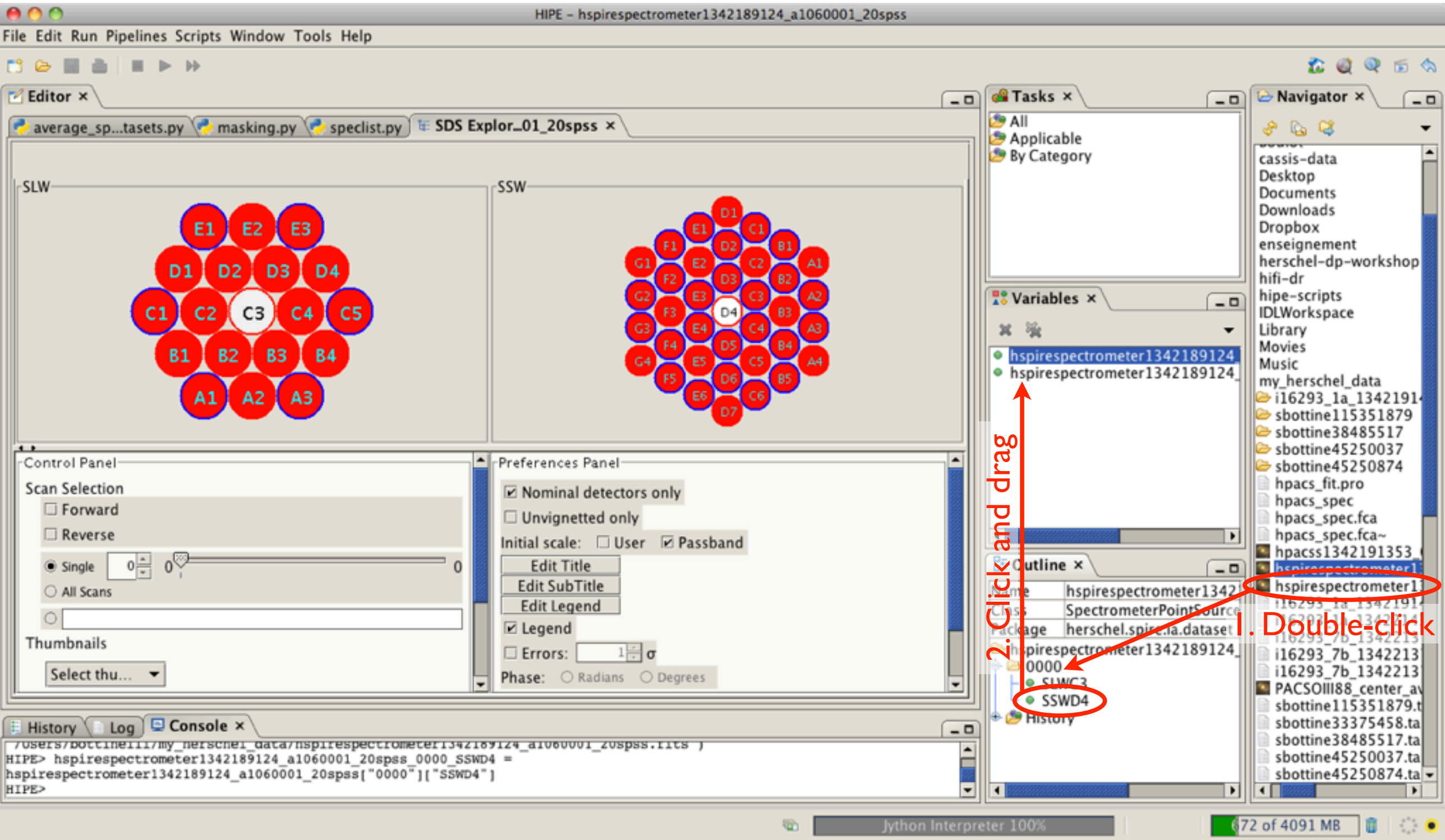
SPIRE spectrum analysis with CASSIS-2.9.6 in HIPE

Contents:

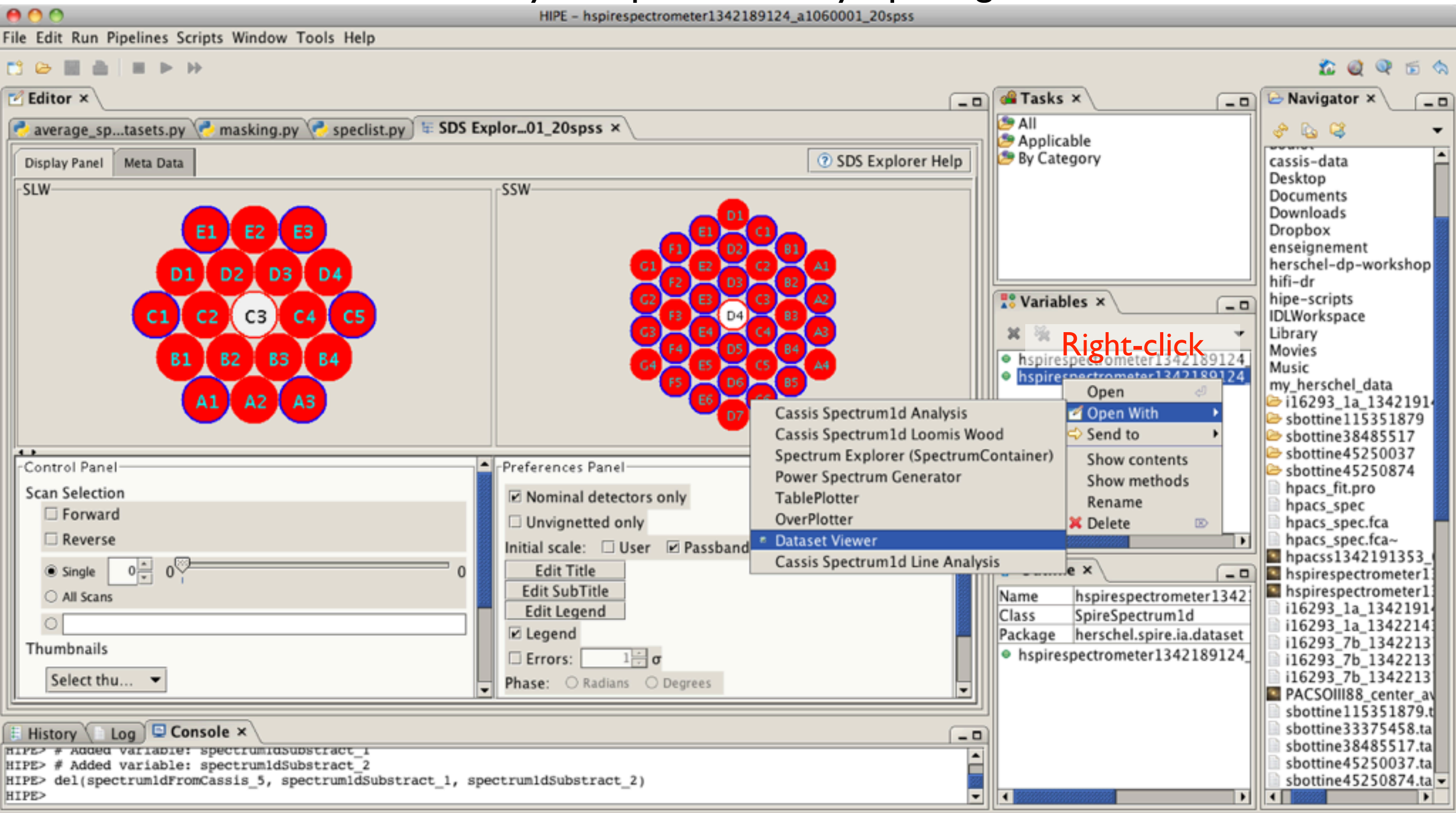
Note: Spectrum1d Line Analysis is currently not working with SPIRE data.

1. Create a spectrum Id variable



2. Check your metadata

In order for CASSIS to recognize your data's units and hence to work correctly, you need to check the metadata of your spectrum1d by opening with Dataset Viewer.



2. Check your metadata

Check the 'waveunit' and 'wavename' fields ; defaults in CASSIS for SPIRE data are:

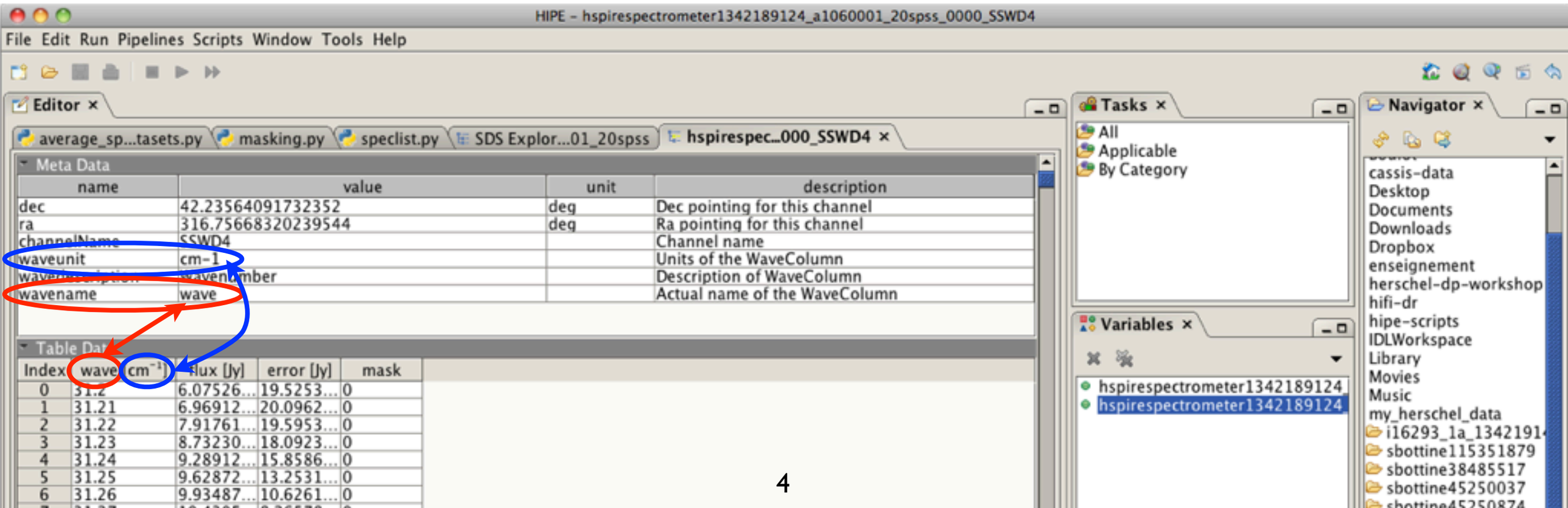
waveunit = cm-1

wavename = wave

(Note: the values 'cm-1' and 'wave' must match the column header of the table data as shown in the screenshot)

In this case, you are in principle good to go. However, for consistency/good practice, we recommend that you add an 'instrument' field in the metadata by typing the following command in the console (see also next page):

HIPE> variable_name_of_spectrum1d.meta['instrument'] = StringParameter('SPIRE')



2. Check your metadata

Close tab after you are done and reopen with Dataset Viewer to verify that the field has been added

File Edit Run Pipelines Scripts Window Tools Help

Editor ×

average_sp...tasets.py | masking.py | speclist.py | SDS Explor...01_20spss | hspirespec...000_SSWD4 ×

Meta Data

name	value	unit	description
dec	42.23564091732352	deg	Dec pointing for this channel
ra	316.75668320239544	deg	Ra pointing for this channel
channelName	SSWD4		Channel name
waveunit	cm-1		Units of the WaveColumn
wavedescription	Wavenumber		Description of WaveColumn
wavename	wave		Actual name of the WaveColumn

Table Data

Index	wave [cm^{-1}]	flux [Jy]	error [Jy]	mask
0	31.2	6.07526...	19.5253...	0
1	31.21	6.96912...	20.0962...	0
2	31.22	7.91761...	19.5953...	0
3	31.23	8.73230...	18.0923...	0
4	31.24	9.28912...	15.8586...	0
5	31.25	9.62872...	13.2531...	0
6	31.26	9.93487...	10.6261...	0
7	31.27	10.4305...	8.26578...	0
8	31.28	11.2557...	6.37508...	0
9	31.29	12.3786...	5.05779...	0
10	31.3	13.5783...	4.30197...	0
11	31.31	14.5248...	3.96628...	0
12	31.32	14.9414...	3.79814...	0
13	31.33	14.7561...	3.51806...	0
14	31.34	14.1307...	2.94698...	0
15	31.35	13.3453...	2.08434...	0
16	31.36	12.6437...	1.08004...	0
17	31.37	12.1476...	0.14187...	0
18	31.38	11.8620...	0.54830...	0
19	31.39	11.7306...	0.87880...	0
20	31.4	11.6986...	0.82366...	0

Tasks ×
All
Applicable
By Category

Variables ×
hspirespectrometer1342189124
hspirespectrometer1342189124

Outline ×

Name	hspirespectrometer1342
Class	SpireSpectrum1d
Package	herschel.spire.ia.dataset

hspirespectrometer1342189124_

Navigator ×
cassis-data
Desktop
Documents
Downloads
Dropbox
enseignement
herschel-dp-workshop
hifi-dr
hipe-scripts
IDLWorkspace
Library
Movies
Music
my_herschel_data
i16293_1a_1342191
sbottine115351879
sbottine38485517
sbottine45250037
sbottine45250874
hpacs_fit.pro
hpacs_spec
hpacs_spec.fca
hpacs_spec.fca~
hpacss1342191353_
hspirespectrometer1
hspirespectrometer1
i16293_1a_1342191
i16293_1a_1342214
i16293_7b_1342213
i16293_7b_1342213
i16293_7b_1342213
PACSOIII88_center_a
sbottine115351879.t
sbottine33375458.ta
sbottine38485517.ta
sbottine45250037.ta
sbottine45250874.ta

Click and drag the variable's name in the console to avoid typing it

History | Log | Console ×

```
HIPE>
HIPE>
HIPE> hspirespectrometer1342189124_a1060001_20spss_0000_SSWD4.meta['instrument']=StringParameter('SPIRE')
HIPE>
```

Jython Interpreter 100%

754 of 4091 MB

2. Check your metadata

HIPE - hspirespectrometer1342189124_a1060001_20spss_0000_SSWD4

File Edit Run Pipelines Scripts Window Tools Help

Editor ×

average_sp...tasets.py | masking.py | speclist.py | SDS Explor...01_20spss | hspirespec...000_SSWD4 ×

Meta Data

name	value	unit	description
dec	42.23564091732352	deg	Dec pointing for this channel
ra	316.75668320239544	deg	Ra pointing for this channel
channelName	SSWD4		Channel name
waveunit	cm-1		Units of the WaveColumn
wavedescription	Wavenumber		Description of WaveColumn
wavename	wave		Actual name of the WaveColumn
instrument	SPIRE		

Table Data

Index	wave [cm^{-1}]	flux [Jy]	error [Jy]	mask
0	31.2	6.07526...	19.5253...	0
1	31.21	6.96912...	20.0962...	0
2	31.22	7.91761...	19.5953...	0
3	31.23	8.73230...	18.0923...	0
4	31.24	9.28912...	15.8586...	0
5	31.25	9.62872...	13.2531...	0
6	31.26	9.93487...	10.6261...	0
7	31.27	10.4305...	8.26578...	0
8	31.28	11.2557...	6.37508...	0
9	31.29	12.3786...	5.05779...	0
10	31.3	13.5783...	4.30197...	0
11	31.31	14.5248...	3.96628...	0
12	31.32	14.9414...	3.79814...	0
13	31.33	14.7561...	3.51806...	0
14	31.34	14.1307...	2.94698...	0
15	31.35	13.3453...	2.08434...	0
16	31.36	12.6437...	1.08004...	0
17	31.37	12.1476...	0.14187...	0
18	31.38	11.8620...	0.54830...	0
19	31.39	11.7306...	0.87880...	0
20	31.4	11.6986...	0.82366...	0
21	31.41	11.7519...	0.44622...	0

History | Log | Console ×

```
HIPE>
HIPE>
HIPE> hspirespectrometer1342189124_a1060001_20spss_0000_SSWD4.meta['instrument']=StringParameter('SPIRE')
HIPE>
```

Tasks ×
- All
- Applicable
- By Category

Variables ×
- hspirespectrometer1342189124_
- hspirespectrometer1342189124_

Outline ×

Name	hspirespectrometer1342
Class	SpireSpectrum1d
Package	herschel.spire.ia.dataset

- hspirespectrometer1342189124_

Navigator ×
- cassis-data
- Desktop
- Documents
- Downloads
- Dropbox
- enseignement
- herschel-dp-workshop
- hifi-dr
- hipe-scripts
- IDLWorkspace
- Library
- Movies
- Music
- my_herschel_data
- i16293_1a_1342191
- sbottine115351879
- sbottine38485517
- sbottine45250037
- sbottine45250874
- hpacs_fit.pro
- hpacs_spec
- hpacs_spec.fca
- hpacs_spec.fca~
- hpacss1342191353_
- hspirespectrometer1
- hspirespectrometer1
- i16293_1a_1342191
- i16293_1a_1342214
- i16293_7b_1342213
- i16293_7b_1342213
- i16293_7b_1342213
- PACSOlll88_center_a
- sbottine115351879.t
- sbottine33375458.ta
- sbottine38485517.ta
- sbottine45250037.ta
- sbottine45250874.ta

Jython Interpreter 100% | 770 of 4091 MB

2. Check your metadata

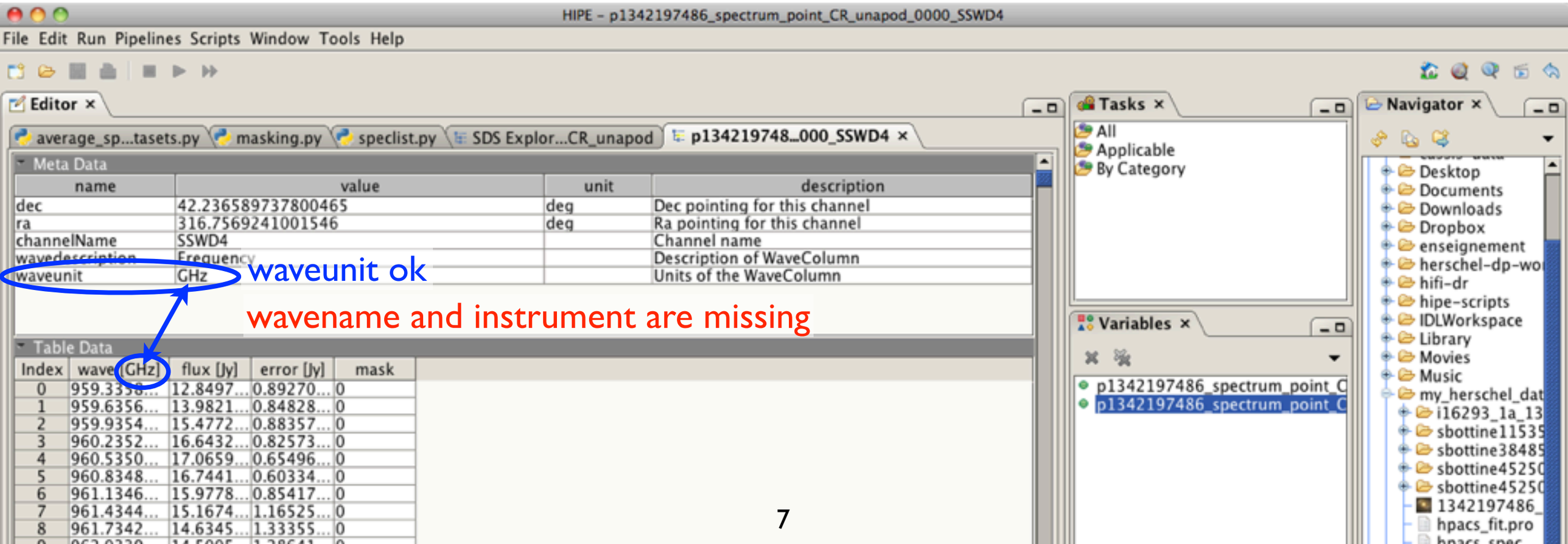
- If waveunit ≠ cm-1, or wavename ≠ wave (or if they are missing - cf. next point), then you *must* add the 'instrument' field:

  HIPE> variable_name_of_spectrum1d.meta['instrument'] = StringParameter('SPIRE')
- If 'waveunit' or 'wavename' are missing, you must add the corresponding field in the metadata by typing the following command(s) (with the appropriate corresponding value) in the console:

  HIPE> variable_name_of_spectrum1d.meta['waveunit'] = StringParameter('unit')

  HIPE> variable_name_of_spectrum1d.meta['wavename'] = StringParameter('name')

  where unit and name are the values from the column header of the table data.



2. Check your metadata

HIPE - p1342197486_spectrum_point_CR_unapod_0000_SSWD4

File Edit Run Pipelines Scripts Window Tools Help

Editor ×

average_sp...tasets.py | masking.py | speclist.py | SDS Explor...CR_unapod | p134219748..._000_SSWD4 ×

Meta Data

name	value	unit	description
dec	42.236589737800465	deg	Dec pointing for this channel
ra	316.7569241001546	deg	Ra pointing for this channel
channelName	SSWD4		Channel name
wavedescription	Frequency		Description of WaveColumn
waveunit	GHz		Units of the WaveColumn

Table Data

Index	wave [GHz]	flux [Jy]	error [Jy]	mask
0	959.3358...	12.8497...	0.89270...	0
1	959.6356...	13.9821...	0.84828...	0
2	959.9354...	15.4772...	0.88357...	0
3	960.2352...	16.6432...	0.82573...	0
4	960.5350...	17.0659...	0.65496...	0
5	960.8348...	16.7441...	0.60334...	0
6	961.1346...	15.9778...	0.85417...	0
7	961.4344...	15.1674...	1.16525...	0
8	961.7342...	14.6345...	1.33355...	0
9	962.0339...	14.5005...	1.28641...	0
10	962.3337...	14.6522...	1.08501...	0
11	962.6335...	14.8233...	0.94091...	0
12	962.9333...	14.7838...	0.98040...	0
13	963.2331...	14.5206...	1.01148...	0
14	963.5329...	14.2434...	0.89947...	0
15	963.8327...	14.2035...	0.74326...	0
16	964.1325...	14.4921...	0.71874...	0
17	964.4323...	14.9780...	0.77269...	0
18	964.7321...	15.3947...	0.74497...	0
19	965.0319...	15.4941...	0.67284...	0
20	965.3317...	15.1837...	0.79365...	0
21	965.6315...	14.6003...	1.07349...	0

Add the missing field

History | Log | Console ×

```
HIPE> p1342197486_spectrum_point_CR_unapod_0000_SSWD4.meta['wavename']=StringParameter('wave')
HIPE> p1342197486_spectrum_point_CR_unapod_0000_SSWD4.meta['instrument']=StringParameter('SPIRE')
HIPE>
```

Tasks ×

All
Applicable
By Category

Variables ×

p1342197486_spectrum_point_C
p1342197486_spectrum_point_C

Outline ×

Name	p1342197486_spectrum
Class	SpireSpectrum1d
Package	herschel.spire.ia.dataset

p1342197486_spectrum_point_C

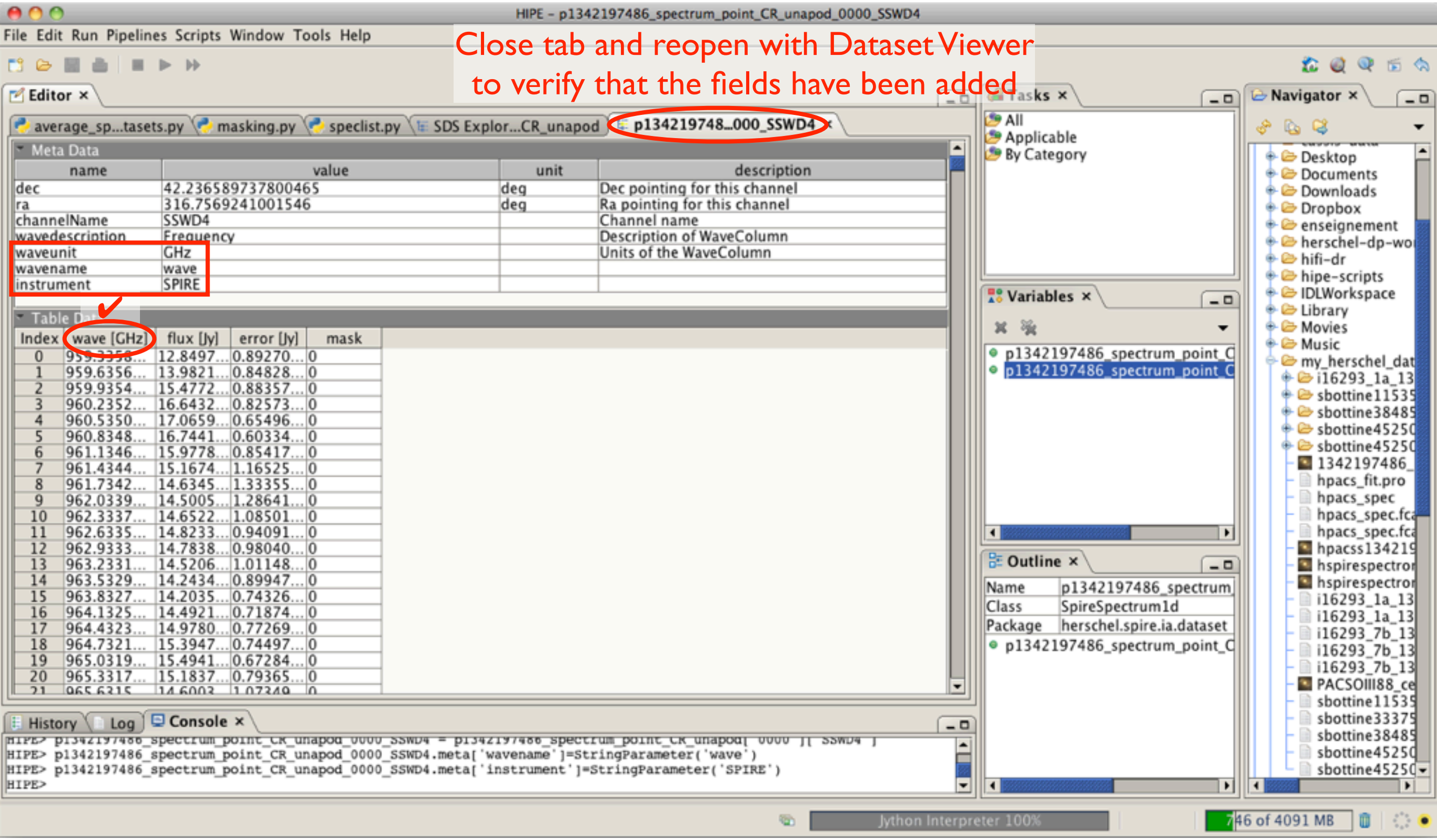
Navigator ×

Desktop
Documents
Downloads
Dropbox
enseignement
herschel-dp-wo
hifi-dr
hipe-scripts
IDLWorkspace
Library
Movies
Music
my_herschel_dat
i16293_1a_13
sbottine11535
sbottine38485
sbottine45250
sbottine45250
1342197486_
hpacs_fit.pro
hpacs_spec
hpacs_spec.fc
hpacs_spec.fc
hpacss134219
hspirespectror
hspirespectror
i16293_1a_13
i16293_1a_13
i16293_7b_13
i16293_7b_13
i16293_7b_13
PACSOIII88_ce
sbottine11535
sbottine33375
sbottine38485
sbottine45250
sbottine45250

