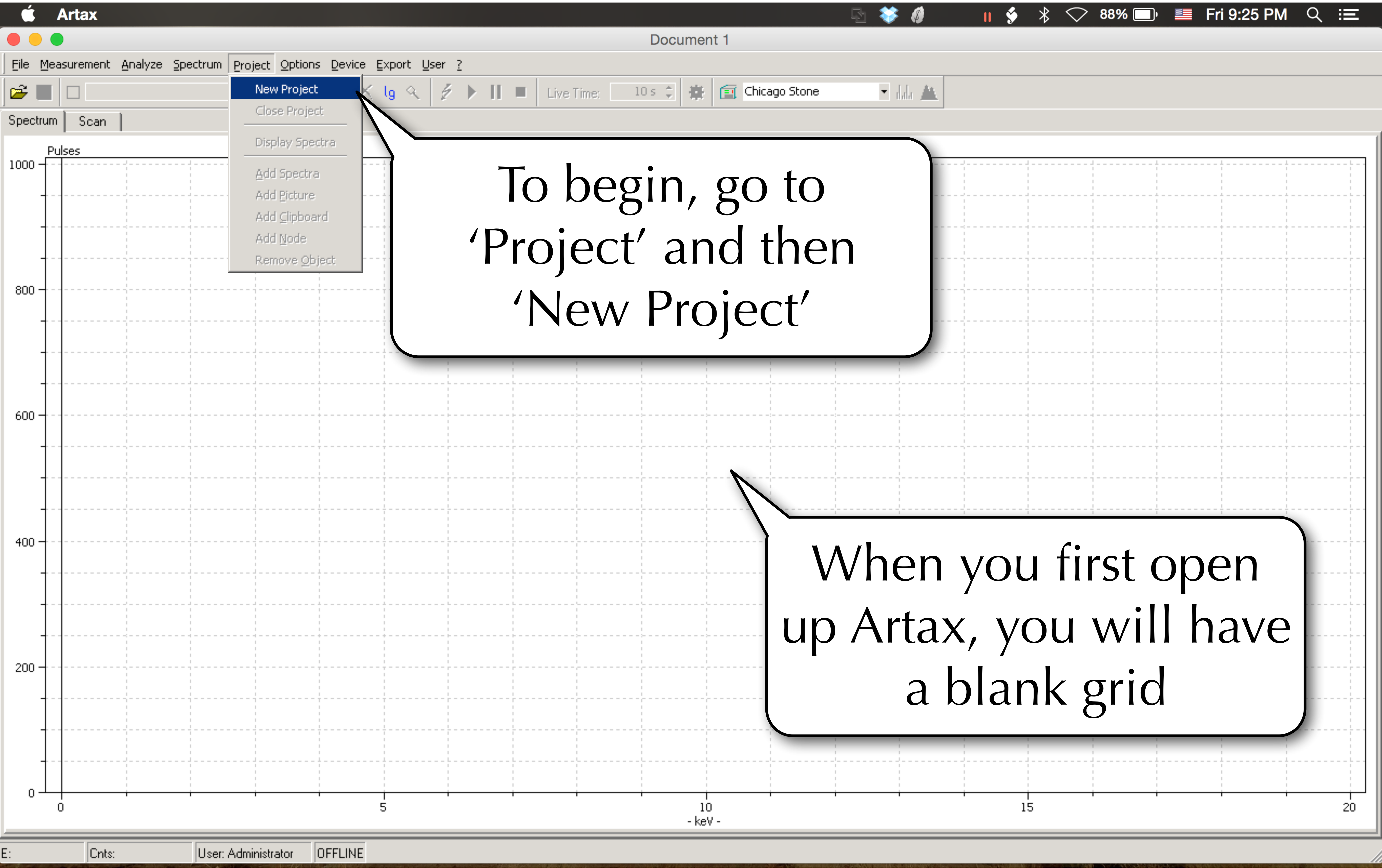
ROI Analysis

This presentation takes you through Region of Interest (ROI) Analysis.

There are many reasons to pursue this time of manual selection of spectrum, it can include reducing variation and selecting peaks that have less interference of others. Be deliberate about what ranges you choose, and don’t be afraid to try different modifications to improve your data

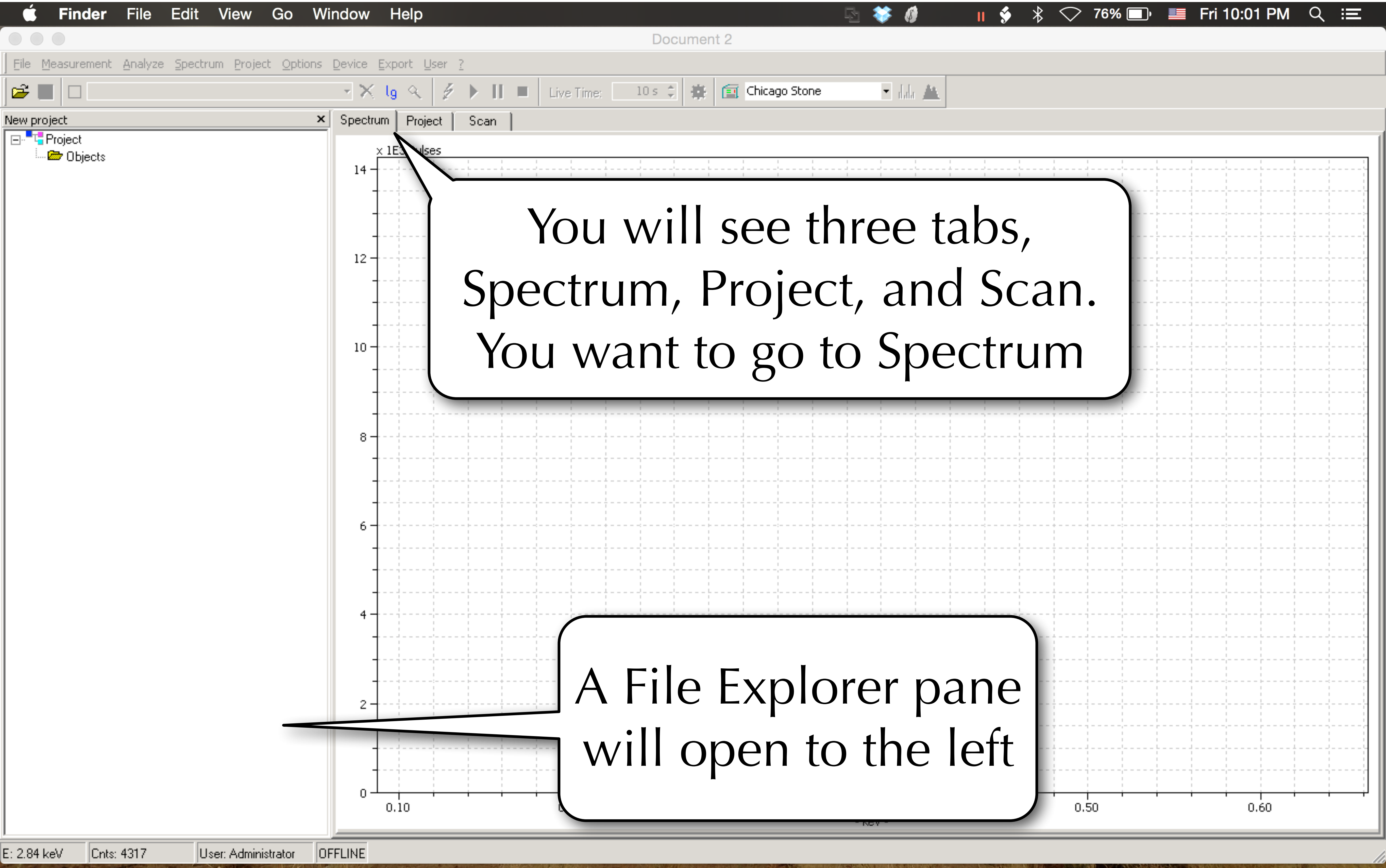
ROI Analysis



To begin, go to 'Project' and then 'New Project'

When you first open up Artax, you will have a blank grid

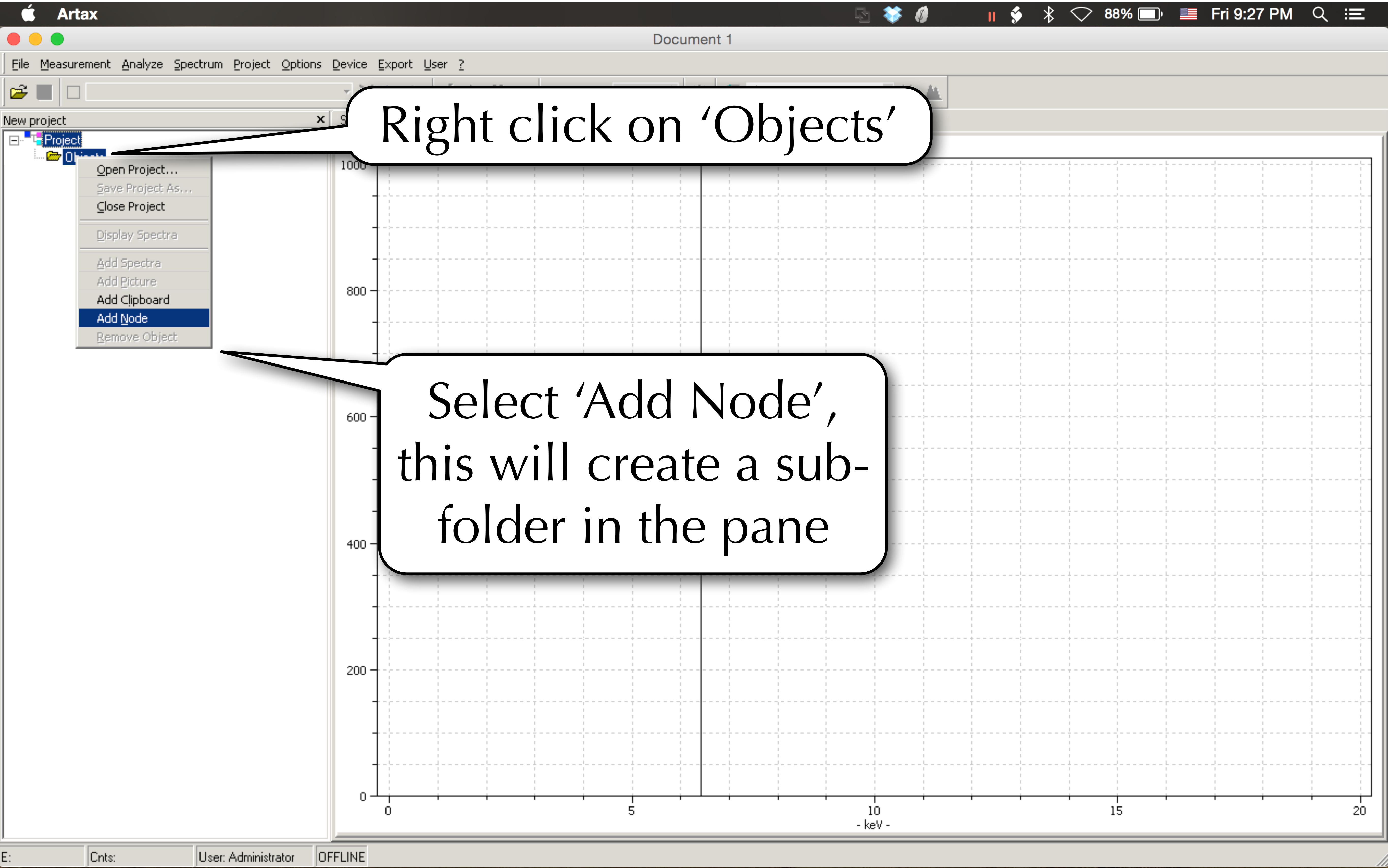
ROI Analysis



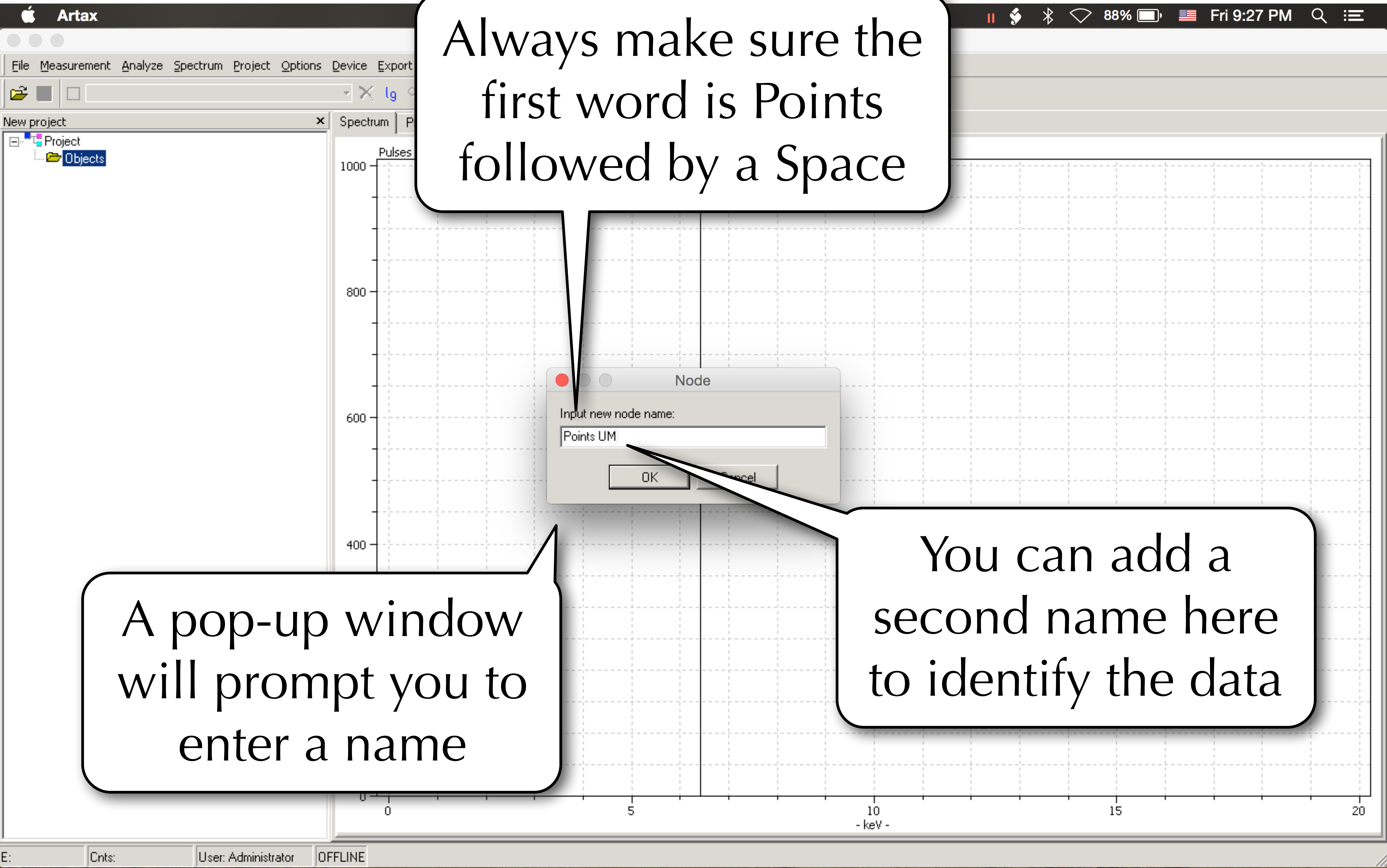
You will see three tabs, Spectrum, Project, and Scan. You want to go to Spectrum

A File Explorer pane will open to the left

ROI Analysis



ROI Analysis



Always make sure the first word is Points followed by a Space

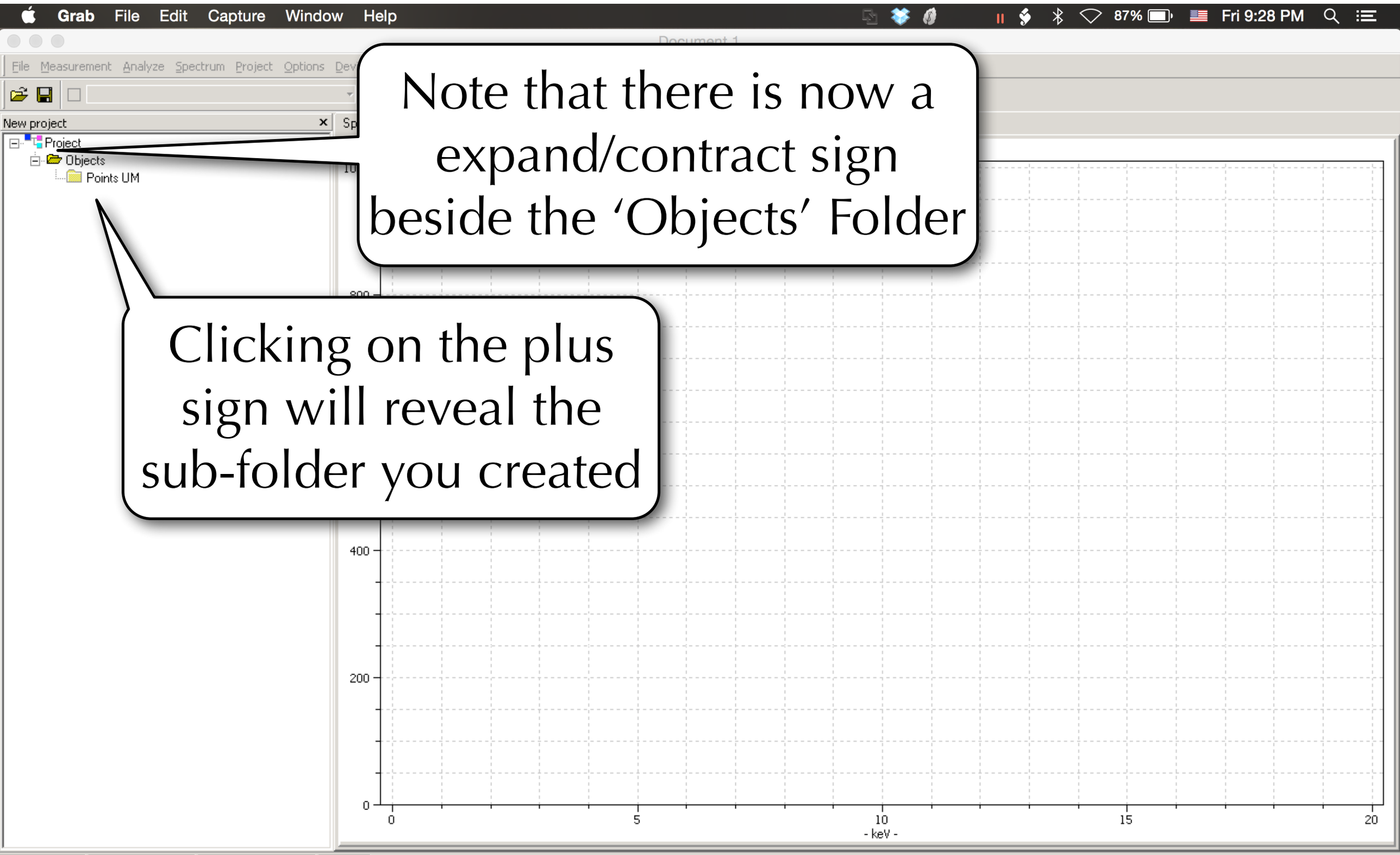
A pop-up window will prompt you to enter a name

