CASSIS as a plug-in tool in HIPE 10.0

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To install, select Plug-ins from the Tools menu. Click Install new and enter the following URL:

http://cassis.irap.omp.eu/download/cassis_3.2.jar

If you have an old version of this plugin, please remove it (using “File” “Remove completely” on the plug-ins panel) and install the new version.

Open Hipe 10 with enough memory:

java.vm.memory.max=5120m

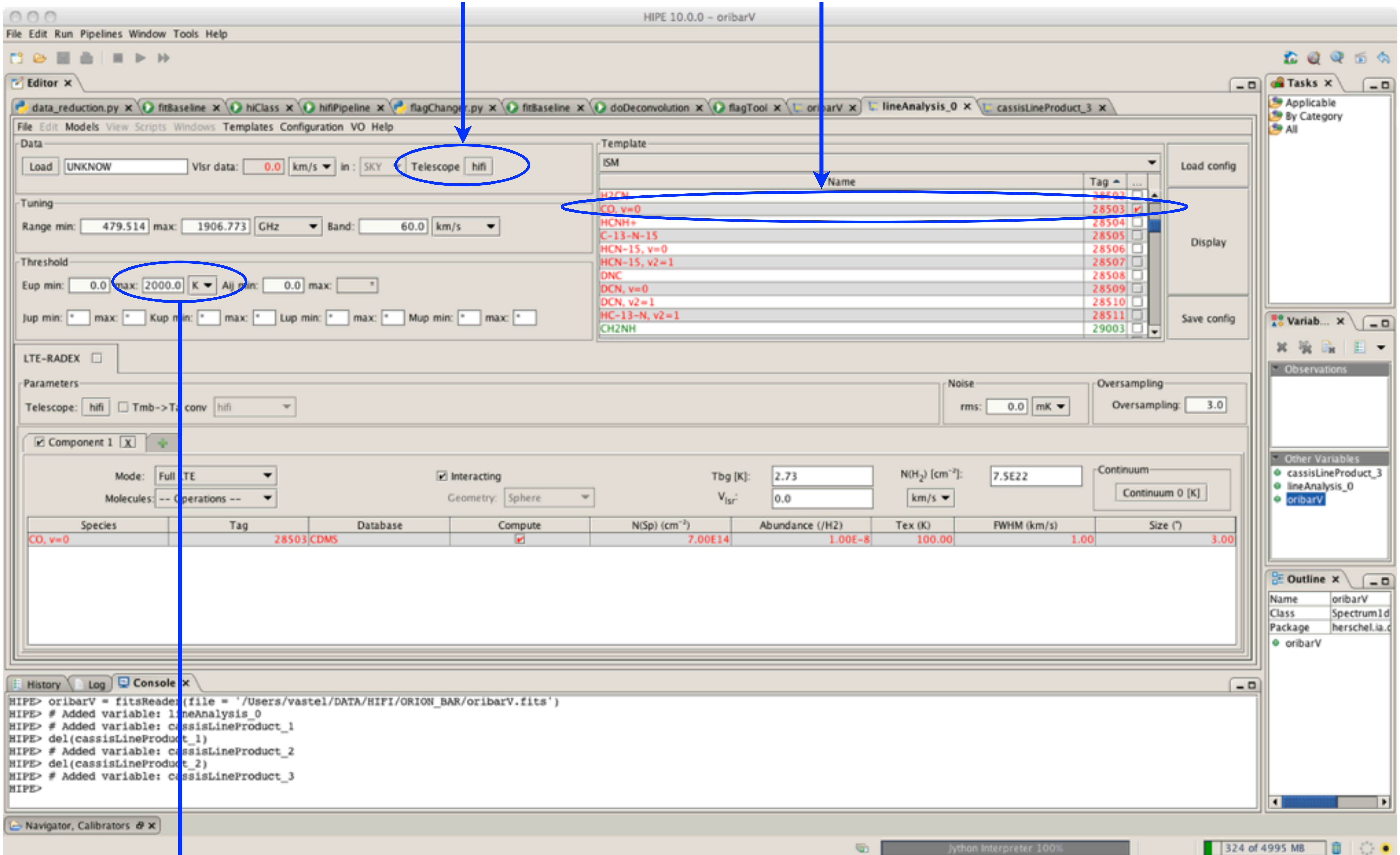
hcss.ia.pal.pool.lstore.dir=/Users/vastel/.hcss/lstore

Open the oribar_ALL_clean.fits file through the navigator or through the Console:

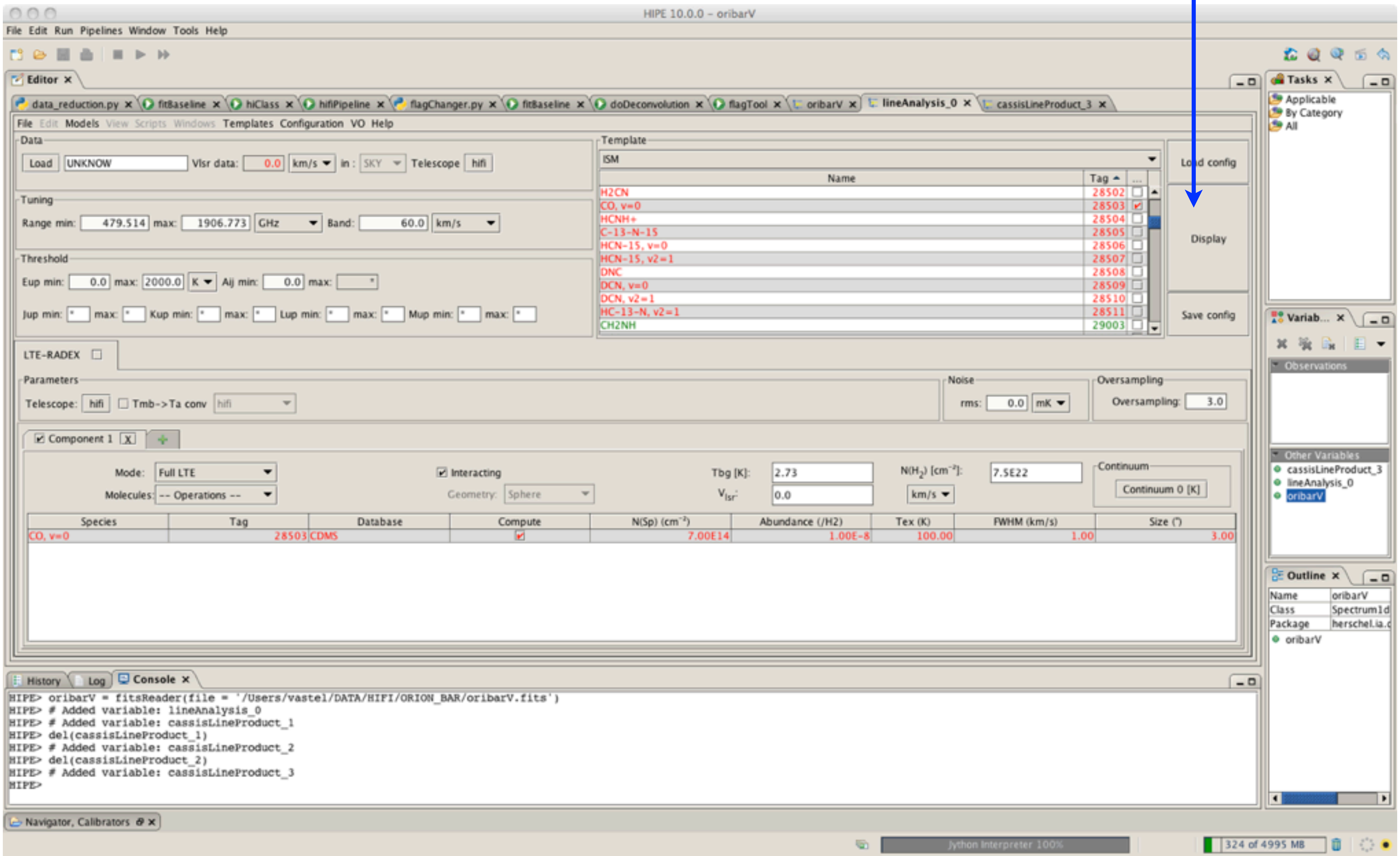
oribar_ALL_clean = fitsReader(file = '/Users/vastel/DATA/HIFI/ORION_BAR/oribar_ALL_clean.fits')

It creates a variable: oribar_ALL_clean. Right click on the oribar_ALL_clean variable and “open with” “CASSIS Spectrum1dLineAnalysis” select HIFI

Click on CO

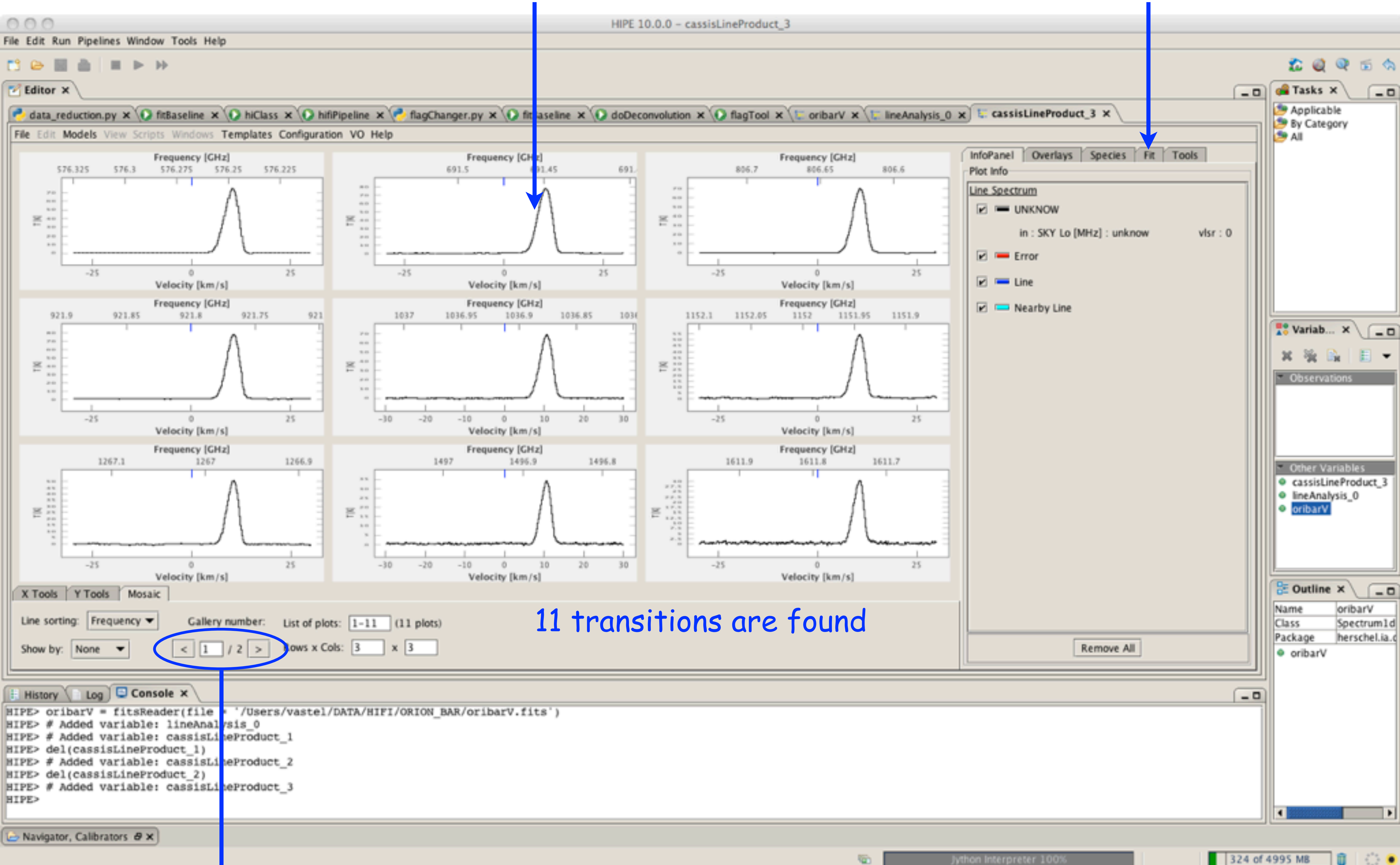


Select the upper energy: 2000K means that it will look for all the transitions for energy lower than 2000K press DISPLAY