Jython Interpreter 100%

750 of 4091 MB

2. Check your metadata



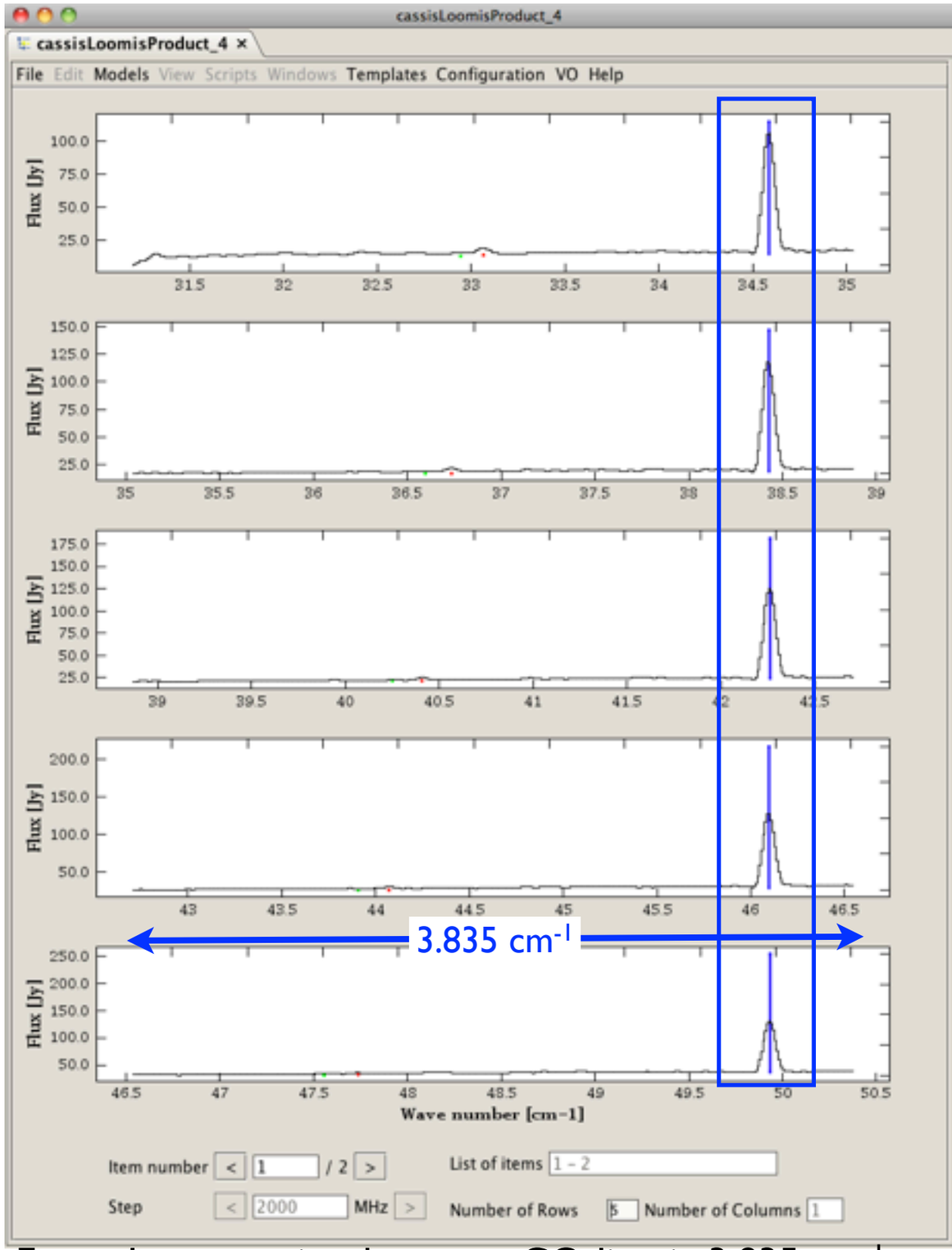
3. Spectrum Id Loomis-Wood

A Loomis-Wood diagram is a two-dimensional peak diagram in which:

- the occurrence of a transition is plotted versus frequency/wavenumber/wavelength, in segments of a given width
- the height of a line is proportional to the column density, weighted by the partition function at the chosen excitation temperature

Interactive Loomis-Wood assignment programs help assign spectra, and estimate column densities.

Note that, **at the moment**, for the calculation of the line intensity (and hence the estimate of the column density) to be correct, **the data must be in Jy**. Any other unit will only allow you to determine relative column densities (assuming you look at more than one species).



Exemple: separation between CO line is 3.835 cm^{-1} ; setting the segment width to this value yields a Loomis-Wood diagram with aligned CO transitions.

3. SpectrumId Loomis-Wood

HIPE - p1342197486_spectrum_point_CR_unapod_0000_SSWD4

File Edit Run Pipelines Scripts Window Tools Help

Editor ×

average_sp...tasets.py | masking.py | speclist.py | SDS Explor...CR_unapod | p134219748...000_SSWD4 ×

Meta Data

name	value	unit	description
dec	42.236589737800465	deg	Dec pointing for this channel
ra	316.7569241001546	deg	Ra pointing for this channel
channelName	SSWD4		Channel name
wavedescription	Frequency		Description of WaveColumn
waveunit	GHz		Units of the WaveColumn
wavename	wave		
instrument	SPIRE		

Table Data

Index	wave [GHz]	flux [Jy]	error [Jy]	mask
0	959.3358...	12.8497...	0.89270...	0
1	959.6356...	13.9821...	0.84828...	0
2	959.9354...	15.4772...	0.88357...	0
3	960.2352...	16.6432...	0.82573...	0
4	960.5350...	17.0659...	0.65496...	0
5	960.8348...	16.7441...	0.60334...	0
6	961.1346...	15.9778...	0.85417...	0
7	961.4344...	15.1674...	1.16525...	0
8	961.7342...	14.6345...	1.33355...	0
9	962.0339...	14.5005...	1.28641...	0
10	962.3337...	14.6522...	1.08501...	0
11	962.6335...	14.8233...	0.94091...	0
12	962.9333...	14.7838...	0.98040...	0
13	963.2331...	14.5206...	1.01148...	0
14	963.5329...	14.2434...	0.89947...	0
15	963.8327...	14.2035...	0.74326...	0
16	964.1325...	14.4921...	0.71874...	0
17	964.4323...	14.9780...	0.77269...	0
18	964.7321...	15.3947...	0.74497...	0
19	965.0319...	15.4941...	0.67284...	0
20	965.3317...	15.1837...	0.79365...	0
21	965.6315...	14.6003...	1.07349...	0

Tasks ×
All
Applicable
By Category

Variables ×

Right-click

p1342197486_spectrum_point_C
p134219

Open
Open With
Send to
Show contents
Show methods
Rename
Delete

Cassis Spectrum1d Analysis
Cassis Spectrum1d Loomis Wood
Spectrum Explorer (SpectrumContainer)
Power Spectrum Generator
TablePlotter
OverPlotter
Dataset Viewer
Cassis Spectrum1d Line Analysis

Outline ×

Name	p1342197486_spectrum_
Class	SpireSpectrum1d
Package	herschel.spire.ia.dataset

p1342197486_spectrum_point_C

Navigator ×

Desktop
Documents
Downloads
Dropbox
enseignement
herschel-dp-wo
hifi-dr
hipe-scripts
IDLWorkspace
Library
Movies
Music
my_herschel_dat
i16293_1a_13
sbottine11535
sbottine38485
sbottine45250
sbottine45250
1342197486_
hpacs_fit.pro
hpacs_spec
hpacs_spec.fc
hpacs_spec.fc
hpacss134219
hspirespectror
hspirespectror
i16293_1a_13
i16293_1a_13
i16293_7b_13
i16293_7b_13
i16293_7b_13
PACSOlll88_ce
sbottine11535
sbottine33375
sbottine38485
sbottine45250
sbottine45250

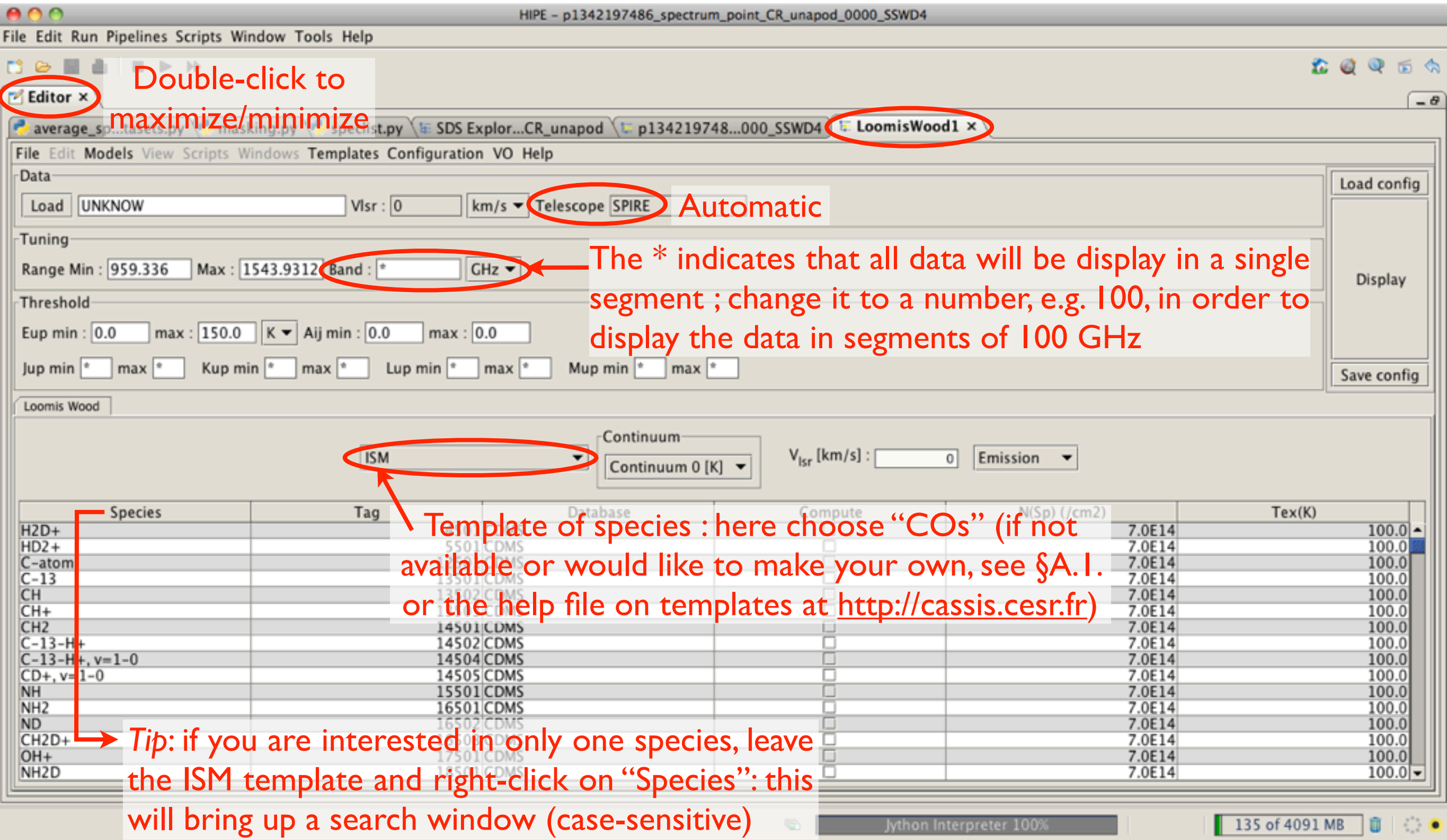
History | Log | Console ×

```
HIPE> p1342197486_spectrum_point_CR_unapod_0000_SSWD4 = p1342197486_spectrum_point_CR_unapod[ '0000' ][ 'SSWD4' ]
HIPE> p1342197486_spectrum_point_CR_unapod_0000_SSWD4.meta['wavename']=StringParameter('wave')
HIPE> p1342197486_spectrum_point_CR_unapod_0000_SSWD4.meta['instrument']=StringParameter('SPIRE')
HIPE>
```