You can add a second name here to identify the data

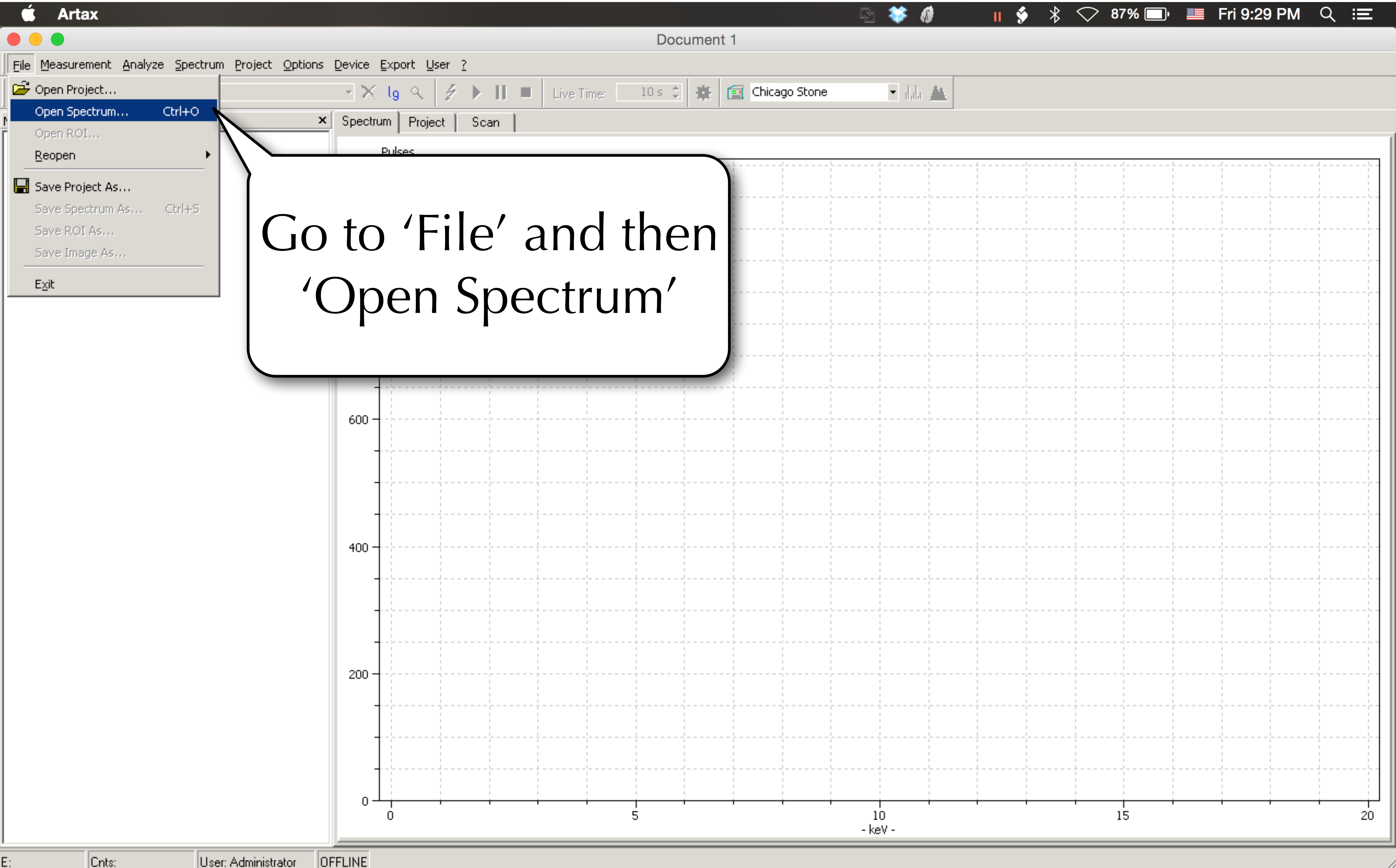
ROI Analysis

Note that there is now a expand/contract sign beside the ‘Objects’ Folder

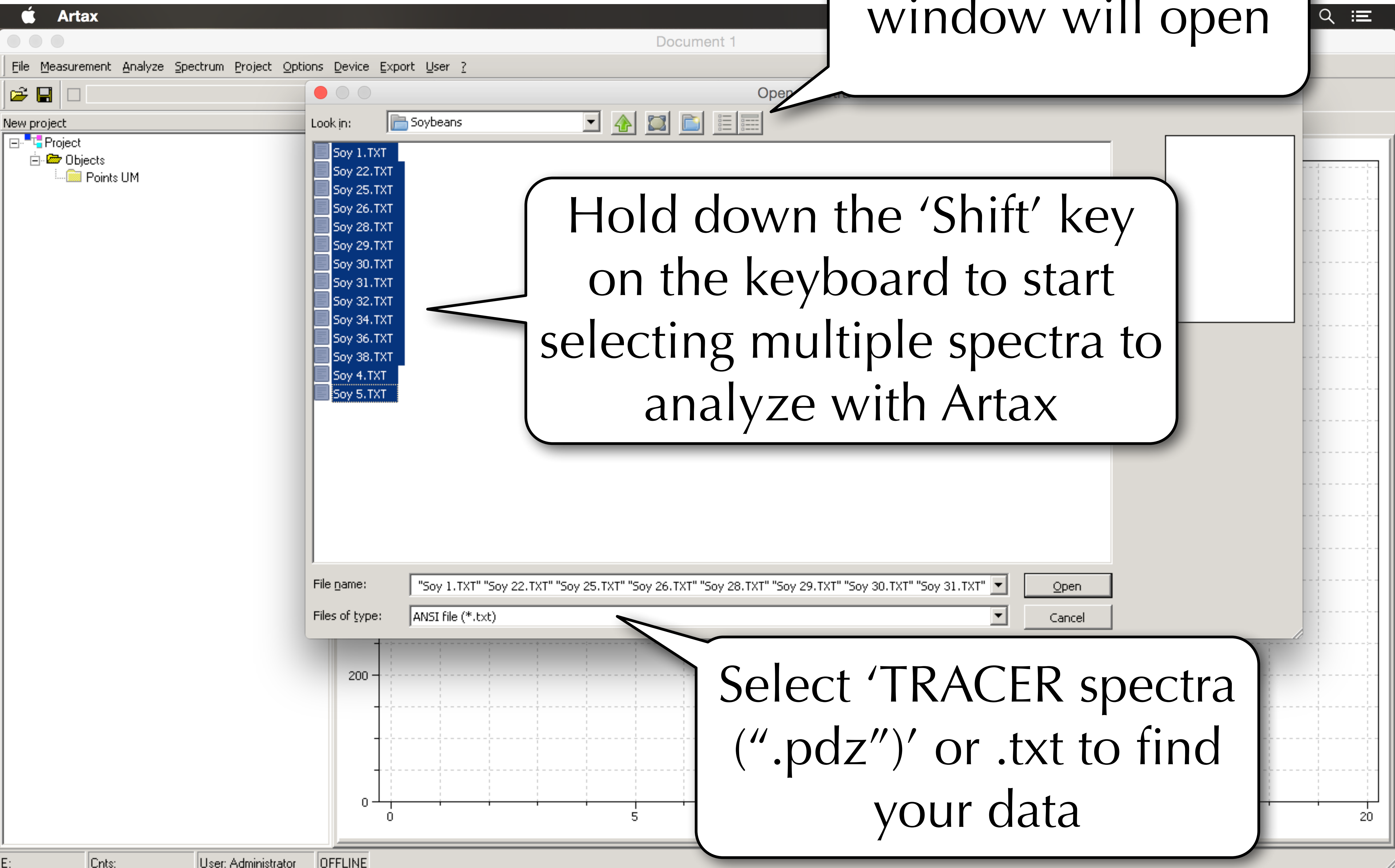
Clicking on the plus sign will reveal the sub-folder you created



ROI Analysis



ROI Analysis

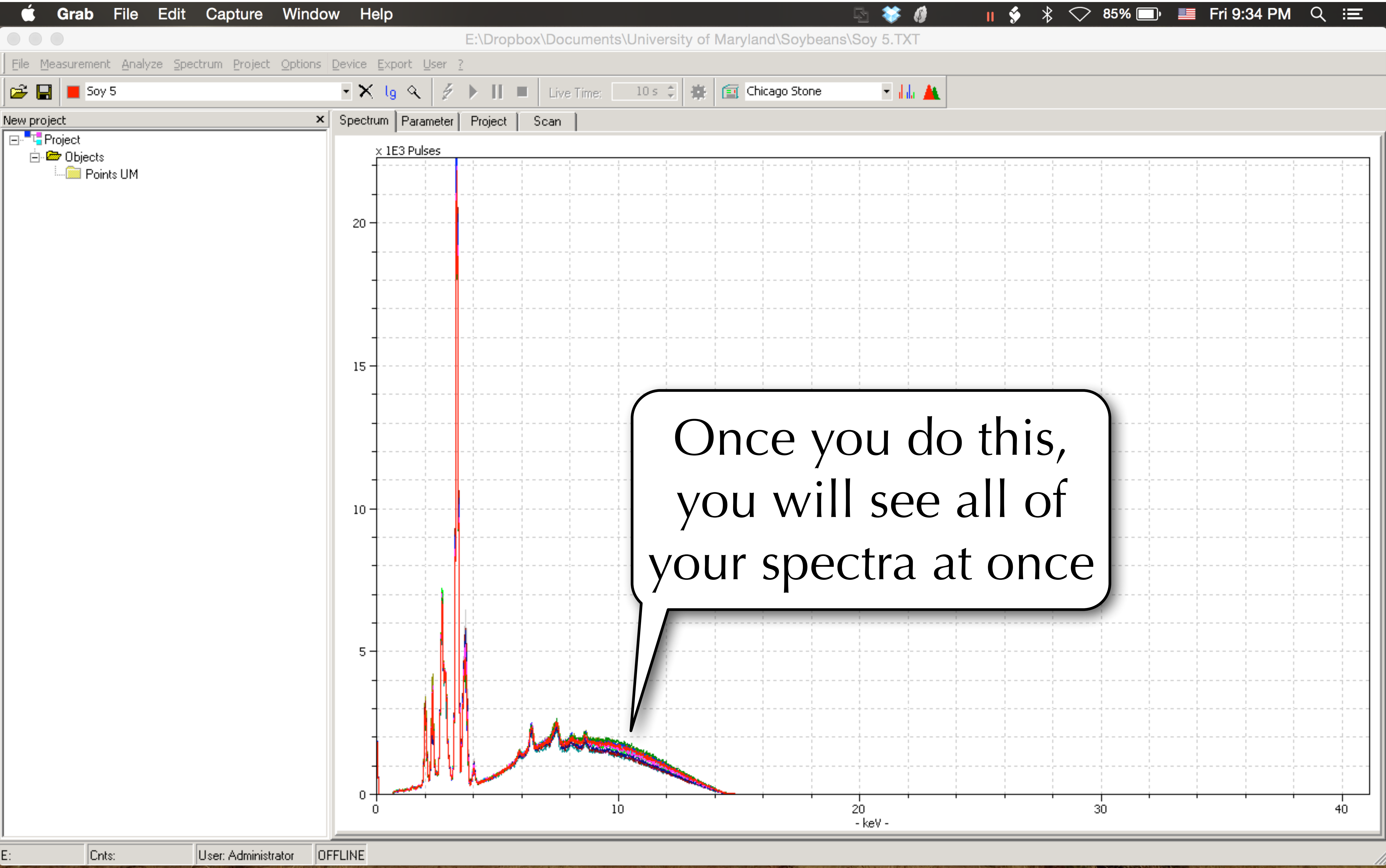


A File Explorer window will open

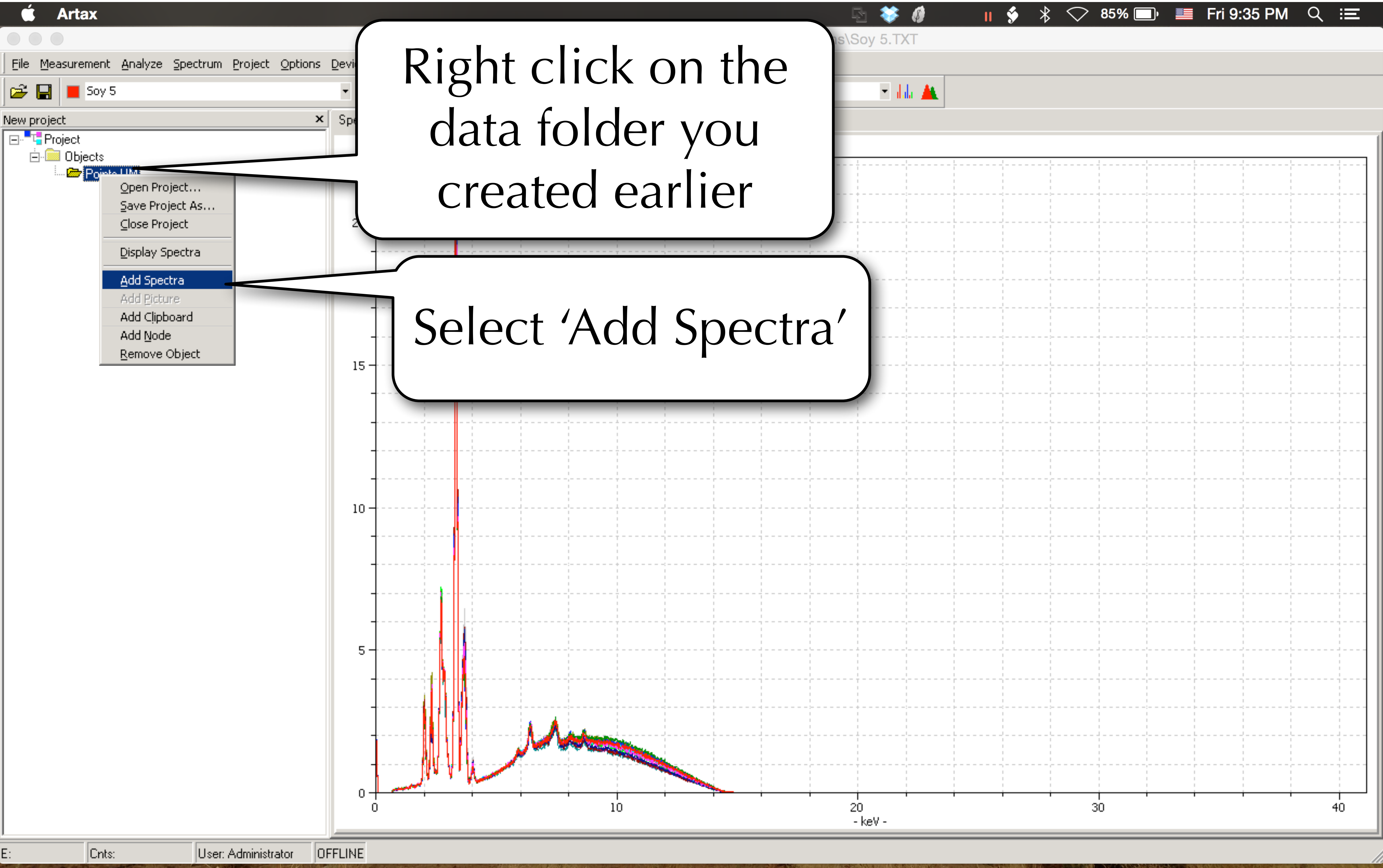
Hold down the ‘Shift’ key on the keyboard to start selecting multiple spectra to analyze with Artax