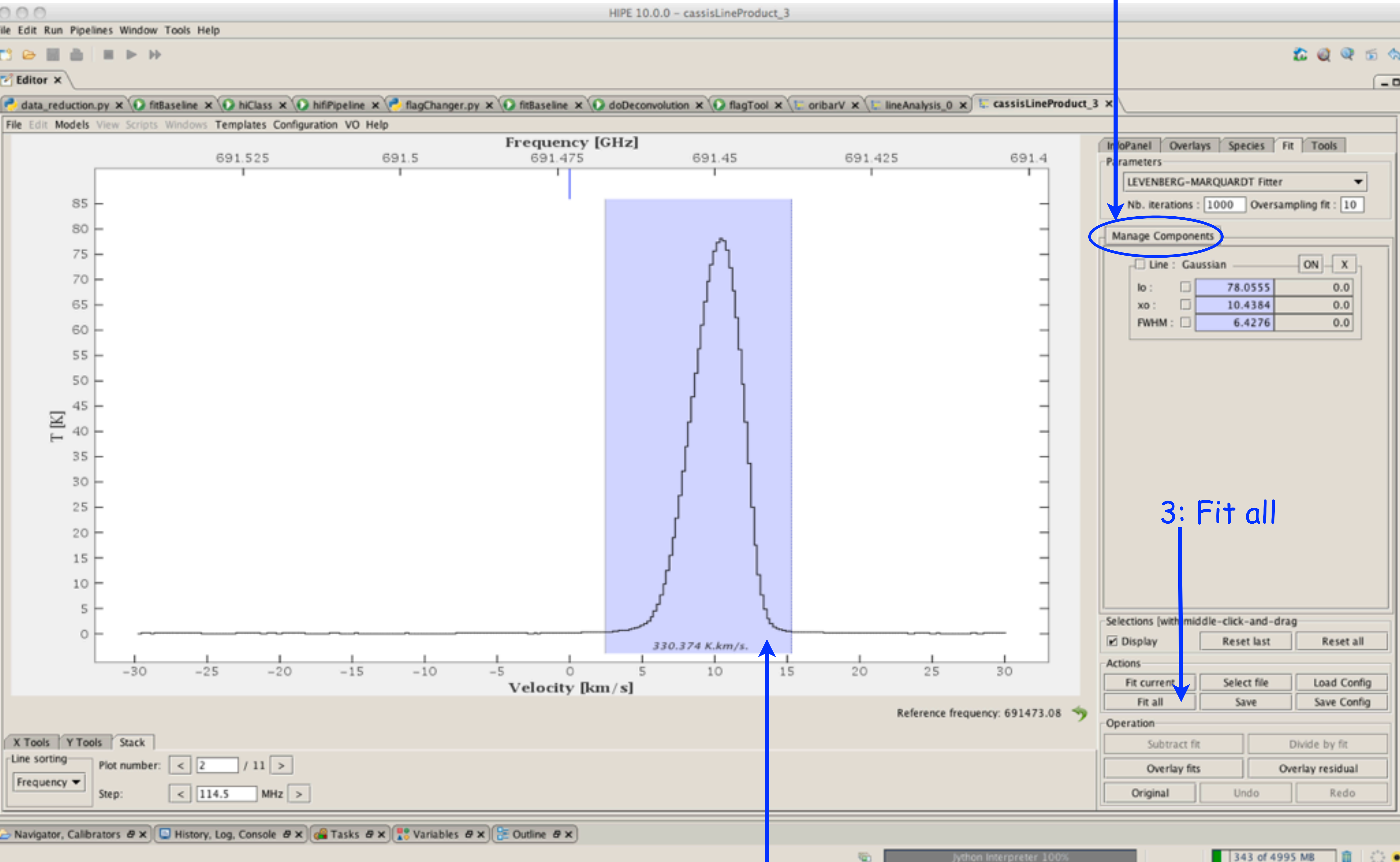
Double-Click on 1 of the transition

Click on Fit



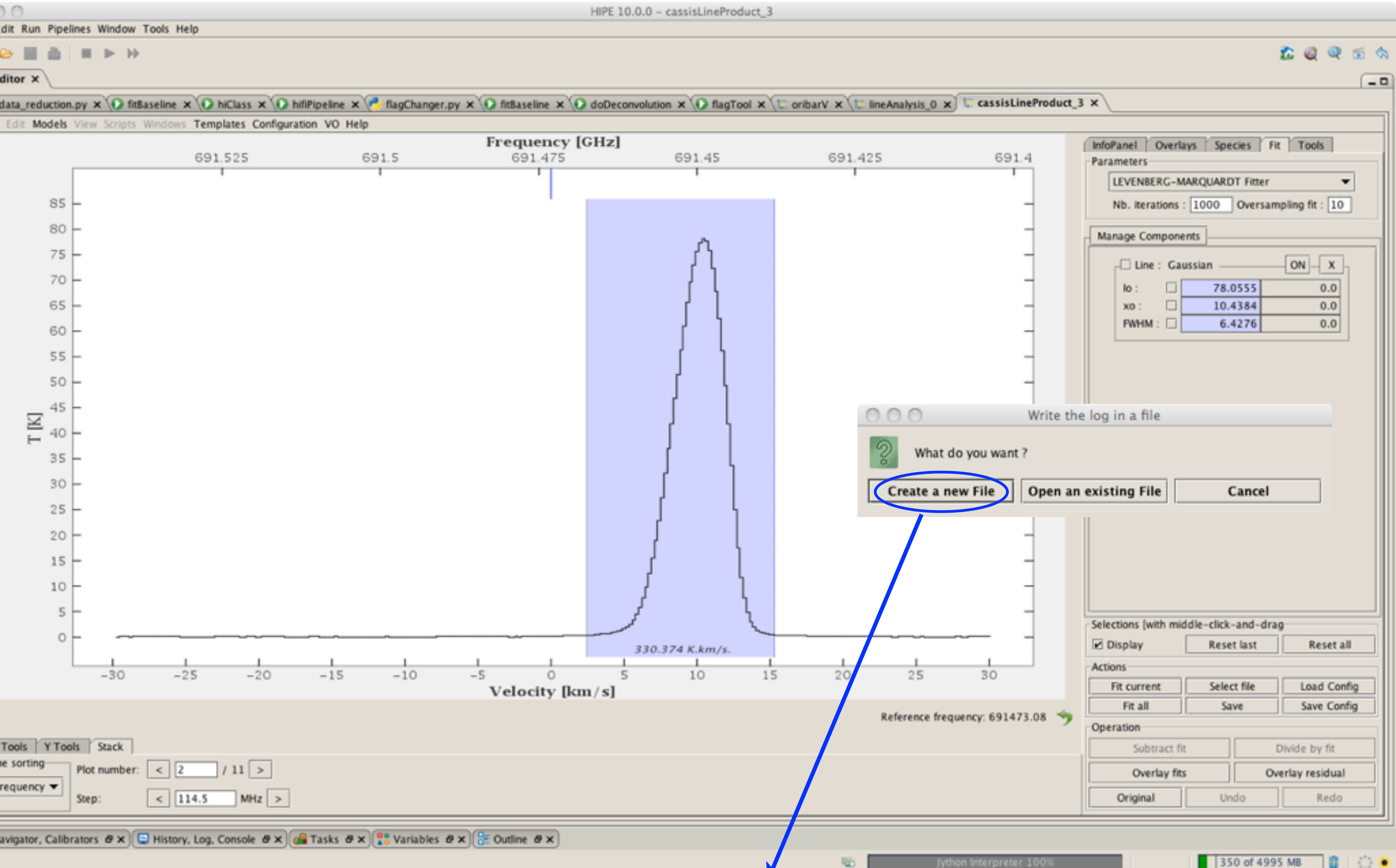
browse the transition from 1 window to another

1: Select Gaussian (the baselines are already substracted in these data, but you can also fit the continuum)

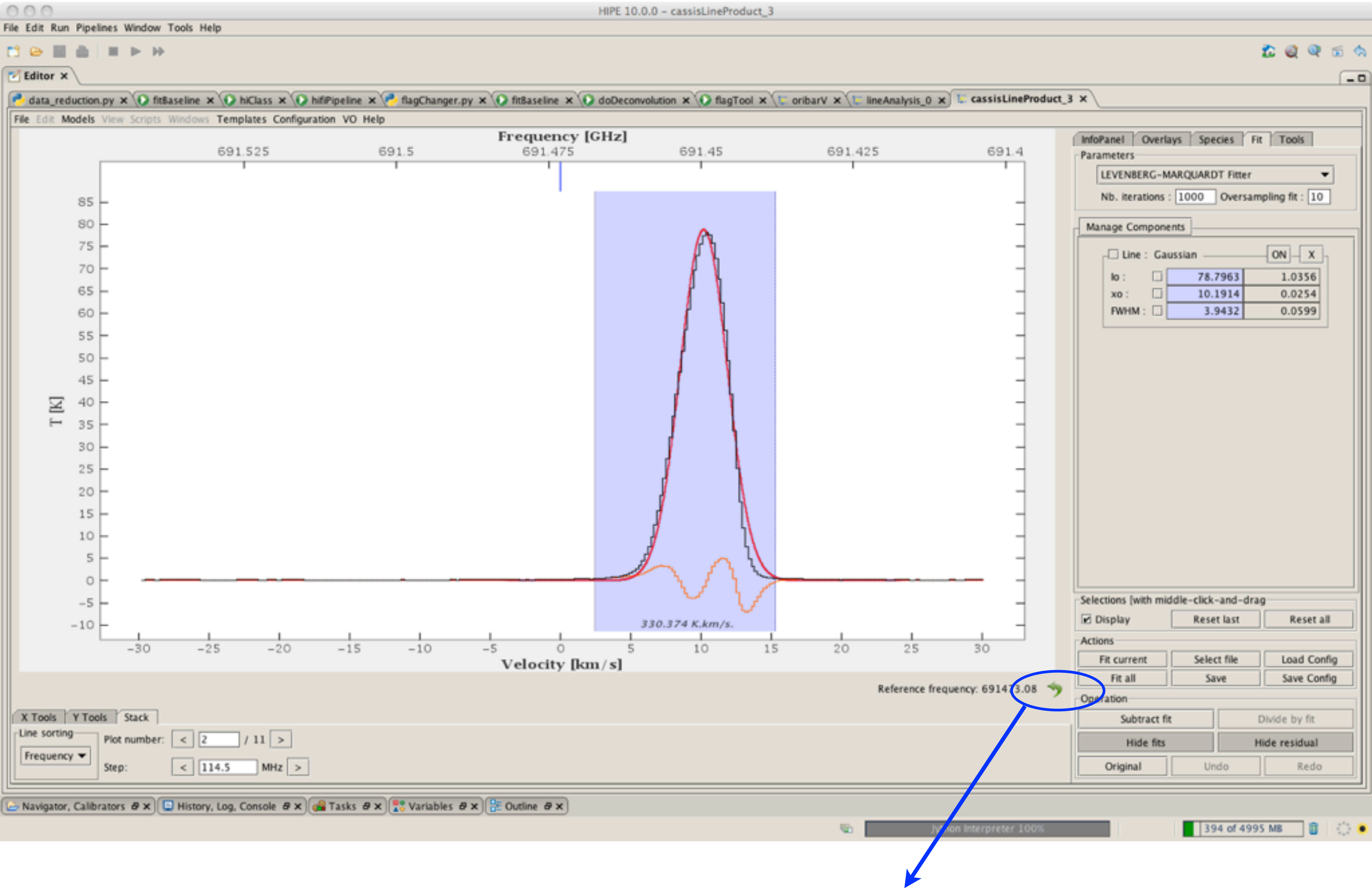


3: Fit all

2: Use your mouse (middle-click, or alt-left click if you don't have a mouse) to select the area to be fitted (here in blue)