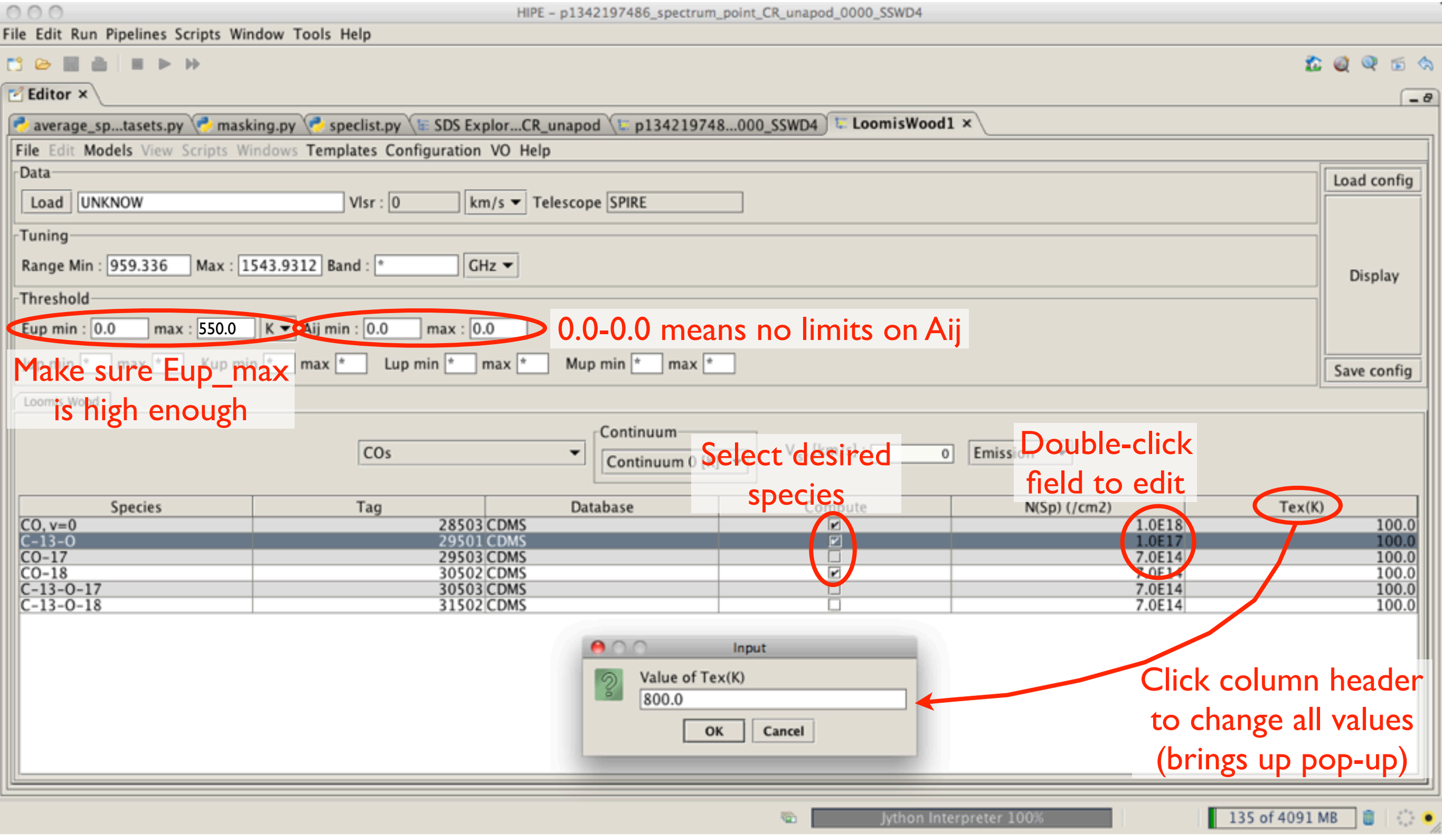
Jython Interpreter 100%

748 of 4091 MB

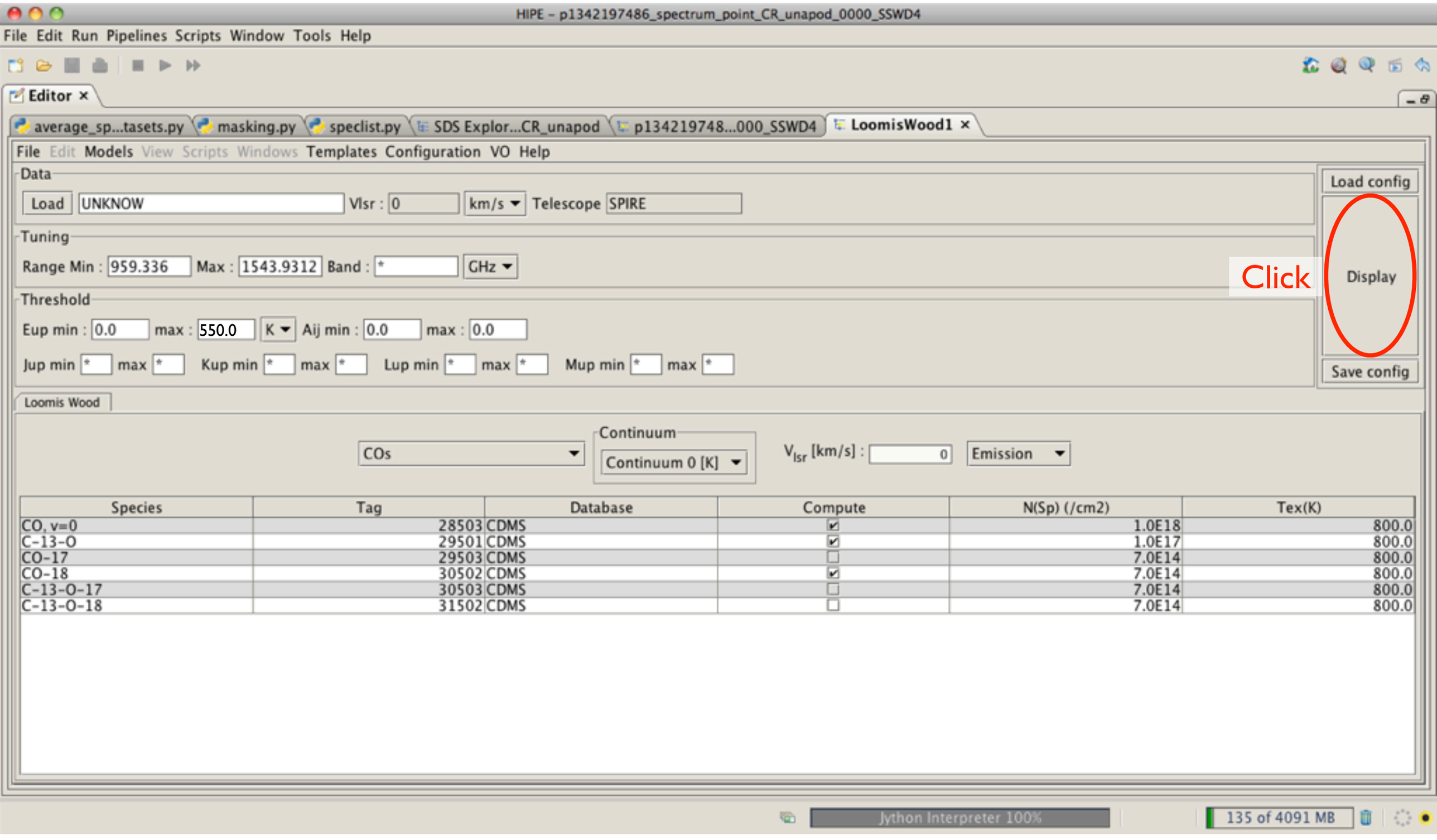
3. Spectrum Id Loomis-Wood



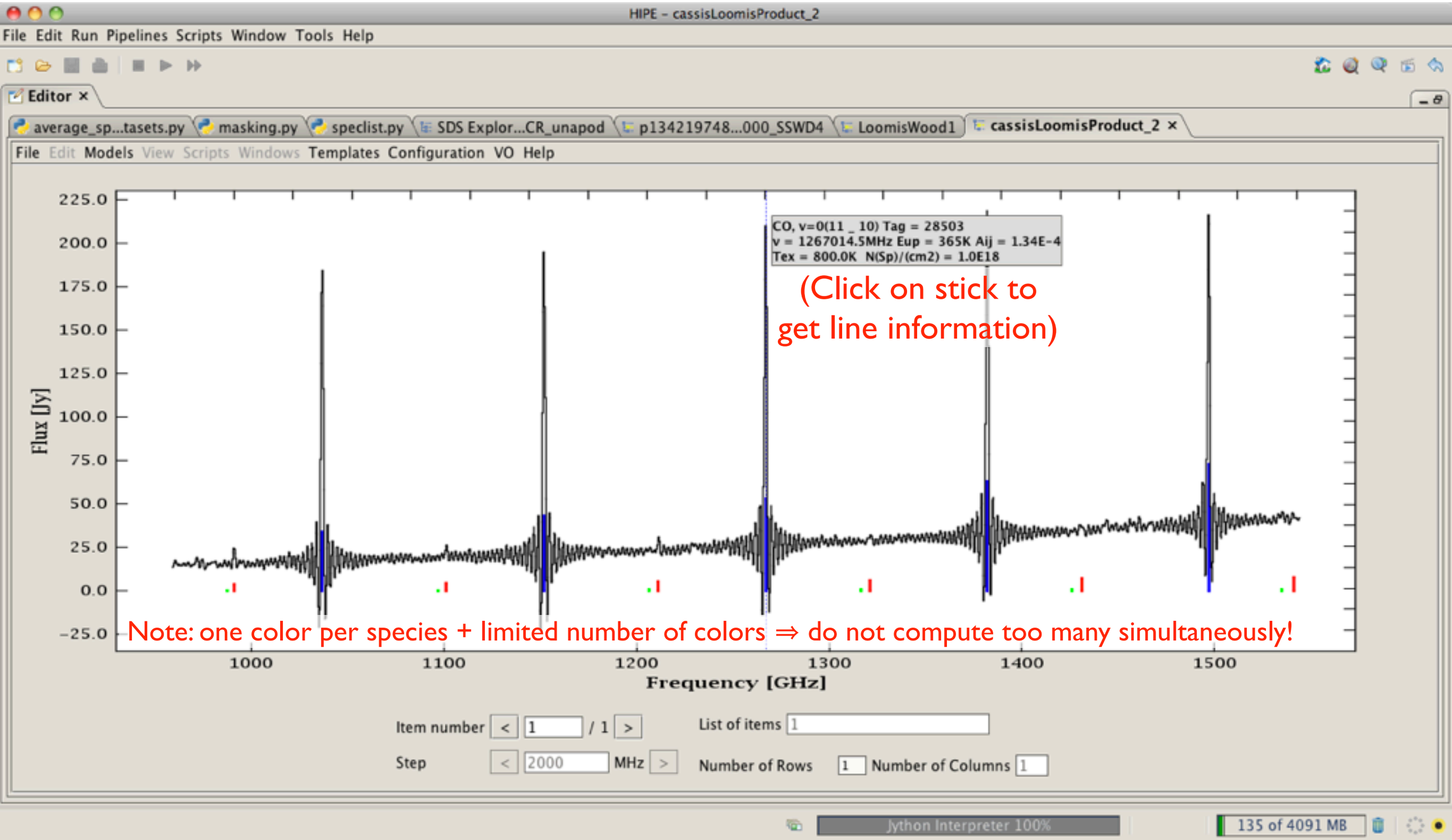
3. SpectrumId Loomis-Wood



3. SpectrumId Loomis-Wood

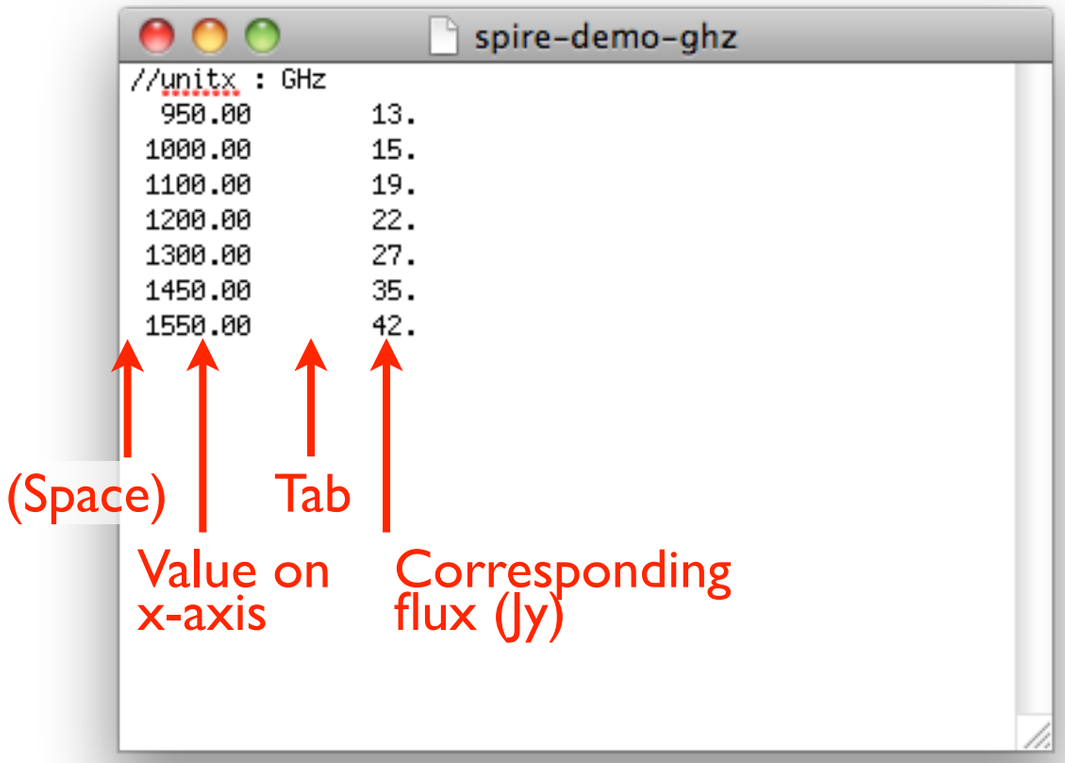


3. SpectrumId Loomis-Wood



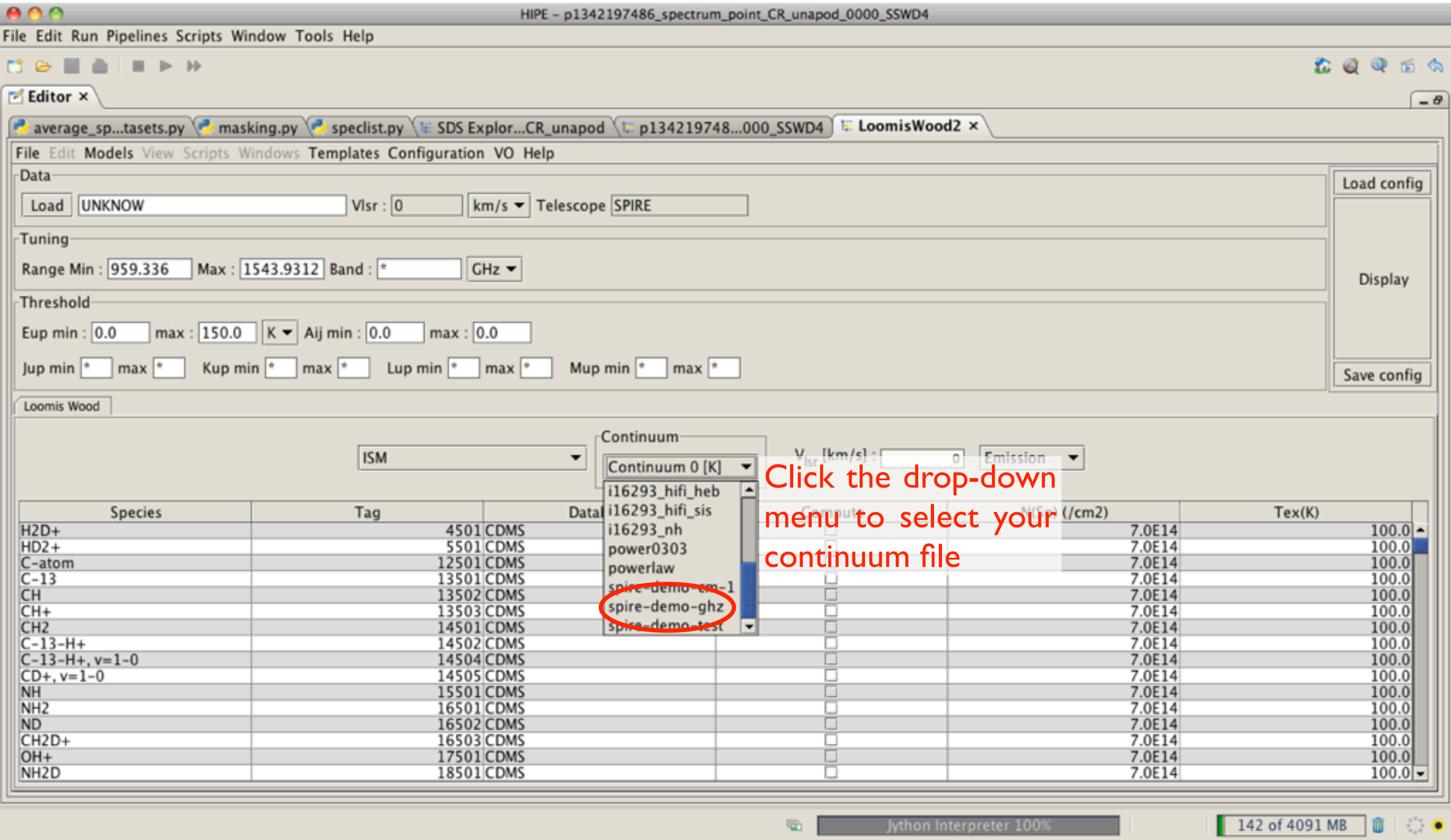
3. Spectrum1d Loomis-Wood : adding continuum

1. In YOUR_CASSIS_DIR/user/continuum/, create an ascii file with the name of your choice, no extension
2. Fill it in with the continuum information, following the format below:



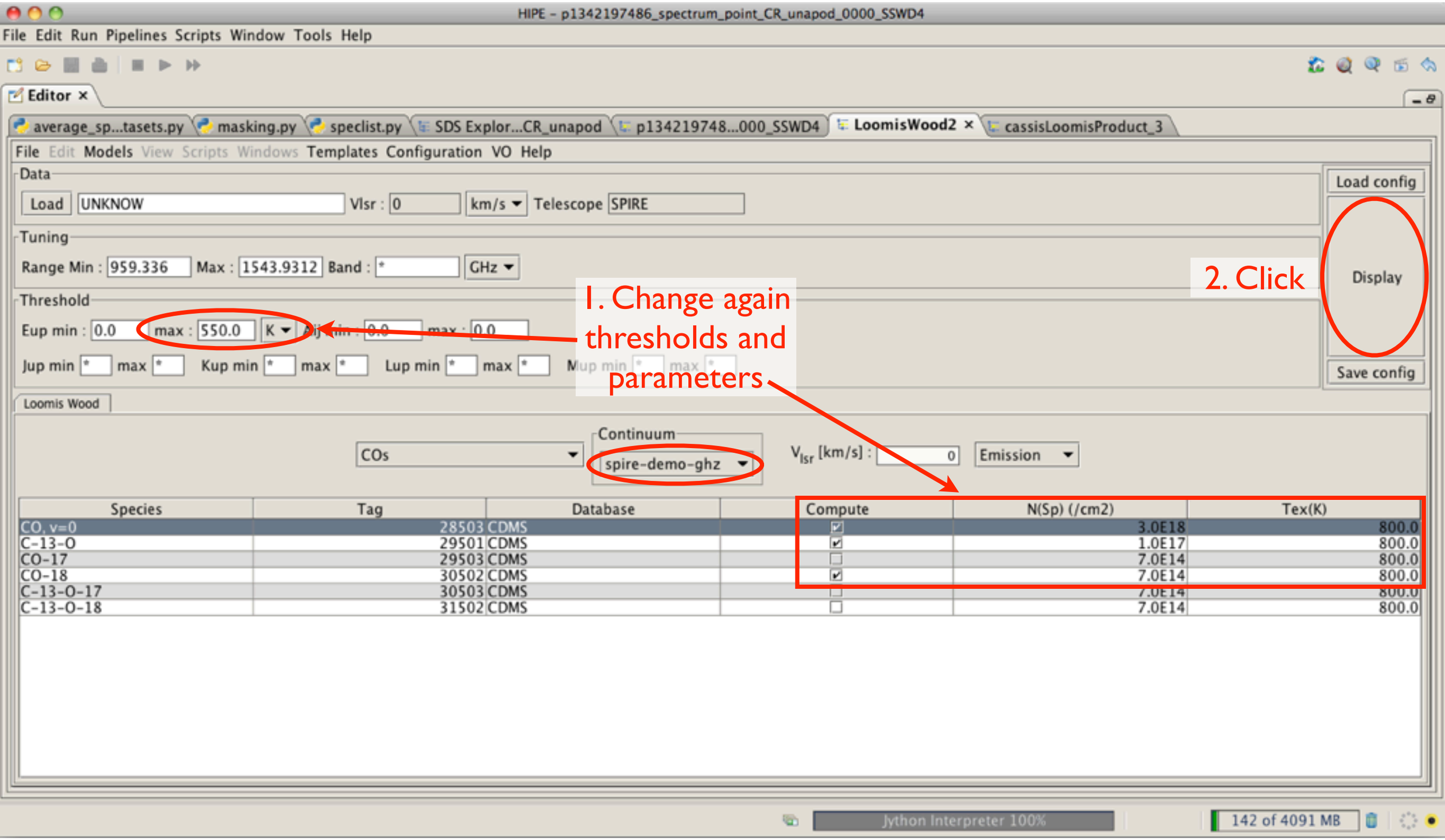
3. Close and re-open your spectrum1d with "Cassis Spectrum1d Loomis Wood"

3. Spectrum Id Loomis-Wood : adding continuum

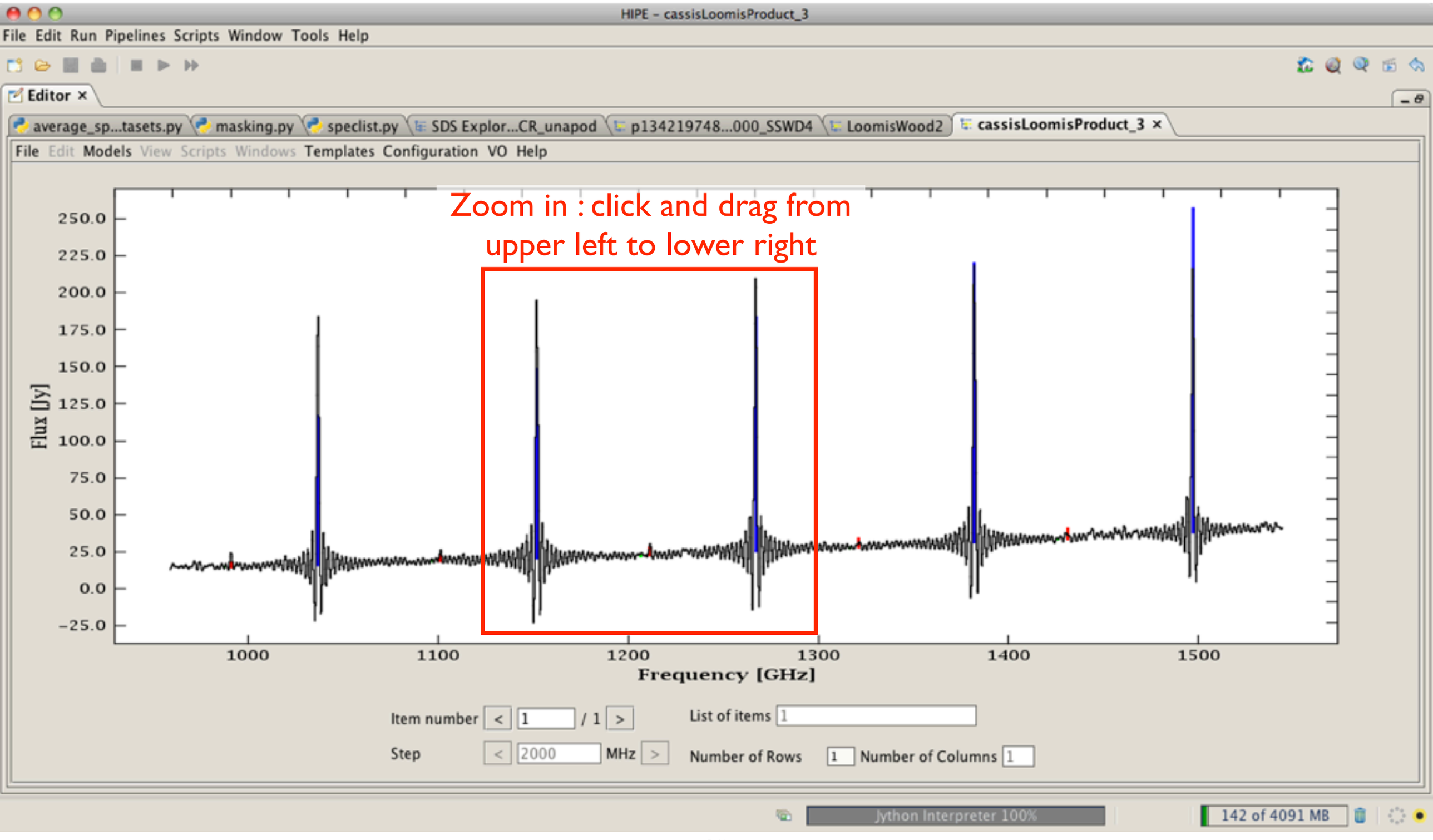


Click the drop-down menu to select your continuum file

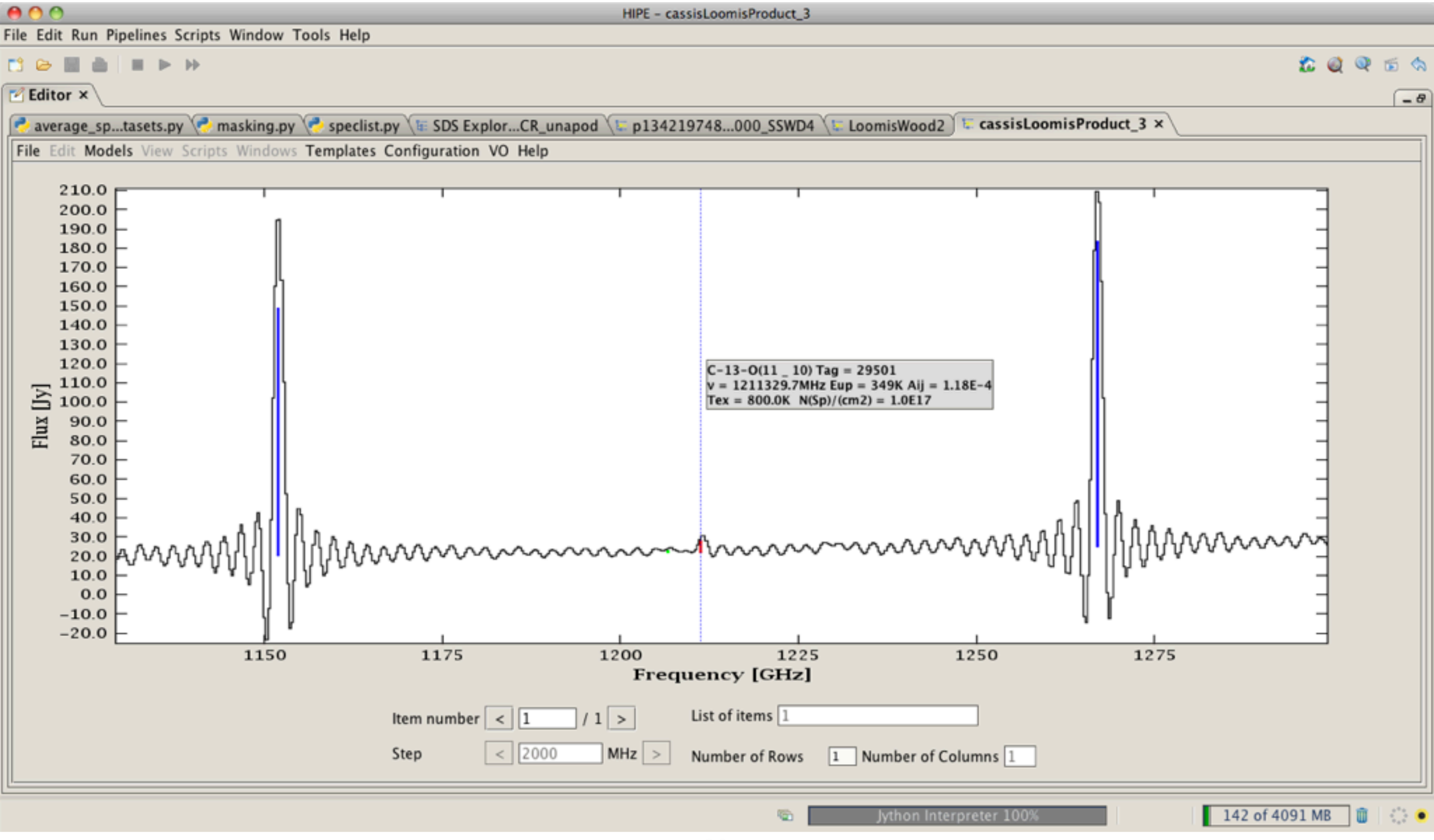
3. SpectrumId Loomis-Wood : adding continuum



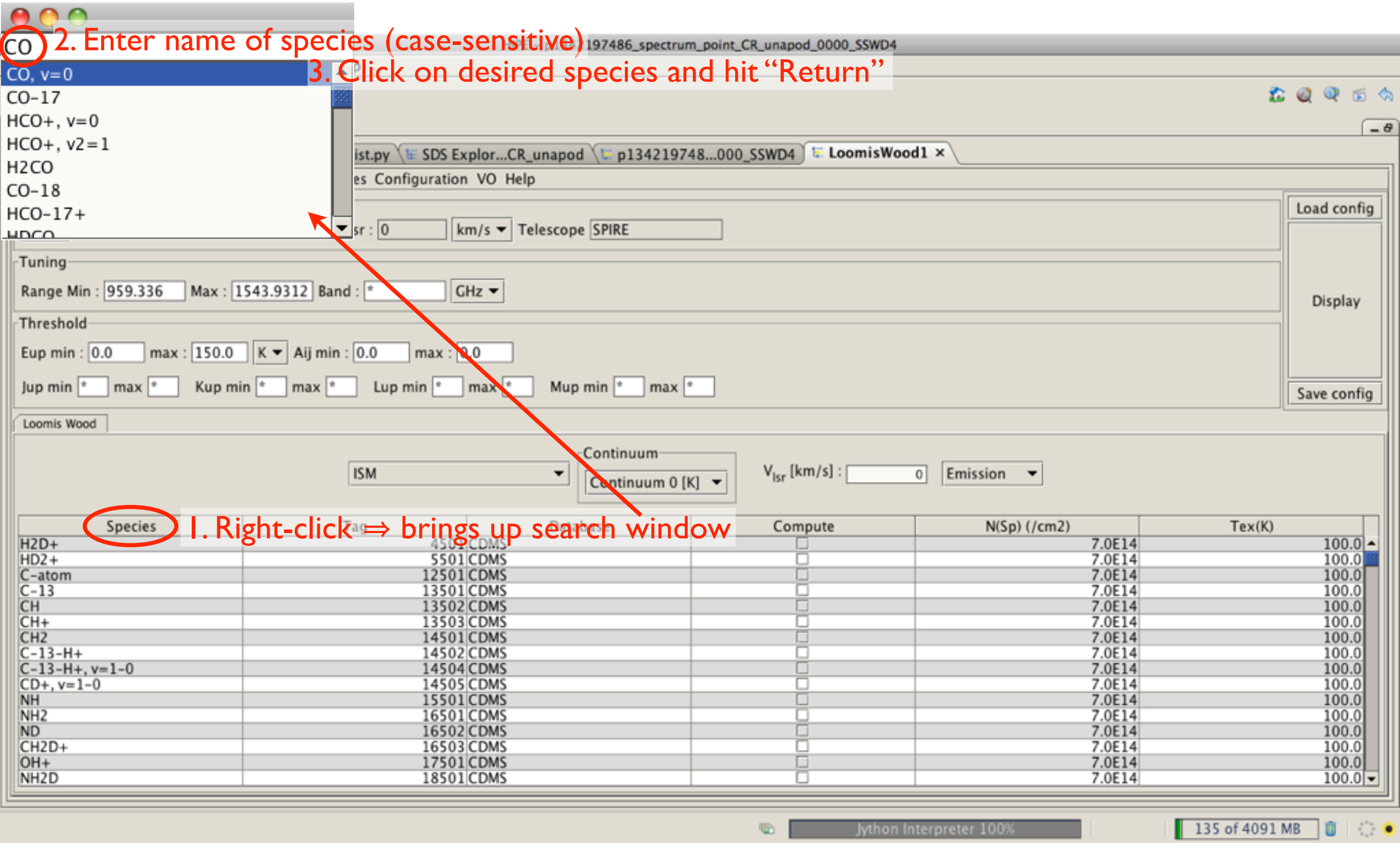
3. SpectrumId Loomis-Wood : adding continuum



3. Spectrum Id Loomis-Wood : adding continuum



A-3. Creating your template within L-W



A-3. Creating your template within L-W

HIPE - p1342197486_spectrum_point_CR_unapod_0000_SSWD4

File Edit Run Pipelines Scripts Window Tools Help

Editor ×

average_sp...tasets.py | masking.py | speclist.py | SDS Explor...CR_unapod | p134219748...000_SSWD4 | LoomisWood1 × | cassisLoomisProduct_2

File Edit Models View Scripts Windows Templates Configuration VO Help

Data

Load | UNKNOW | Vlsr : 0 | km/s | Telescope SPIRE

Tuning

Range Min : 959.336 Max : 1543.9312 Band : * GHz

Threshold

Eup min : 0.0 max : 1500.0 K Aij min : 0.0 max : 0.0

Jup min * max * Kup min * max * Lup min * max * Mup min * max *

Load config | Display | Save config

Loomis Wood

ISM | Continuum: Continuum 0 [K] | V_{lsr} [km/s] : 0 | Emission

The chosen species is highlighted and can be selected

Species				N(Sp) (/cm2)	Tex(K)
HCN, v1=1	27510	CDMS		7.0E14	100.0
HCCD	27511	CDMS		7.0E14	100.0
HC-13-N, v=0	28501	CDMS		7.0E14	100.0
H2CN	28502	CDMS		7.0E14	100.0
CO, v=0	28503	CDMS	☑	7.0E14	100.0
HCNH+	28504	CDMS		7.0E14	100.0
C-13-N-15	28505	CDMS		7.0E14	100.0
HCN-15, v=0	28506	CDMS		7.0E14	100.0
HCN-15, v2=1	28507	CDMS		7.0E14	100.0
DNC	28508	CDMS		7.0E14	100.0
DCN, v=0	28509	CDMS		7.0E14	100.0
DCN, v2=1	28510	CDMS		7.0E14	100.0
HC-13-N, v2=1	28511	CDMS		7.0E14	100.0
C-13-O	29501	CDMS		7.0E14	100.0
HCND+	29502	CDMS		7.0E14	100.0
CO-17	29503	CDMS		7.0E14	100.0

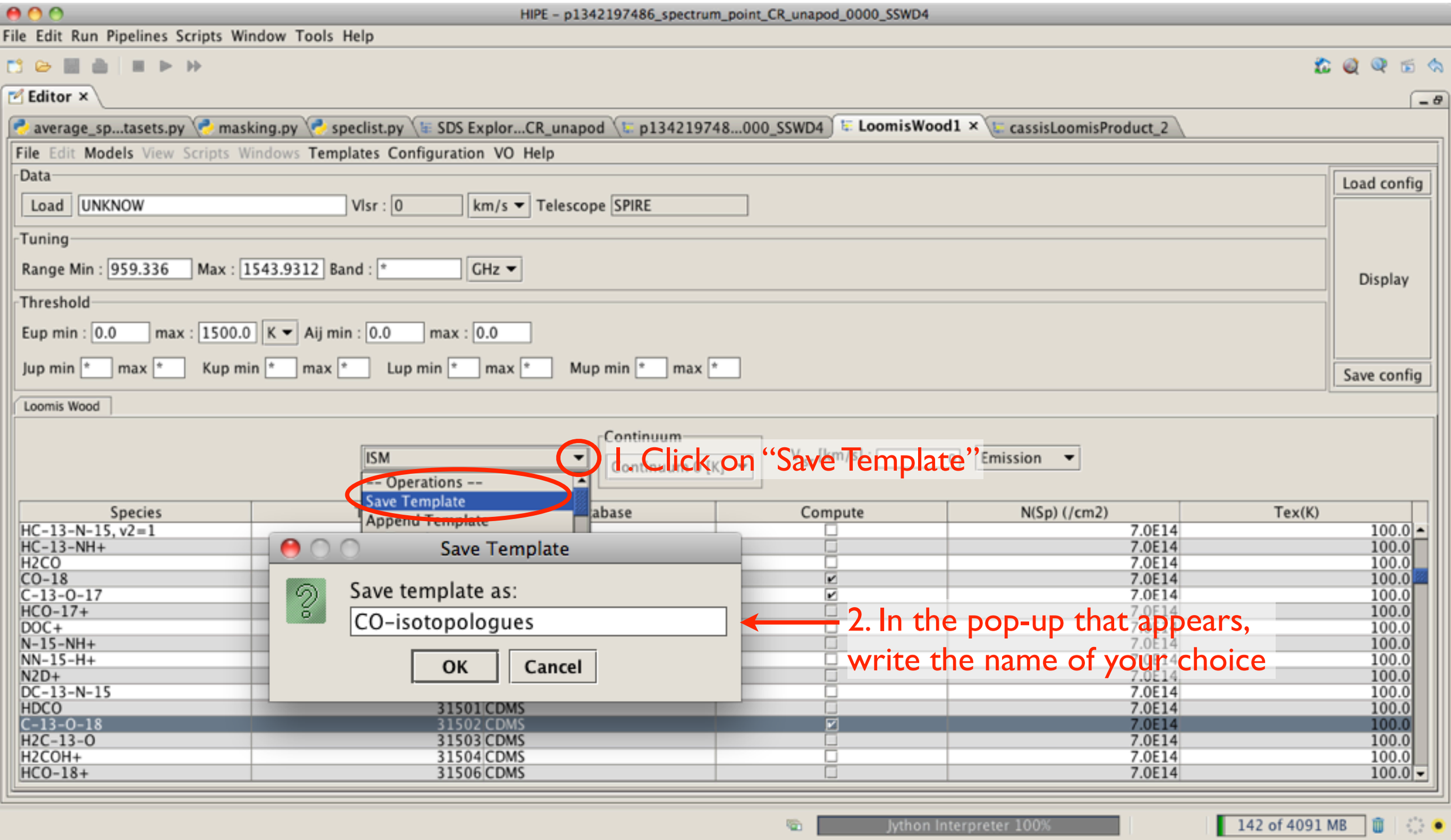
Jython Interpreter 100% | 142 of 4091 MB