Select ‘TRACER spectra (“.pdz”)’ or .txt to find your data

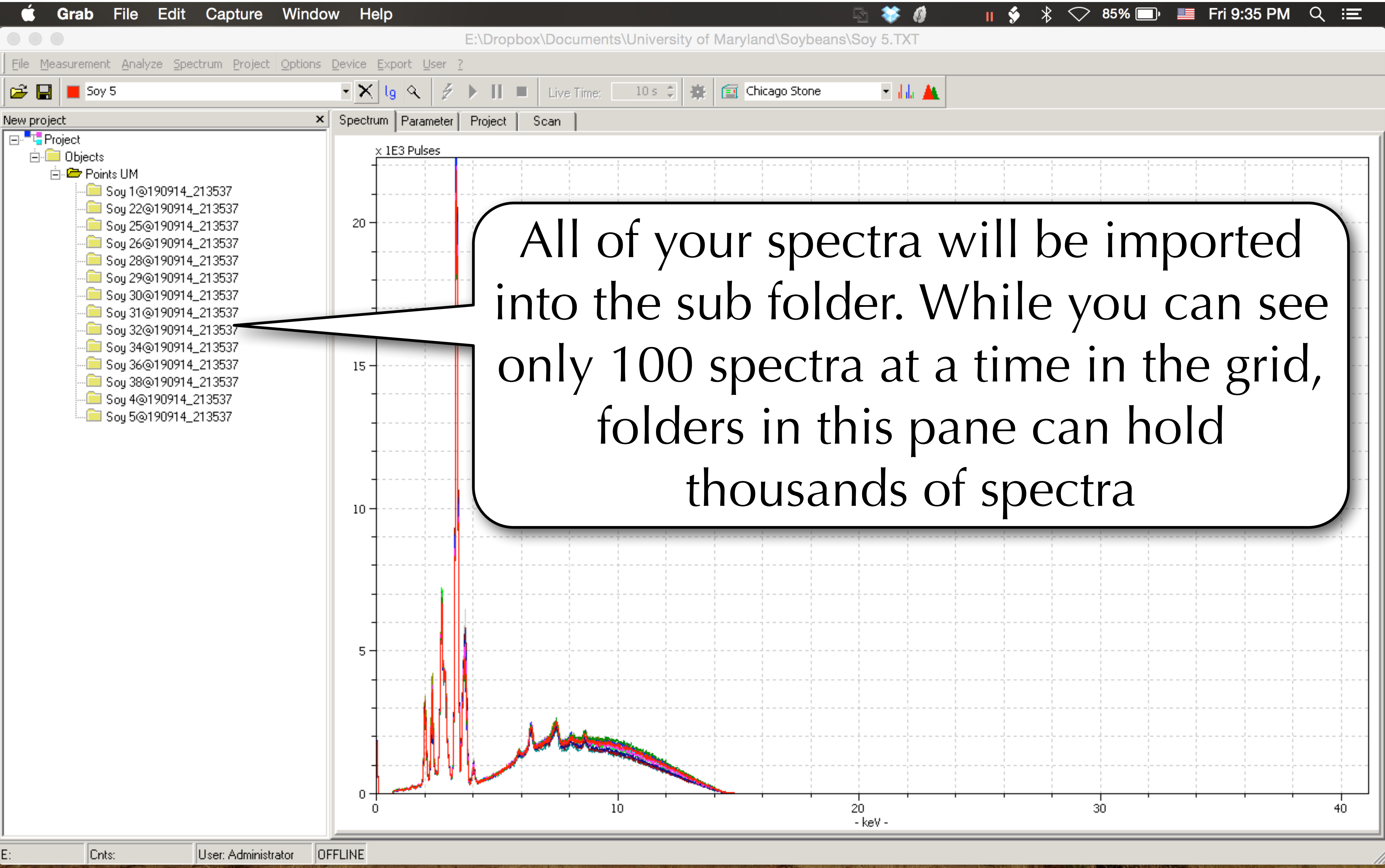
ROI Analysis



ROI Analysis

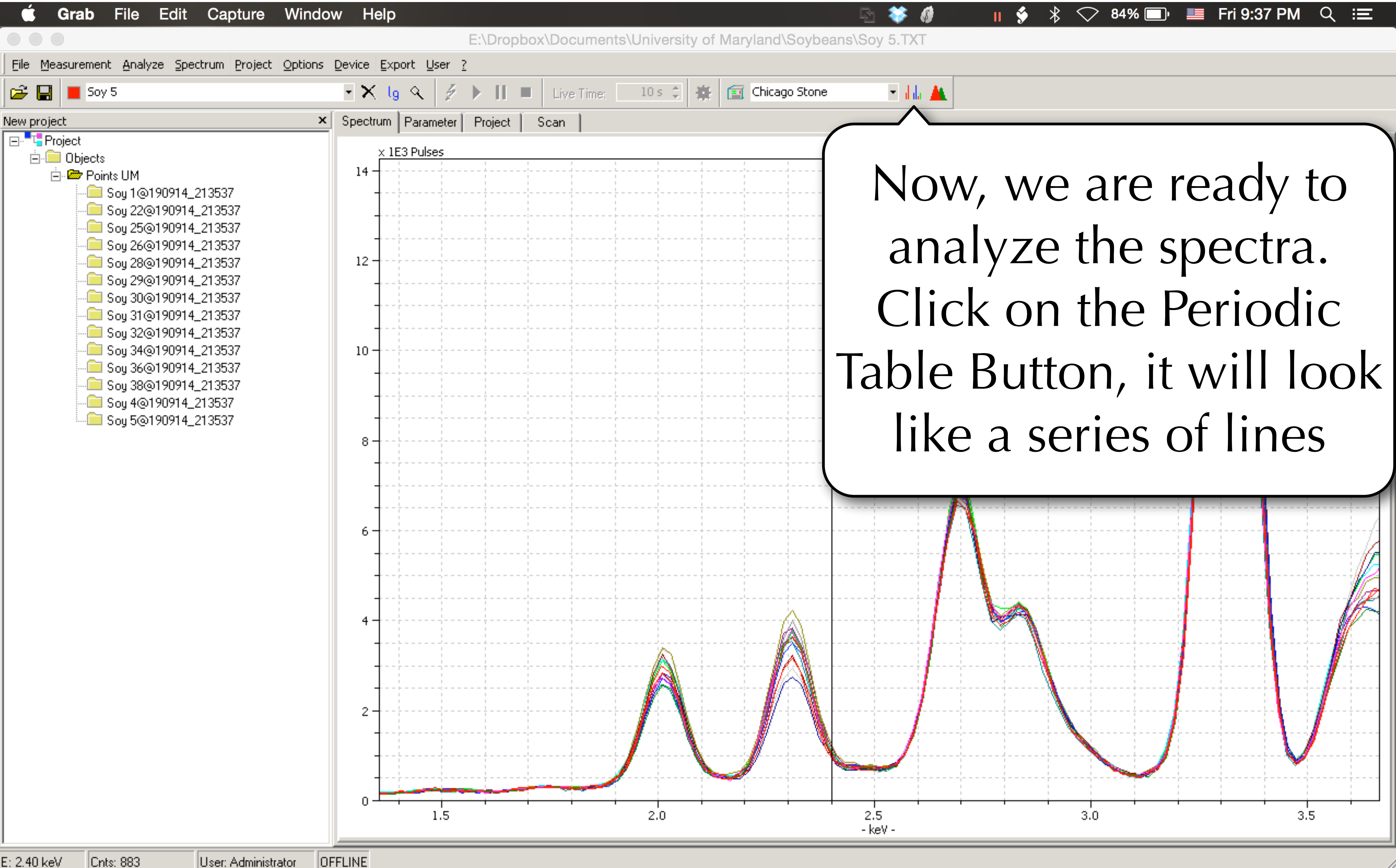


ROI Analysis



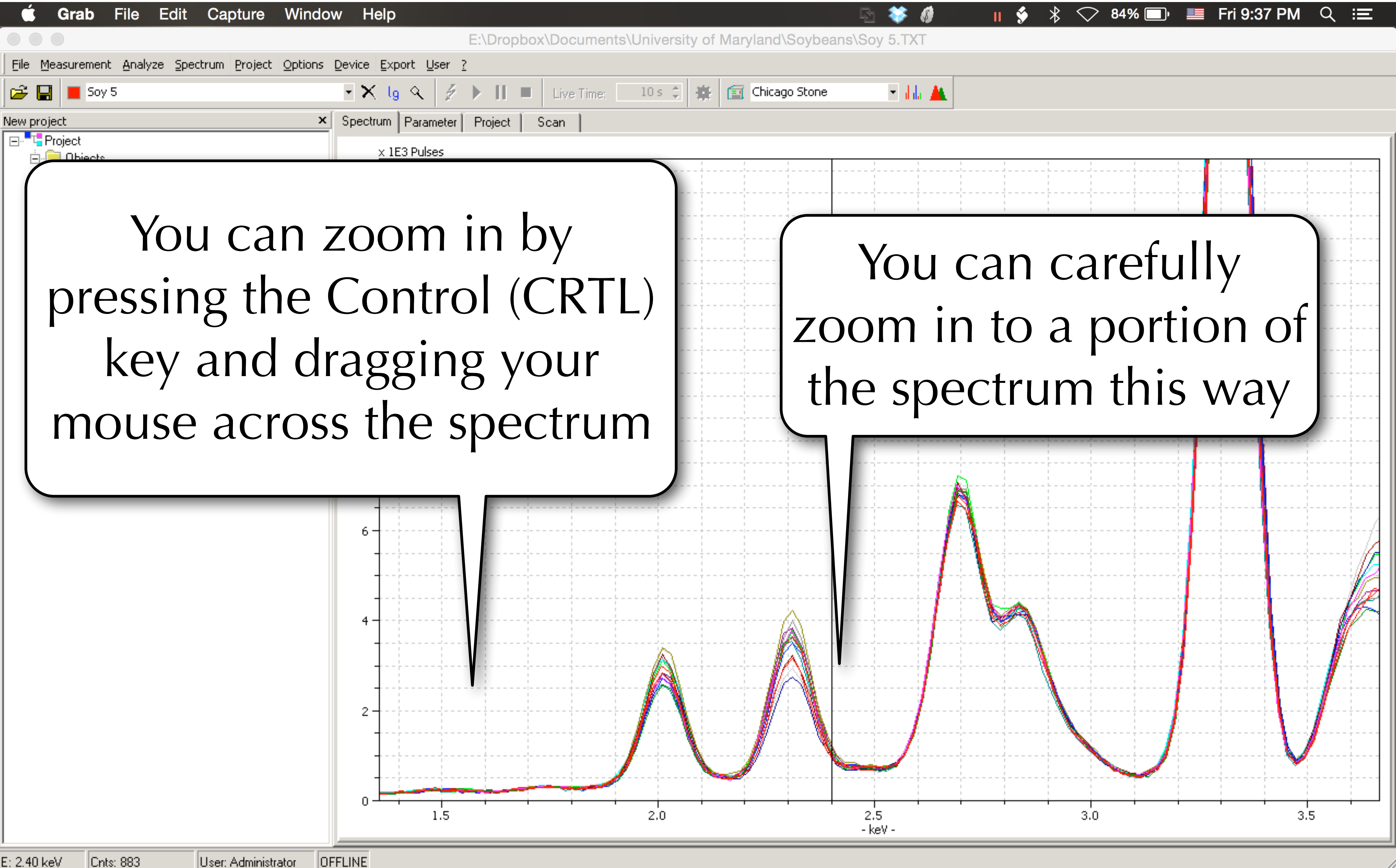
All of your spectra will be imported into the sub folder. While you can see only 100 spectra at a time in the grid, folders in this pane can hold thousands of spectra

ROI Analysis

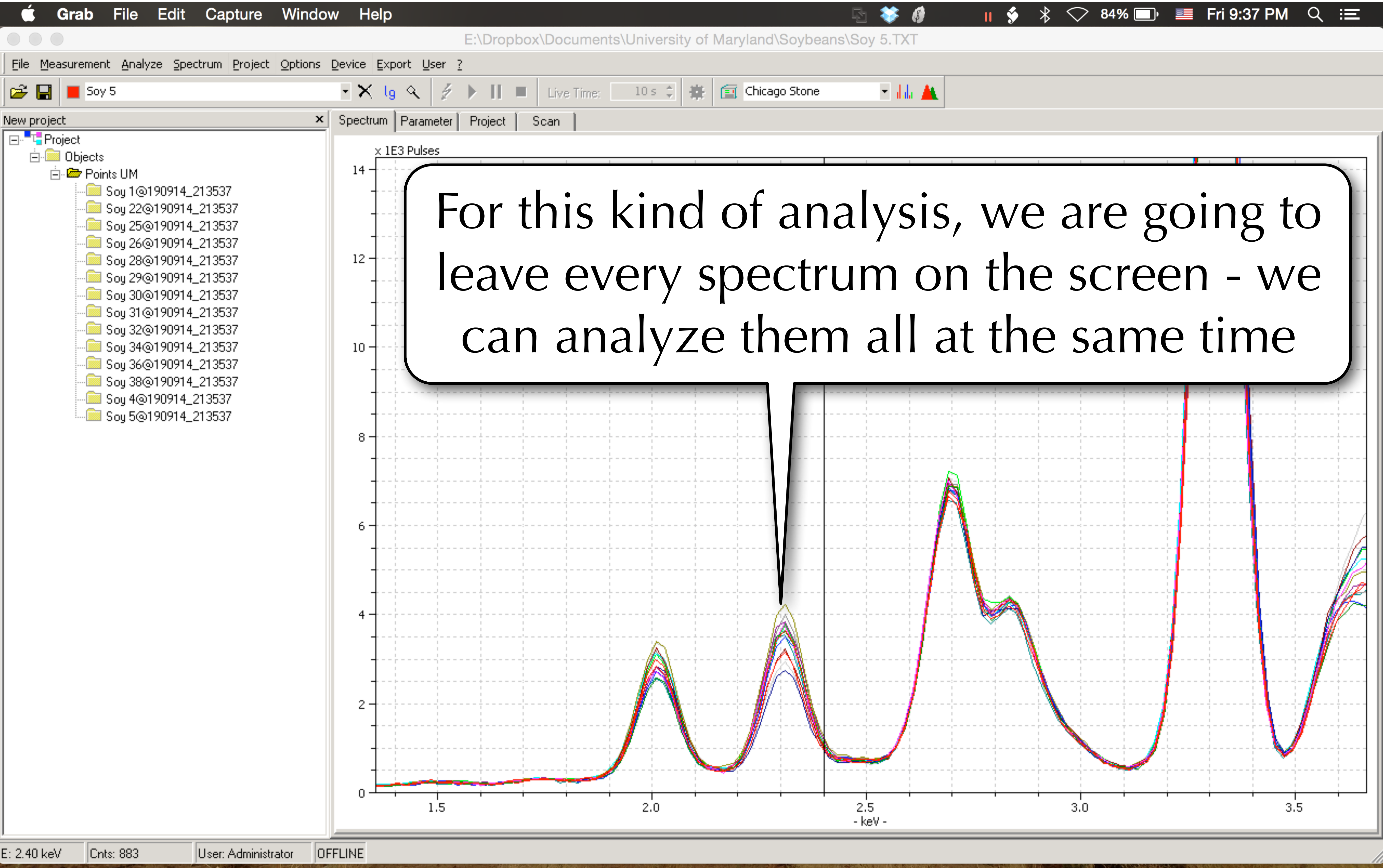


Now, we are ready to analyze the spectra. Click on the Periodic Table Button, it will look like a series of lines

ROI Analysis

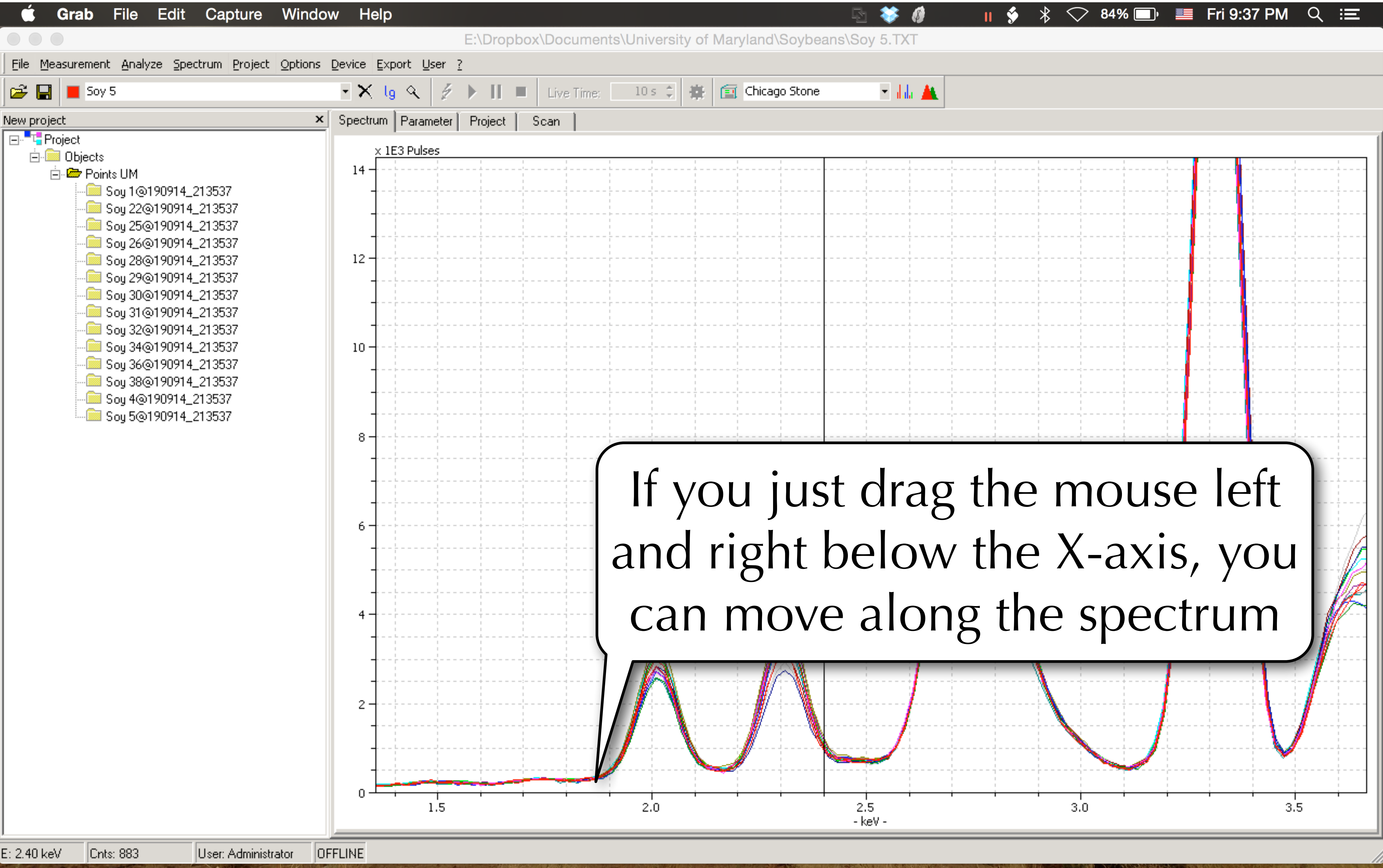


ROI Analysis



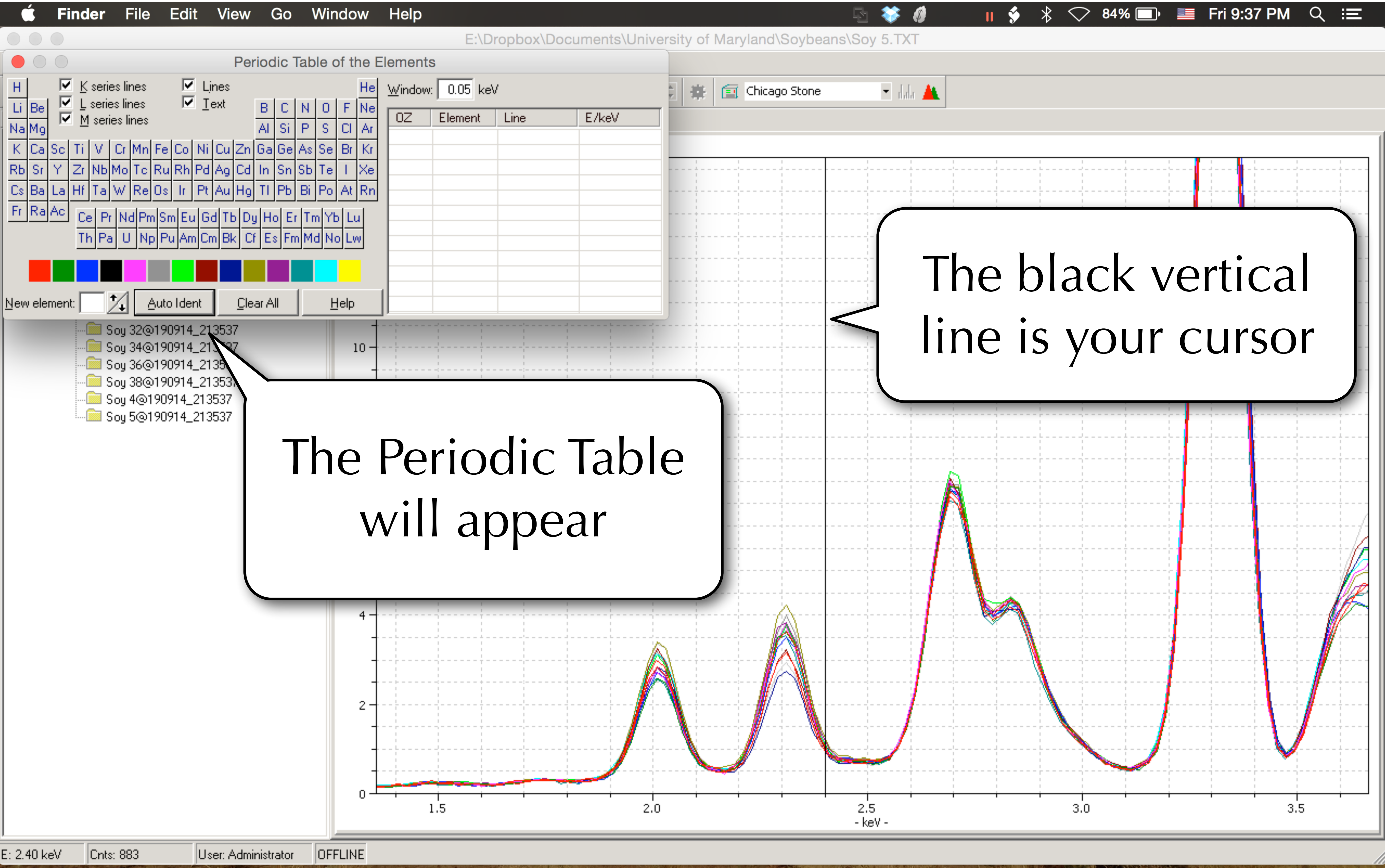
For this kind of analysis, we are going to leave every spectrum on the screen - we can analyze them all at the same time

ROI Analysis

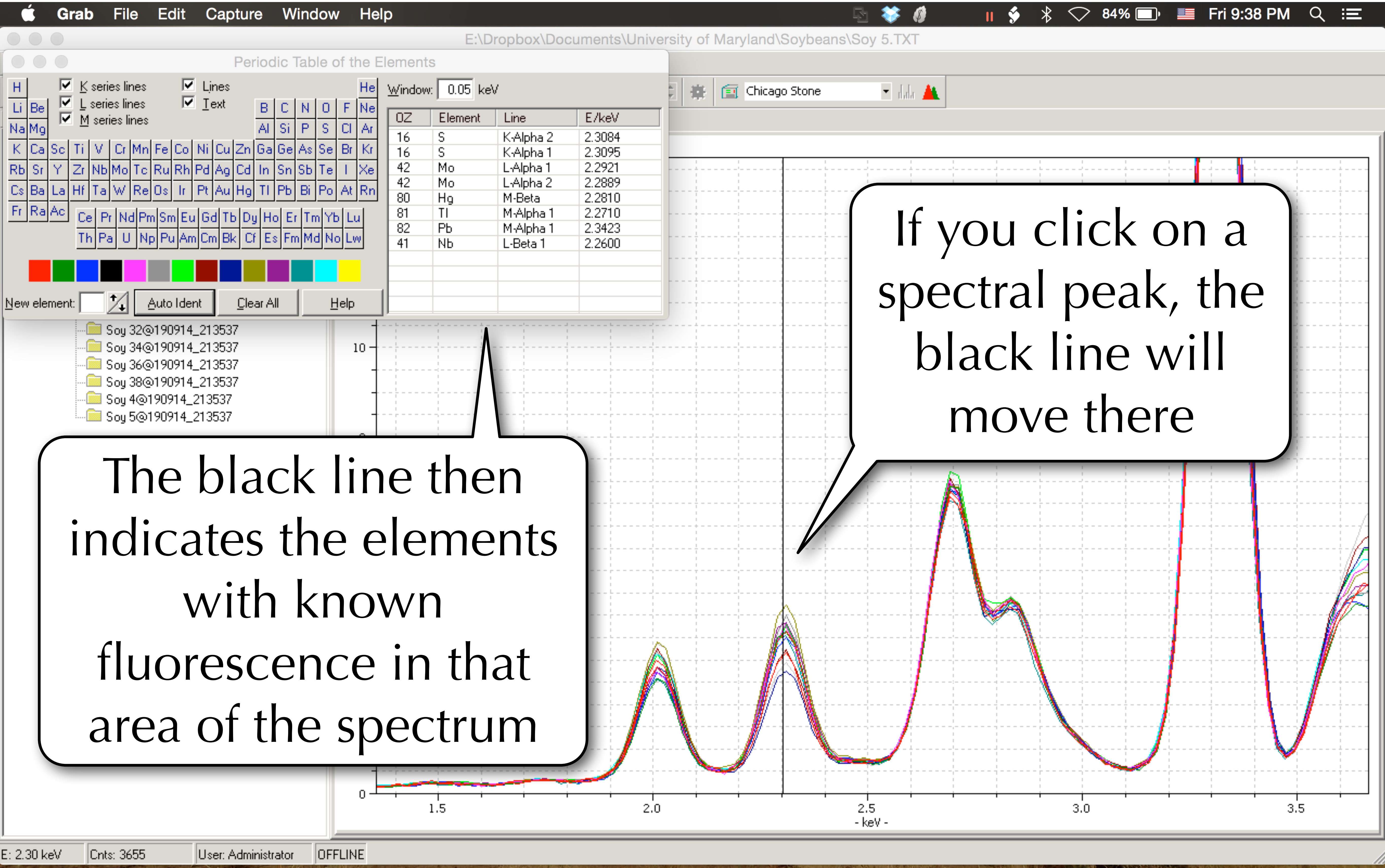


If you just drag the mouse left and right below the X-axis, you can move along the spectrum