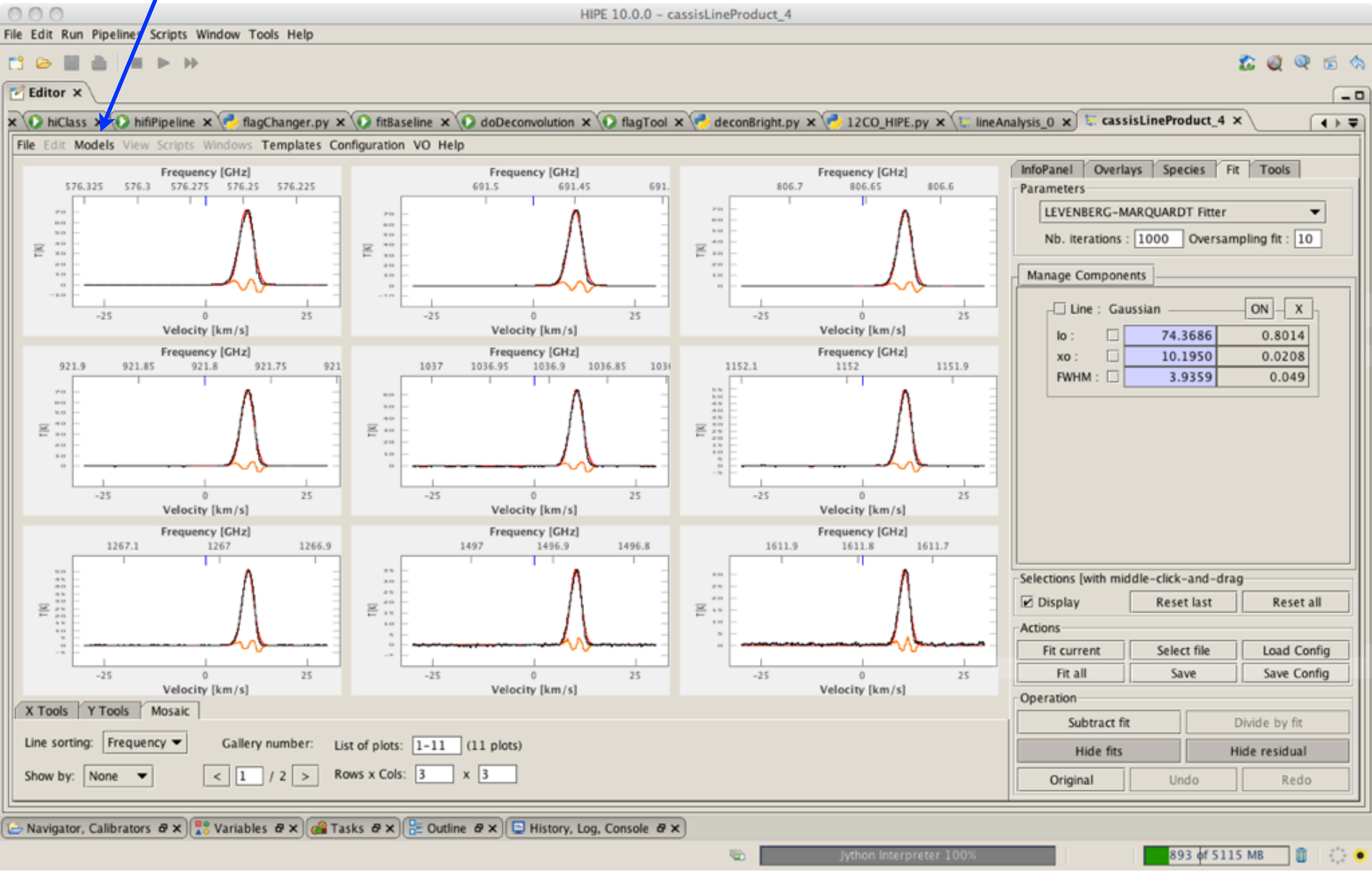


Click on "Create a new file": it will save all the fits (in this case, 1 Gaussian fit per transition, i.e. 11 fits) in the same file



Click on the green arrow to see all the fits

After admiring your beautiful fits, click on “Models”, then “Rotational Diagram”



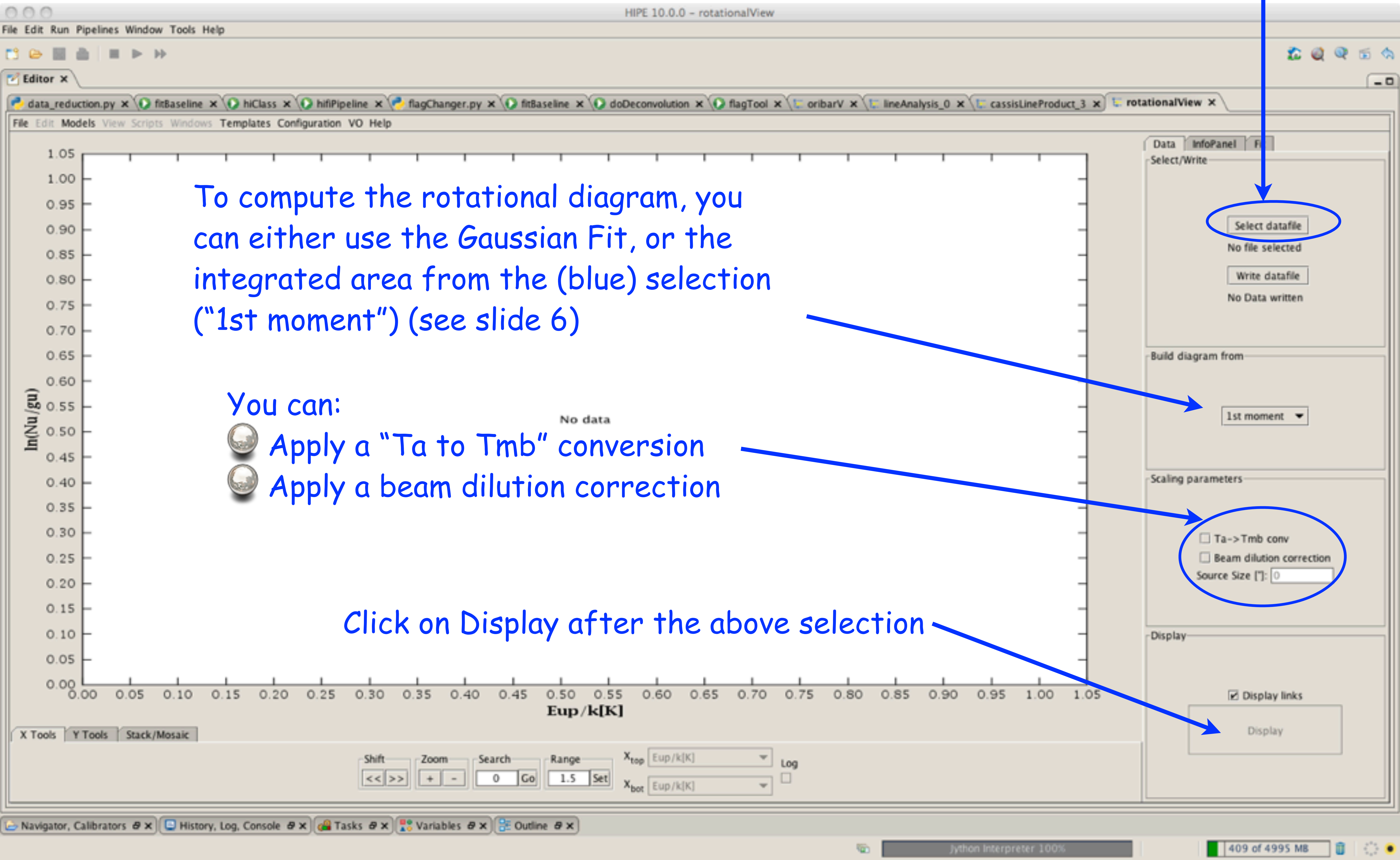
open the file that you created in Slide 7 (where the fits where saved)

To compute the rotational diagram, you can either use the Gaussian Fit, or the integrated area from the (blue) selection ("1st moment") (see slide 6)

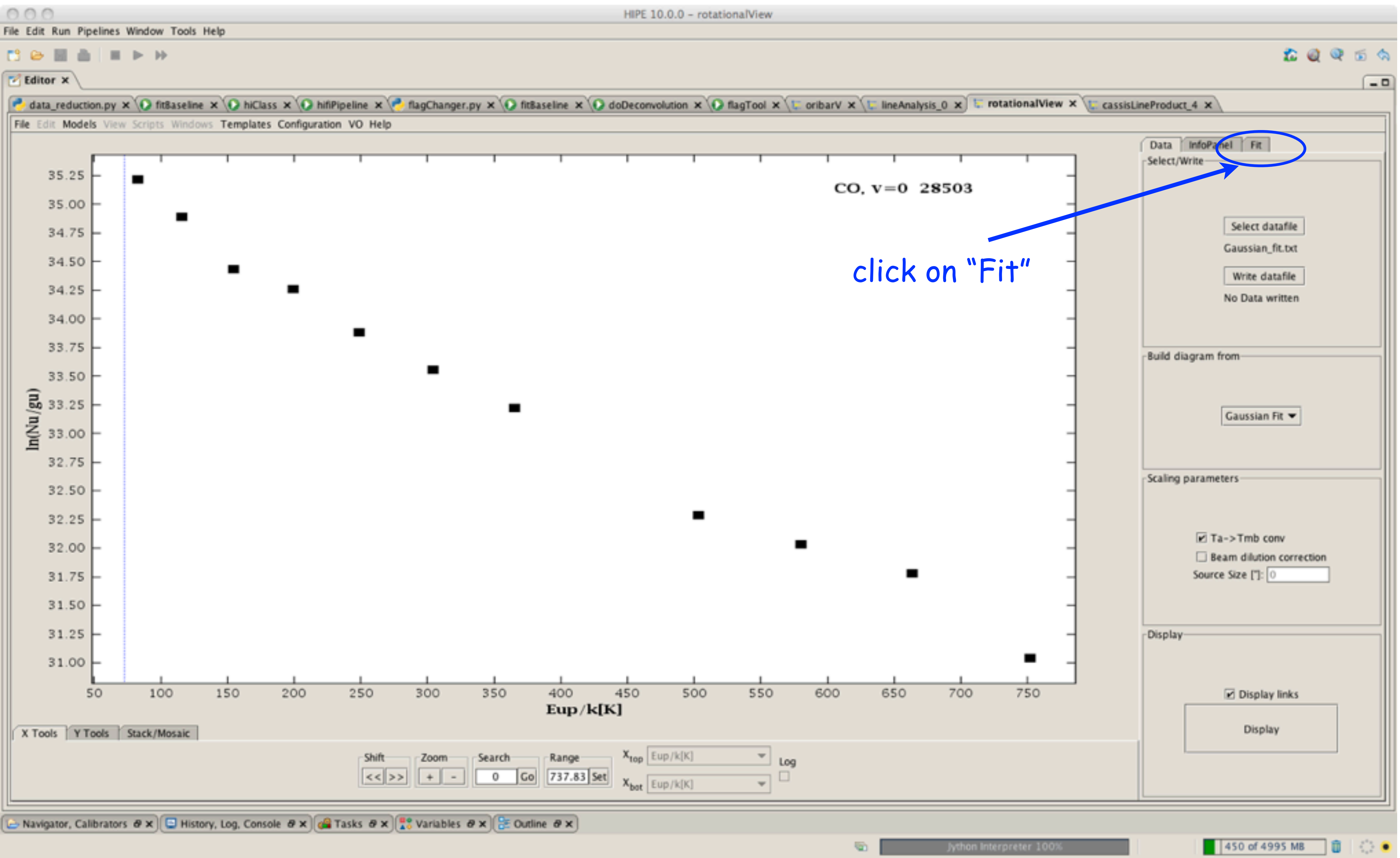
You can:

- Apply a "Ta to Tmb" conversion
- Apply a beam dilution correction

Click on Display after the above selection

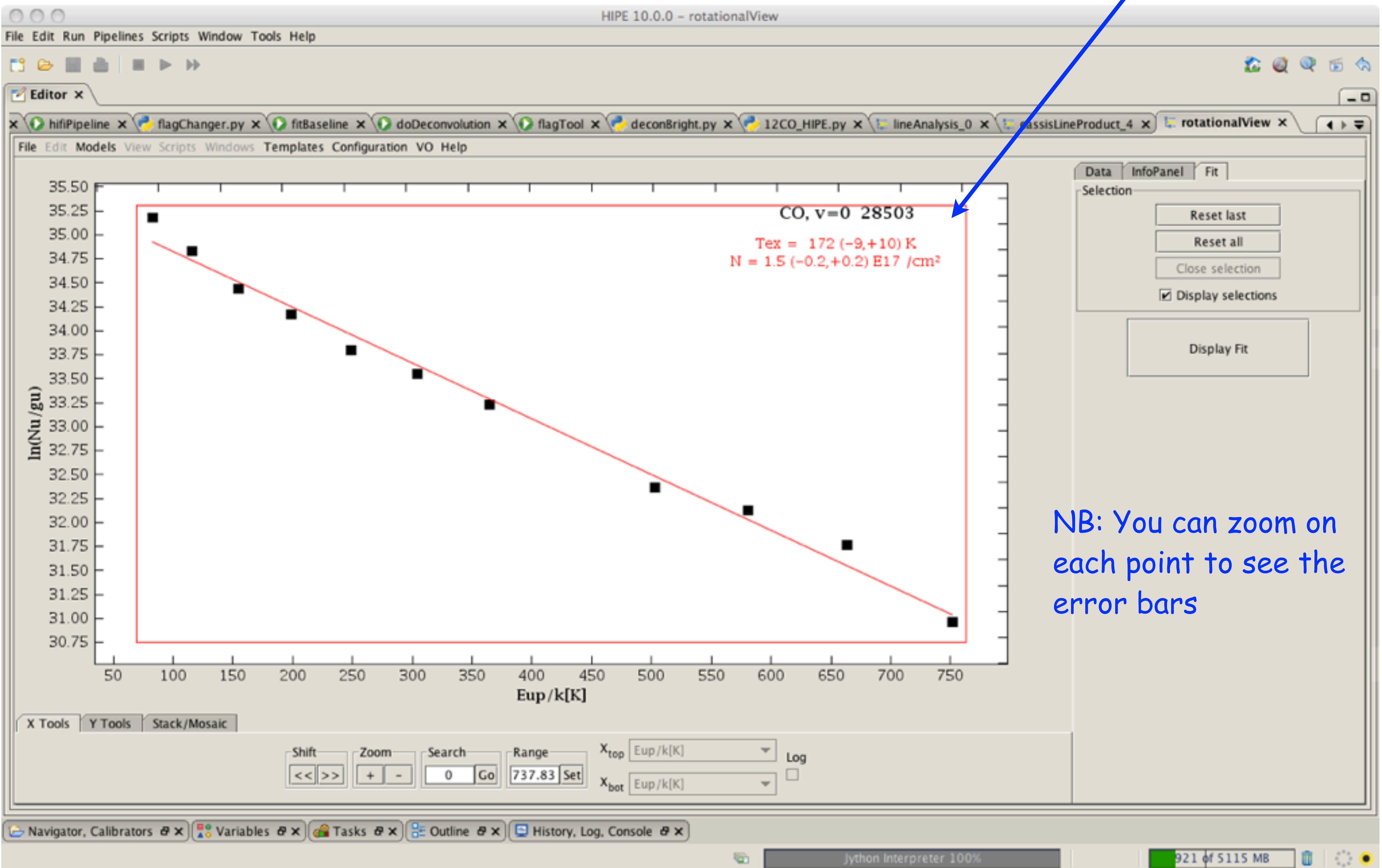


Here are the 11 transitions. You can double-click on each transition to see the informations



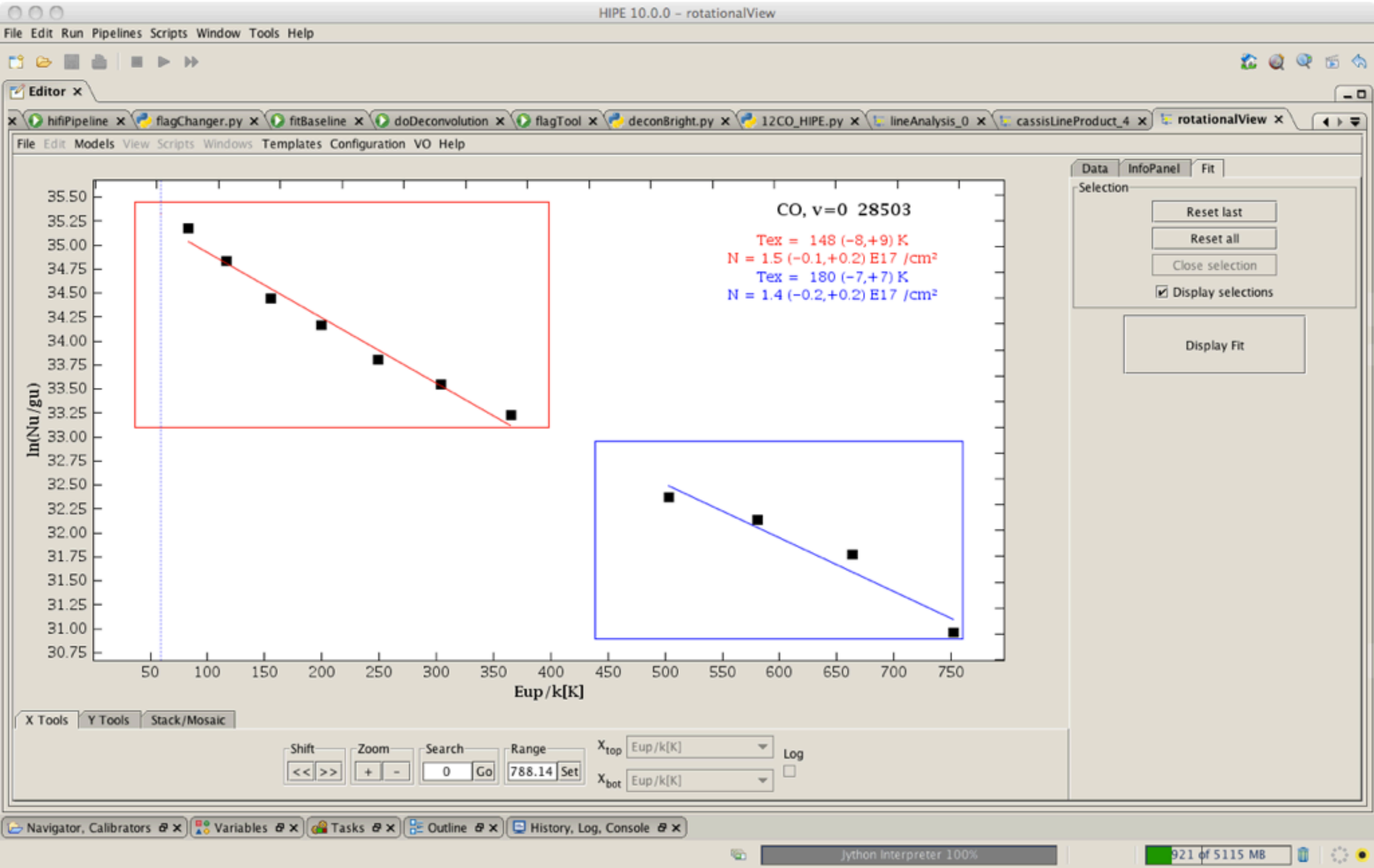
1: Select all your points (or some of them, by using your middle-click),
2: Click on "Close selection"
3: "Display Fit"