A-3. Creating your template within L-W

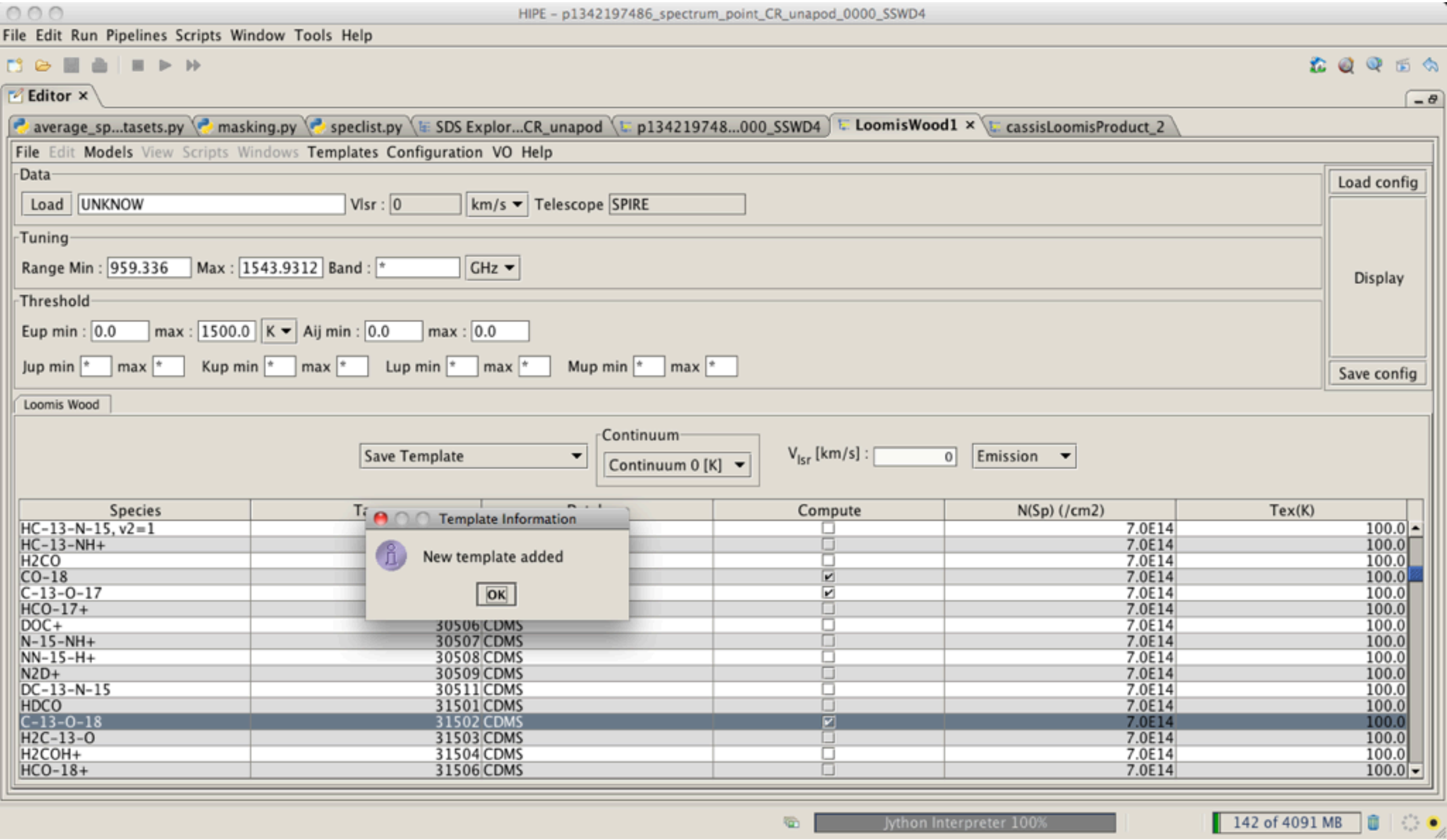
Repeat the search and selection steps for isotopologues of CO : ^{13}CO, $C^{18}O$, $C^{17}O$, $^{13}C^{18}O$, $^{13}C^{17}O$.

Note that, for example, ^{13}CO and $C^{18}O$ are listed as C-13-O and CO-18

A-3. Creating your template within L-W



A-3. Creating your template within L-W



A-3. Creating your template within L-W

HIPE - p1342197486_spectrum_point_CR_unapod_0000_SSWD4

File Edit Run Pipelines Scripts Window Tools Help

Editor ×

average_sp...tasets.py | masking.py | speclist.py | SDS Explor...CR_unapod | p134219748...000_SSWD4 | LoomisWood1 × | cassisLoomisProduct_2

File Edit Models View Scripts Windows Templates Configuration VO Help

Data

Load | UNKNOW | Vlsr : 0 | km/s | Telescope SPIRE

Tuning

Range Min : 959.336 Max : 1543.9312 Band : * | GHz

Threshold

Eup min : 0.0 max : 1500.0 | K | Aij min : 0.0 max : 0.0

Jup min * max * Kup min * max * Lup min * max * Mup min * max *

Load config | Display | Save config

Loomis Wood

You are done, your template is here!

CO-isotopologues

Continuum

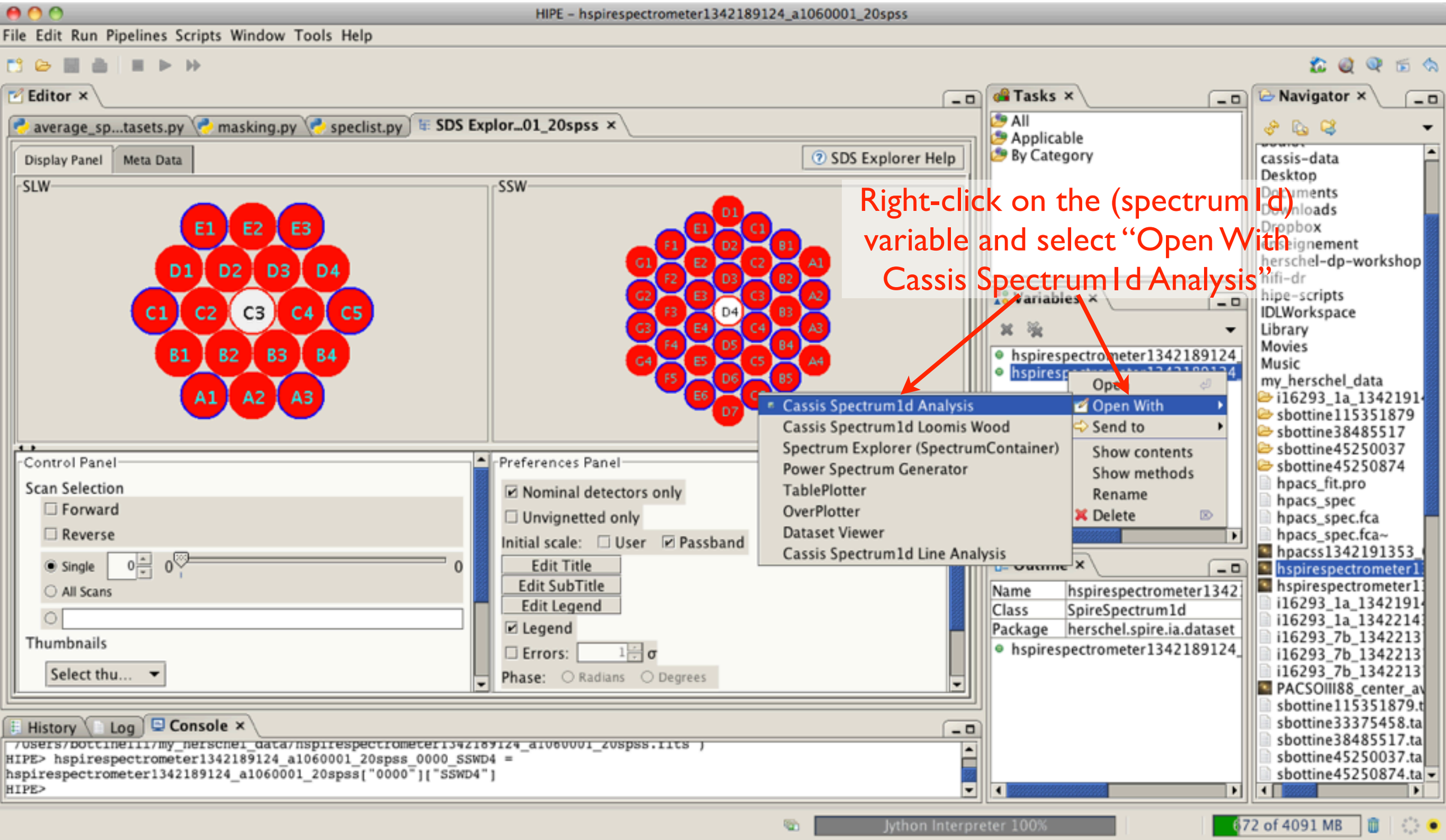
Continuum 0 [K]

V_{lsr} [km/s] : 0 | Emission

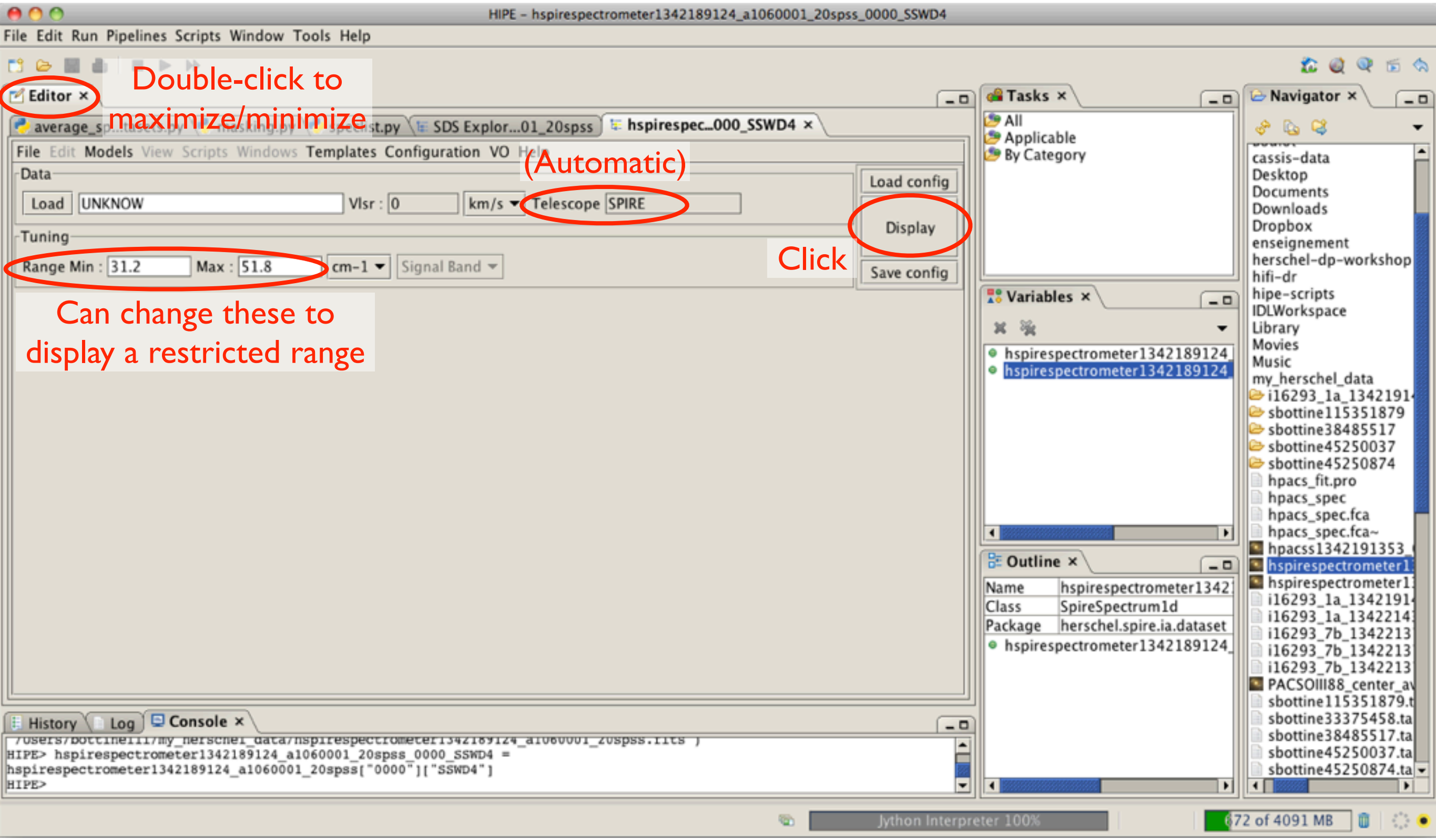
Species	Tag	Database	Compute	N(Sp) (/cm2)	Tex(K)
CO, v=0	28503	CDMS	☐	7.0E14	100.0
C-13-O	29501	CDMS	☐	7.0E14	100.0
CO-17	29503	CDMS	☐	7.0E14	100.0
CO-18	30502	CDMS	☐	7.0E14	100.0
C-13-O-17	30503	CDMS	☐	7.0E14	100.0
C-13-O-18	31502	CDMS	☐	7.0E14	100.0