ROI Analysis



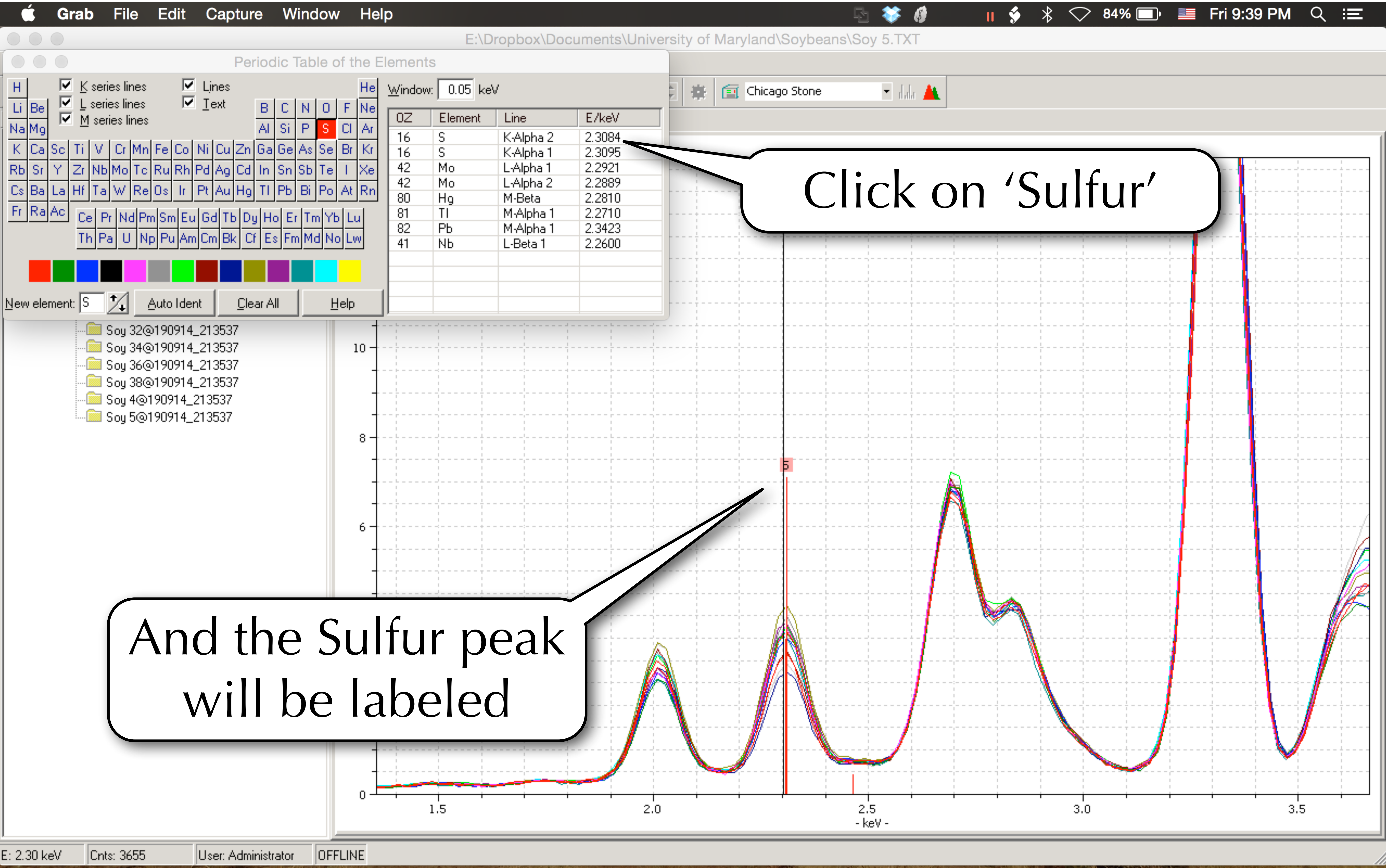
ROI Analysis



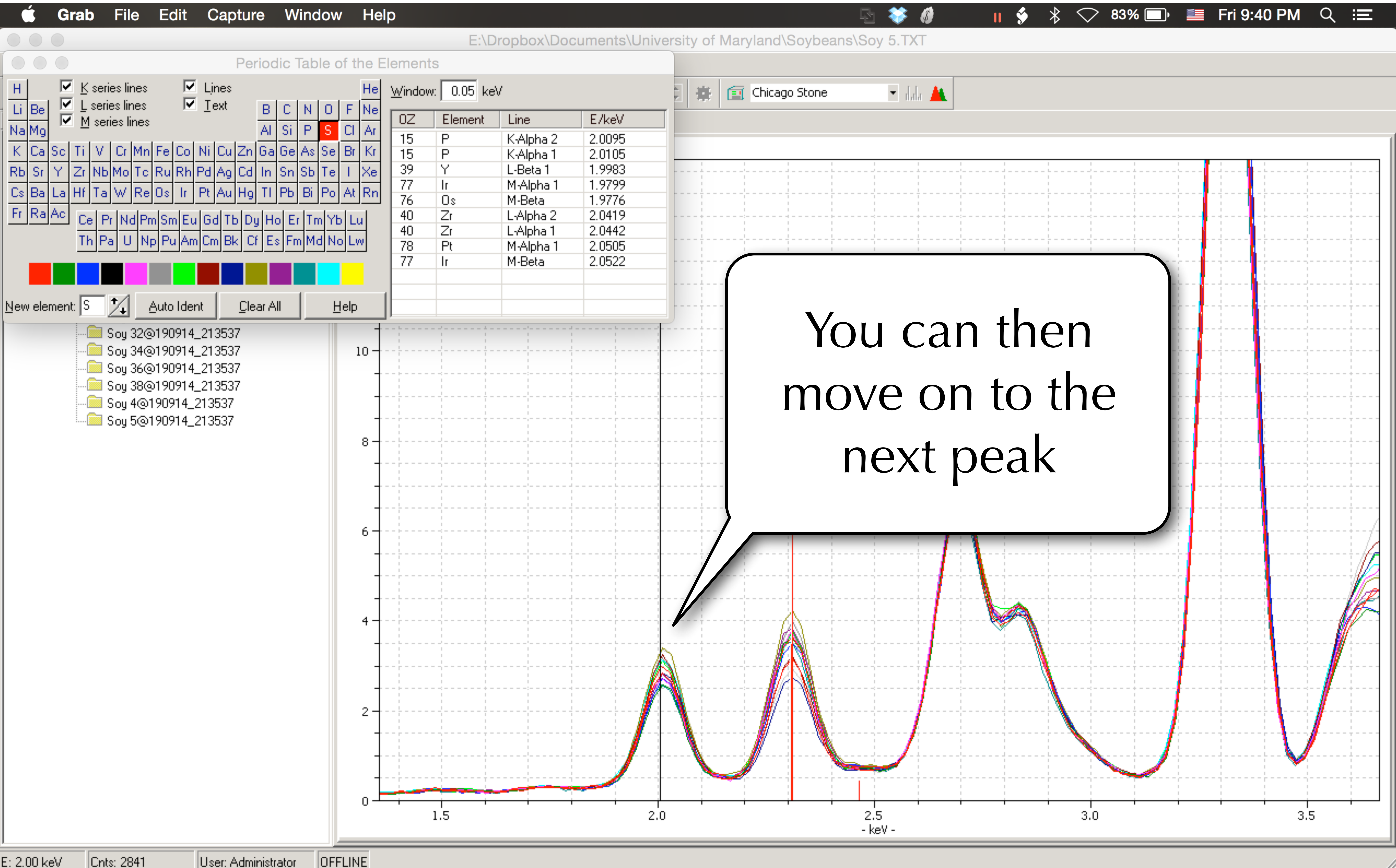
If you click on a spectral peak, the black line will move there

The black line then indicates the elements with known fluorescence in that area of the spectrum

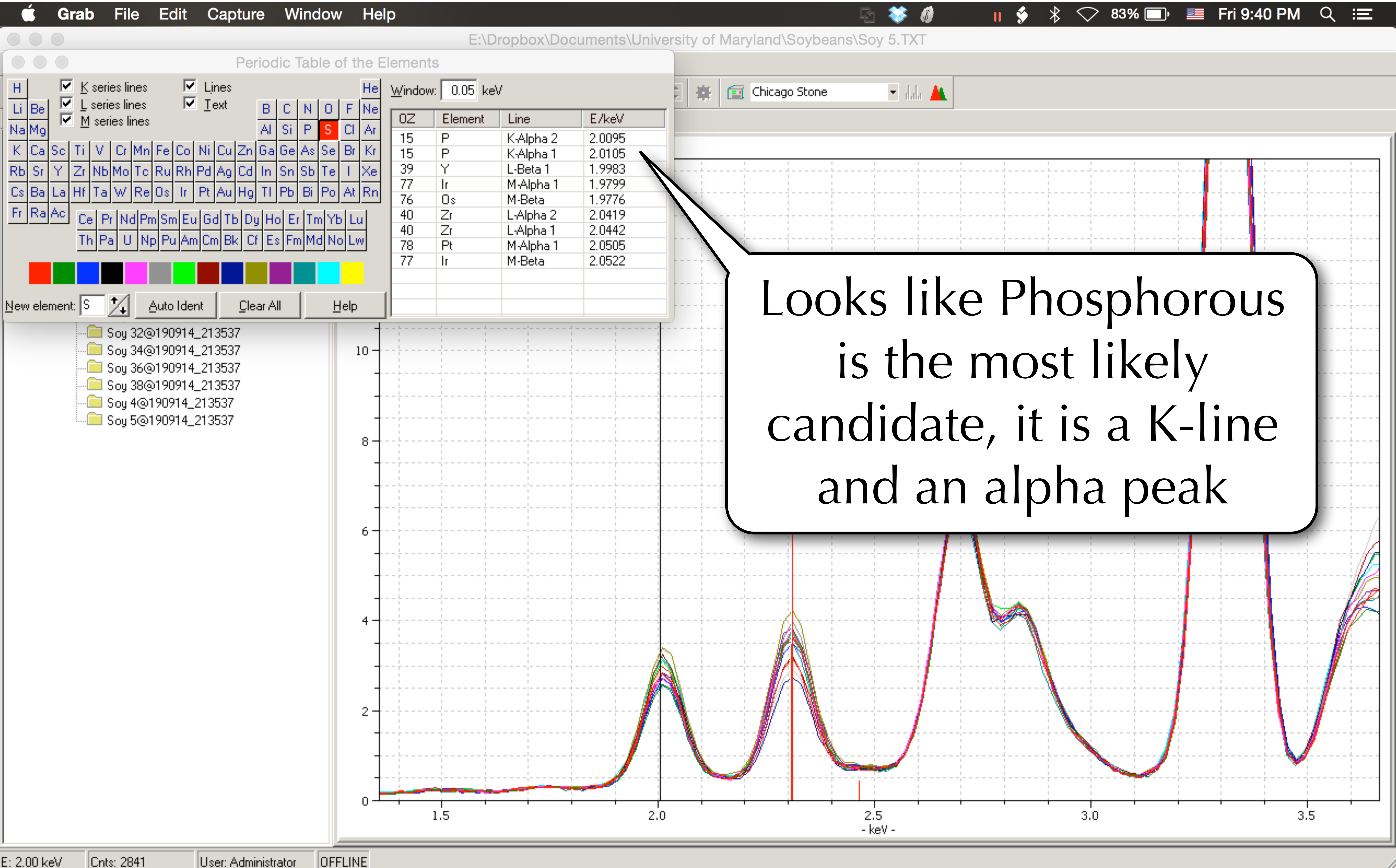
ROI Analysis



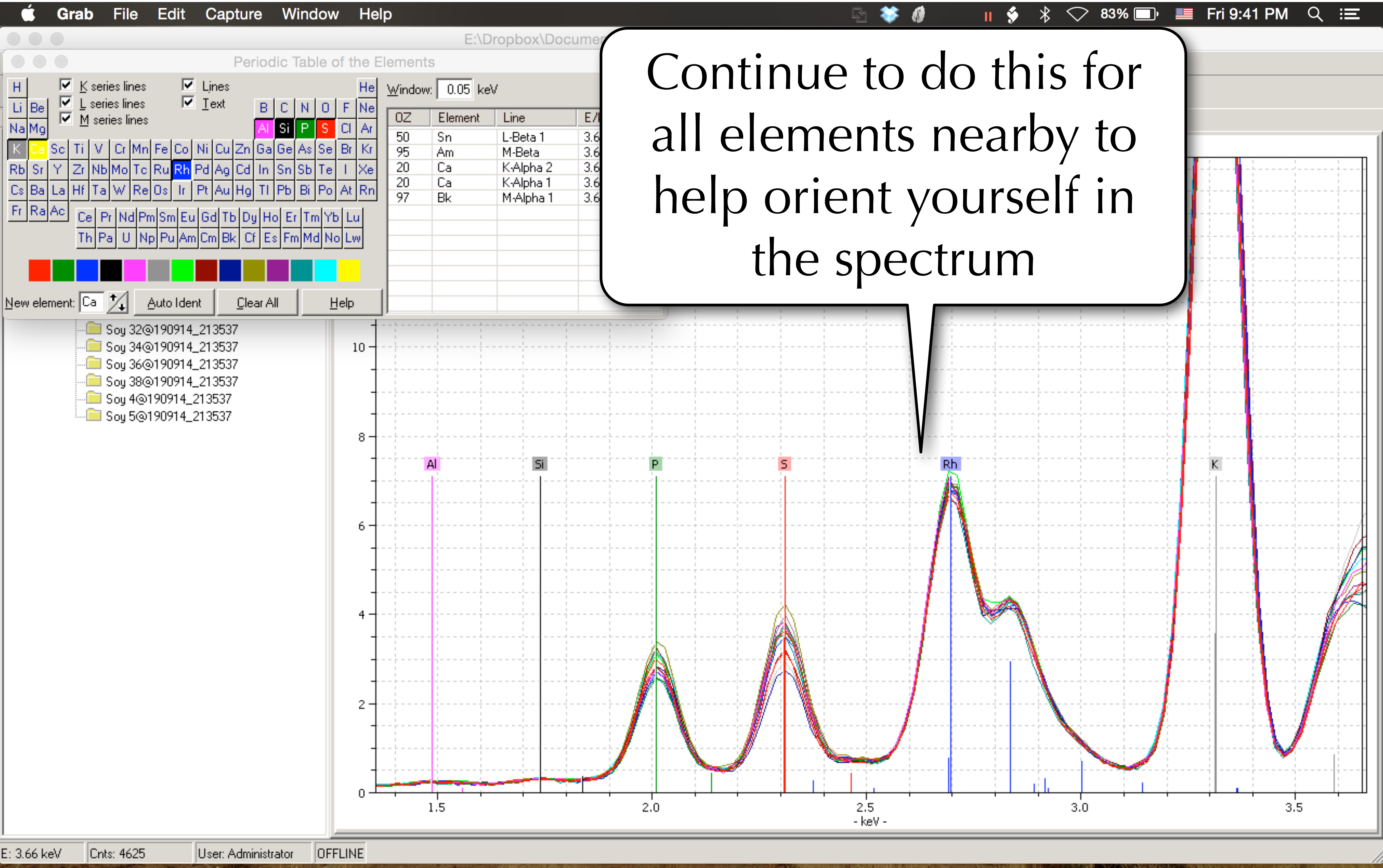
ROI Analysis



ROI Analysis

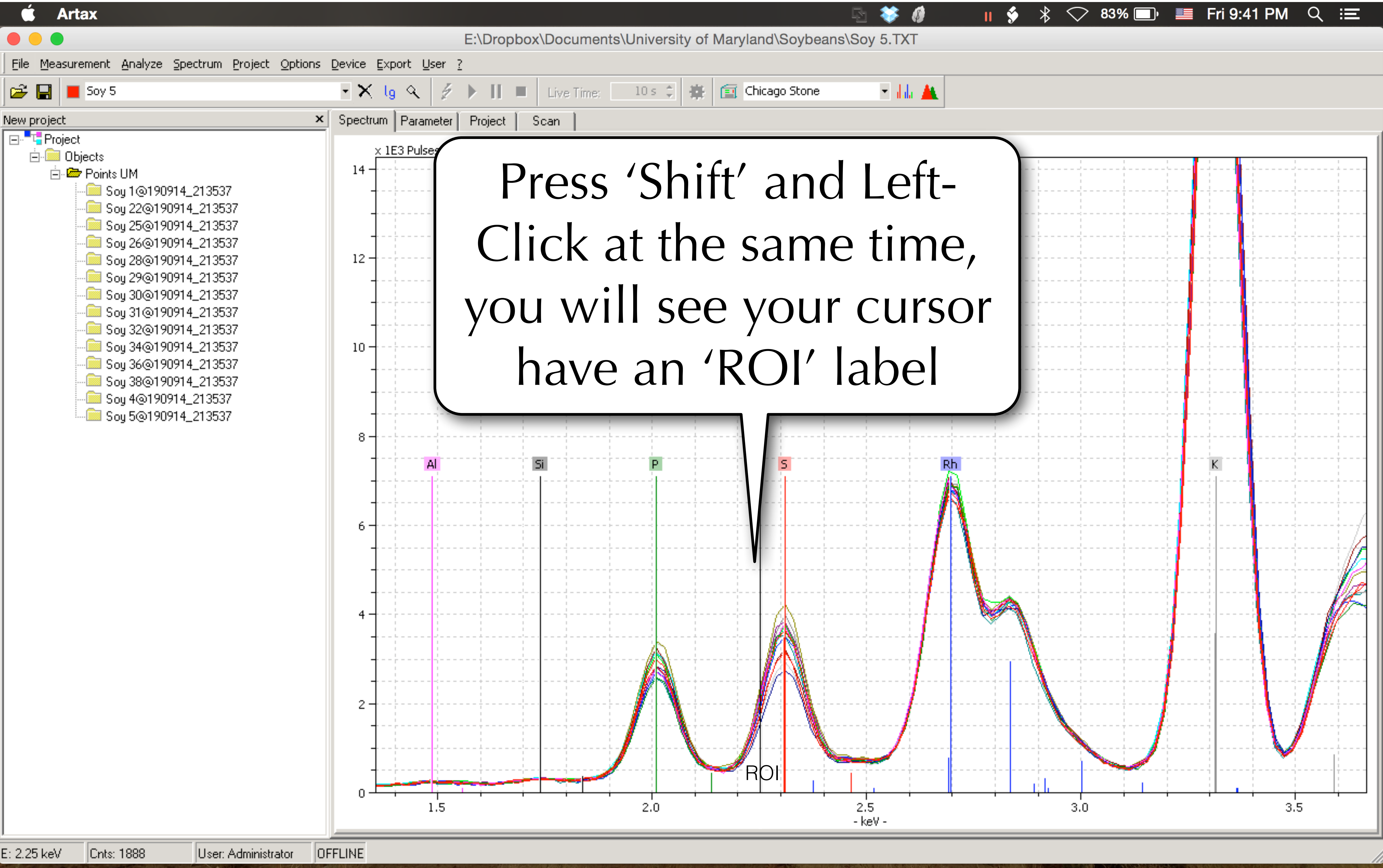


ROI Analysis



Continue to do this for all elements nearby to help orient yourself in the spectrum