results from the rotational diagram

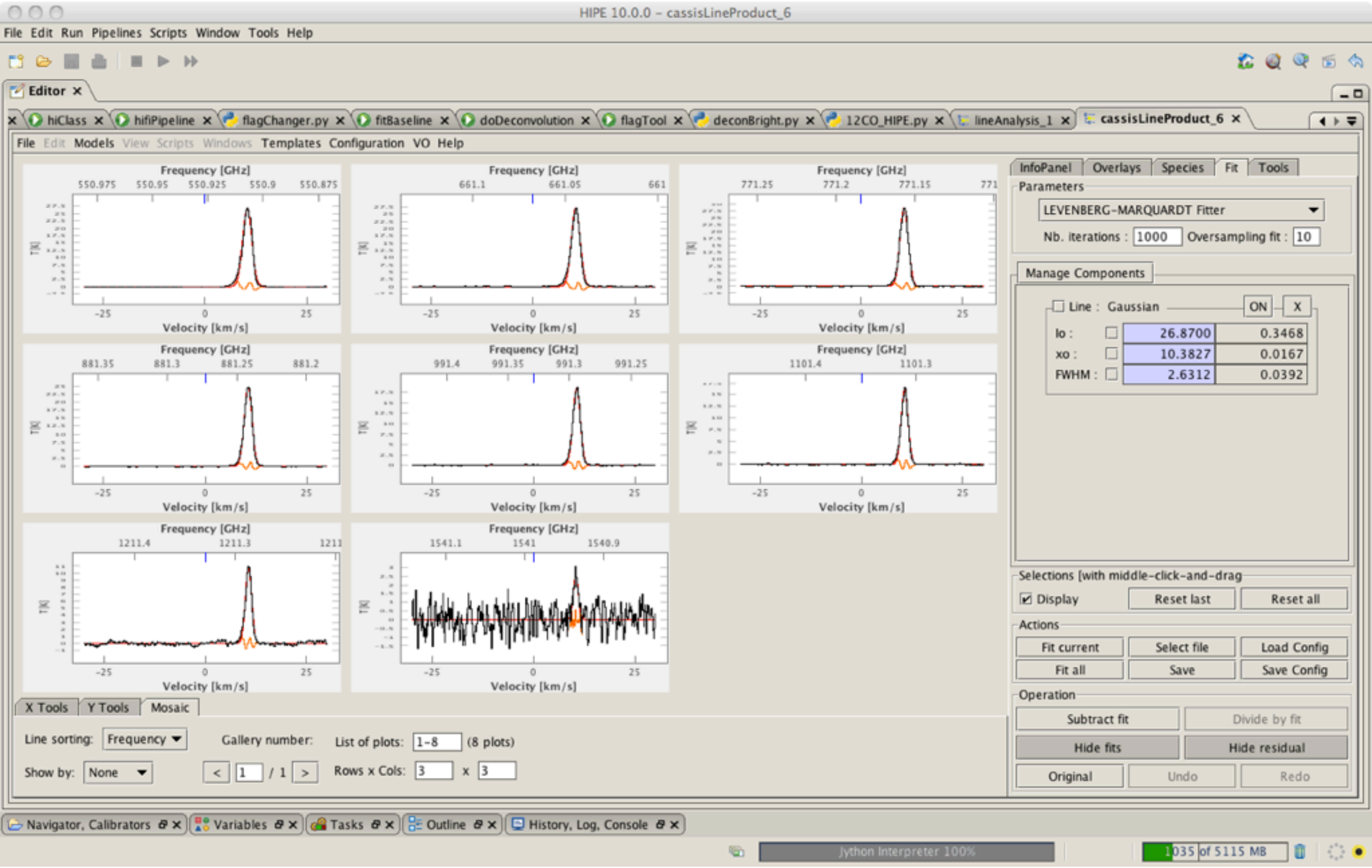


NB: You can zoom on each point to see the error bars

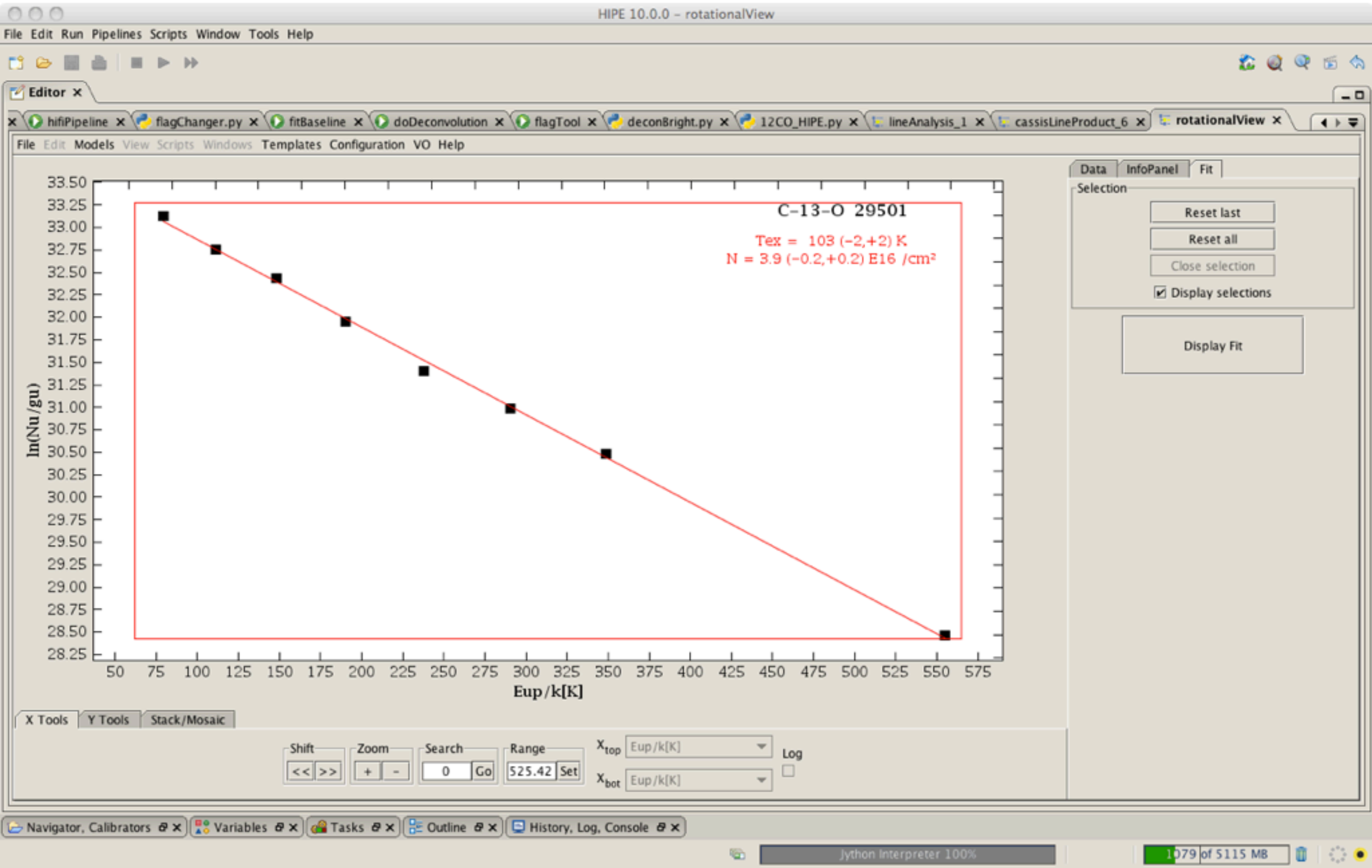
You can also decide for different components. Below 2 components with different Tex and N.



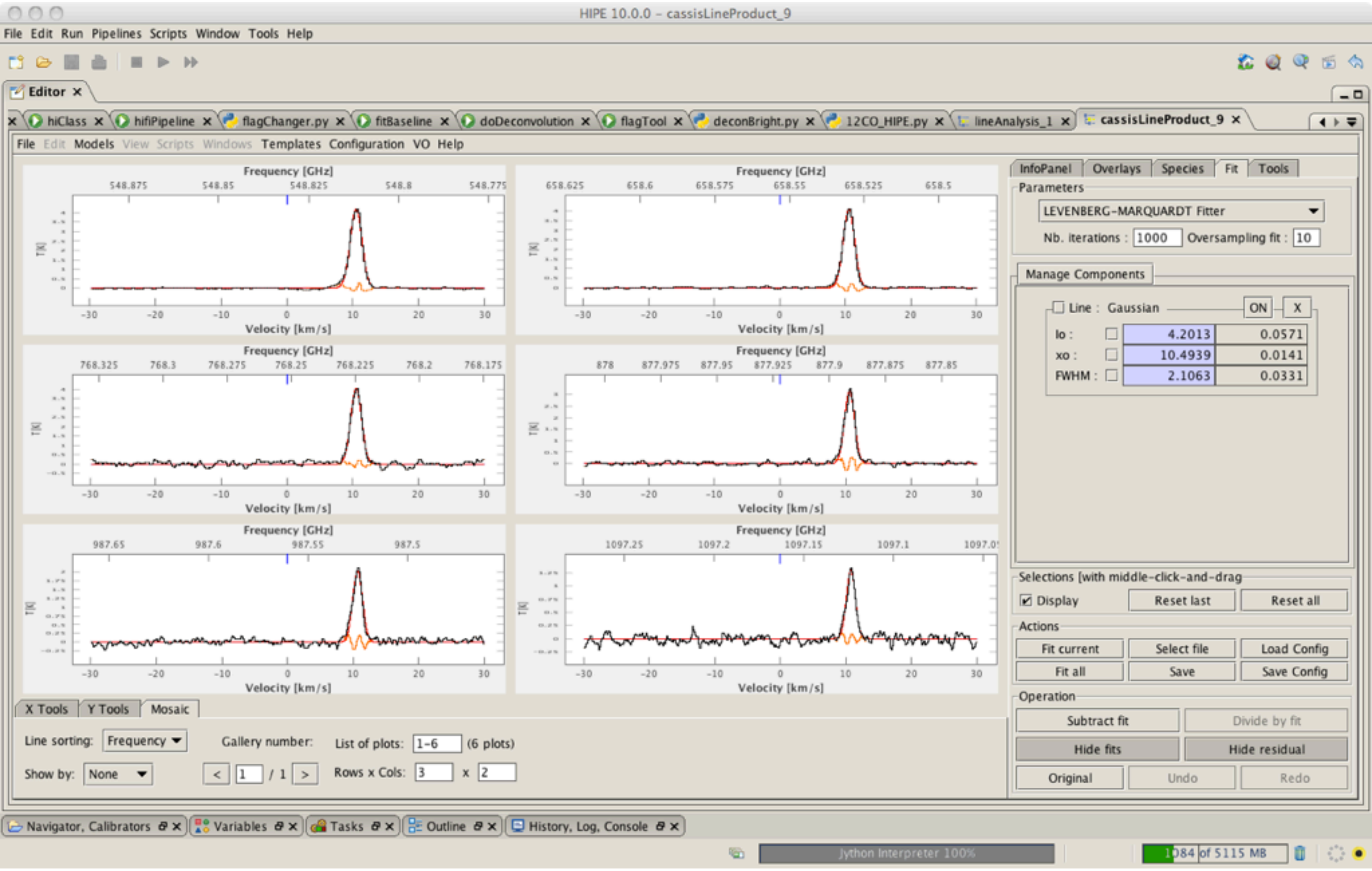
Same thing for ^{13}CO (select Eup lower than 630 K)