Jython Interpreter 100% | 142 of 4091 MB

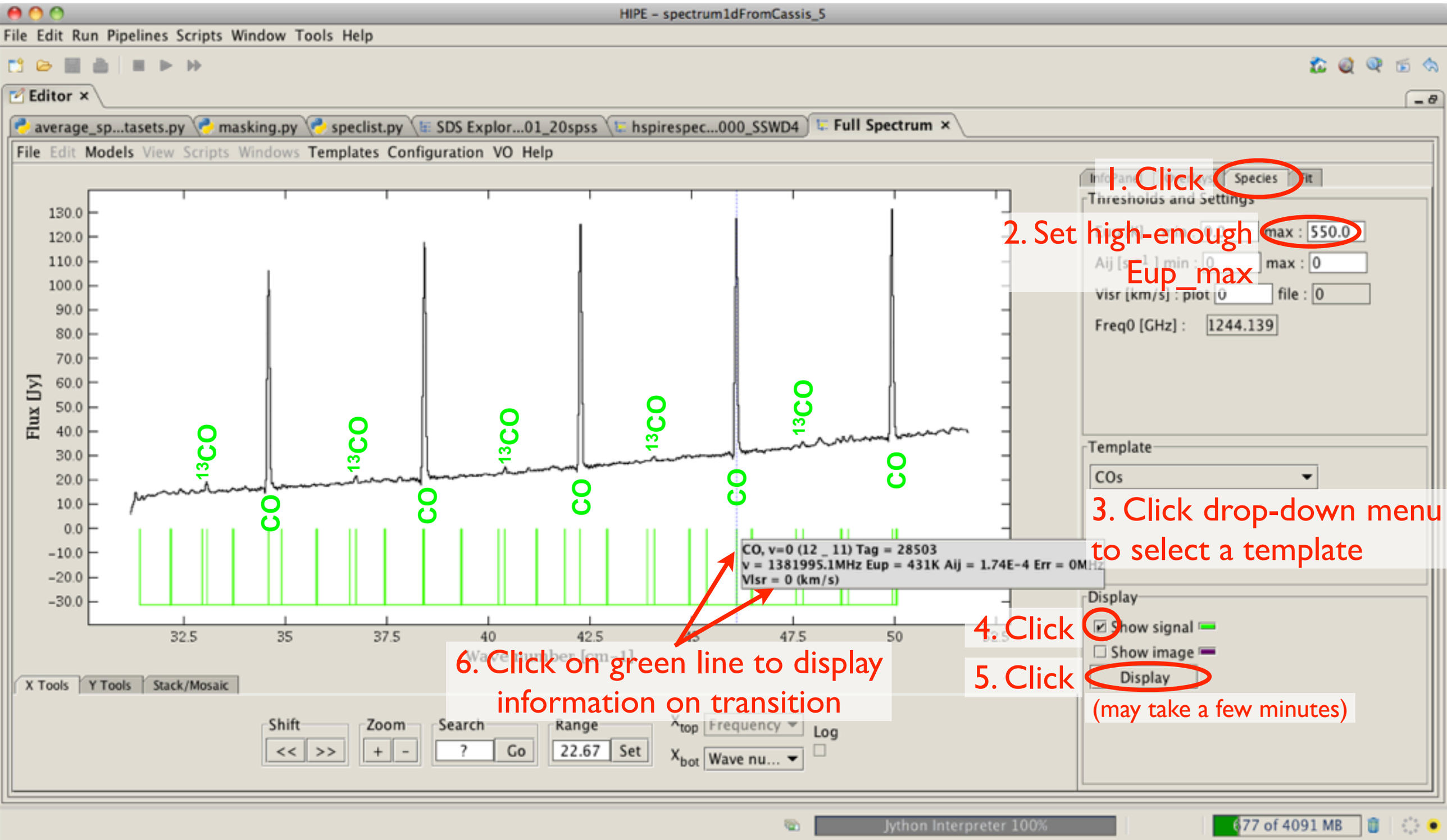
4. Spectrum1d Analysis



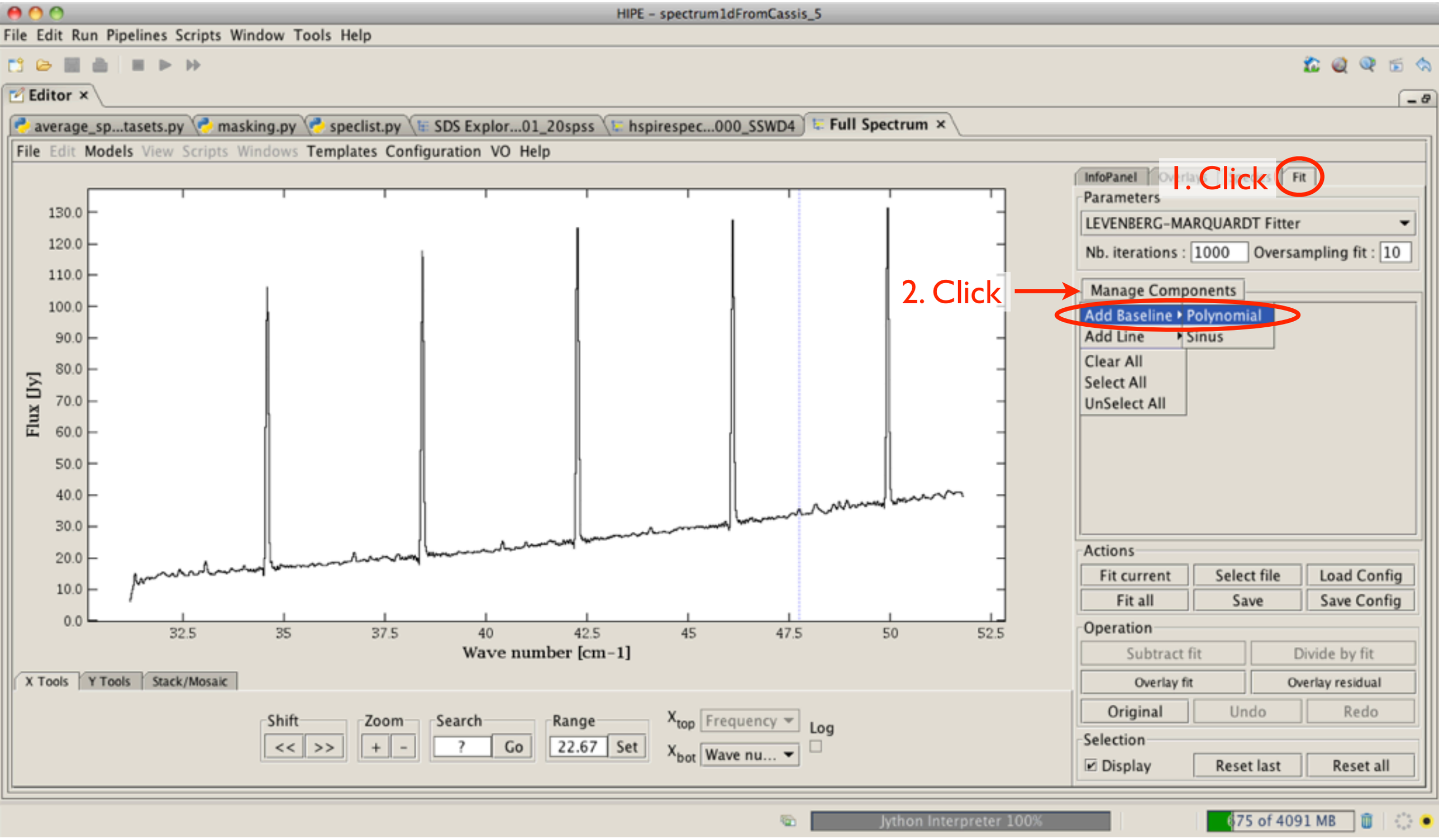
4. Spectrum1d Analysis



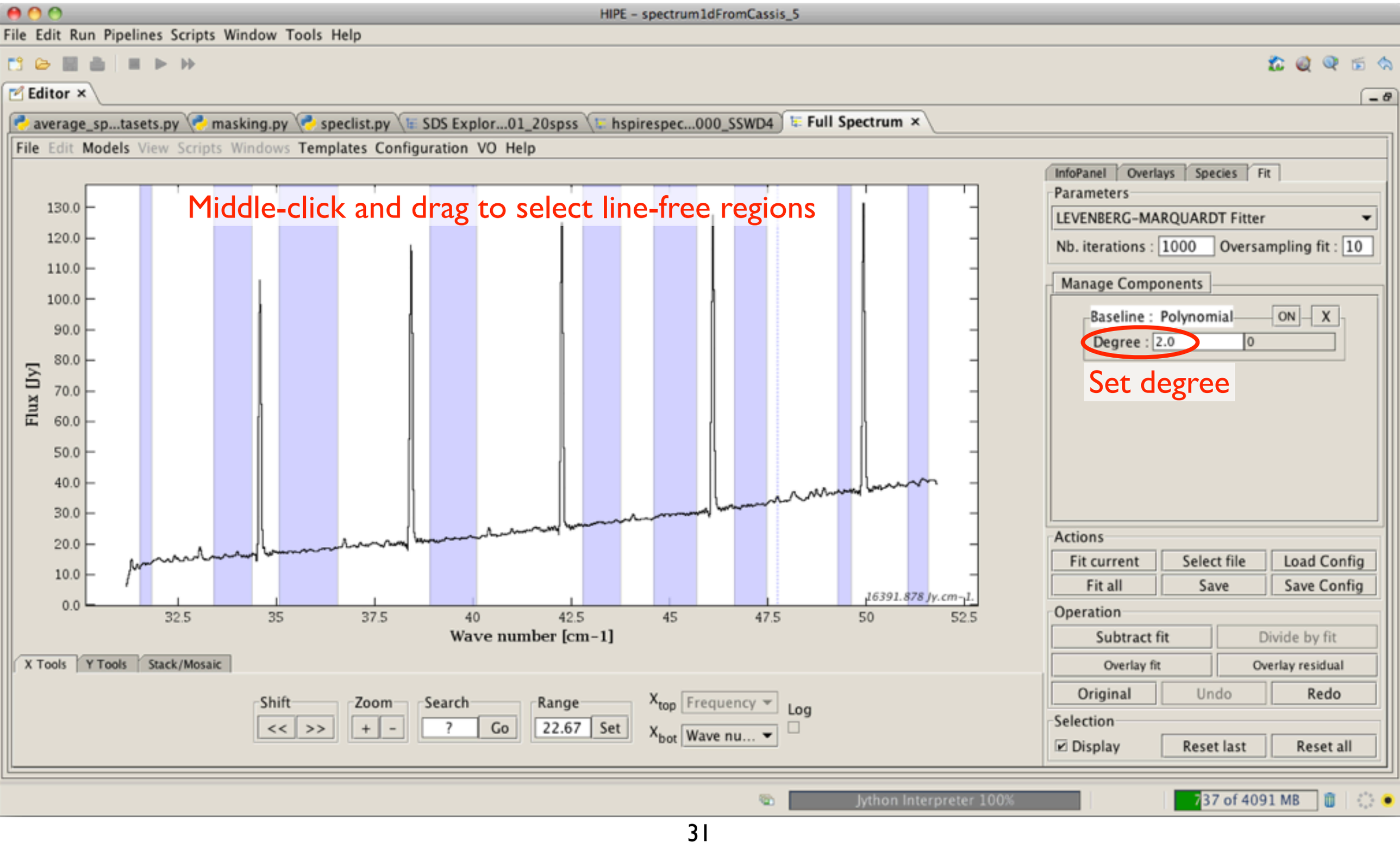
4.1. Line identification



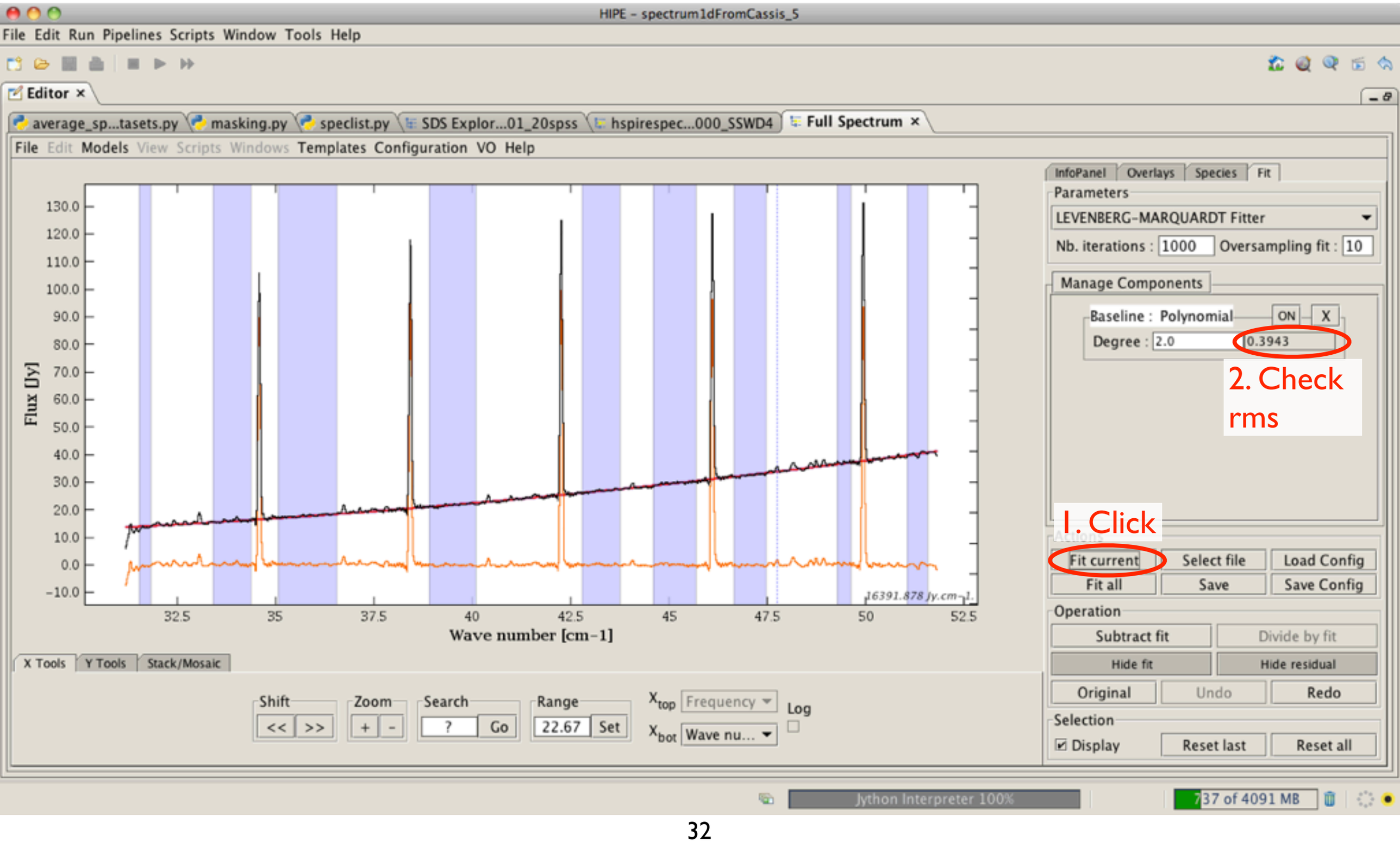
4.2. Baseline removal



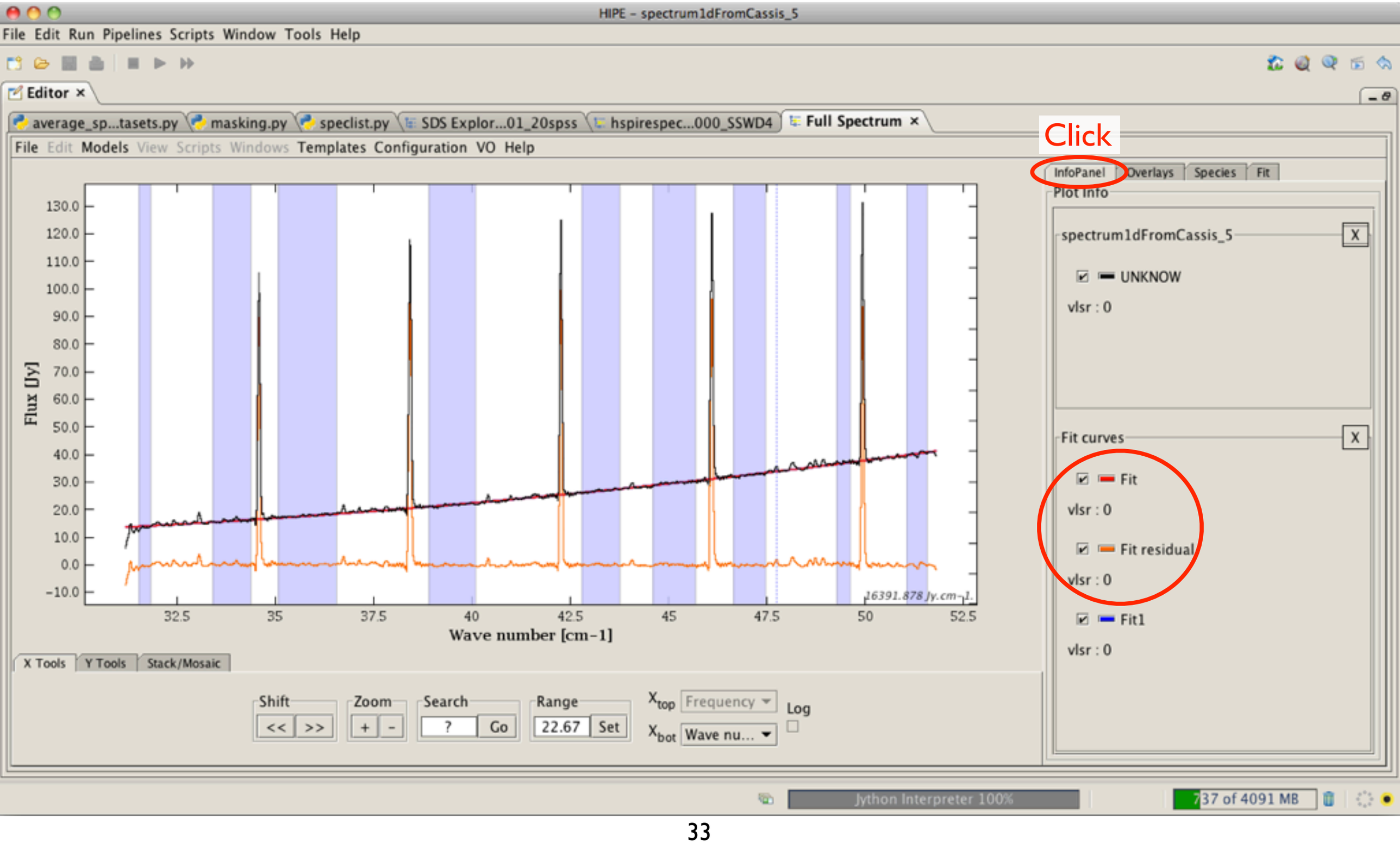
4.2. Baseline removal



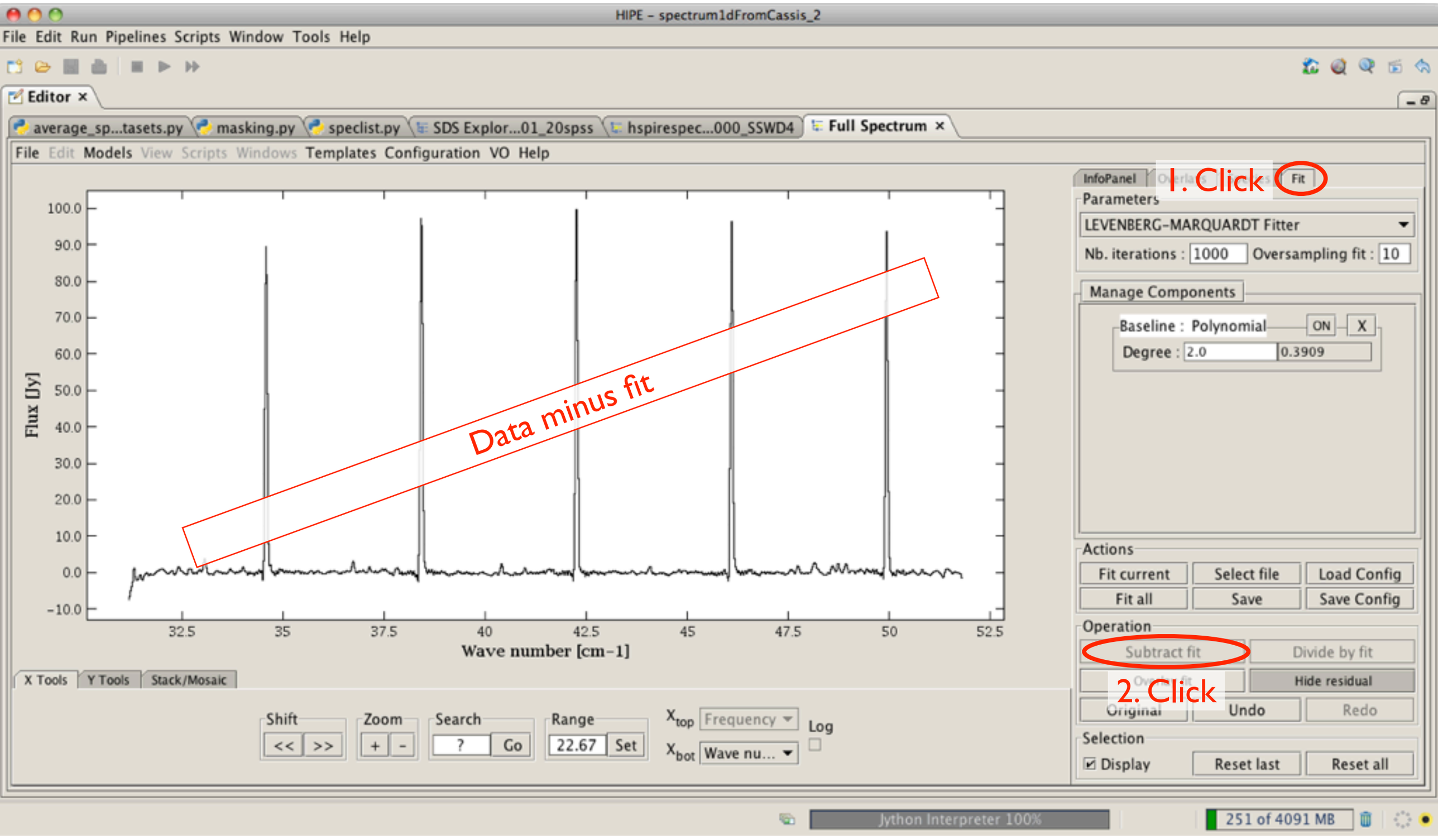
4.2. Baseline removal



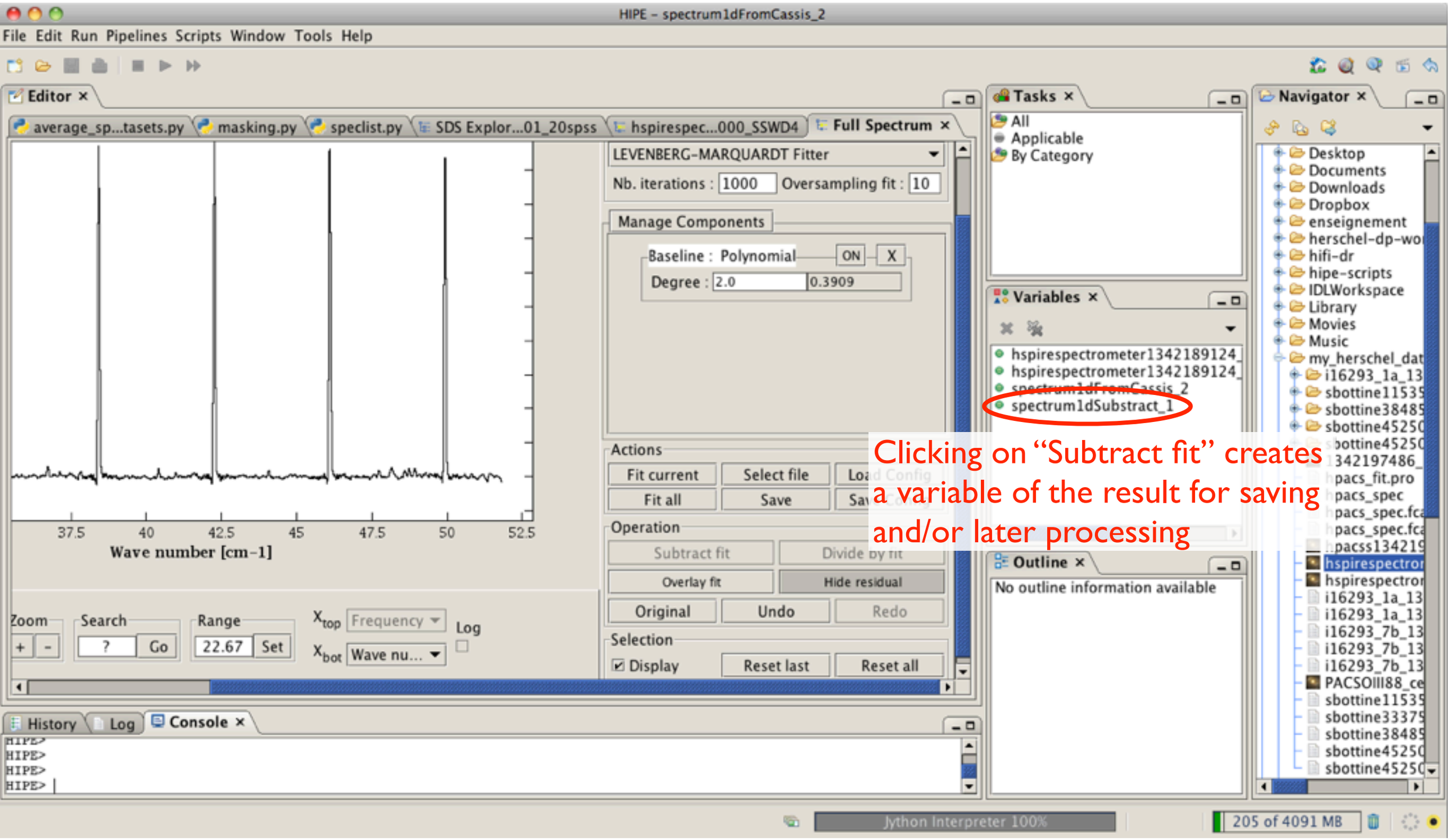
4.2. Baseline removal



4.2. Baseline removal

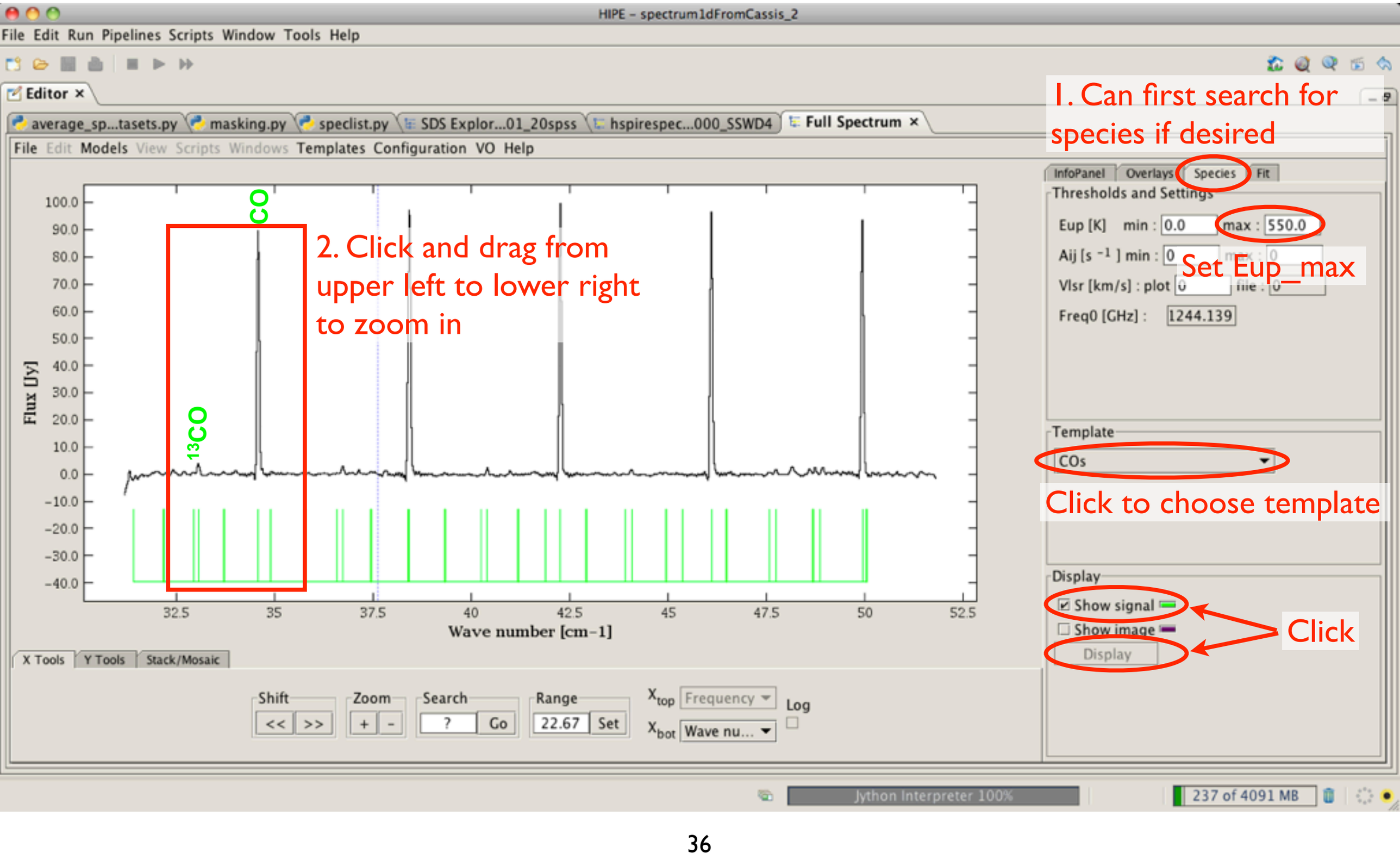


4.2. Baseline removal

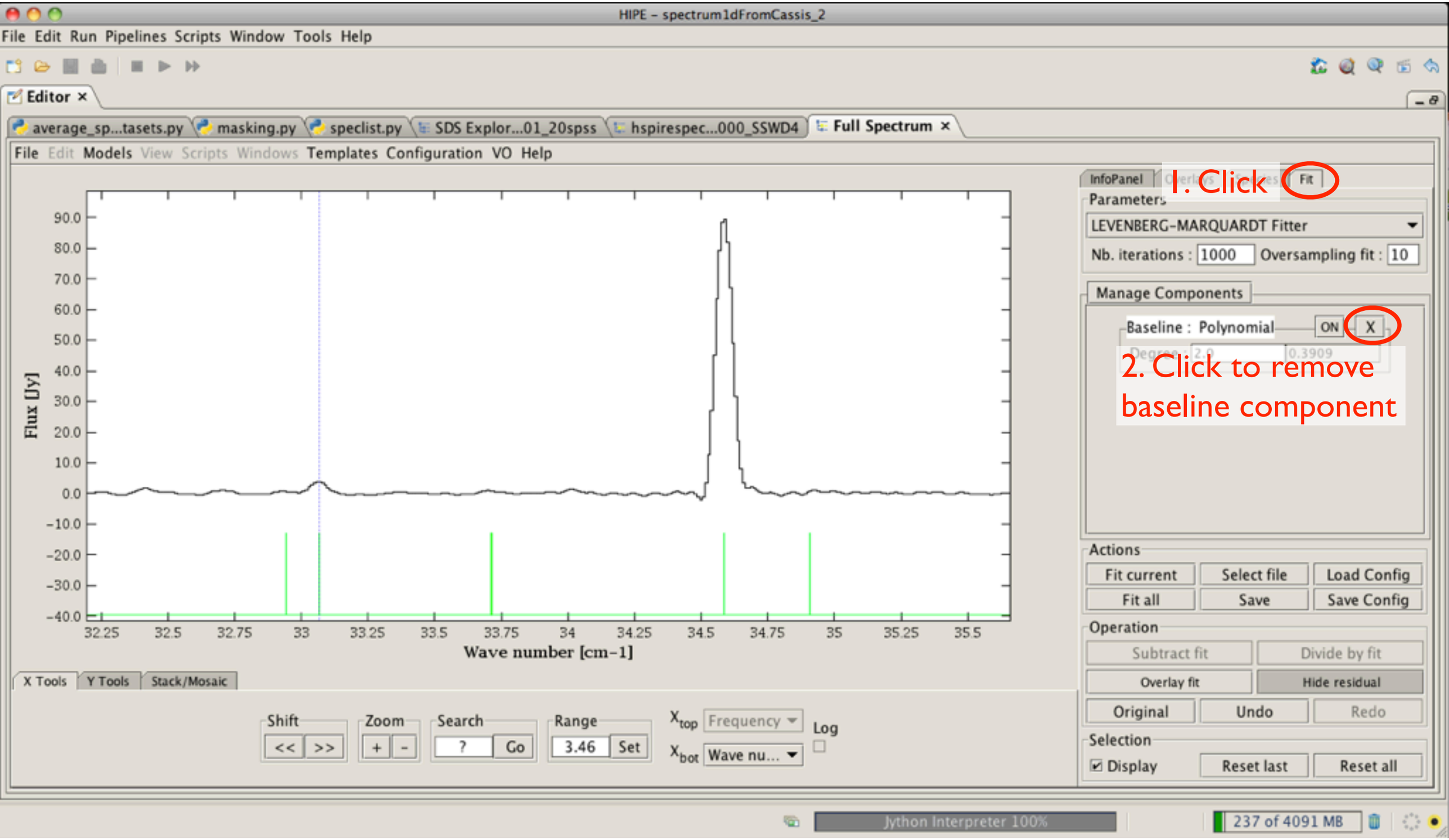


Clicking on "Subtract fit" creates a variable of the result for saving and/or later processing