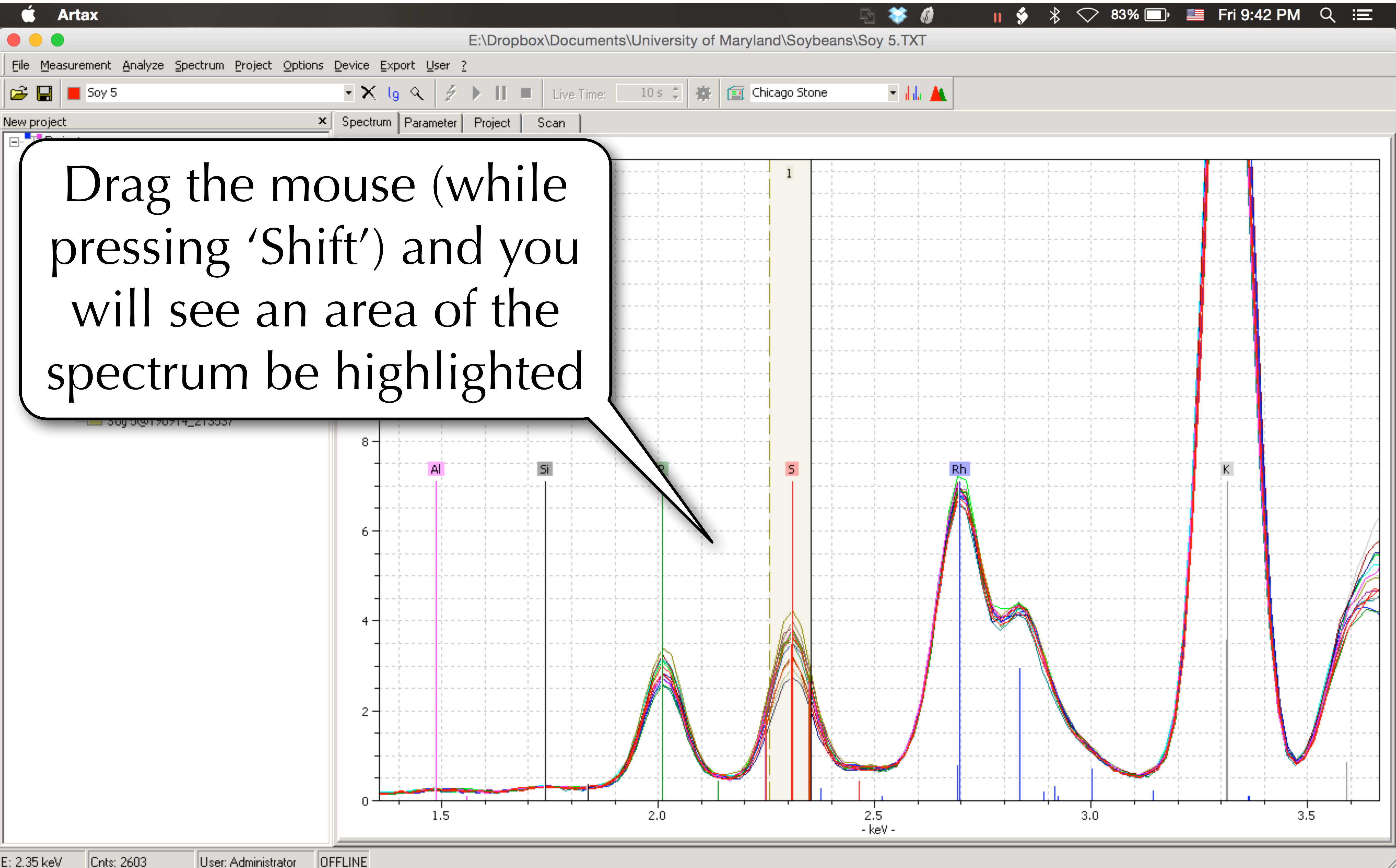
ROI Analysis



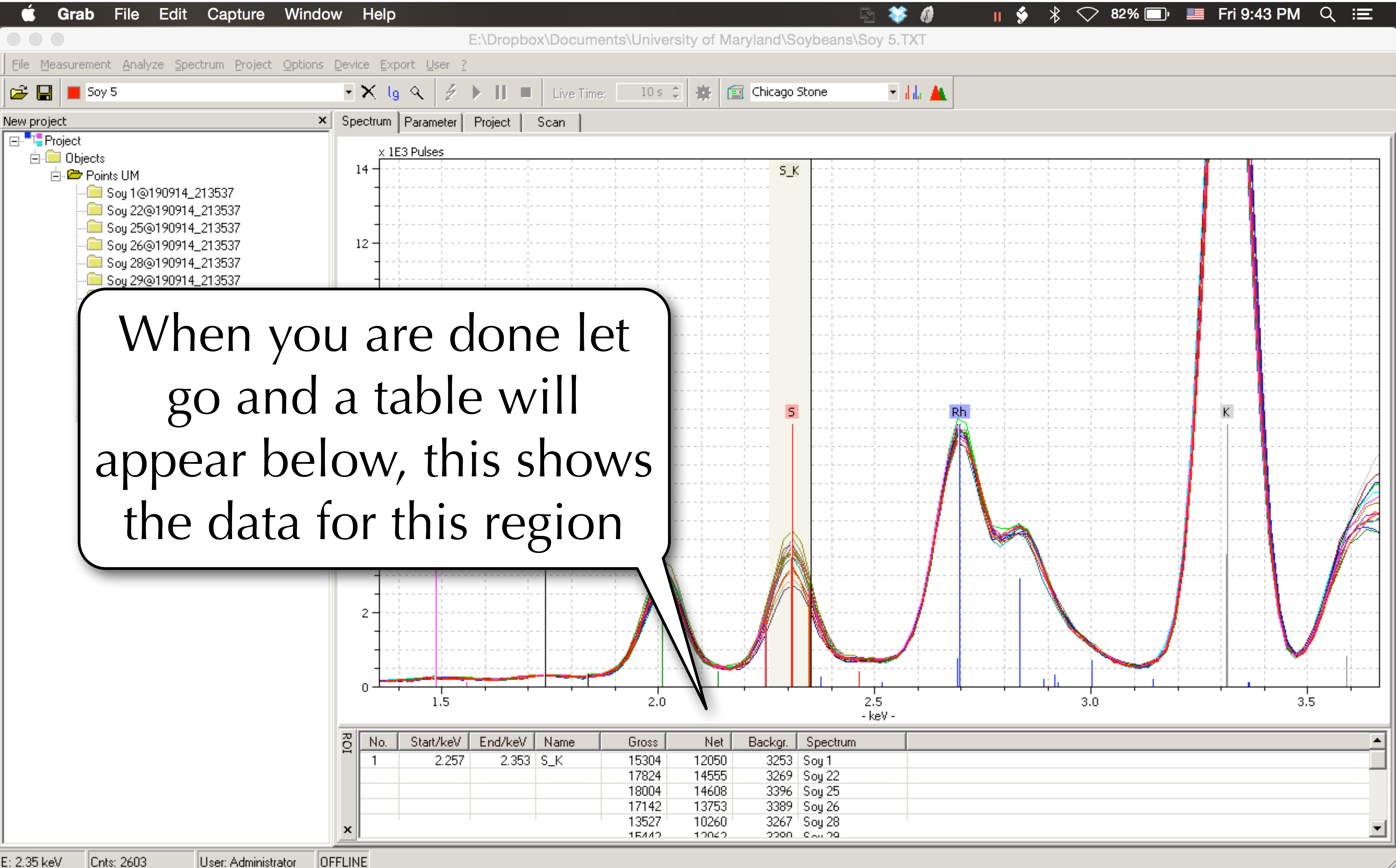
Press 'Shift' and Left-Click at the same time, you will see your cursor have an 'ROI' label

ROI Analysis

Drag the mouse (while pressing ‘Shift’) and you will see an area of the spectrum be highlighted

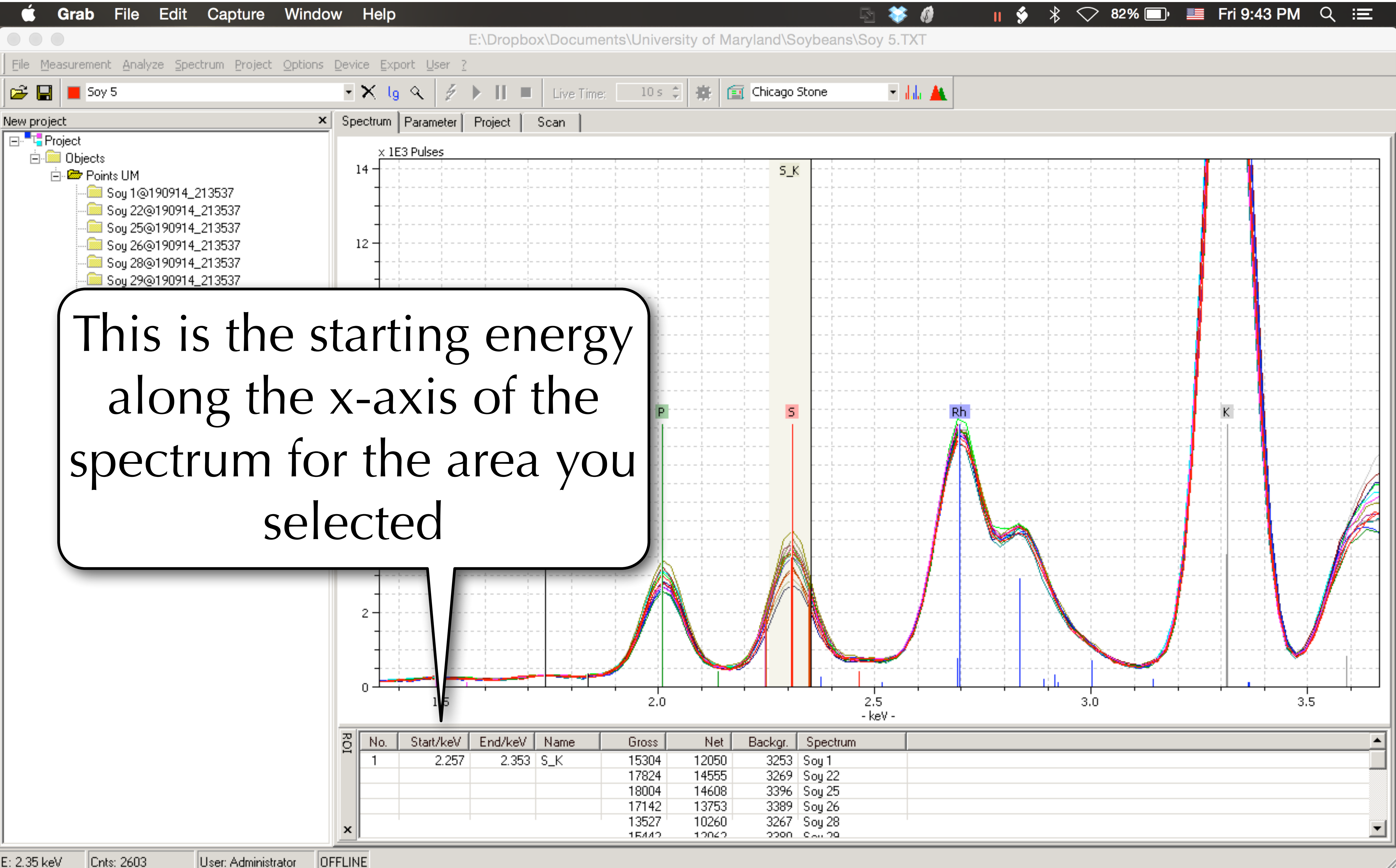


ROI Analysis



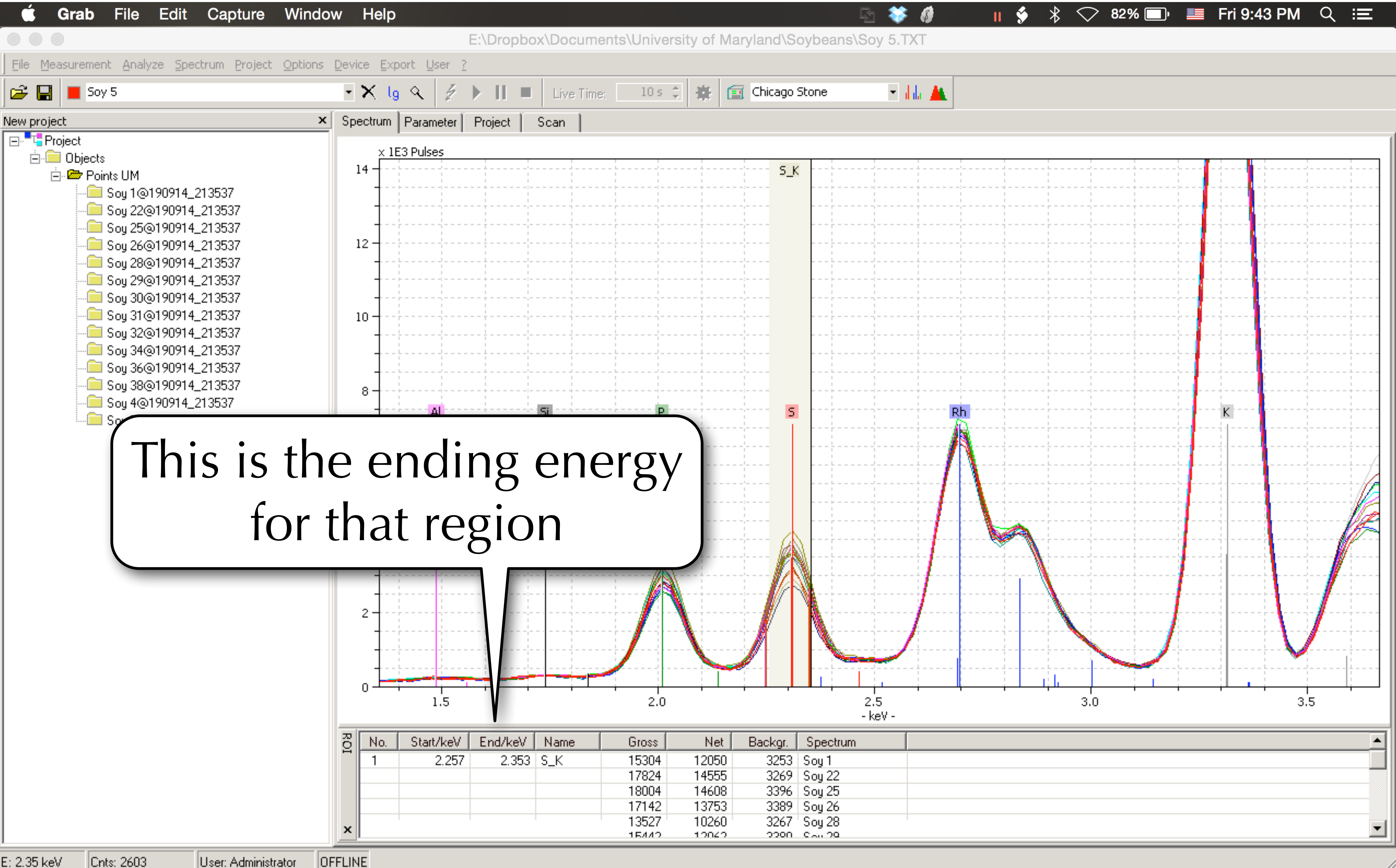
When you are done let go and a table will appear below, this shows the data for this region

ROI Analysis



This is the starting energy along the x-axis of the spectrum for the area you selected

ROI Analysis



This is the ending energy for that region

ROI Analysis

Grab File Edit Capture Window Help 82% Fri 9:43 PM

E:\Dropbox\Documents\University of Maryland\Soybeans\Soy 5.TXT

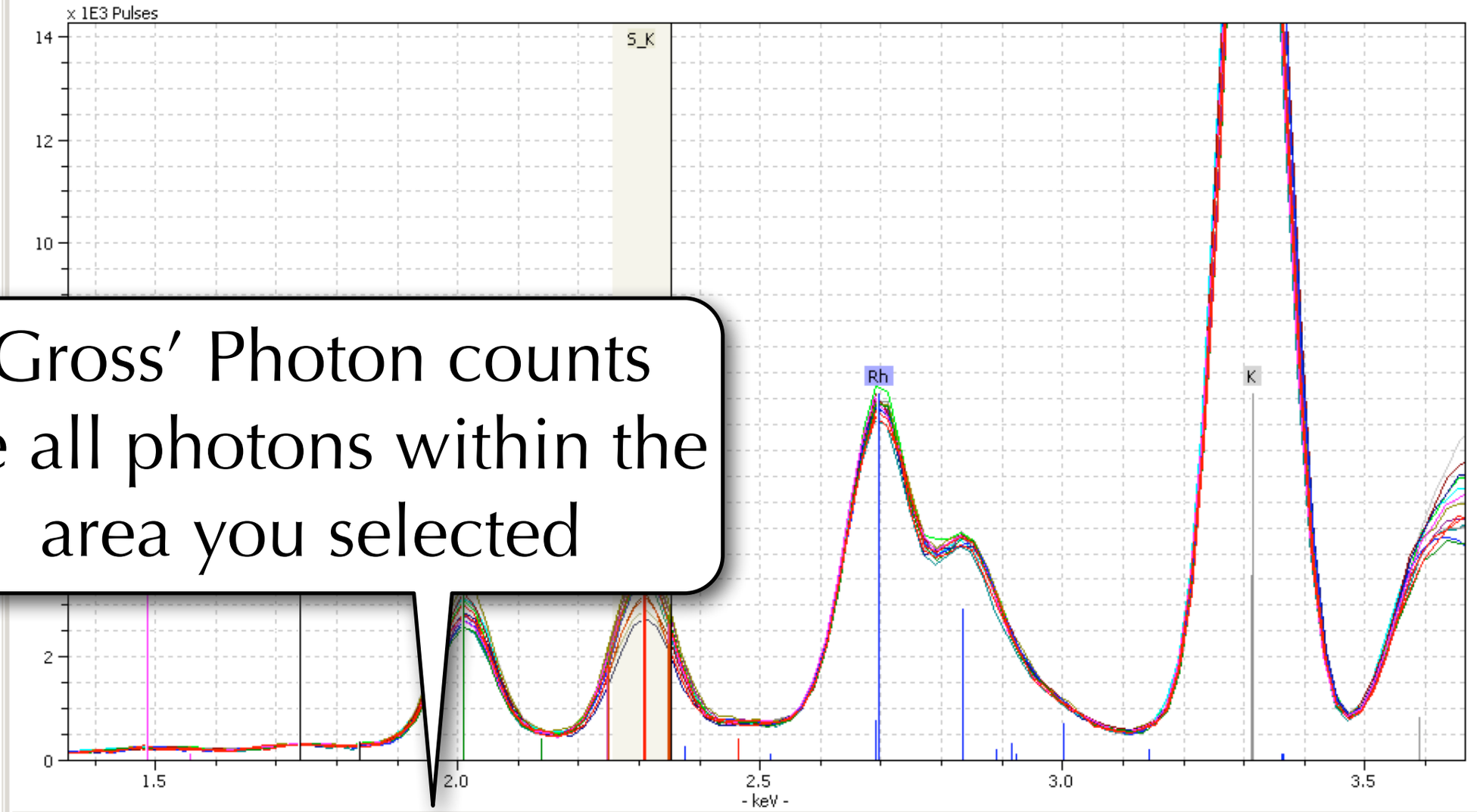
File Measurement Analyze Spectrum Project Options Device Export User ?

Soy 5 | Live Time: 10 s | Chicago Stone

New project

- Project
  - Objects
    - Points UM
      - Soy 1@190914_213537
      - Soy 22@190914_213537
      - Soy 25@190914_213537
      - Soy 26@190914_213537
      - Soy 28@190914_213537
      - Soy 29@190914_213537
      - Soy 30@190914_213537
      - Soy 31@190914_213537
      - Soy 32@190914_213537
      - Soy 34@190914_213537
      - Soy 36@190914_213537
      - Soy 38@190914_213537
      - Soy 4@190914_213537
      - Soy 5@190914_213537

Spectrum | Parameter | Project | Scan



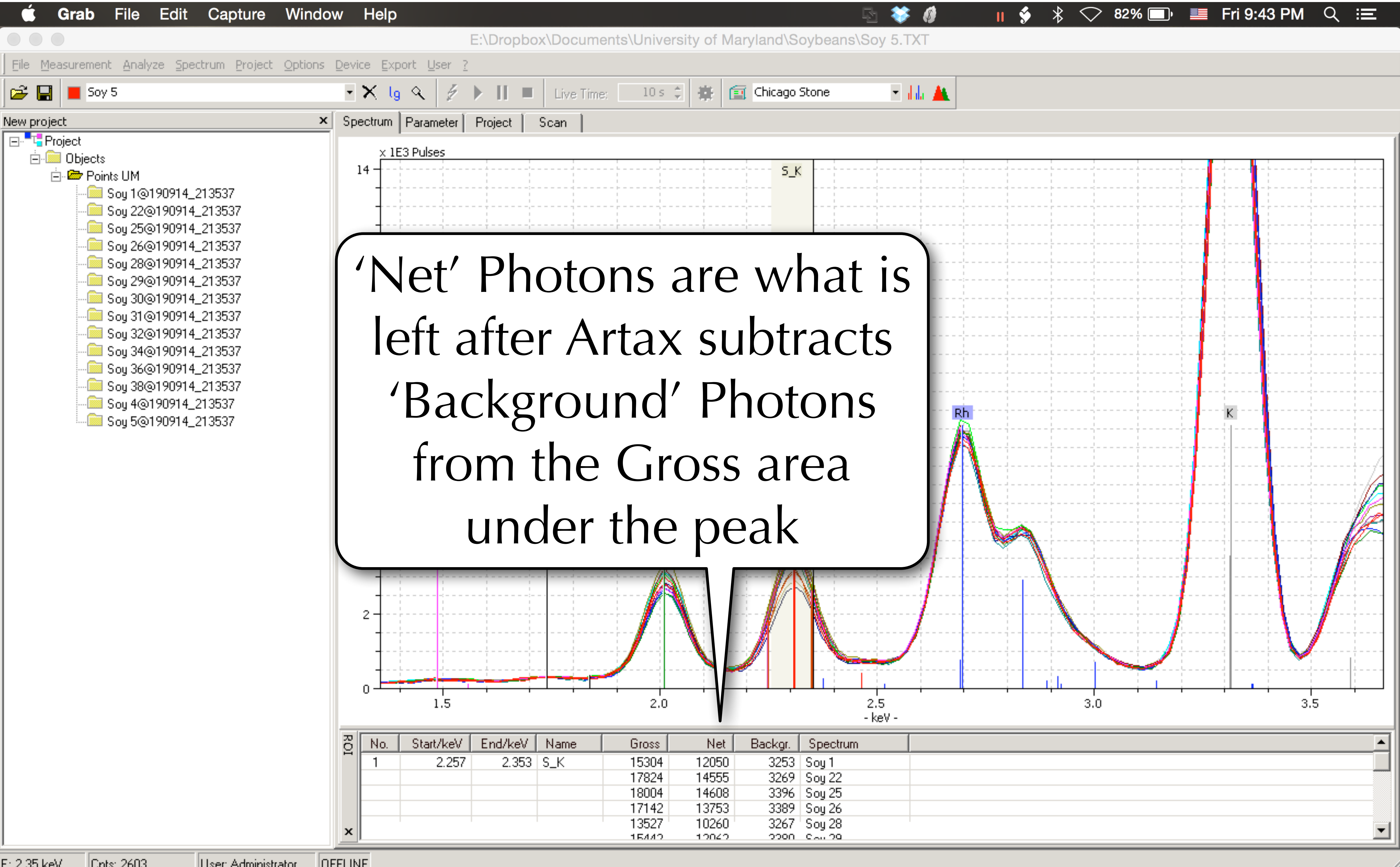
‘Gross’ Photon counts are all photons within the area you selected