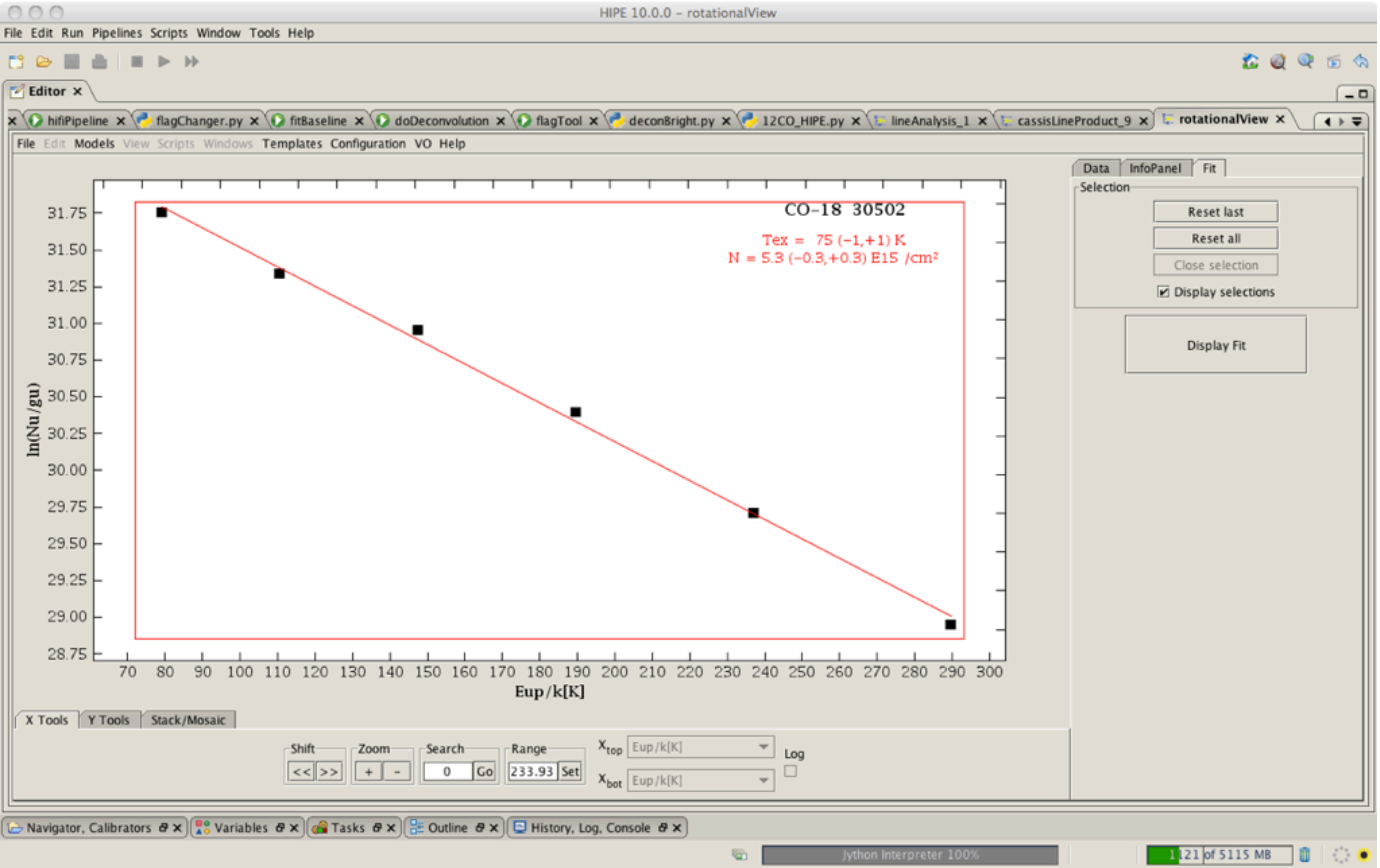
results for ^{13}CO



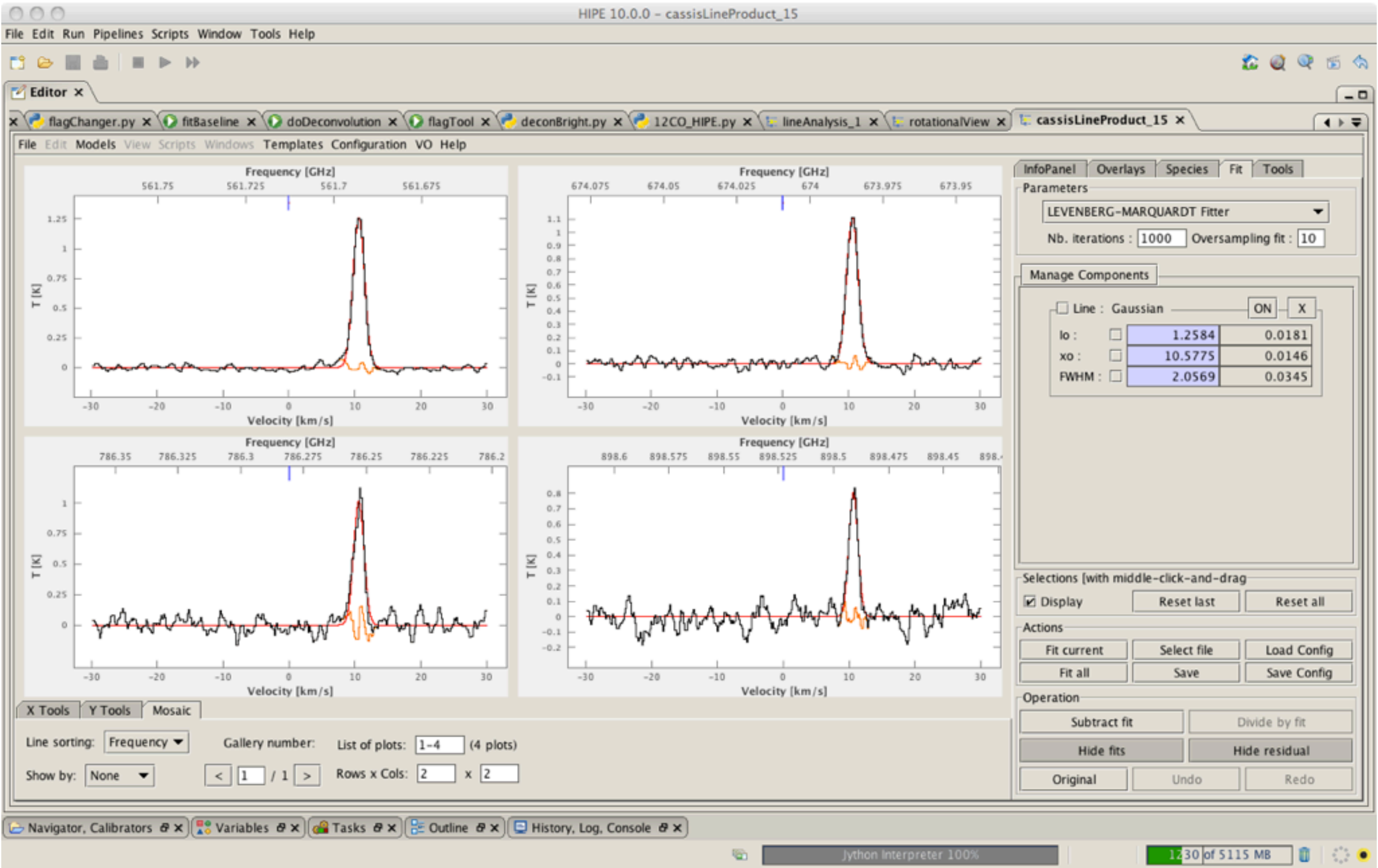
Same thing for $C^{18}O$ (select Eup lower than 300 K)



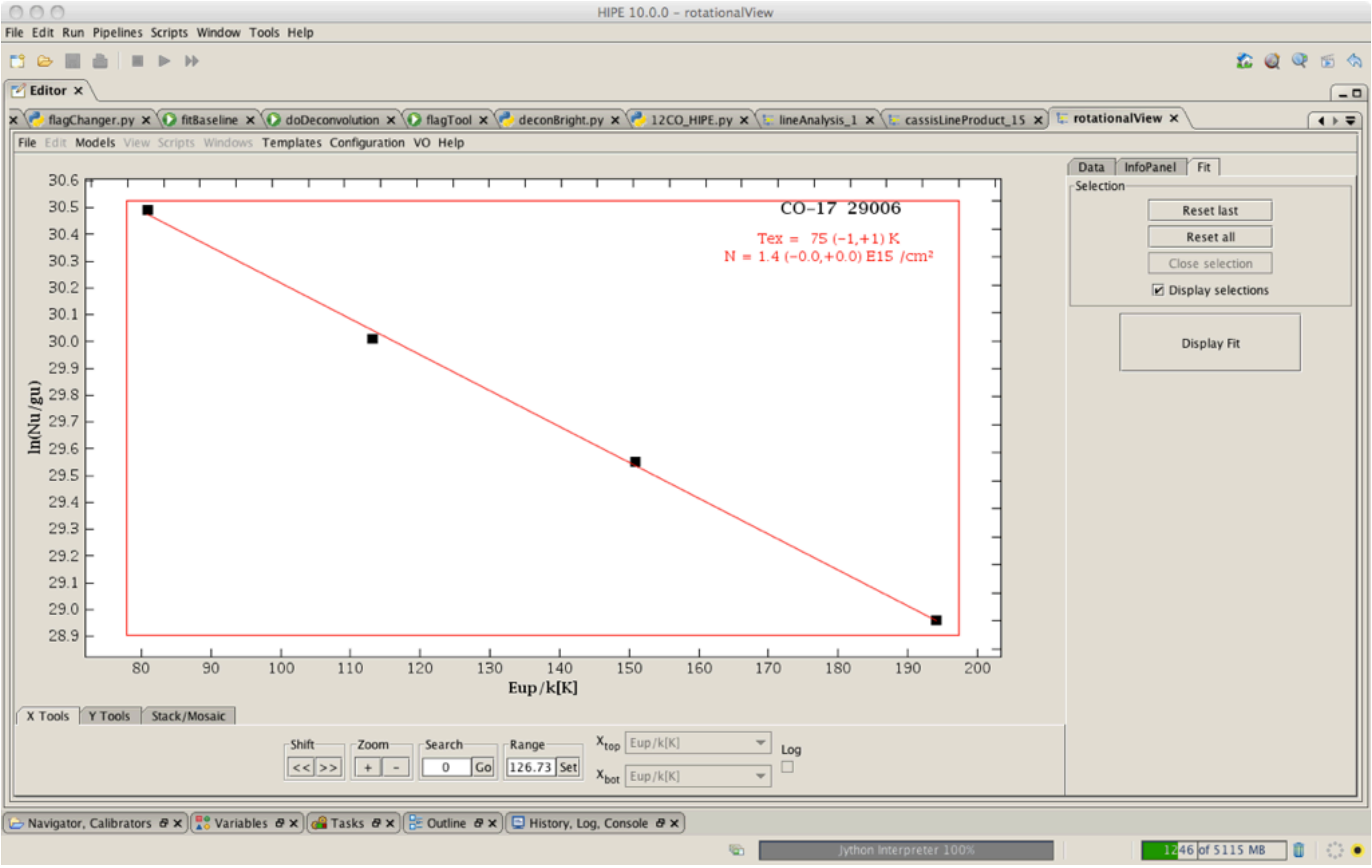
results for $C^{18}O$



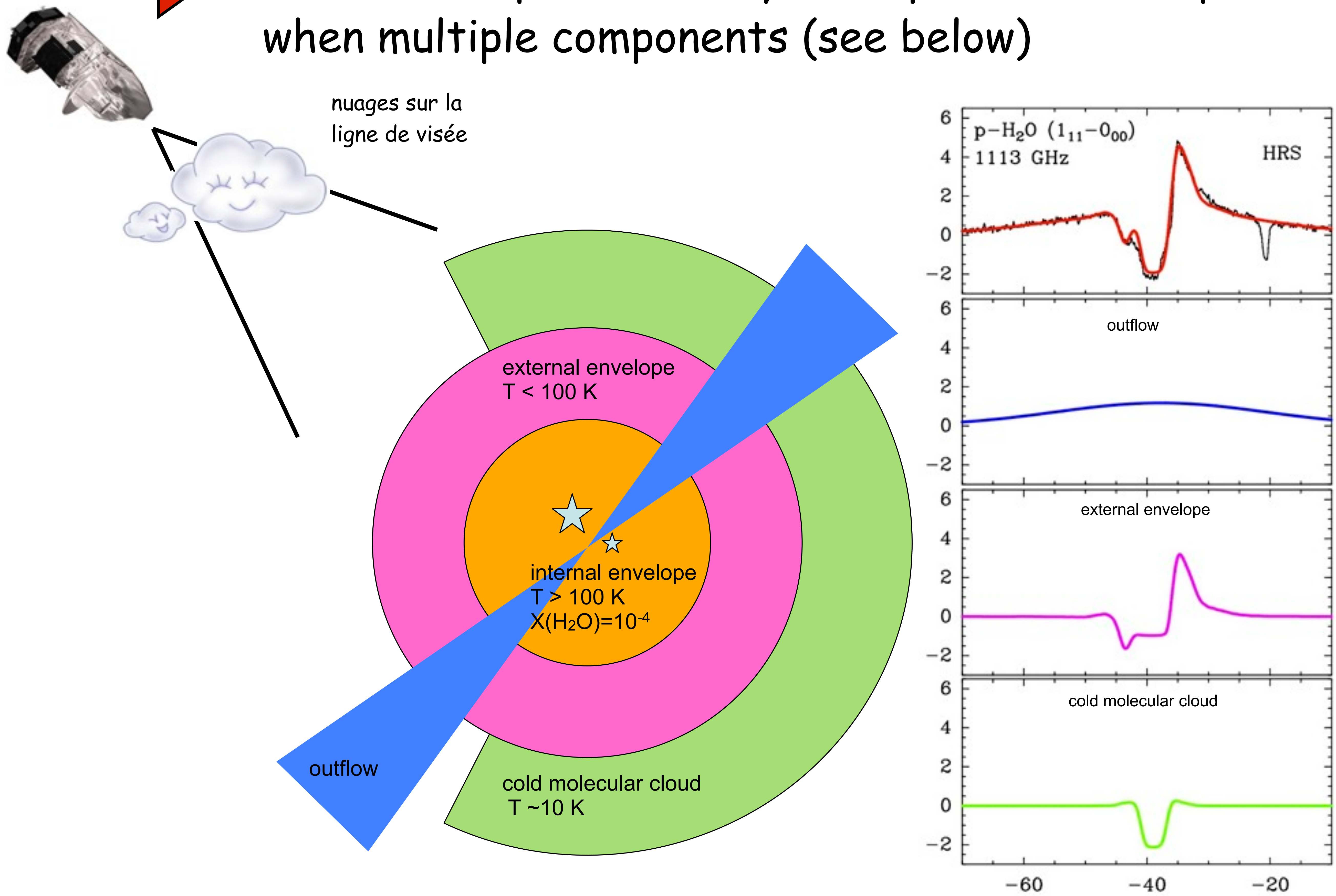
Same thing for $C^{17}O$ (select Eup lower than 300 K), with JPL database (no hyperfine structure)



results for $C^{17}O$



We performed a rotational diagram analysis.
Caveats: simple when only 1 component, but impossible when multiple components (see below)



Then we might need to disentangle the many components, before doing the rotational diagram fitting for each of the components.