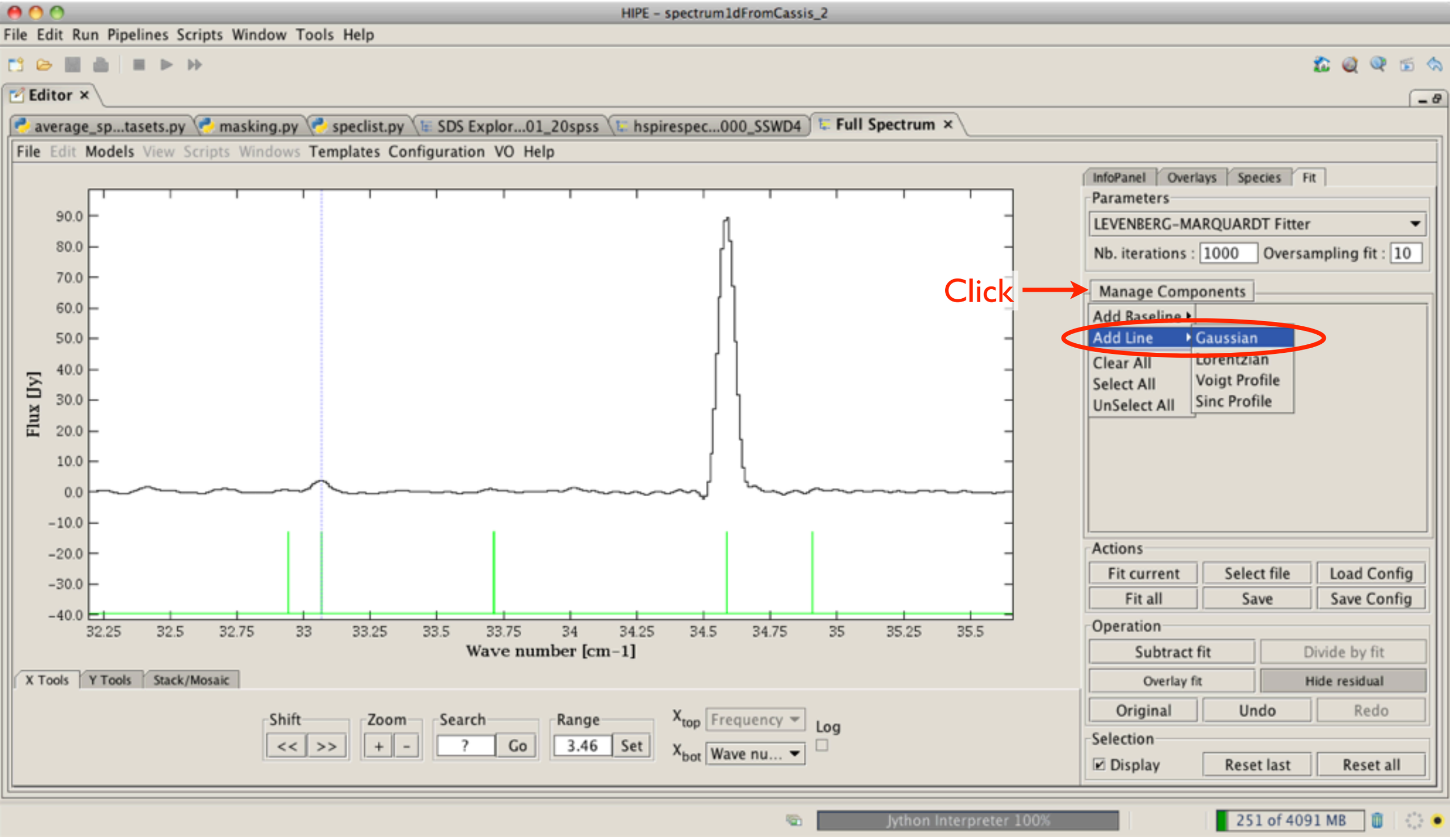
4.2. Line fitting



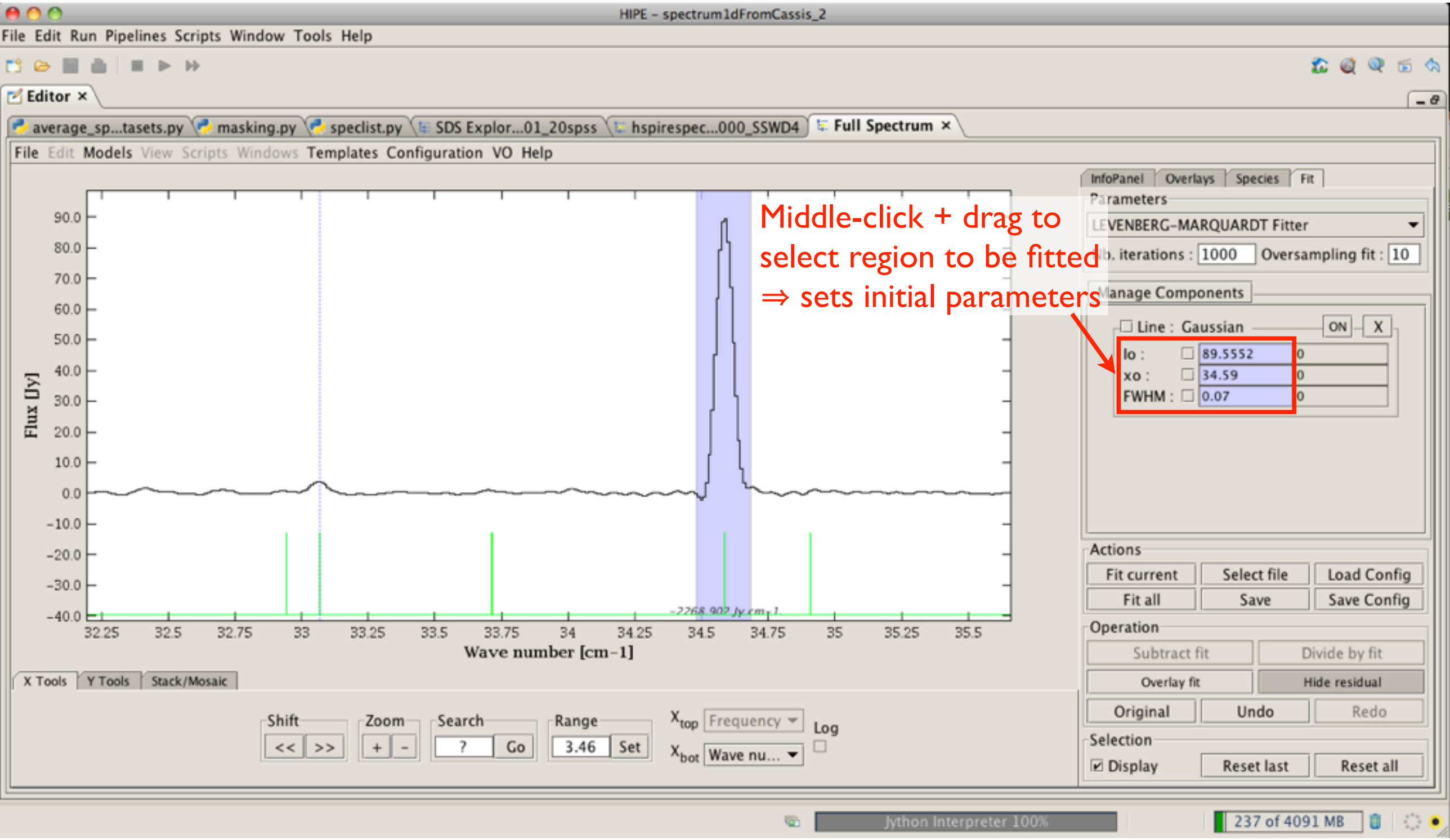
4.2. Line fitting



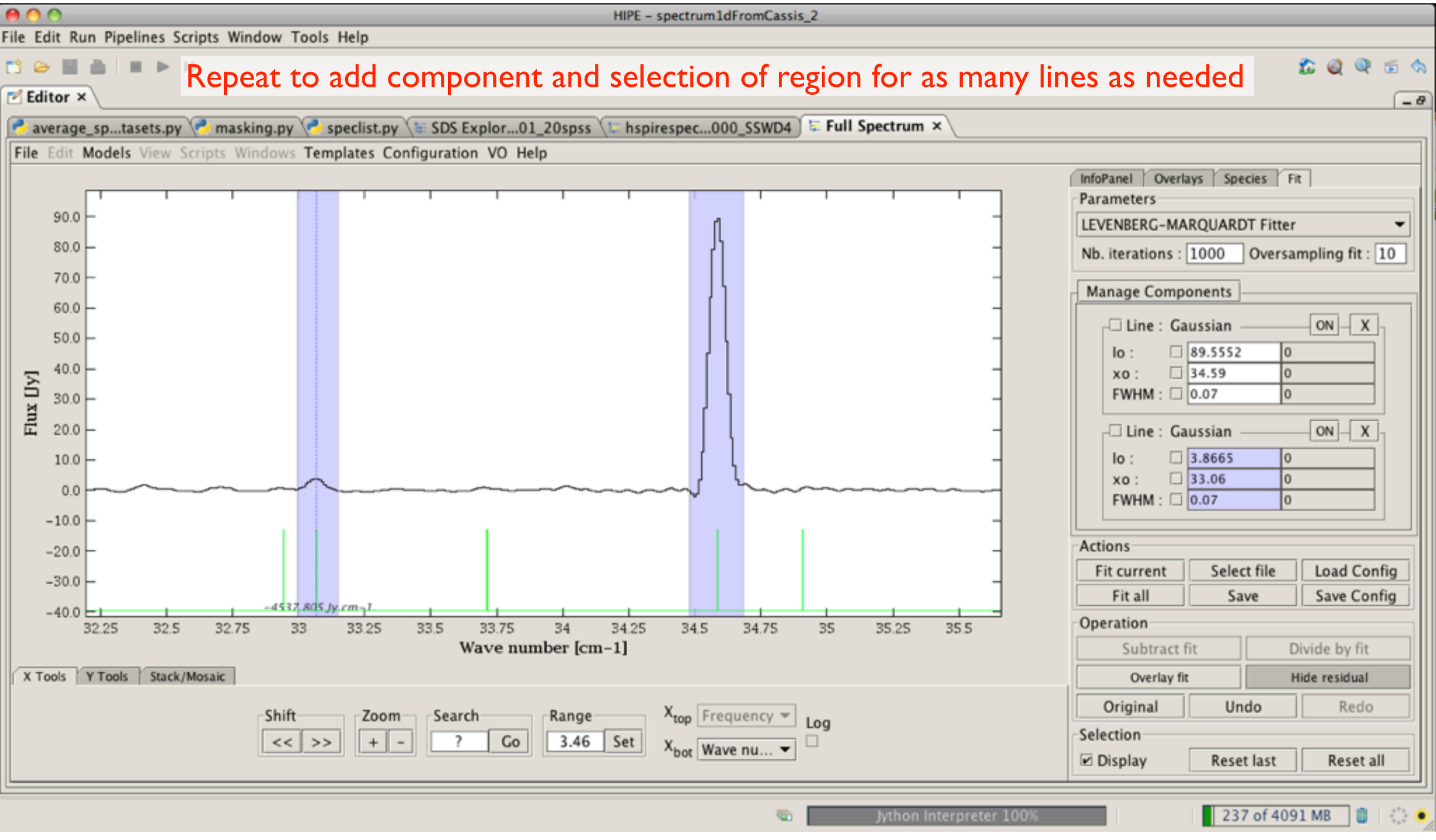
4.2. Line fitting



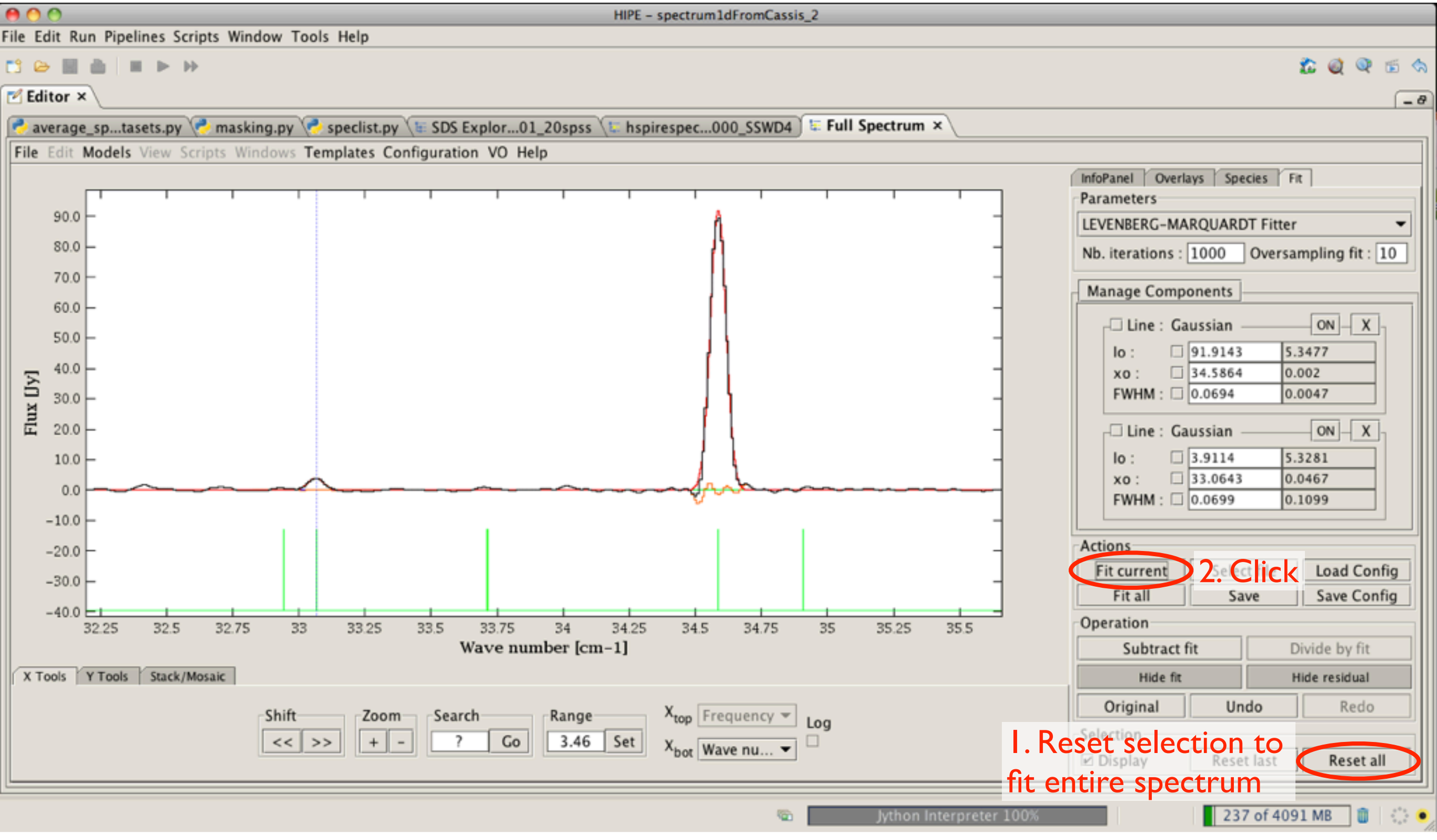
4.2. Line fitting



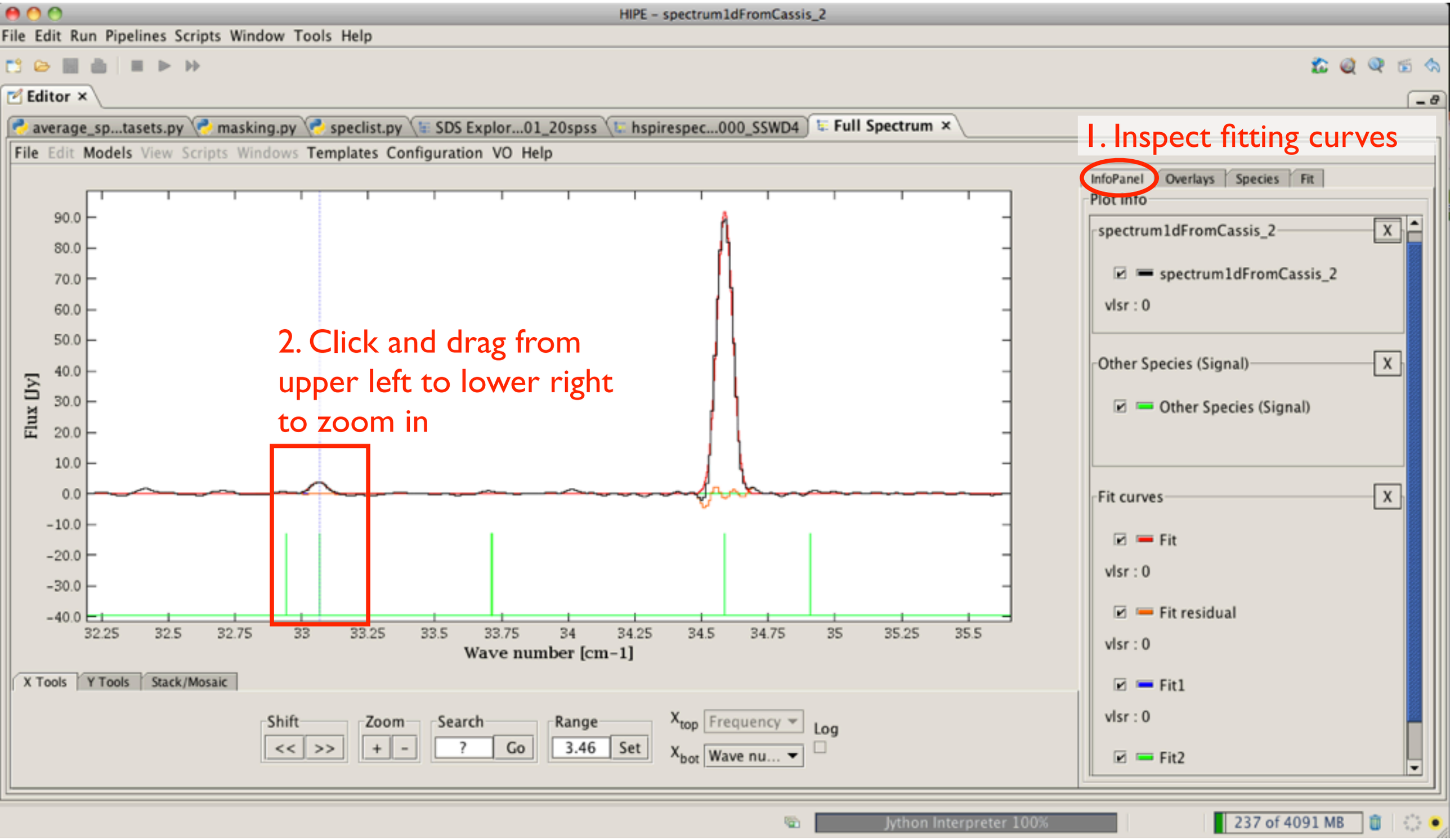
4.2. Line fitting



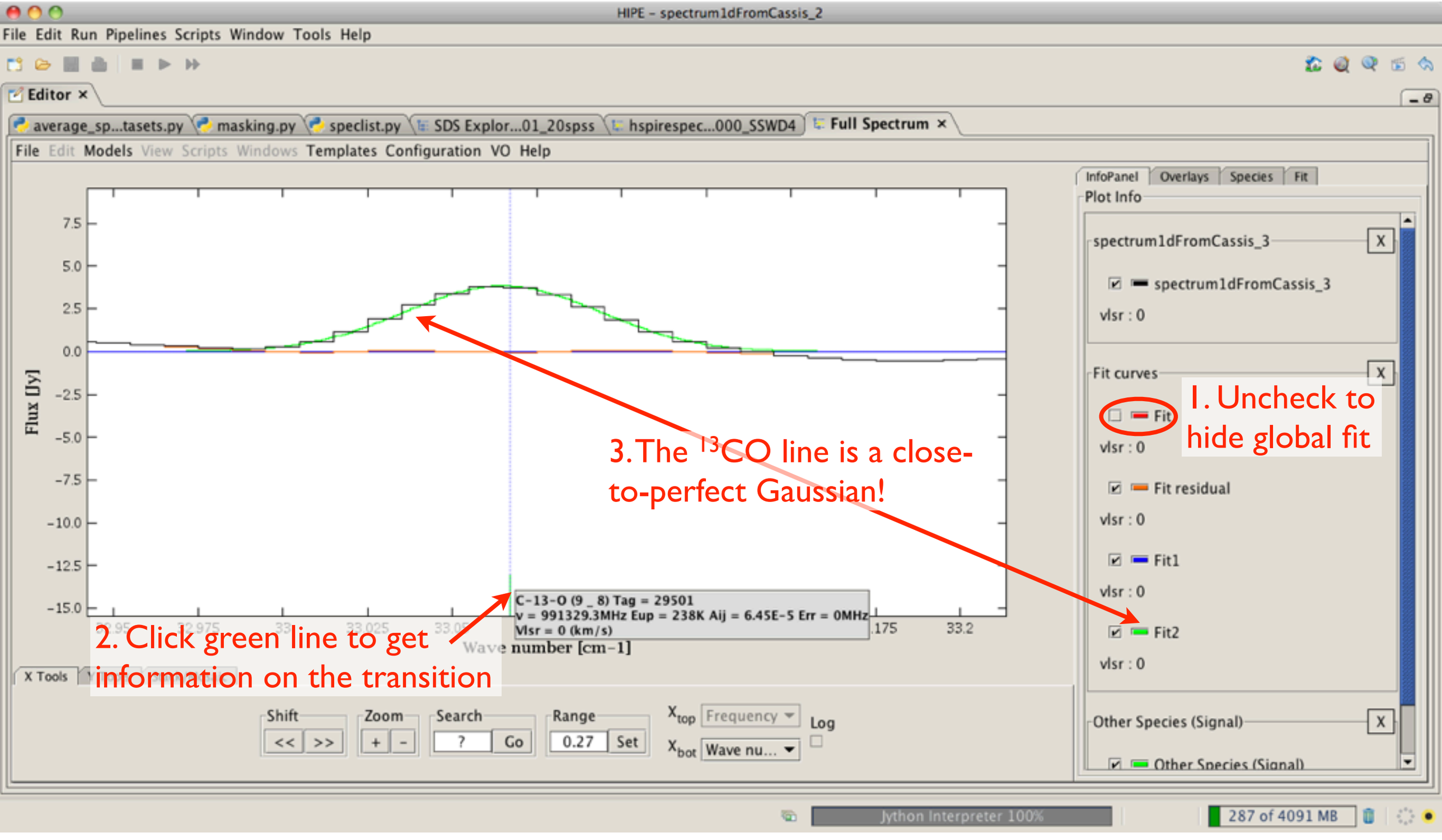
4.2. Line fitting



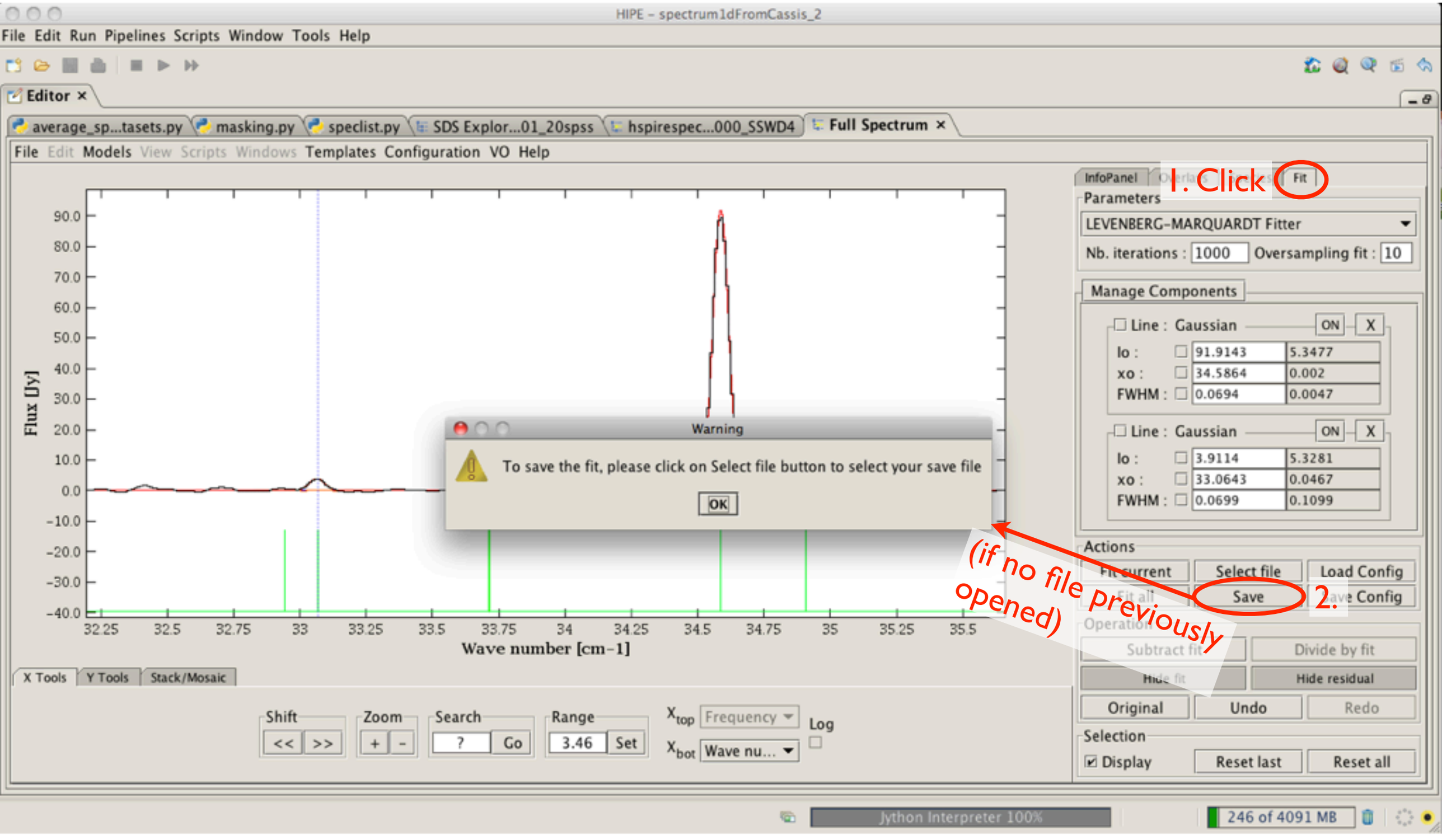
4.2. Line fitting



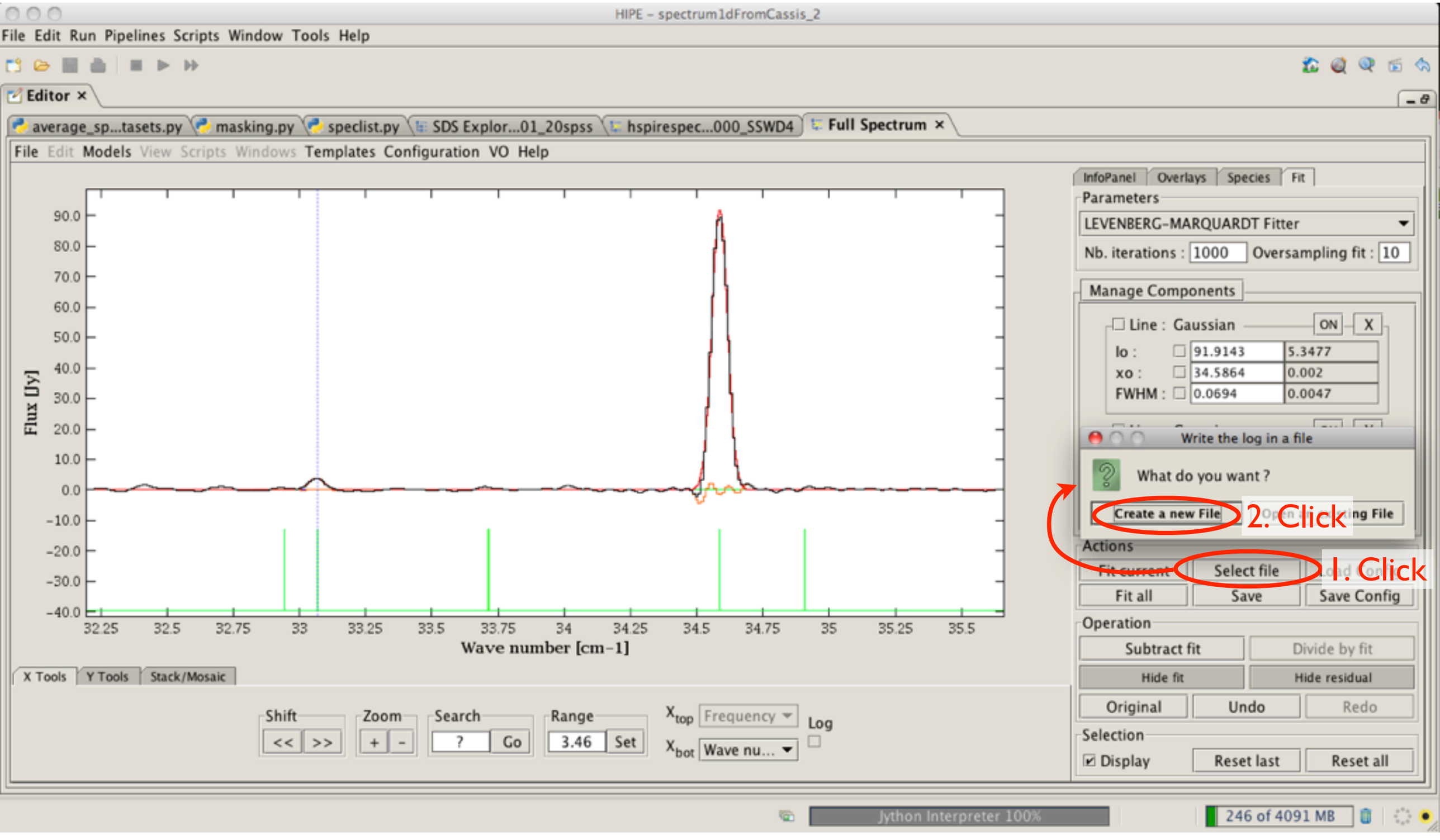
4.2. Line fitting



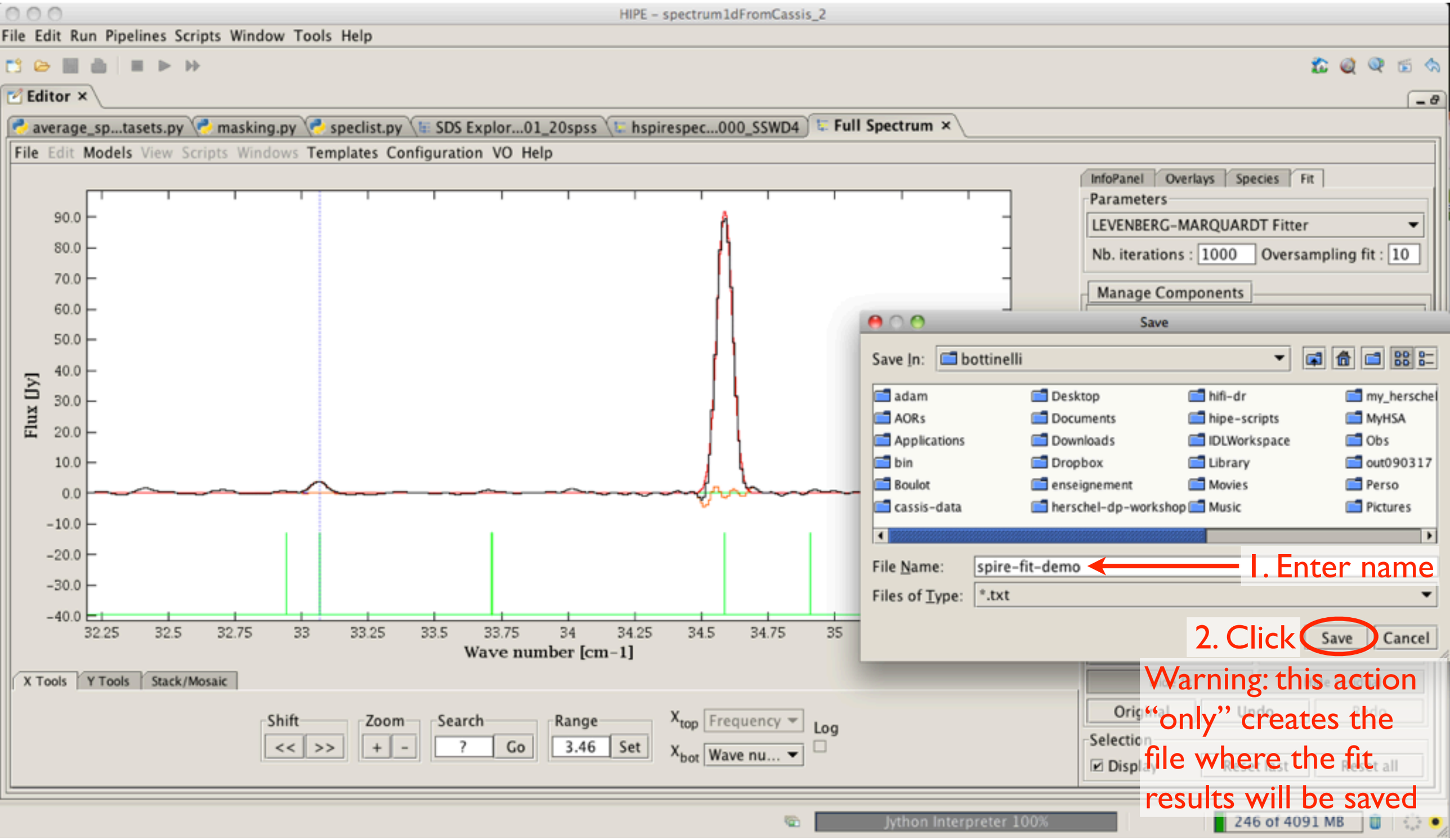
4.2. Line fitting : saving results of the fit



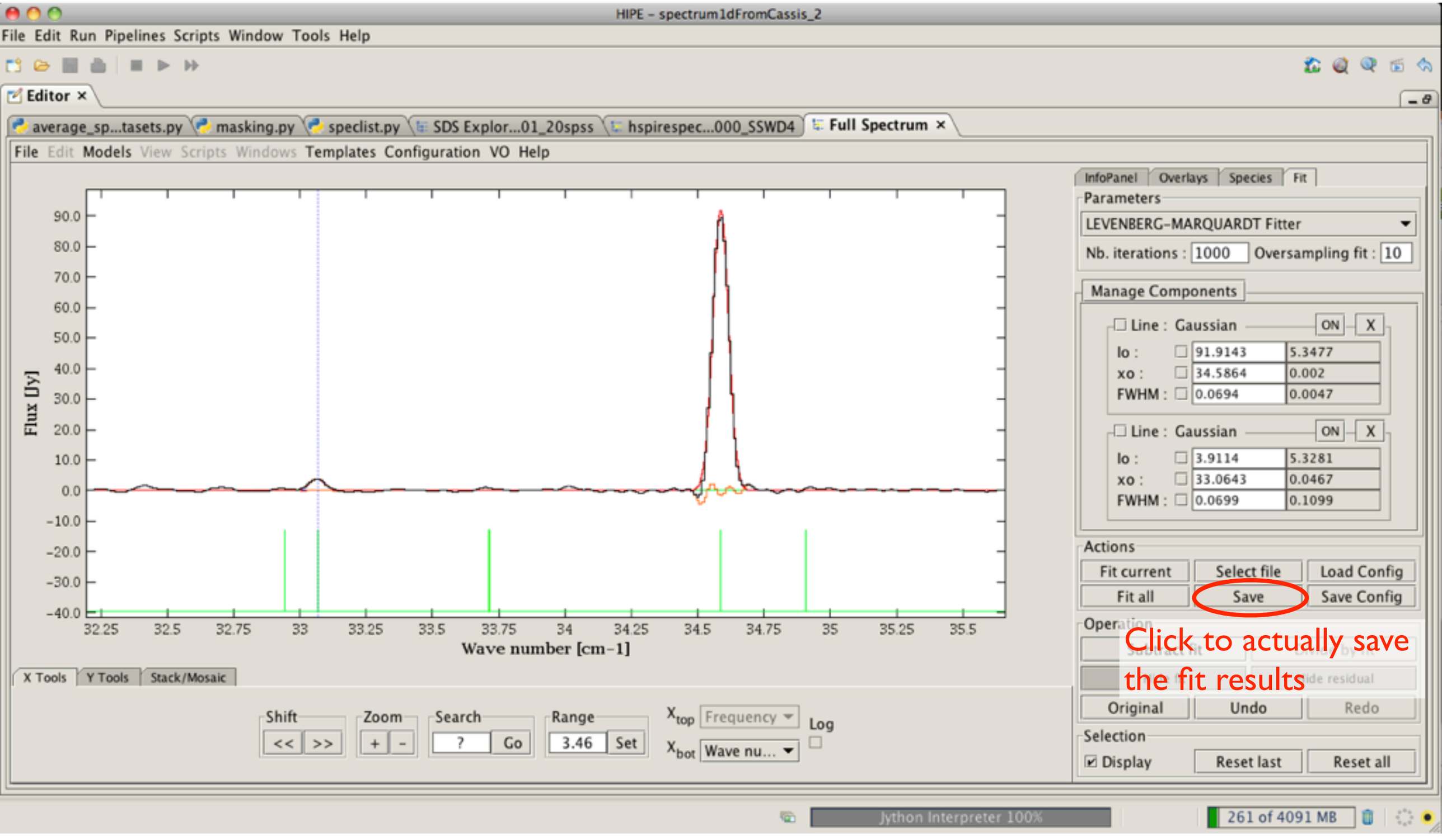
4.2. Line fitting : saving results of the fit



4.2. Line fitting : saving results of the fit



4.2. Line fitting : saving results of the fit



4.2. Line fitting : saving results of the fit

Import in / open with spreadsheet for easier viewing

spire-fit-demo.txt

Home | Layout | Tables | Charts | SmartArt | Formulas | Data | Review