ROI

No.	Start/keV	End/keV	Name	Gross	Net	Backgr.	Spectrum
1	2.257	2.353	S_K	15304	12050	3253	Soy 1
				17824	14555	3269	Soy 22
				18004	14608	3396	Soy 25
				17142	13753	3389	Soy 26
				13527	10260	3267	Soy 28
				15442	12062	3290	Soy 29

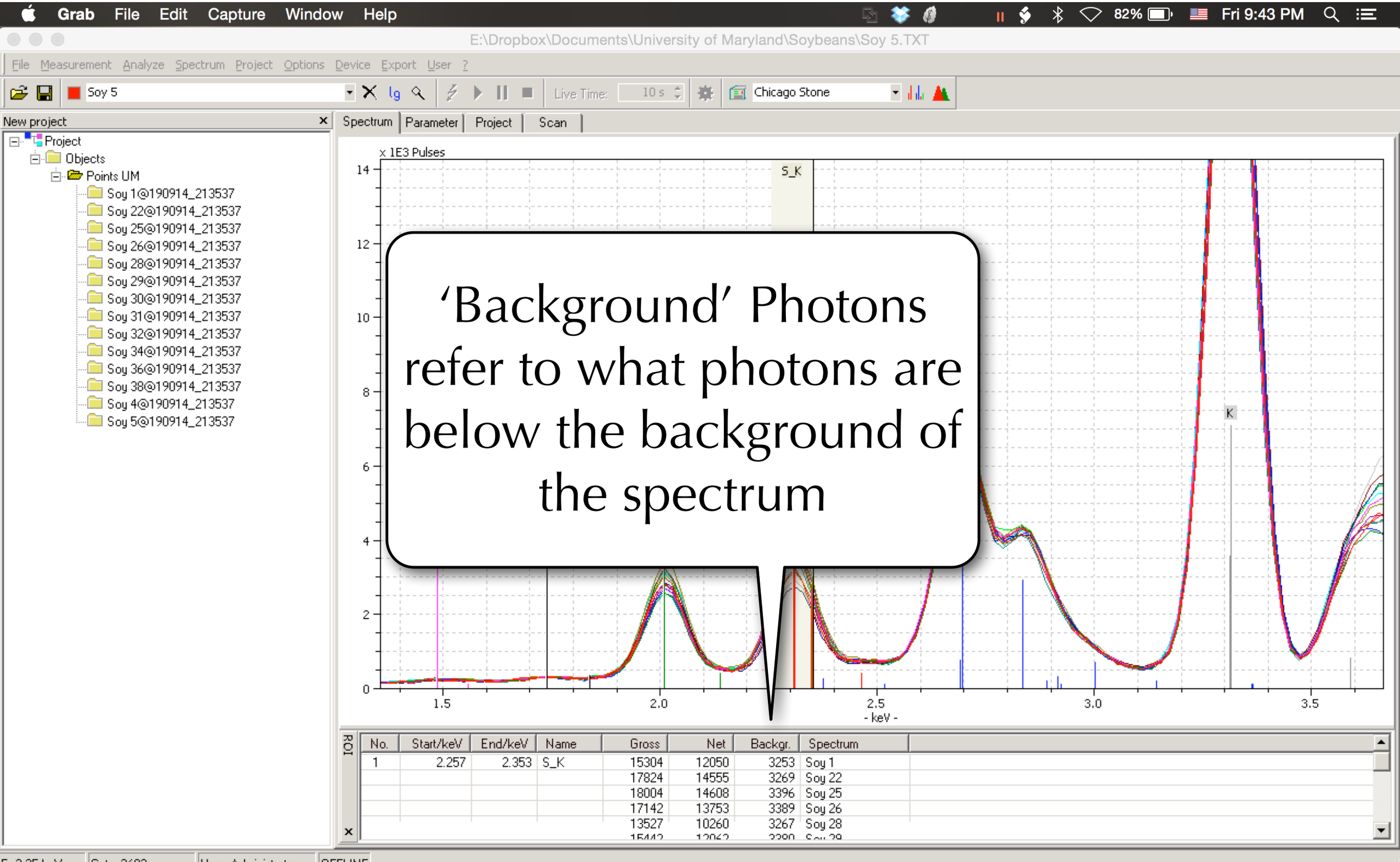
E: 2.35 keV | Cnts: 2603 | User: Administrator | OFFLINE

ROI Analysis



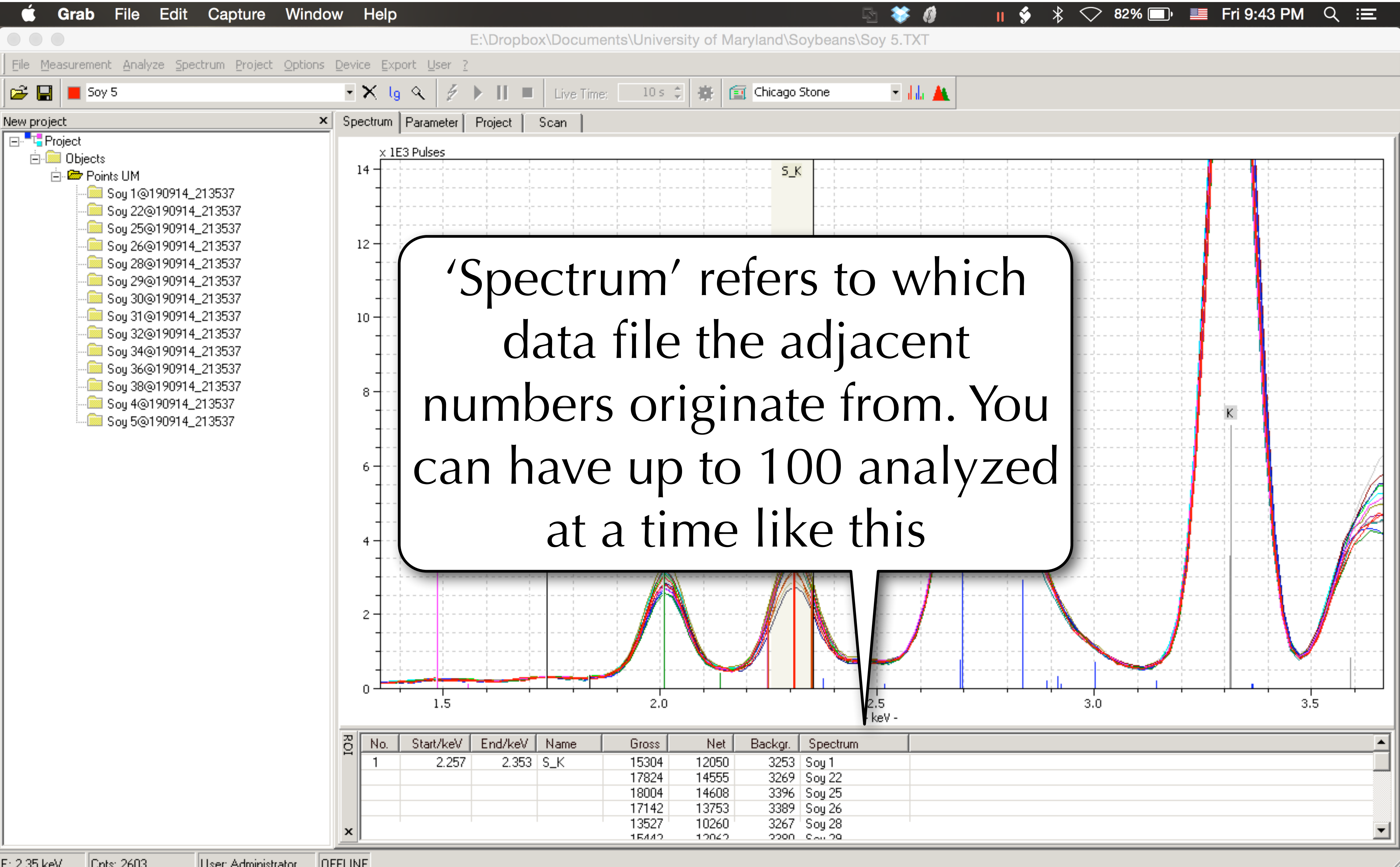
'Net' Photons are what is left after Artax subtracts 'Background' Photons from the Gross area under the peak

ROI Analysis

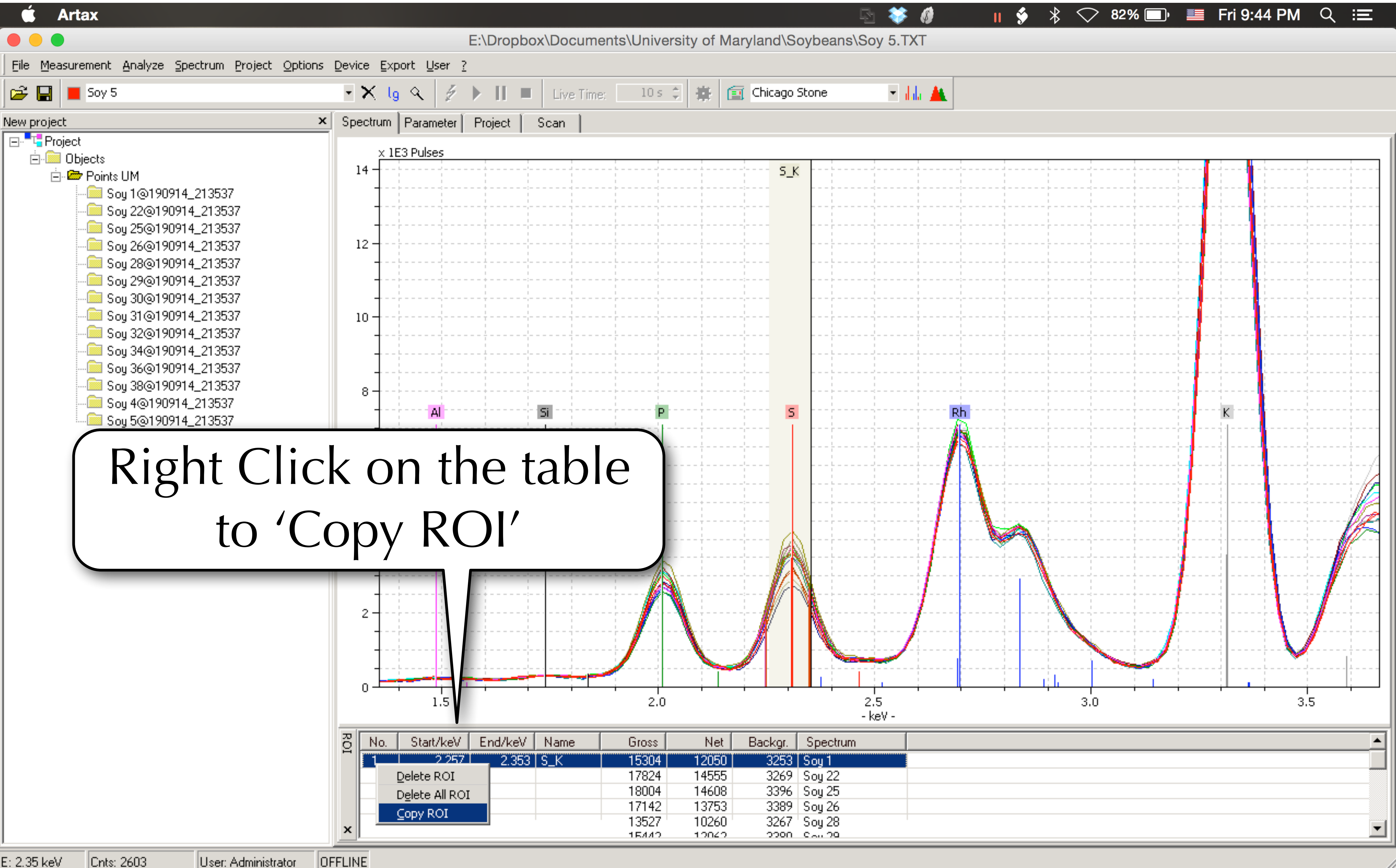


'Background' Photons refer to what photons are below the background of the spectrum

ROI Analysis



ROI Analysis



Right Click on the table to 'Copy ROI'

ROI Analysis

Grab File Edit Capture Window Help — 81% — Fri 9:46 PM

Untitled.numbers — Edited

View | Zoom 125% | Function | Table | Chart | Text | Shape | Media | Comment | Share | Tips | Format | Sort & Filter

Sheet 1

No.	Start/keV	End/keV	Name	Gross	Net	Backgr.	Spectrum
1	2.257	2.353	S_K	15304	12050	3253	Soy 1
				17824	14555	3269	Soy 22
				18004	14608	3396	Soy 25
				17142	13753	3389	Soy 26
				13527	10260	3267	Soy 28
				15442	12062	3380	Soy 29
				20422	16739	3683	Soy 30
				18957	15549	3408	Soy 31
				17710	14244	3466	Soy 32
				17819	14290	3529	Soy 34
				19057	15482	3576	Soy 36
				14465	11082	3384	Soy 38
				17192	13945	3247	Soy 4
				17715	14225	3490	Soy 5

Table | Cell | Text | Arrange

Table Styles

Headers & Footer

1 1 0

Table Name

Alternating Row Color

Row & Column Size

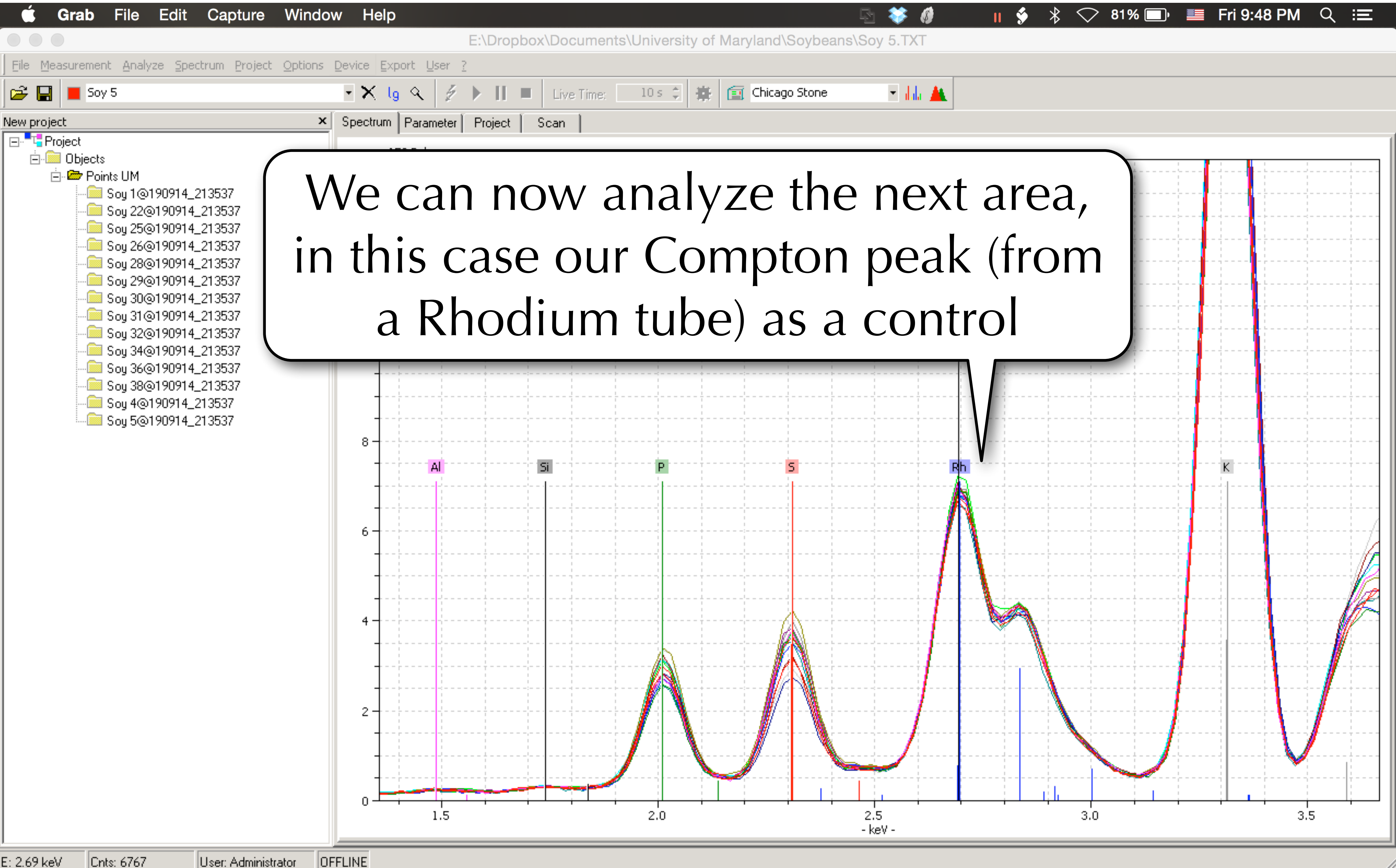
SUM 481,166.61 AVERAGE 10,692.591333... MIN 1 MAX 20,422 COUNTA 68

You can then paste this data in the application of your choice

ROI Analysis

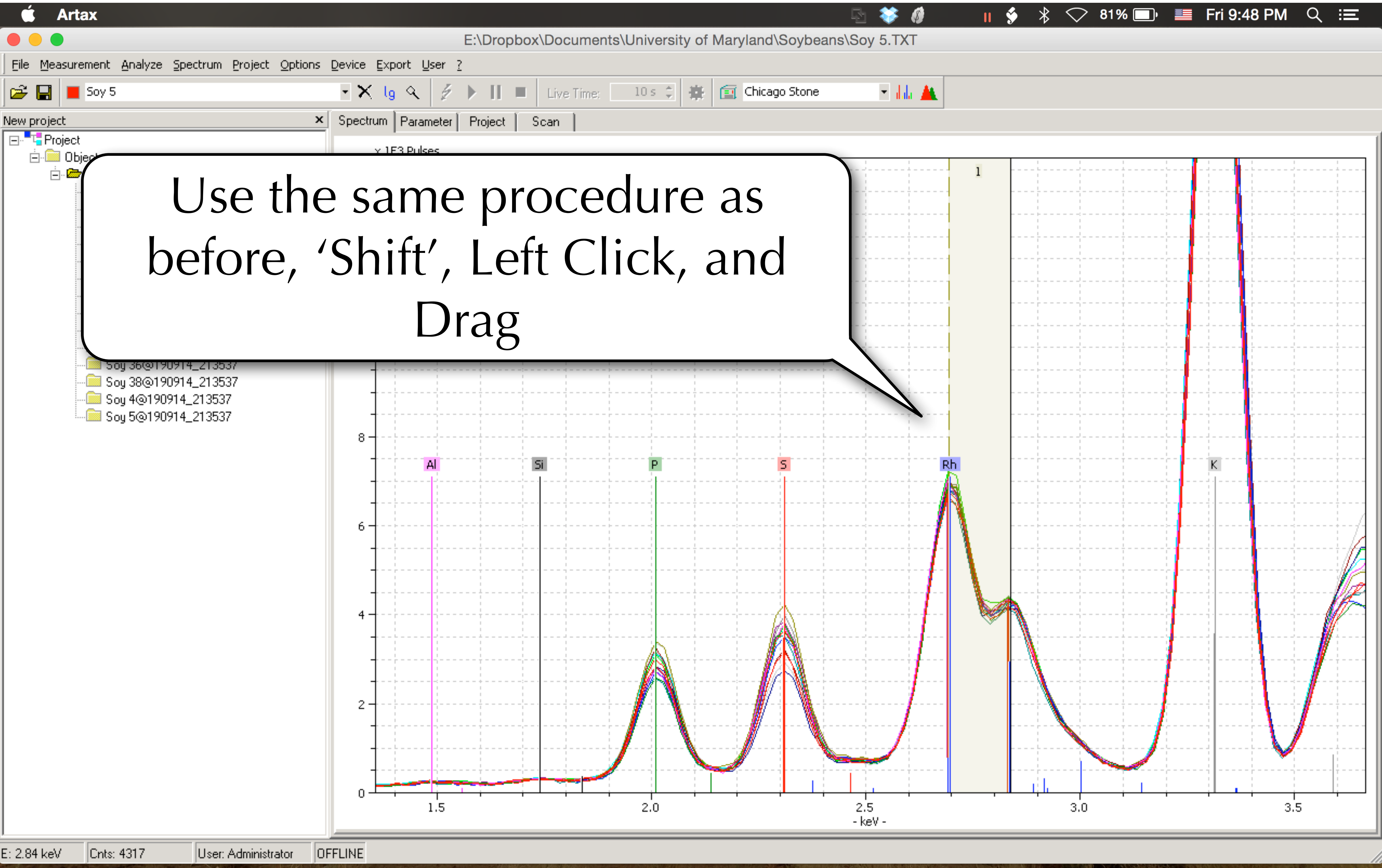
Once this is done, go to ‘Spectrum’ in the Menu Bar and select ‘Delete All ROI’