Also, we might need to explore the many parameters needed for complete radiative transfer modeling: excitation temperature, column density, velocity in the local standard of rest, linewidth, beam dilution, interaction with the continuum, (and H_2 density, kinetic temperature for non-LTE modeling). Then you must explore all those parameters (beware that it can be time consuming) within grids of parameters spacing. That can be done within CASSIS with the χ^2 minimization. The best fit can be found when the χ^2_{red} is minimum.

for each spectrum

$$\boxed{\chi_i^2 = \sum_{j=1}^{N} \frac{(I_{obs,j} - I_{model,j})^2}{rms_i^2 + cal_i^2 (I_{obs,j} - I_{cont,j})^2}}$$

N: number of channels in the spectrum
rms: noise in the spectrum
cal: calibration factor

I_{obs}: observed intensity within a channel
I_{model}: modeled intensity within a channel

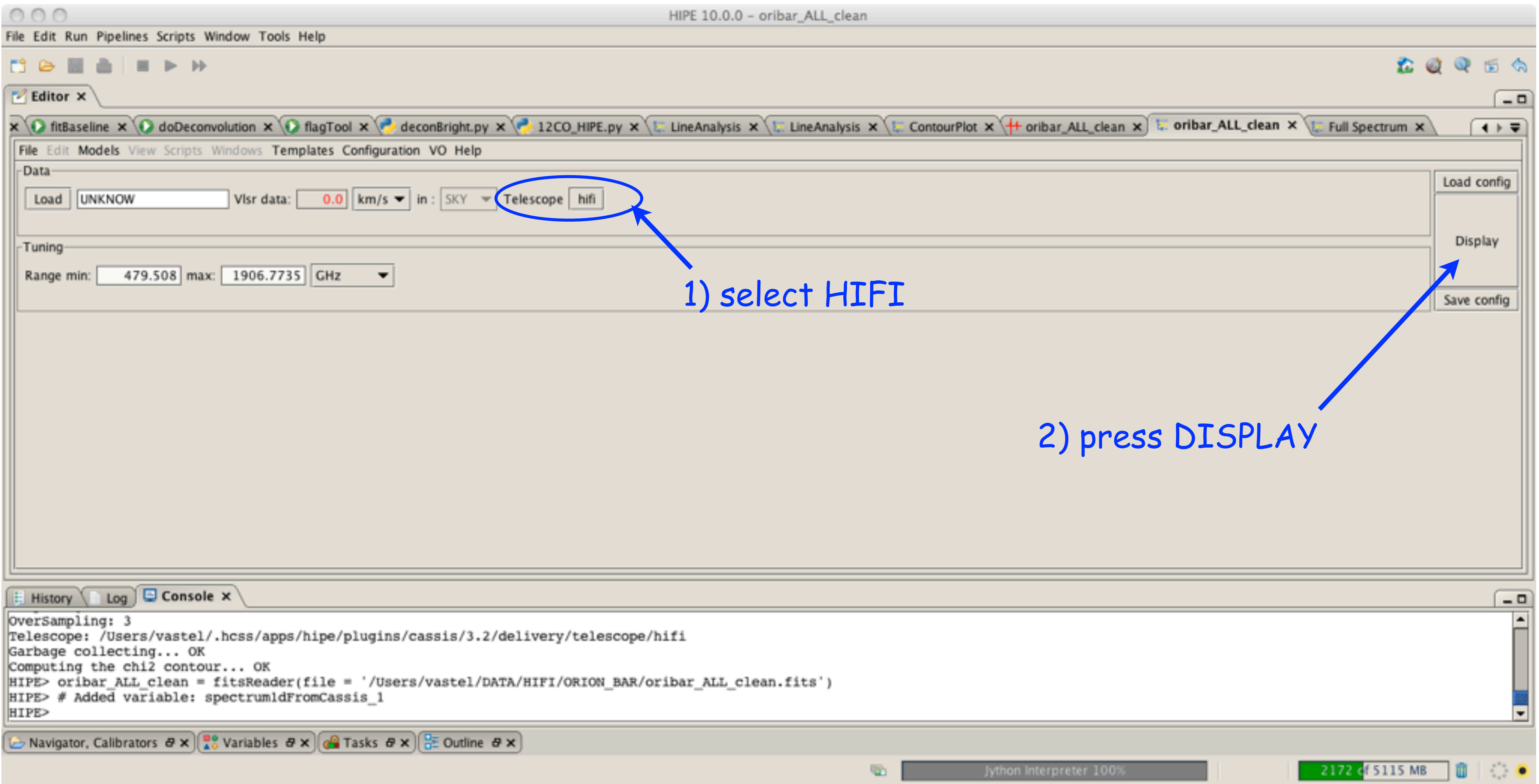
taking into account all spectra

$$\boxed{\chi^2_{reduit} = \frac{1}{N_{spectre} \sum_{i=1}^{N_{spectre}} w_i} \sum_{i=1}^{N_{spectre}} \frac{\chi_i^2 w_i}{\frac{N}{N_{ind}} - dof}}$$

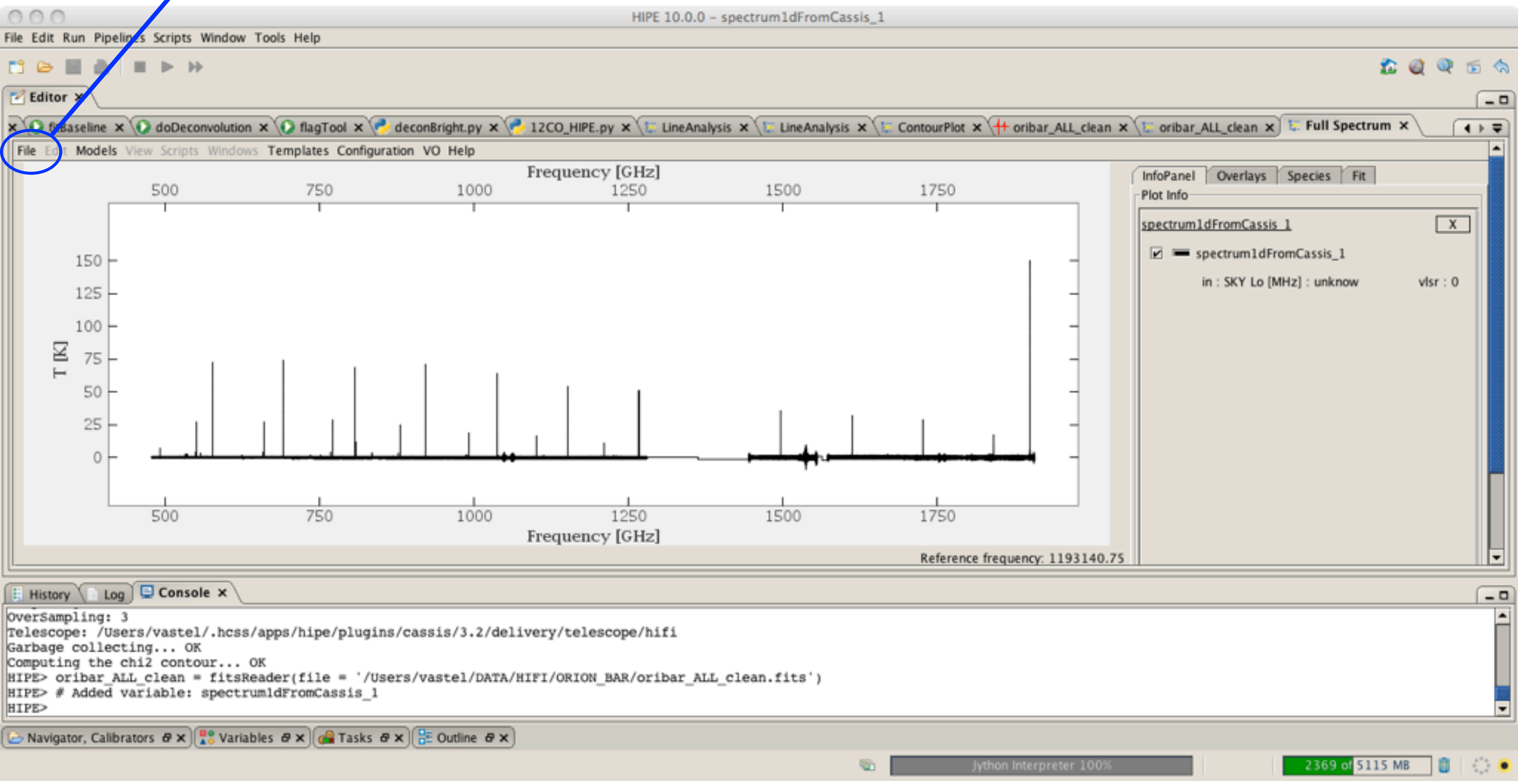
$N_{spectre}$: total number of spectra
N_{ind}: total number of independent points

dof: degree of liberty
w_i: weigth for each spectrum

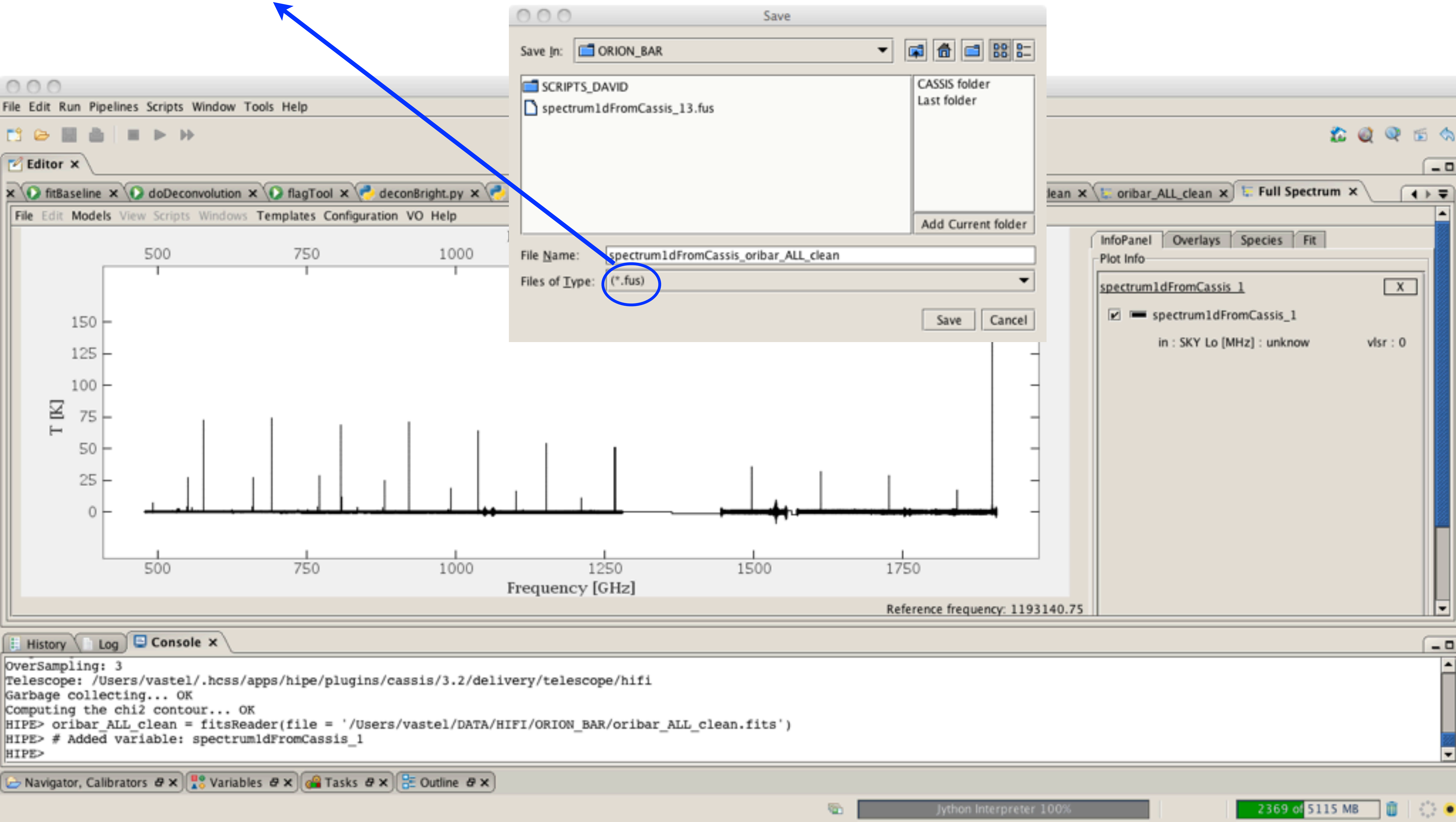
Right click on the oribar_ALL_clean variable and "open with" "CASSIS Spectrum1dAnalysis"