Edit | Font | Alignment | Number | Format

Paste | Fill | Clear | Calibri (Body) | 12 | Wrap | General | Merge | Conditional Formatting | Normal | Bad | Good | Neutral

M14

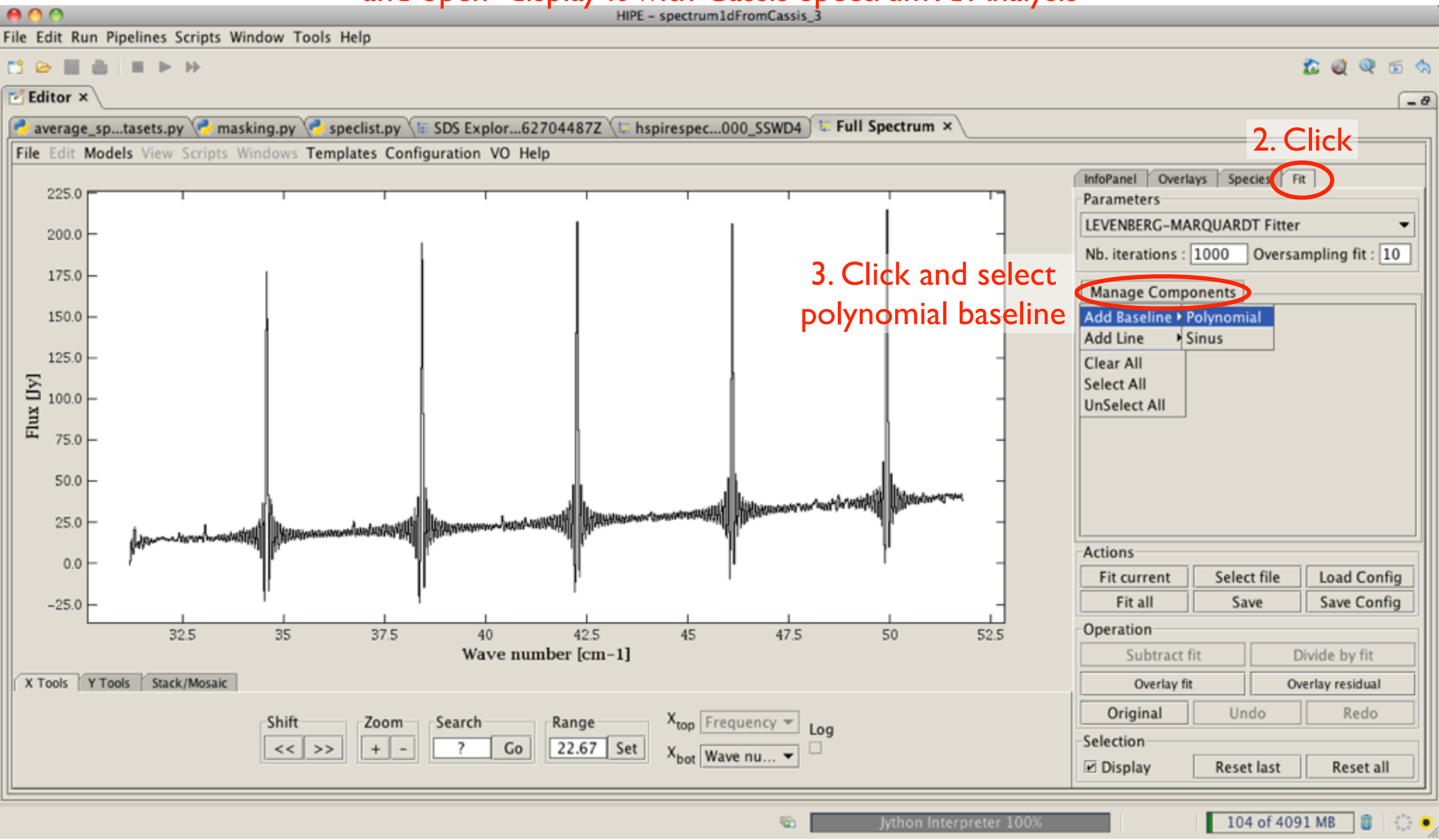
	A	B	C	D	E	F	G	H	I	J	K	L
1	Comp	Profile	Degree	Rms	Io	IoErr	Xo	XoErr	FWHM_G	FWHM_GErr	FWHM_L	FWHM_LErr
2	1	GAUSS			91.91426221551384	5.347746289563881	34.586352779900096	0.0019793017510607216	0.06937361842250327	0.004660899438562695		
3	2	GAUSS			3.9114130714687168	5.328052159993089	33.0643415990384	0.046683821797240864	0.06988599992082117	0.10993199934679676		
4												
5												

Notes:

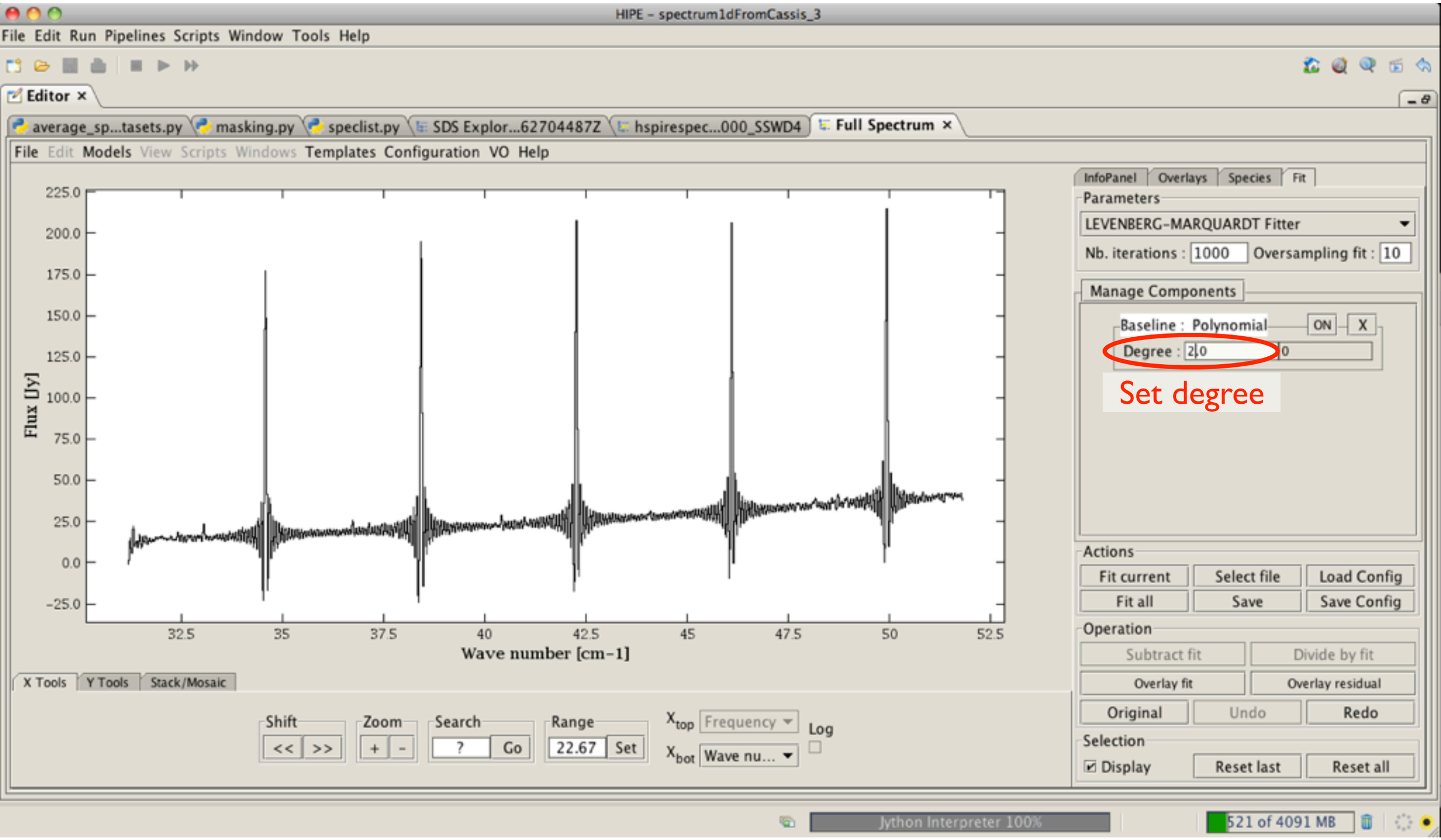
- columns C, D, K, L are not relevant for Gaussian fitting and are therefore empty here
- units are not written (here cm^{-1} and Jy)

4.3. Sinc profile removal

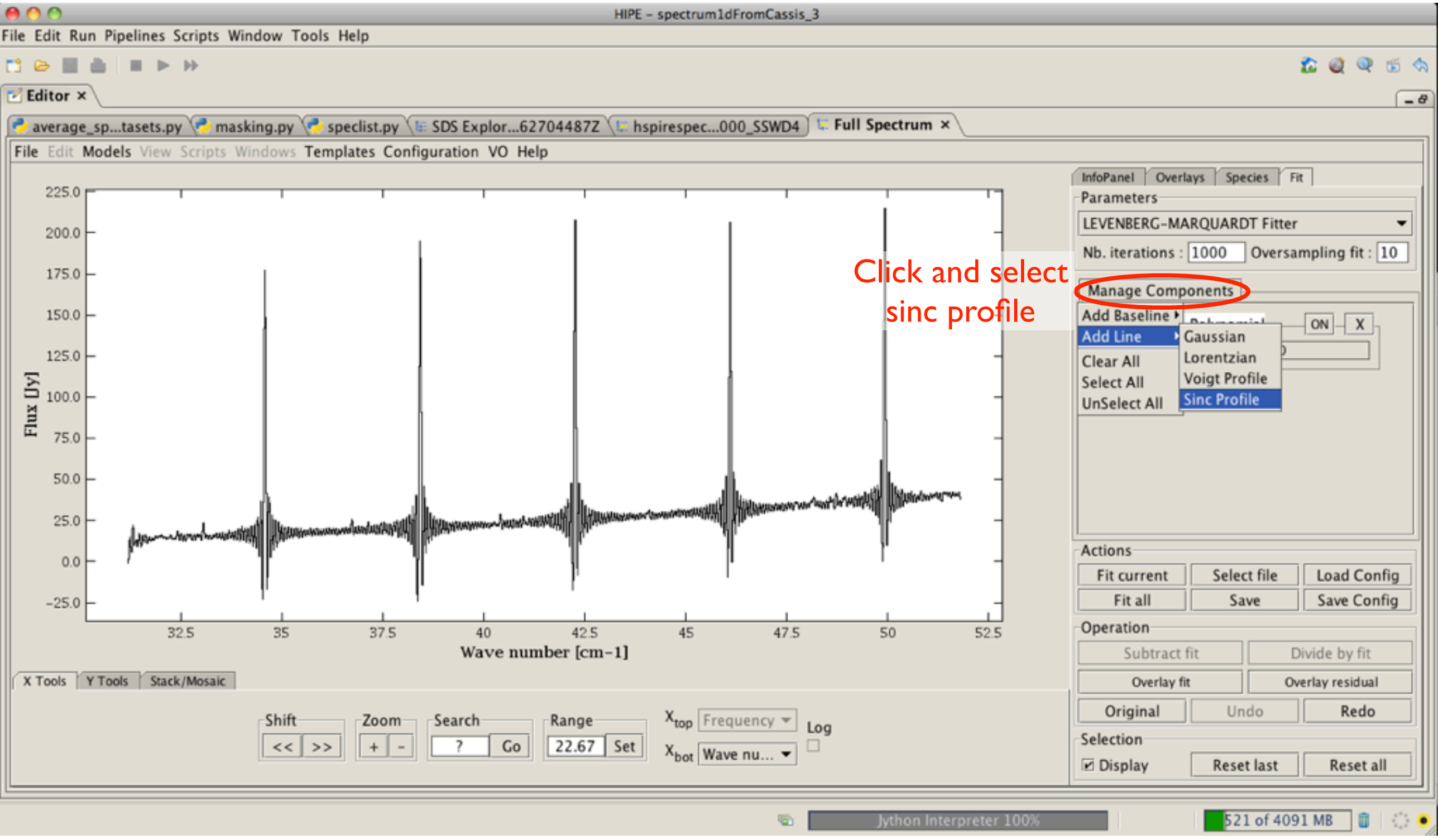
1. Start with a spectrum1d of an unapodized spectrum, and open+display it with Cassis Spectrum1d Analysis