ROI Analysis



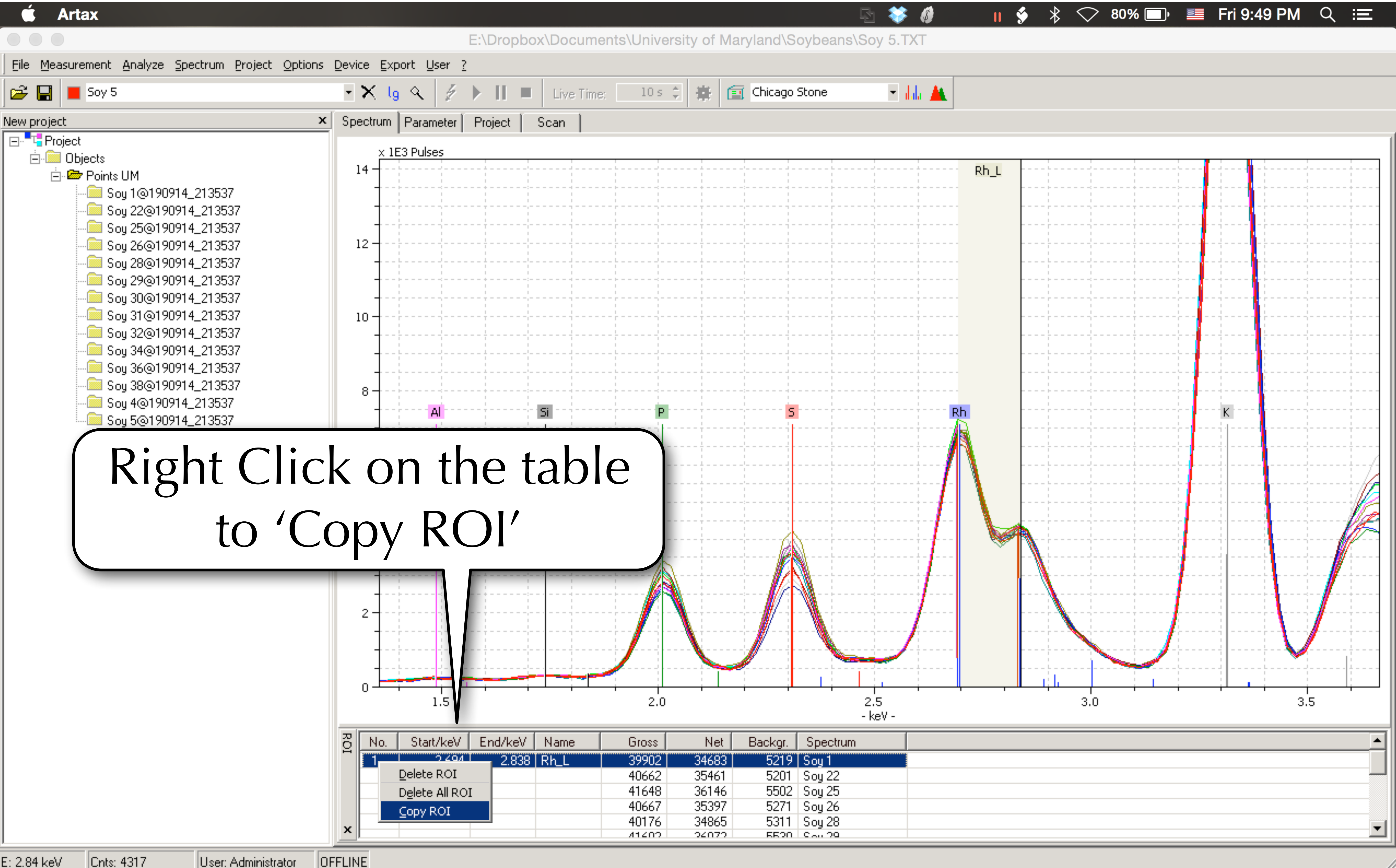
We can now analyze the next area, in this case our Compton peak (from a Rhodium tube) as a control

ROI Analysis



Use the same procedure as before, ‘Shift’, Left Click, and Drag

ROI Analysis



Right Click on the table to 'Copy ROI'

ROI Analysis

Grab File Edit Capture Window Help — 80% — Fri 9:50 PM

Untitled.numbers — Edited

View | Zoom 125% | Function | Table | Chart | Text | Shape | Media | Comment | Share | Tips | Format | Sort & Filter

Sheet 1

	No.	gr.	Spectrum	No.	Start/keV	End/keV	Name	Gross	Net	Backgr.	Spectrum
1	1	3253	Soy 1	1	2.694	2.838	Rh_L	39902	34683	5219	Soy 1
2		3269	Soy 22					40662	35461	5201	Soy 22
3		3396	Soy 25					41648	36146	5502	Soy 25
4		3389	Soy 26					40667	35397	5271	Soy 26
5		3267	Soy 28					40176	34865	5311	Soy 28
6		3380	Soy 29					41602	36072	5530	Soy 29
7		3683	Soy 30					41929	36313	5616	Soy 30
8		3408	Soy 31					41105	35768	5337	Soy 31
9		3466	Soy 32					41024	35610	5414	Soy 32
10		3529	Soy 34					42753	37291	5462	Soy 34
11		3576	Soy 36					41750	36262	5488	Soy 36
12		3384	Soy 38					40593	35286	5307	Soy 38
13		3247	Soy 4					39364	34325	5039	Soy 4
14		3490	Soy 5					40861	35474	5387	Soy 5
15											
16											
17											
18											
19											
20											
21											
22											

Table | Cell | Text | Arrange

Table Styles

Headers & Footer: 1 | 1 | 0

Table Name

Table Font Size: A A

Table Outline: 0.35 pt

Outline table name

Grid Lines

Alternating Row Color

Row & Column Size

SUM 1,148,079.532 | AVERAGE 25,512.878488... | MIN 1 | MAX 42,753 | COUNTA 68

And then paste it in the same spreadsheet

ROI Analysis

Grab File Edit Capture Window Help — 80% — Fri 9:50 PM

Untitled.numbers — Edited

View | Zoom 125% | Function | Table | Chart | Text | Shape | Media | Comment | Share | Tips | Format | Sort & Filter

Sheet 1

Artax ROI Analysis

No.		Name	Gross	Net	Backgr.	Spectrum		Normalized
1	338	Rh_L	39902	34683	5219	Soy 1		
			40662	35461	5201	Soy 22		
			41648	36146	5502	Soy 25		
			40667	35397	5271	Soy 26		
			40176	34865	5311	Soy 28		
			41602	36072	5530	Soy 29		
			41929	36313	5616	Soy 30		
			41105	35768	5337	Soy 31		
			41024	35610	5414	Soy 32		
			42753	37291	5462	Soy 34		
			41750	36262				
			40593	35286				
			39364	34325				
			40861	35474				

I can now normalize my Sulfur data to the Compton Peak

Table | Cell | Text | Arrange

Table Styles

Headers & Footer: 1 | 1 | 0

Table Name

Table Font Size: A A

Table Outline: 0.35 pt

Outline table name

Grid Lines

Alternating Row Color

Row & Column Size

Formatted | Normalized

ROI Analysis

Grab File Edit Capture Window Help — 80% — Fri 9:51 PM

Untitled.numbers — Edited

View | Zoom 125% | Function | Table | Chart | Text | Shape | Media | Comment | Share | Tips | Format | Sort & Filter

Sheet 1

Artax ROI Analysis

No.		Name	Gross	Net	Backgr.	Spectrum	Normalized
1	338	Rh_L	39902	34683	5219	Soy 1	
			40662	35461	5201	Soy 22	
			41648	36146	5502	Soy 25	
			40667	35397	5271	Soy 26	
			40176	34865	5311	Soy 28	
			41602	36072	5530	Soy 29	
			41929	36313	5616	Soy 30	
			41105	35768	5337	Soy 31	
			41024	35610	5414	Soy 32	
			42753	37291	5462	Soy 34	
			41750	36262			
			40593	35286			
			39364	34325			
			40861	35474			

Hit the '=' key on the keyboard to create a formula

Functions

Search

All	ABS
Recent	ACCRINT
	ACCRINTM
Date and Time	ACOS
Duration	ACOSH
Engineering	ADDRESS
Financial	AND
Logical & Info	AREAS
Numeric	ASIN
Reference	ASINH
Statistical	ATAN
Text	ATAN2
Trigonometric	ATANH

Insert Function

fx ABS

The ABS function returns the absolute value of a number value or of a duration value.

ABS(*num-dur*)

- **num-dur:** A number value or duration value.

Notes

- The result returned by ABS is either a positive number value, positive duration value, or 0.

Examples

=ABS(A1) returns 5, if cell A1 contains 5.

=ABS(8-5) returns 3.

=ABS(5-8) returns 3.

=ABS(0) returns 0.

ROI Analysis

Grab File Edit Capture Window Help — 80% — Fri 9:51 PM

Untitled.numbers — Edited

125% | Function | Table | Chart | Text | Shape | Media | Comment | Share | Tips | Format | Sort & Filter

Sheet 1

No.	Start/keV	End/keV	Name	Gross	Net	Backgr.	Spectrum	No.	Start/keV	End/ke
1	2.257	2.353	S_K	15304	12050	3253	E2	1	2.694	
				17824	14555	3269	Soy 22			
				18004	14608	3396	Soy 25			
				17142	13753	3389	Soy 26			
				13527	10260	3267	Soy 28			
				15442	12062	3380	Soy 29			
				20422	16739	3683	Soy 30			
				18957	15549	3408	Soy 31			
				17710	14244	3466	Soy 32			
				17819	14290	3529	Soy 34			
				19057	15482	3576	Soy 36			
							Soy 38			
							Soy 4			
							Soy 5			

Then select the Sulfur Gross Photons

Formula Result 15304

Functions

Search

All	ABS
Recent	ACCRINT
	ACCRINTM
Date and Time	ACOS
Duration	ACOSH
Engineering	ADDRESS
Financial	AND
Logical & Info	AREAS
Numeric	ASIN
Reference	ASINH
Statistical	ATAN
Text	ATAN2
Trigonometric	ATANH

Insert Function

ABS

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=ABS(5-8) returns 3.

=ABS(0) returns 0.

ROI Analysis

Grab File Edit Capture Window Help — 79% — Fri 9:52 PM

Untitled.numbers — Edited

View | Zoom 125% | Function | Table | Chart | Text | Shape | Media | Comment | Share | Tips | Format | Sort & Filter

Sheet 1

	A	E	F	G	H	I	J	K	L	M
1	No.	Gross	Net	Backgr.	Spectrum	No.	Start/keV	End/keV	Name	Gross
2	1	15304	12050	3253	Soy 1	1	2.6	E2 ÷ M2		39902
3		17824	14555	3269	Soy 22					40662
4		18004	14608	3396	Soy 25					41648
5		17142	13753	3389	Soy 26					40667
6		13527	10260	3267	Soy 28					40176
7		15442	12062	3380	Soy 29					41602
8		20422	16739	3683	Soy 30					41929
9		18957	15549	3408	Soy 31					41105
10		17710	14244	3466	Soy 32					41024
11		17819	14290	3529	Soy 34					42753
12		19057	15482	3576	Soy 36					41750
13		14465	11082	3384	Soy 38					
14		17192	13945	3247	Soy 4					
15		17715	14225	3490	Soy 5					
16										
17										
18										
19										
20										
21										
22										

And divide them by Rhodium

Formula Result 0.383539672196882

Functions

Search

All	ABS
Recent	ACCRINT
	ACCRINTM
Date and Time	ACOS
Duration	ACOSH
Engineering	ADDRESS
Financial	AND
Logical & Info	AREAS
Numeric	ASIN
Reference	ASINH
Statistical	ATAN
Text	ATAN2
Trigonometric	ATANH

Insert Function

fx ABS

The ABS function returns the absolute value of a number value or of a duration value.

ABS(*num-dur*)

- **num-dur:** A number value or duration value.

Notes

- The result returned by ABS is either a positive number value, positive duration value, or 0.

Examples

=ABS(A1) returns 5, if cell A1 contains 5.

=ABS(8-5) returns 3.

=ABS(5-8) returns 3.

=ABS(0) returns 0.

ROI Analysis

Grab File Edit Capture Window Help — 79% — Fri 9:52 PM

Untitled.numbers — Edited

125% | View | Zoom | Function | Table | Chart | Text | Shape | Media | Comment | Share | Tips | Format | Sort & Filter

Sheet 1

Artax ROI Analysis

No.	eV	Name	Gross	Net	Backgr.	Spectrum	Normalized
1	2.838	Rh_L	39902	34683	5219	Soy 1	0.38353967219
			40662	35461	5201	Soy 22	
			41648	36146	5502	Soy 25	
			40667	35397	5271	Soy 26	
			40176	34865	5311	Soy 28	
			41602	36072	5530	Soy 29	
			41929	36313	5616	Soy 30	
			41105	35768	5337	Soy 31	
			41024	35610	5414	Soy 32	
			42753	37291	5462	Soy 34	
			41750	36262	5488	Soy 36	
			40593	35286			
			39364	34325			
			40861	35474			

This gives you your normalized photons

Table | Cell | Text | Arrange

Table Styles

Headers & Footer: 1 | 1 | 0

Table Name

Table Font Size: A A

Table Outline: 0.35 pt

Outline table name

Grid Lines

Alternating Row Color

Row & Column Size

Formula: E2 ÷ M2

ROI Analysis

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Sheet 1

Artax ROI Analysis

No.	eV	Name	Gross	Net	Backgr.	Spectrum	Normalized
1	2.838	Rh_L	39902	34683	5219	Soy 1	0.38353967219
			40662	35461	5201	Soy 22	0.43834538389
			41648	36146	5502	Soy 25	0.43228966577
			40667	35397	5271	Soy 26	0.42152113507
			40176	34865	5311	Soy 28	0.33669354838
			41602	36072	5530	Soy 29	0.37118407768
			41929	36313	5616	Soy 30	0.48706146104
			41105	35768	5337	Soy 31	0.46118477070
			41024	35610	5414	Soy 32	0.43169851794
			42753	37291	5462	Soy 34	0.41678946506
			41750	36262	5488	Soy 36	0.45645508982
			40593	35286	5307	Soy 38	0.35634222649
			39364	34325	5039	Soy 4	0.43674423330
							0.43354298720

Copy and paste this into your spreadsheet

Table | Cell | Text | Arrange

Table Styles

Headers & Footer: 1 | 1 | 0

Table Name

Table Font Size: A A

Table Outline: 0.35 pt

Outline table name

Grid Lines

Alternating Row Color

Row & Column Size

SUM 5.863392235 | AVERAGE 0.418813731 | MIN 0.336693548 | MAX 0.487061461 | COUNTA 14

ROI Analysis

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Sheet 1

Artax ROI Analysis

No.		Backgr.	Spectrum		Normalized			Known
1	34683	5219	Soy 1		0.38353967219			2.61
	35461	5201	Soy 22		0.43834538389			2.44
	36146	5502	Soy 25		0.43228966577			3.05
	35397	5271	Soy 26		0.42152113507			2.75
	34865	5311	Soy 28		0.33669354838			1.98
	36072	5530	Soy 29		0.37118407768			2.14
	36313	5616	Soy 30		0.48706140404			3.44
	35768	5337	Soy 31		0.46118470707			2.94
	35610	5414	Soy 32		0.43169957947			3.2
	37291	5462	Soy 34		0.41678435066			2.82
	36262	5488	Soy 36		0.45643983982			2.8
					0.64964964964			2.17
					0.83083083083			4.1
					0.72072072072			2.85

Now you can compare this data to known values as a quality test

SUM 45.153392235 | AVERAGE 1.612621151 | MIN 0.336693548 | MAX 4.1 | COUNTA 30

Table | Cell | Text | Arrange

Table Styles

Headers & Footer: 1 | 1 | 0

Table Name

Table Font Size: A A

Table Outline: 0.35 pt

Outline table name

Grid Lines

Alternating Row Color

Row & Column Size

ROI Analysis

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View | Zoom 125% | Function | Table | Chart | Text | Shape | Media | Comment | Share | Tips | Format | Sort & Filter

Sheet 1

2D | 3D | Interactive

	A	O	P	U	V	W
1	No.		Backgr.	Spectru	Known	
2	1	34683	5219	Soy 1	2.61	
3		35461	5201	Soy 22	2.44	
4		36146	5502	Soy 25	3.05	
5		35397	5271	Soy 26	2.75	
6		34865	5311	Soy 28	1.98	
7		36072	5530	Soy 29	2.14	
8		36313	5616	Soy 30	3.44	
9		35768	5337	Soy 31	2.94	
10		35610	5414	Soy 32	3.2	
11		37291	5462	Soy 34	2.82	
12		36262	5488	Soy 36	2.8	
13		35286	5307	Soy 38	2.17	
14		34325	5039	Soy 4		
15		35474	5387	Soy 5		
16						
17						
18						
19						
20						
21						
22						

Table | Cell | Text | Arrange

Table Styles

Headers & Footer: 1 | 1 | 0

Table Name

Table Font Size: A A

Table Outline: 0.35 pt

SUM 45.153392235 | AVERAGE 1.612621151 | MIN 0.336693548 | MAX 4.1 | COUNTA 30

A scatterplot can be made to compare the normalized photons to known values

ROI Analysis

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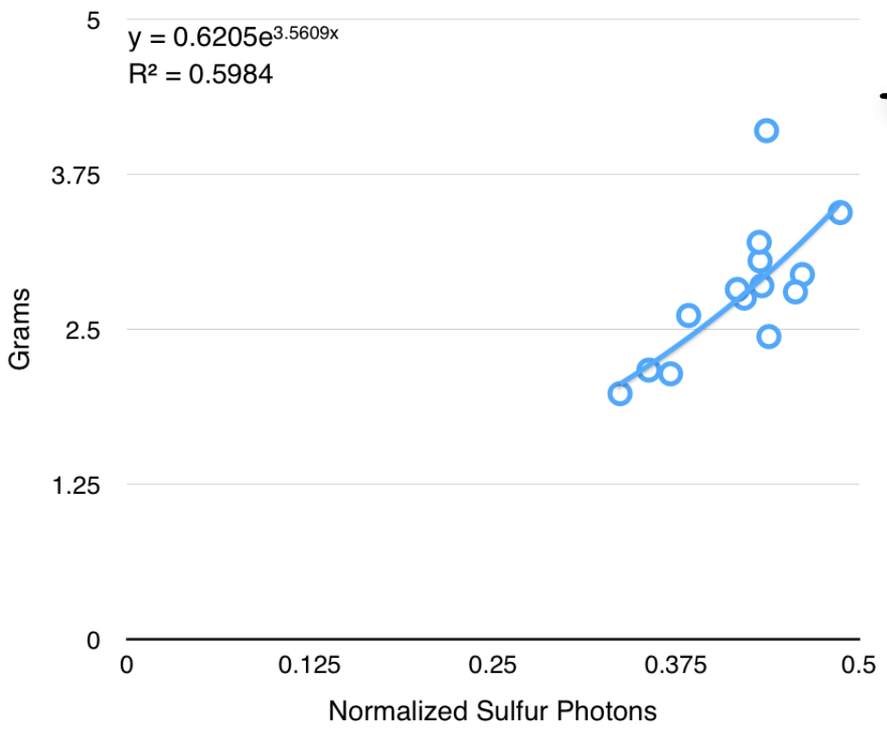
Sheet 1

No.	Start/keV	End/keV	Name	Gross	Net	Backgr.	Spectrum	No.	Start/keV	End/ke



Here, these data have a correlation with an r^2 of ~0.60, good, but perhaps we can do better