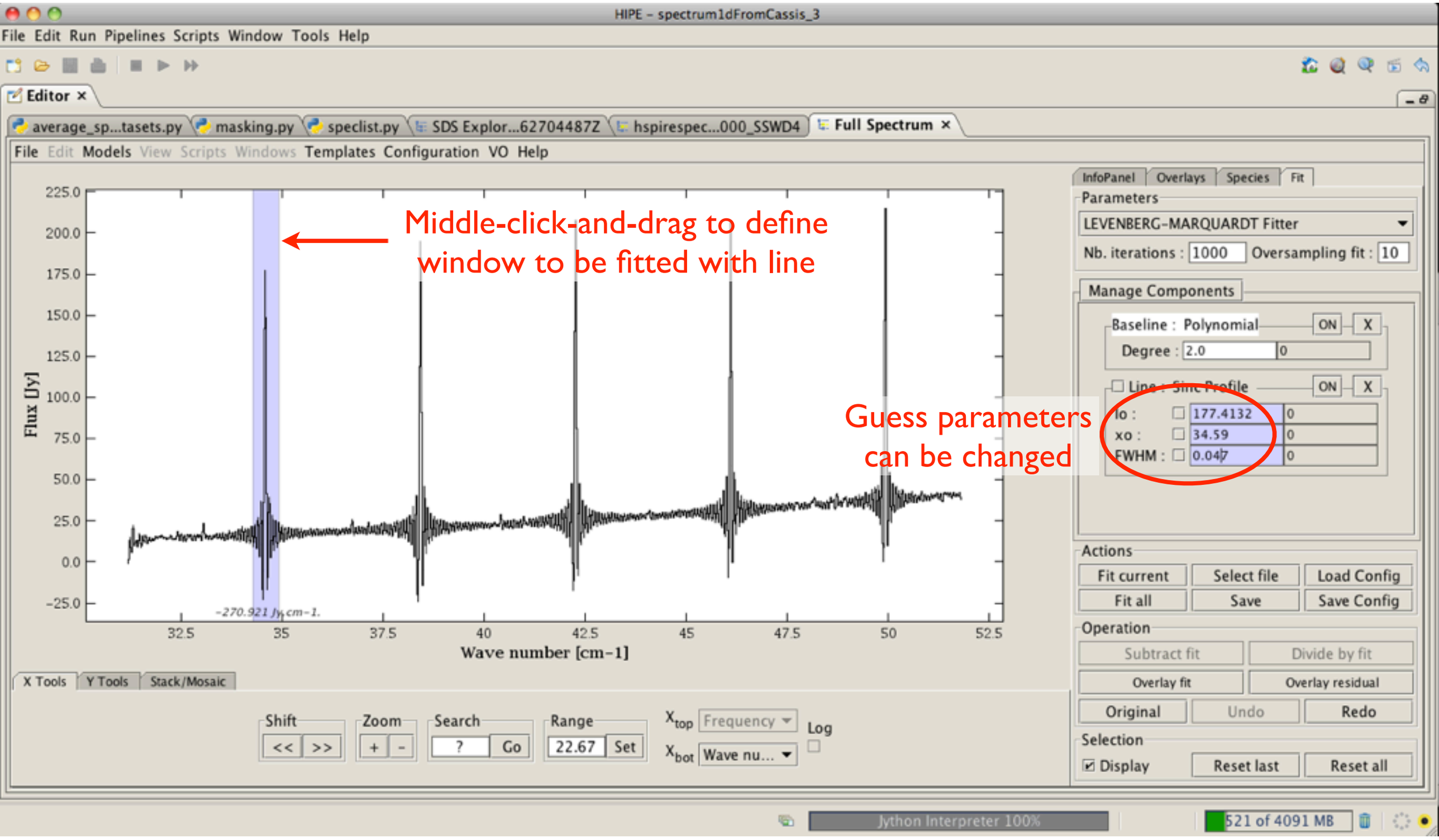
4.3. Sinc profile removal



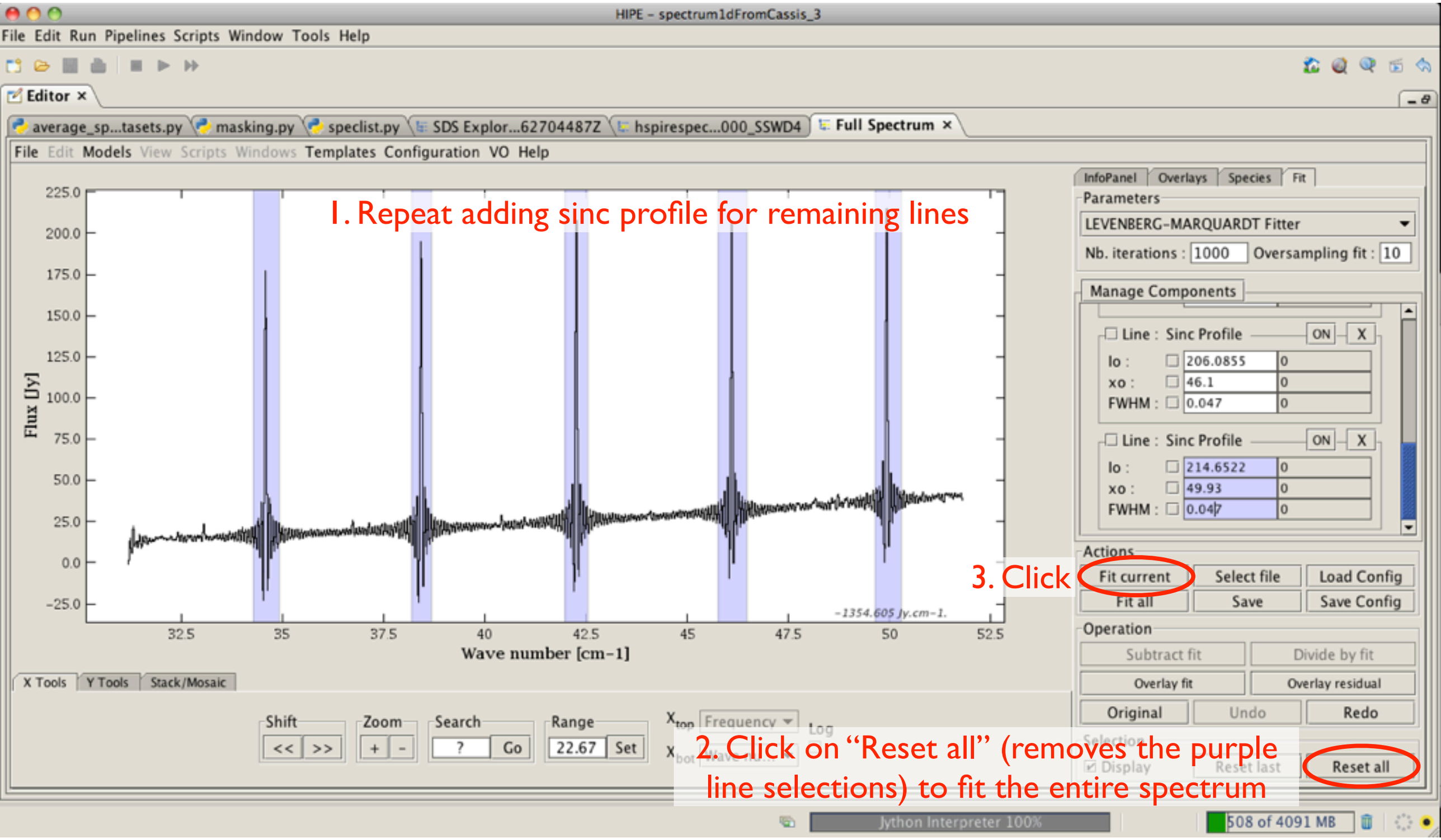
4.3. Sinc profile removal



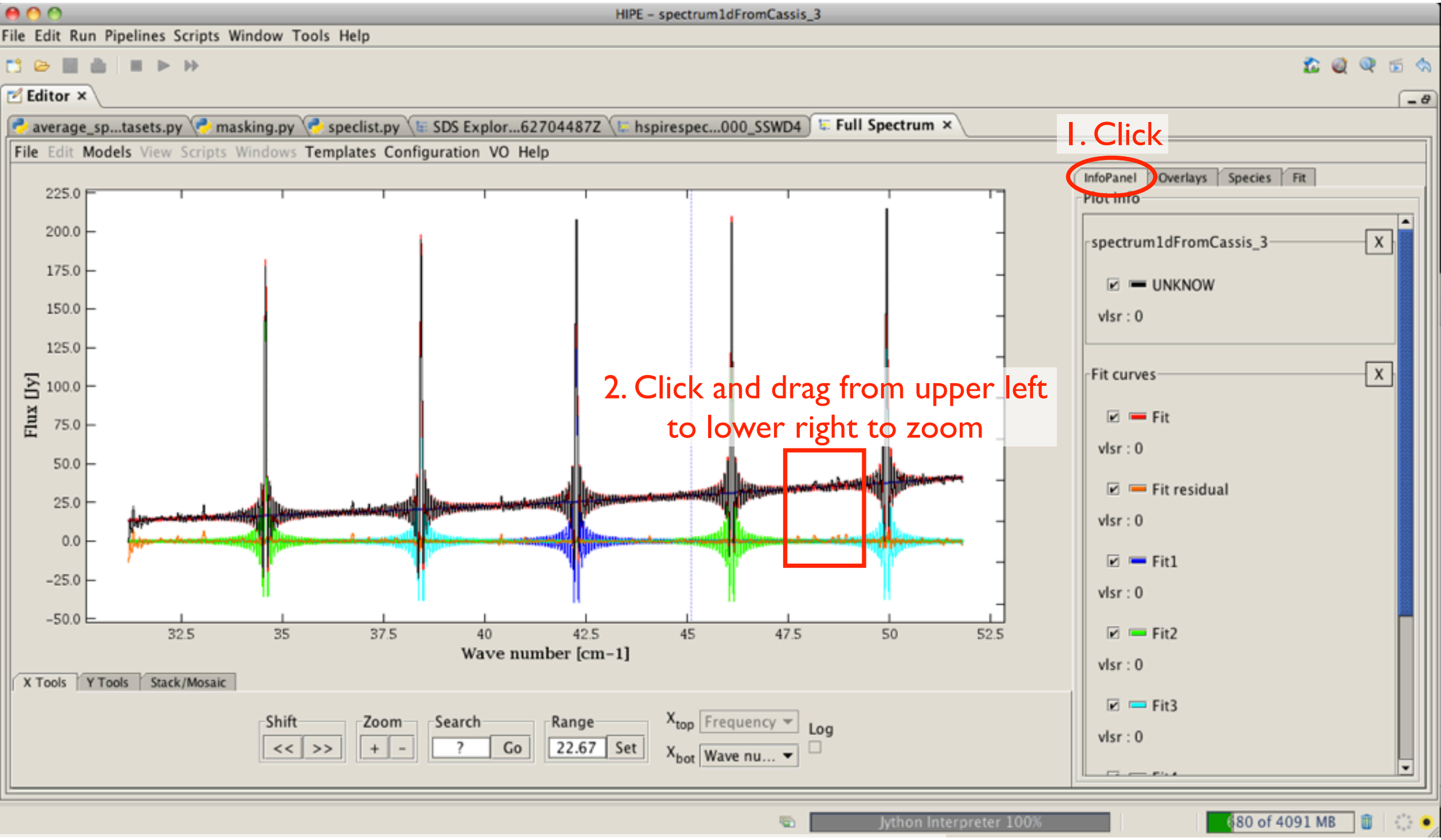
4.3. Sinc profile removal



4.3. Sinc profile removal

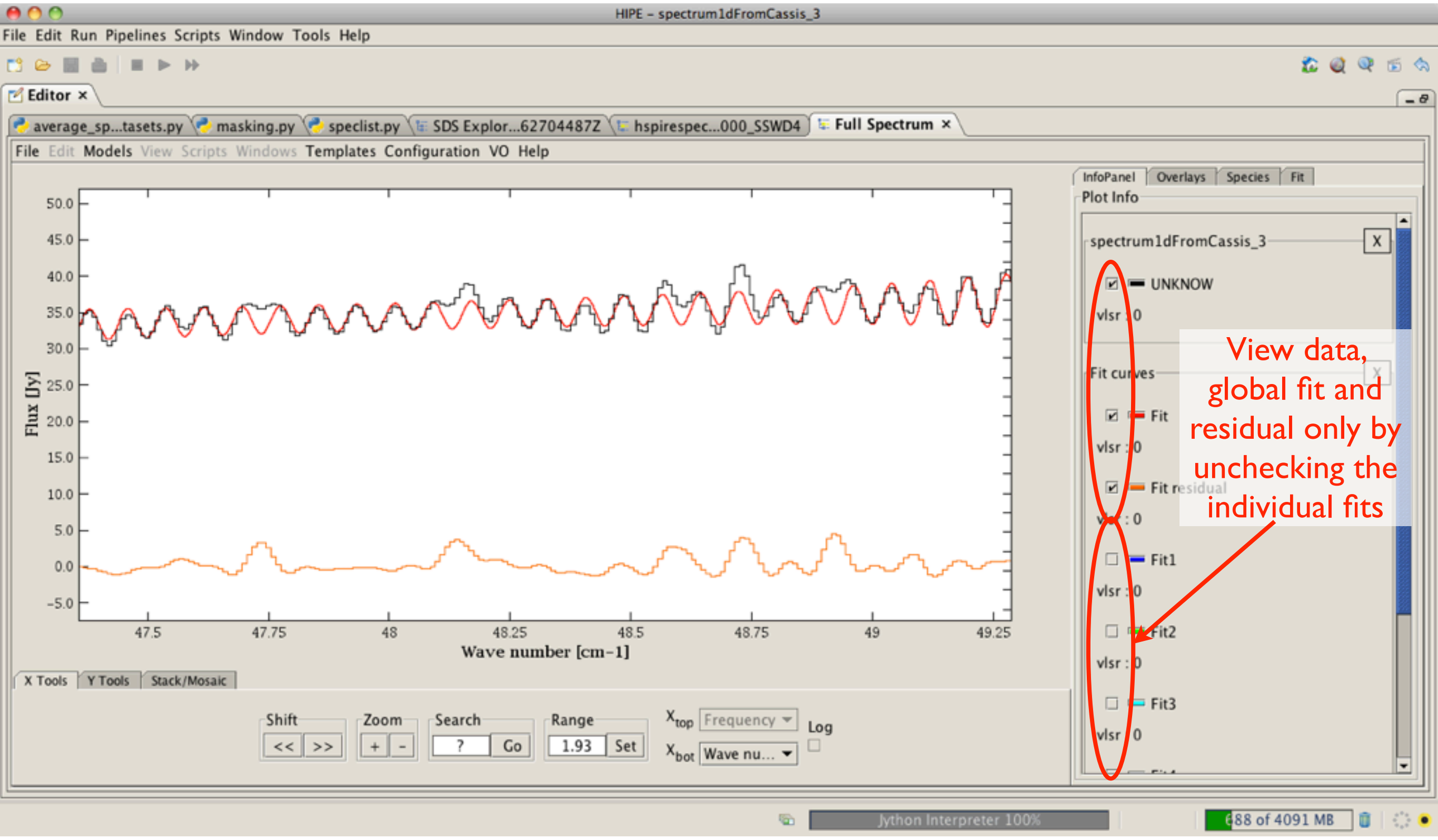


4.3. Sinc profile removal



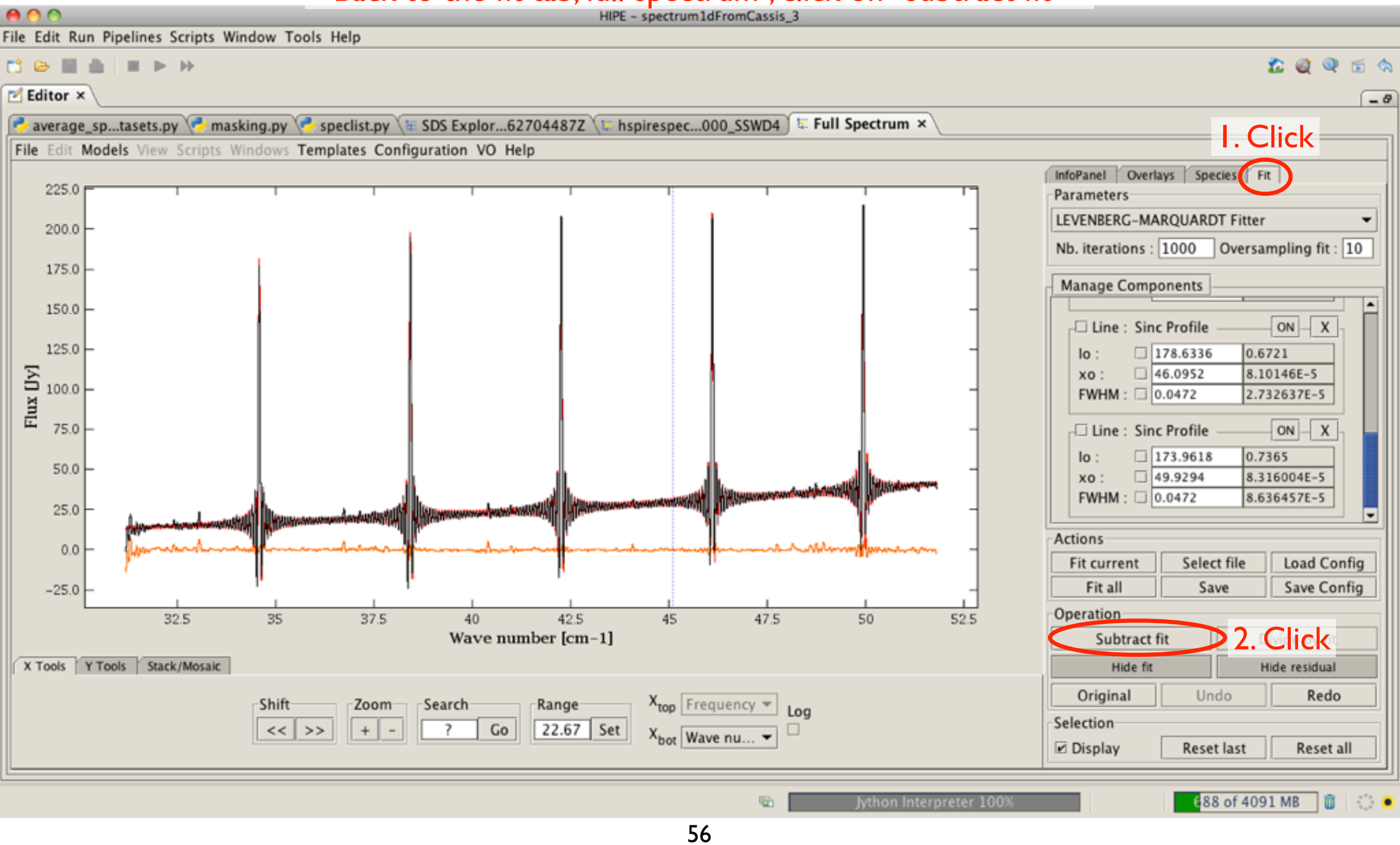
(Note: Click and drag from lower right to upper left to unzoom)

4.3. Sinc profile removal



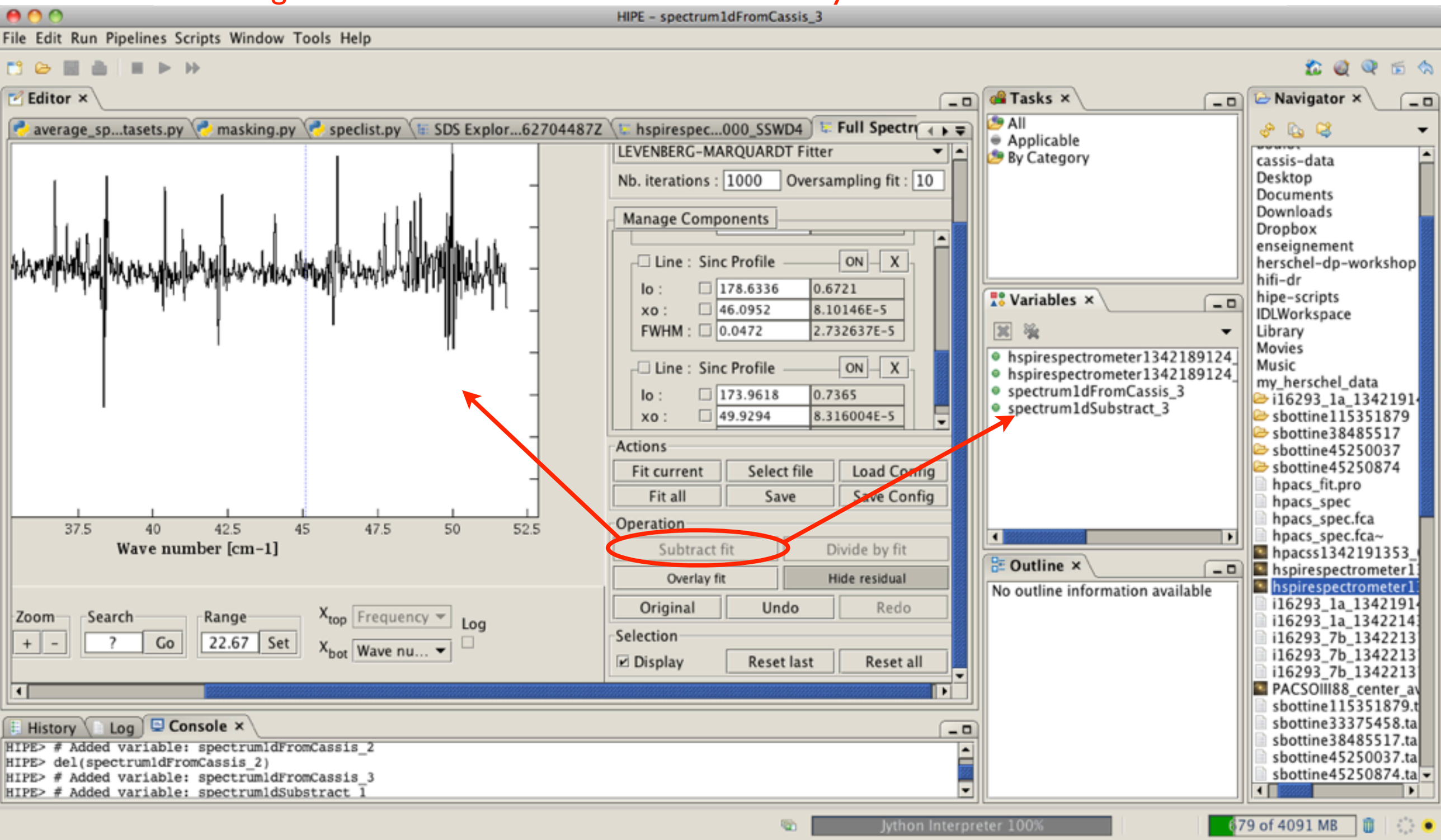
4.3. Sinc profile removal

Back to the fit tab, full spectrum ; click on "Subtract fit"

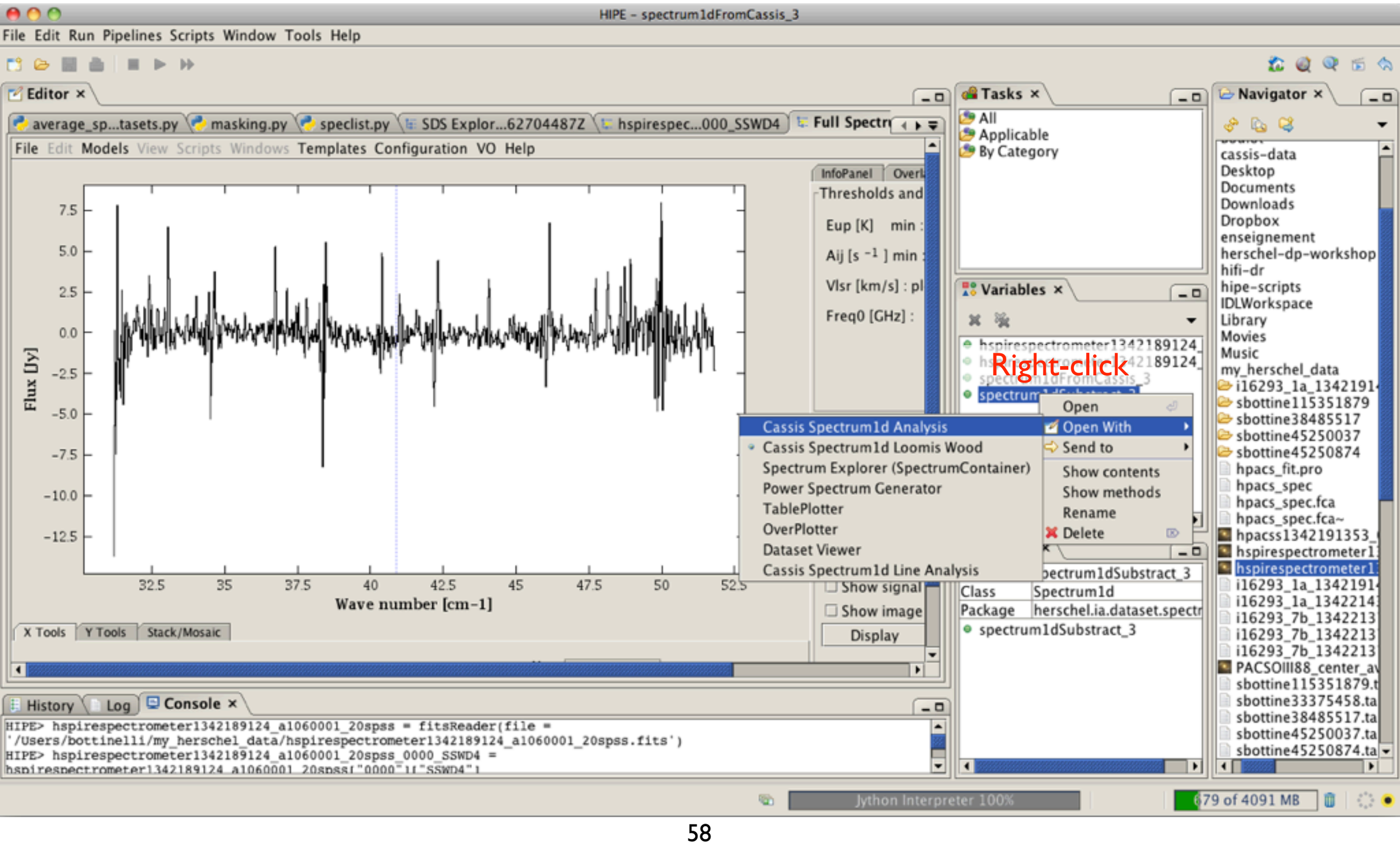


4.3. Sinc profile removal

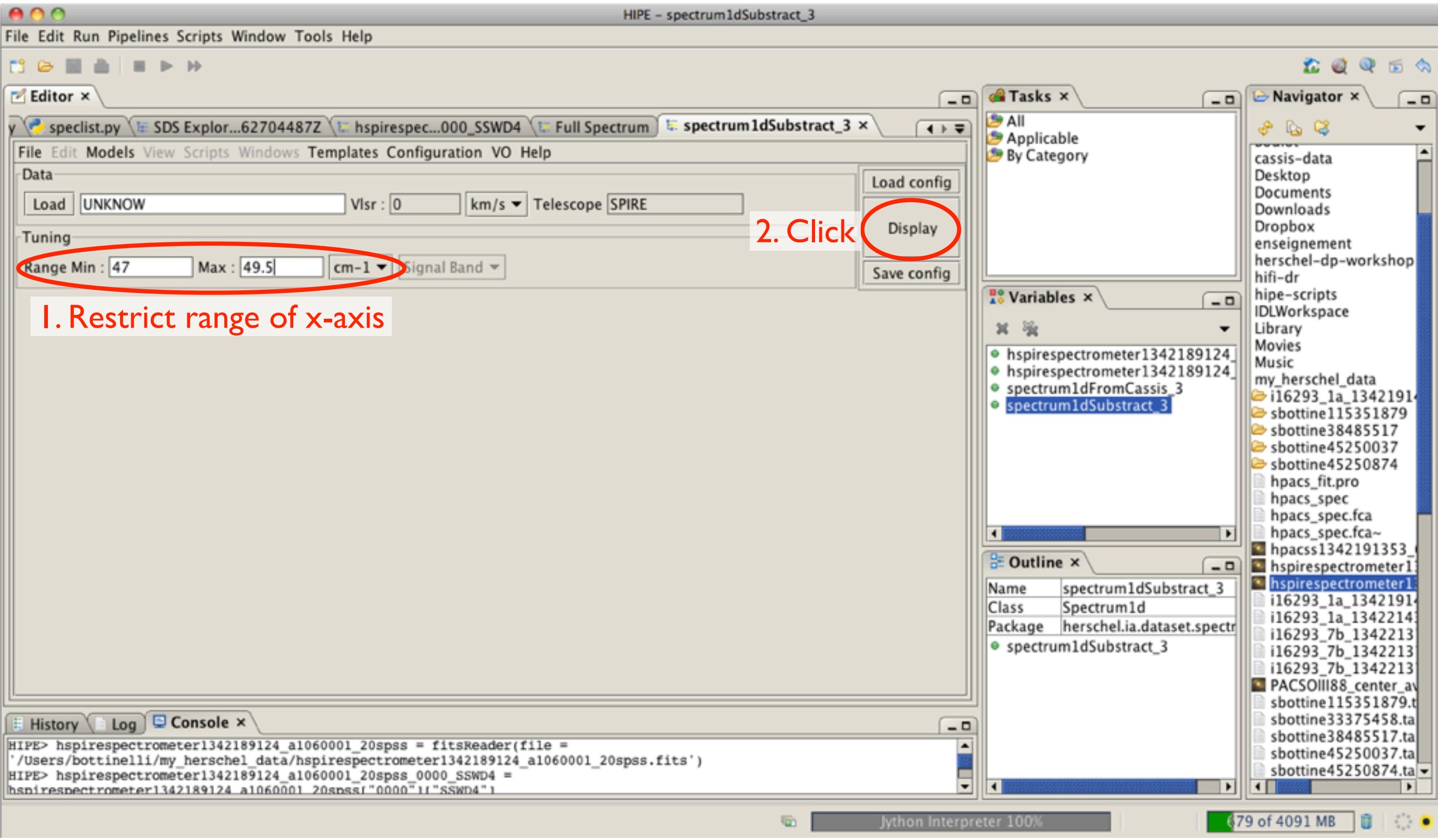
Clicking on "Subtract fit" shows the residual only and creates a variable in HIPE



4.3. Sinc profile removal : line identification



4.3. Sinc profile removal : line identification



4.3. Sinc profile removal : line identification