Chart | Axis | Series | Arrange

Chart Styles

Chart Options

Border

Hidden Data

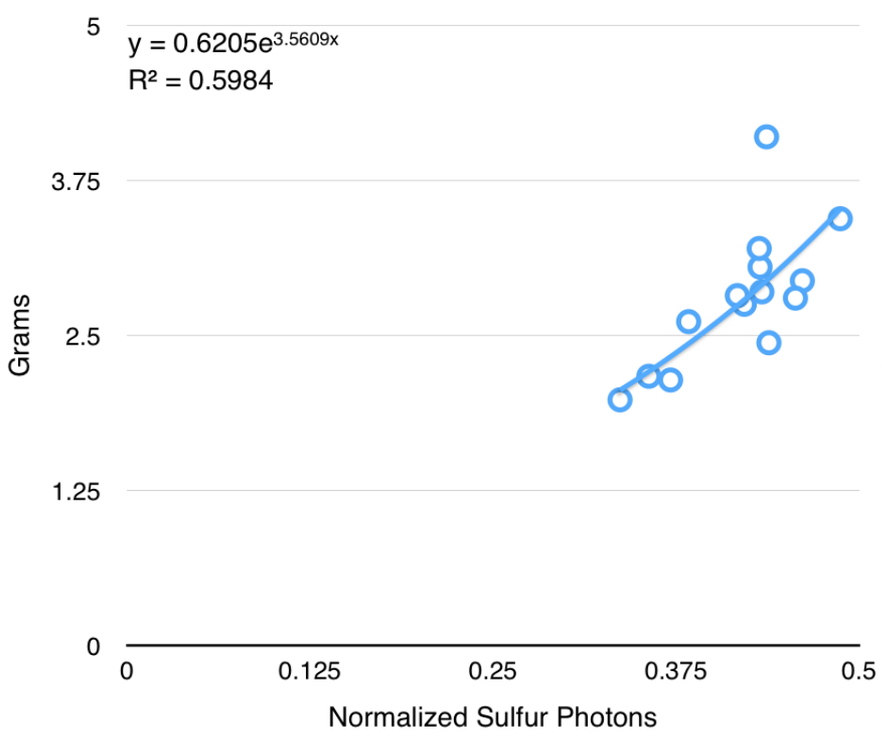
Chart Type

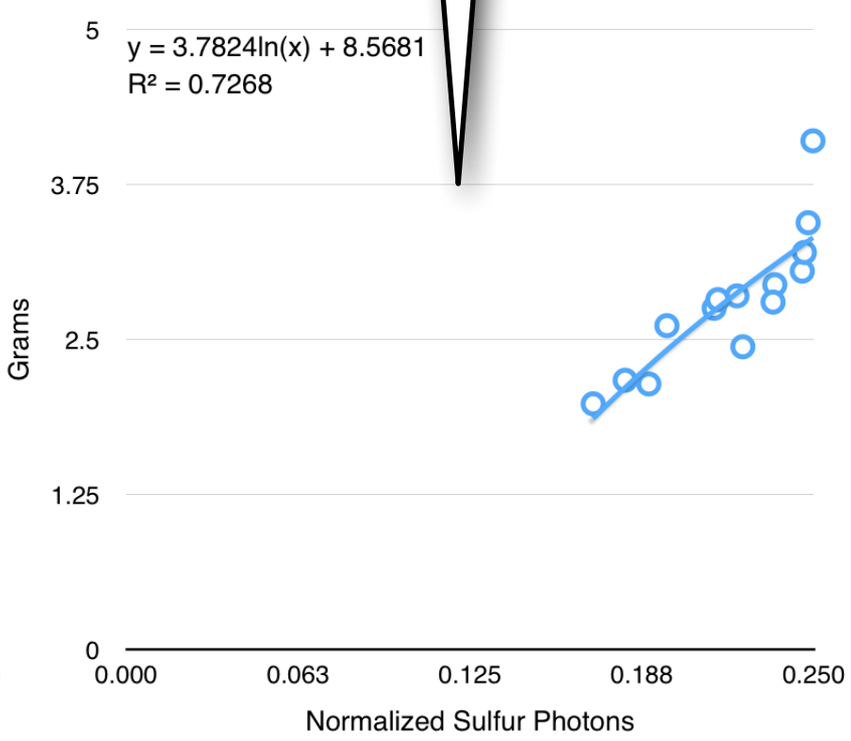
2D Scatter

ROI Analysis

For comparison, a different area of Compton was selected, using more of that peak

No.	Start/keV	End/keV	N	Start/keV	End/ke





Nothing selected.
Select an object to format.

ROI Analysis

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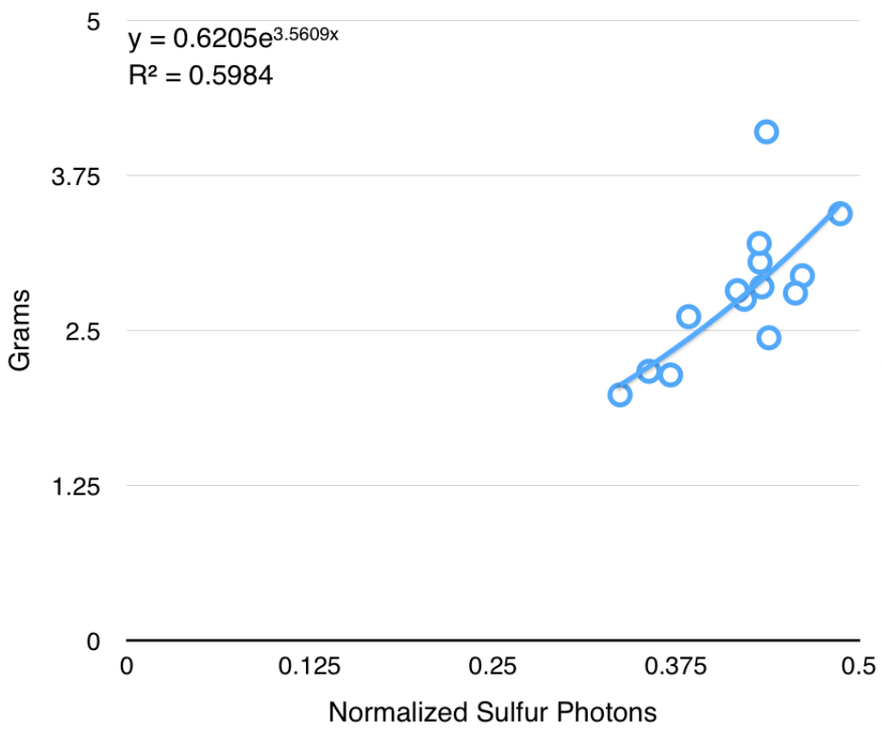
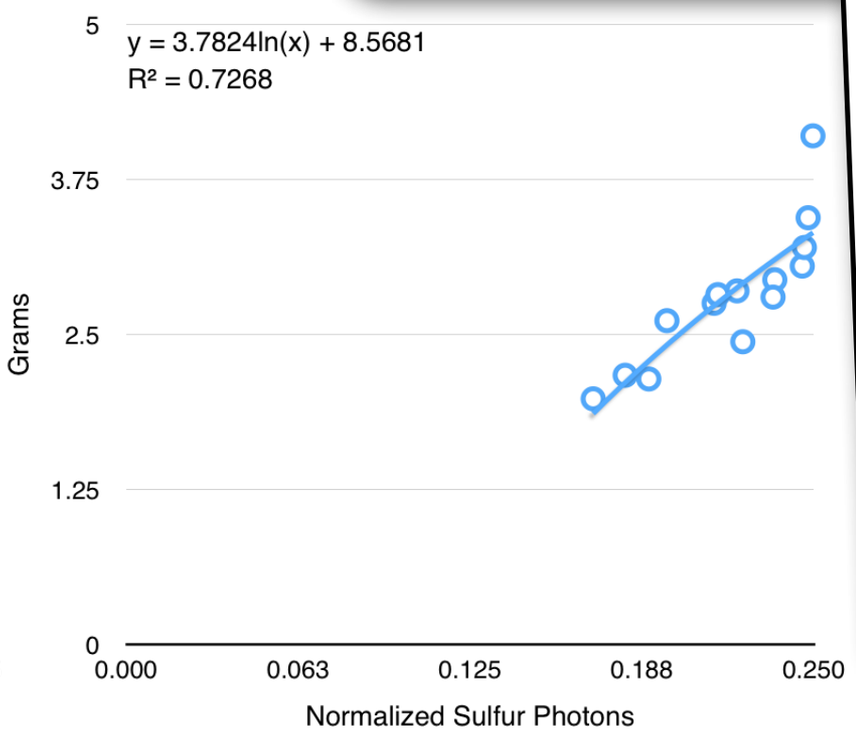
Sheet 1

No.	Start/keV	End/keV	Name	Gross	Net	Backgr.	Spectrum	No.	Start/keV	End/ke

This can be seen as the Sulfur:Compton ratio is lower



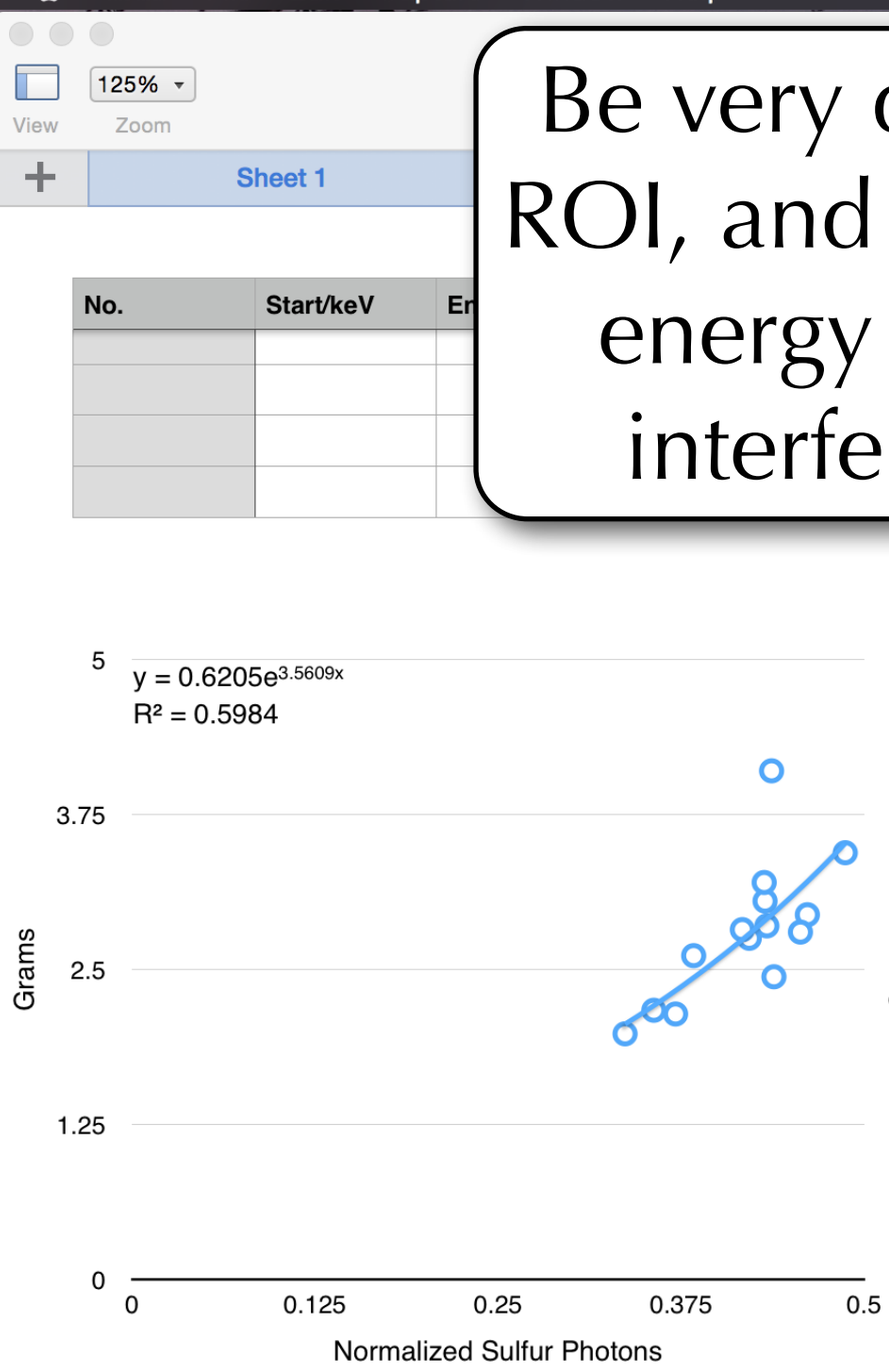


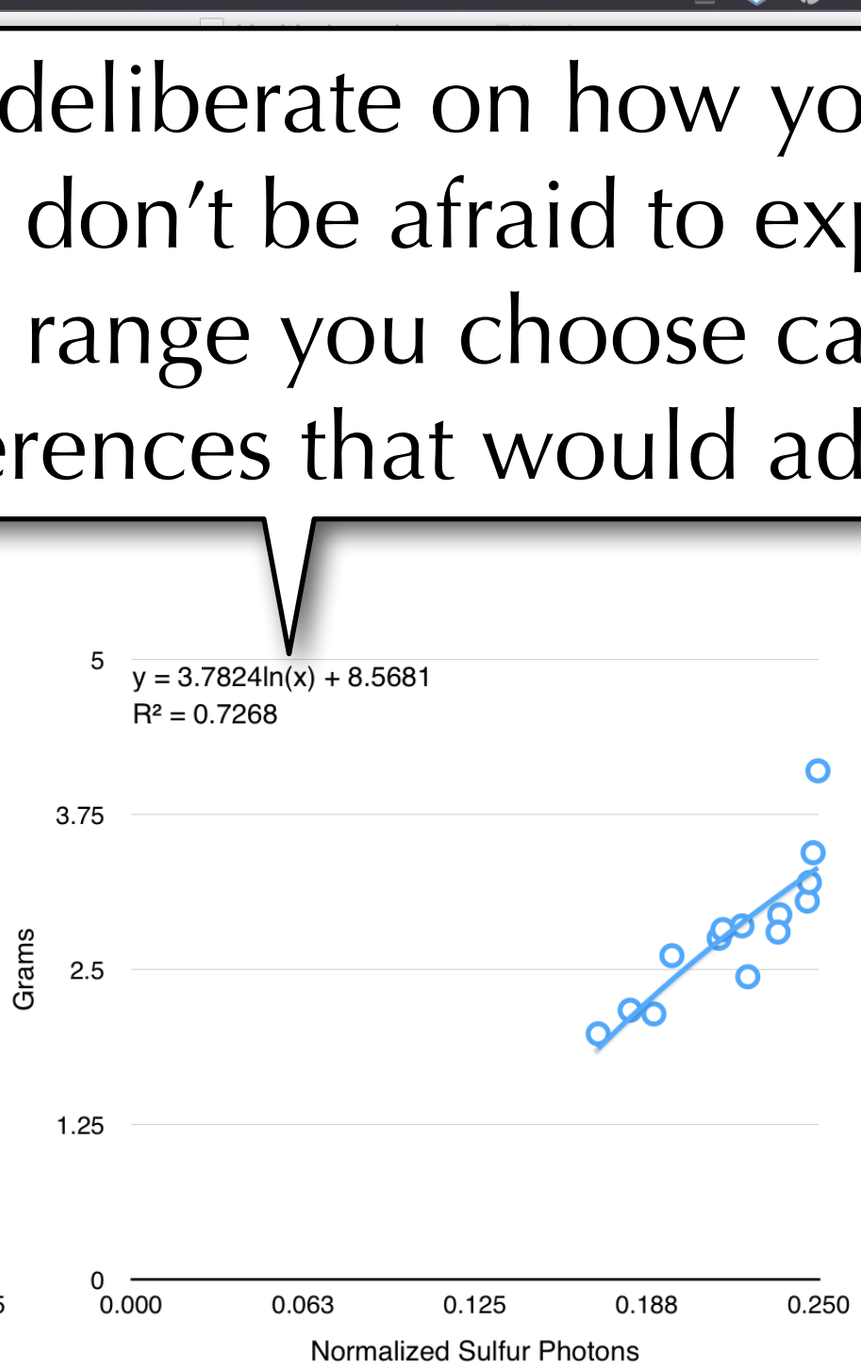
Nothing selected.
Select an object to format.

ROI Analysis

ROI Analysis

Be very deliberate on how you select your ROI, and don't be afraid to experiment - the energy range you choose can eliminate interferences that would add variation





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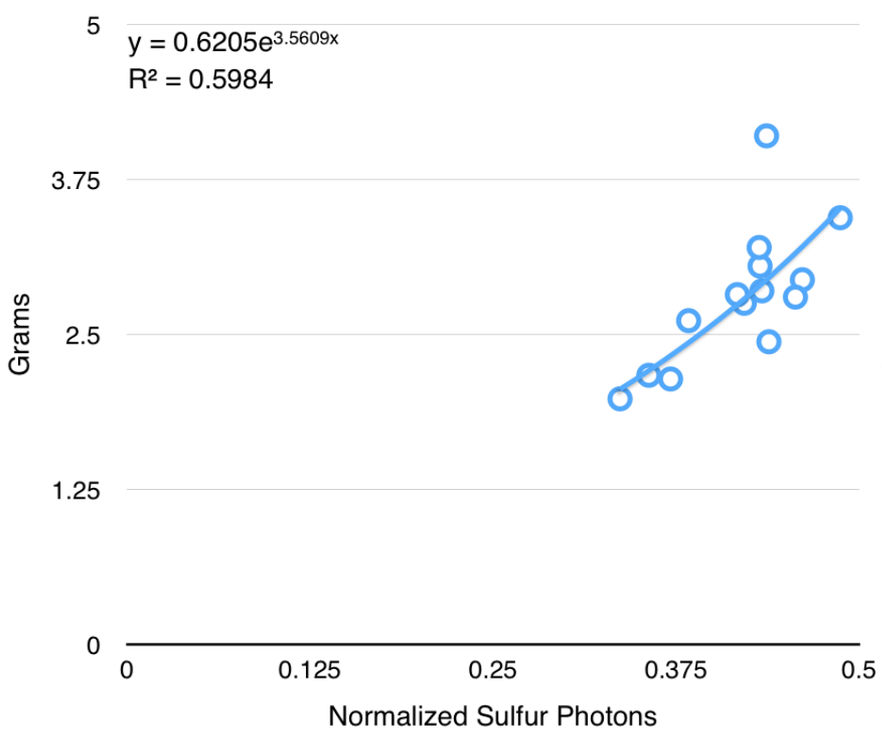
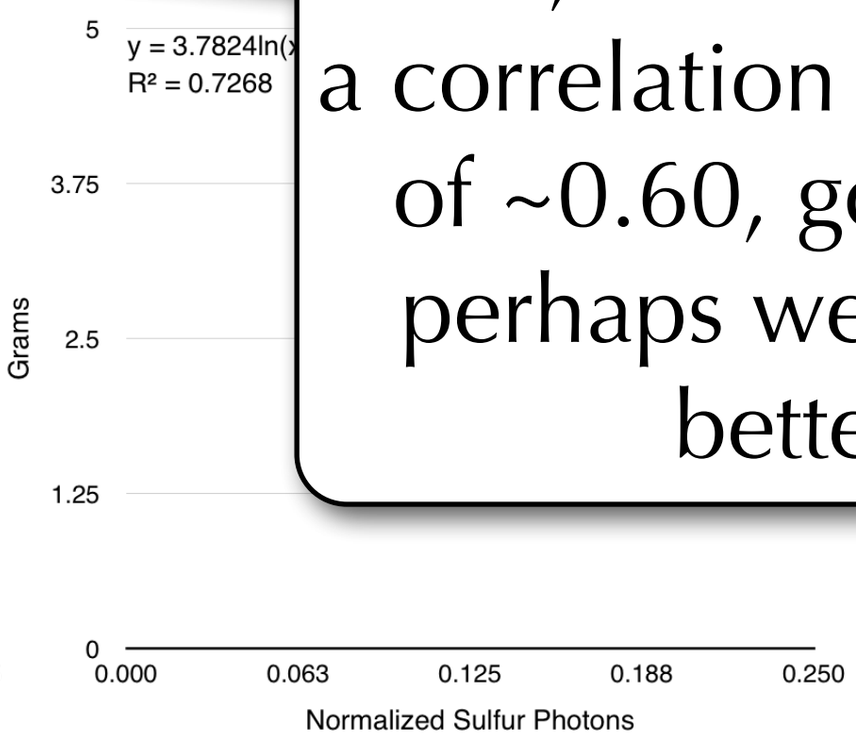
Sheet 1

No.	Start/keV	End/keV	Name	Gross	Net	Backgr.	Spectrum	No.	Start/keV	End/ke





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othing selected.
an object to format.