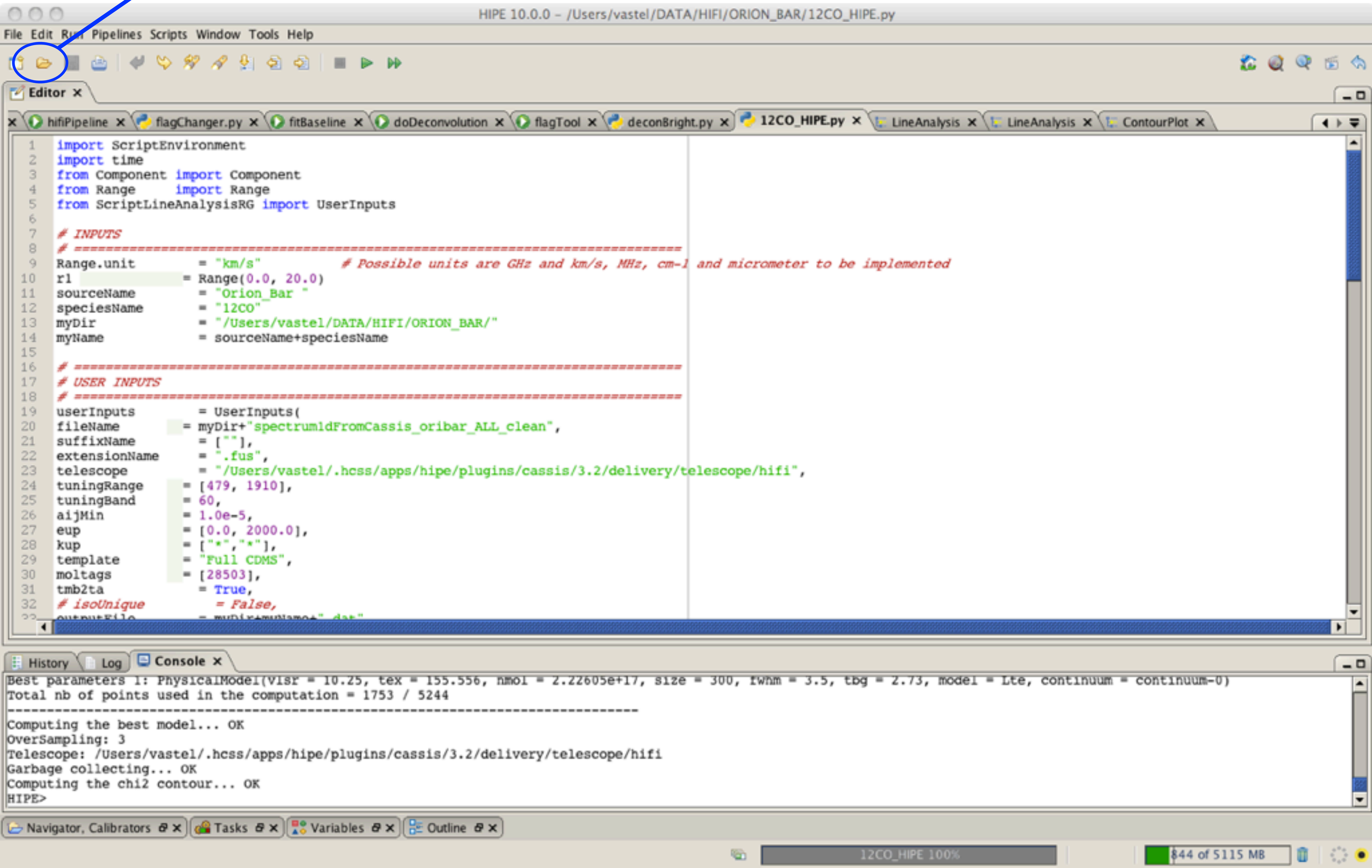
“File”, “Save”


HIPE 10.0.0 – spectrum1dFromCassis_1
File Edit Run Pipelines Scripts Window Tools Help
Editor
fitBaseline doDeconvolution flagTool deconBright.py 12CO_HIPE.py LineAnalysis LineAnalysis ContourPlot oribar_ALL_clean oribar_ALL_clean Full Spectrum
File Edit Models View Scripts Windows Templates Configuration VO Help
Frequency [GHz]
500 750 1000 1250 1500 1750
T [K]
150 125 100 75 50 25 0
Reference frequency: 1193140.75
InfoPanel Overlays Species Fit
Plot Info
spectrum1dFromCassis_1
in : SKY Lo [MHz] : unknow vlsr : 0
History Log Console
OverSampling: 3
Telescope: /Users/vastel/.hcss/apps/hipe/plugins/cassis/3.2/delivery/telescope/hifi
Garbage collecting... OK
Computing the chi2 contour... OK
HIPE> oribar_ALL_clean = fitsReader(file = '/Users/vastel/DATA/HIFI/ORION_BAR/oribar_ALL_clean.fits')
HIPE> # Added variable: spectrum1dFromCassis_1
HIPE>
Navigator, Calibrators Variables Tasks Outline
Jython Interpreter 100%
2369 of 5115 MB

Save your file as a .fus file



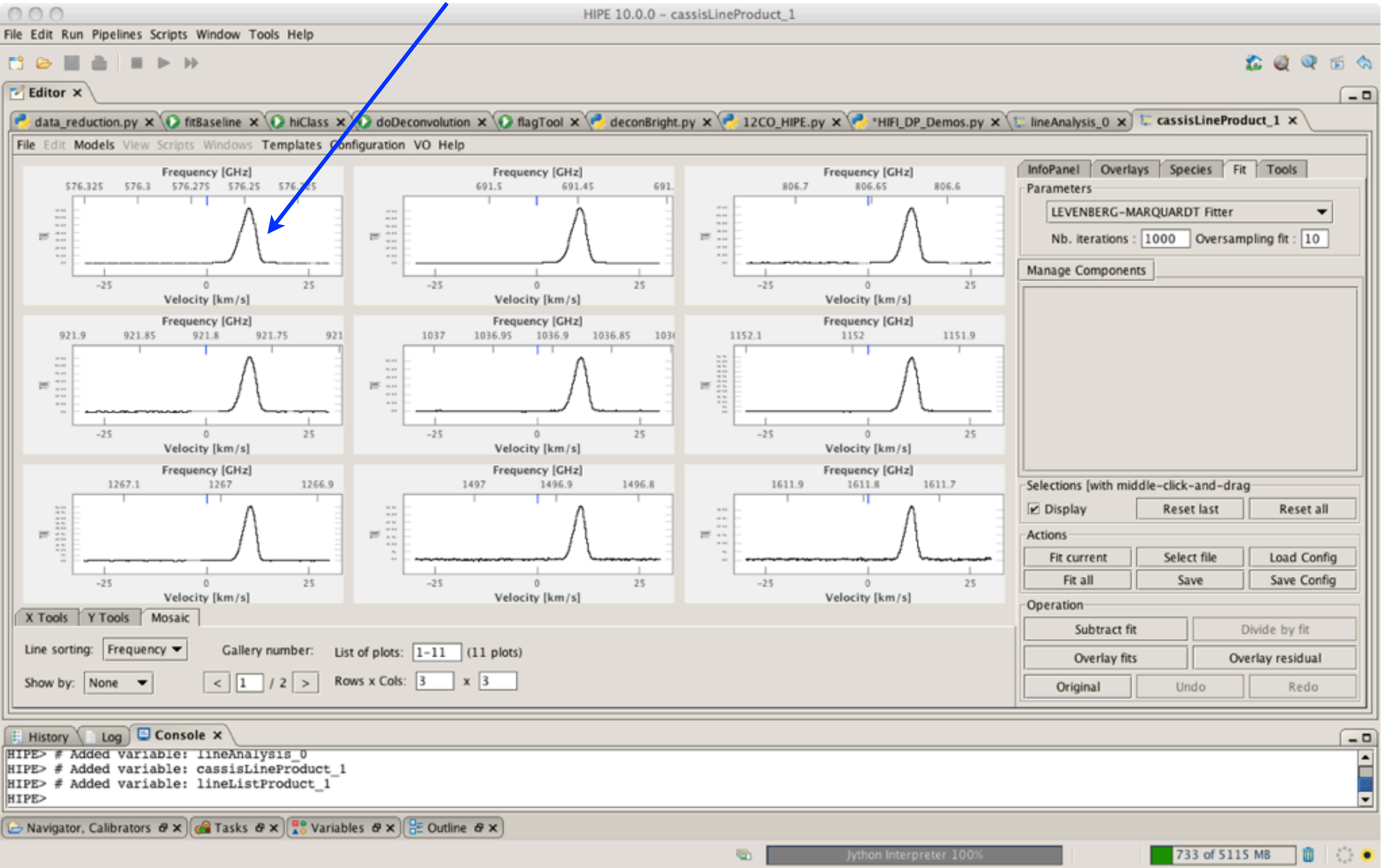
Open the 12CO_HIPE.py script



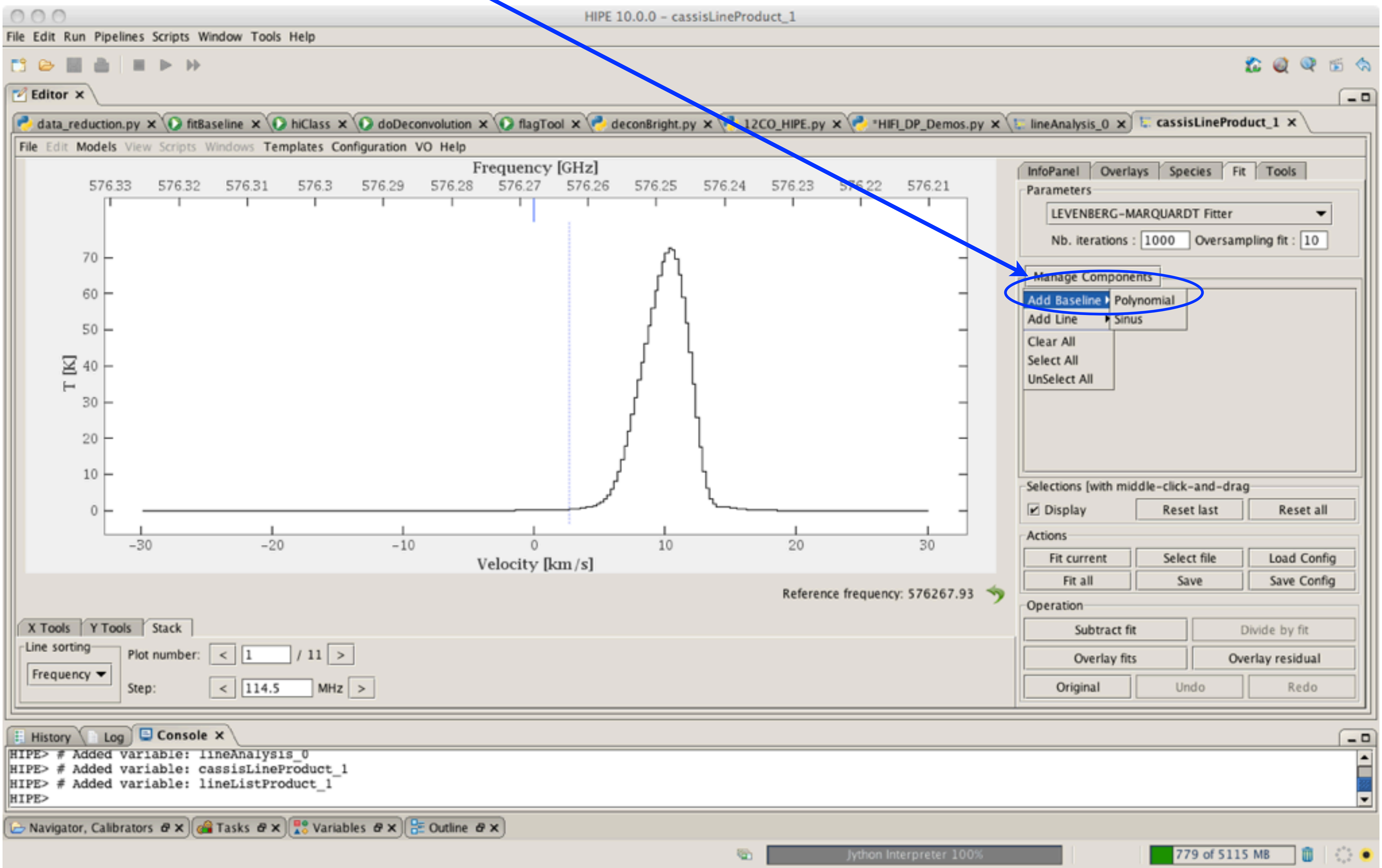
Interactive part with the user to modify the parameters of the python script

How to compute the rms with CASSIS?

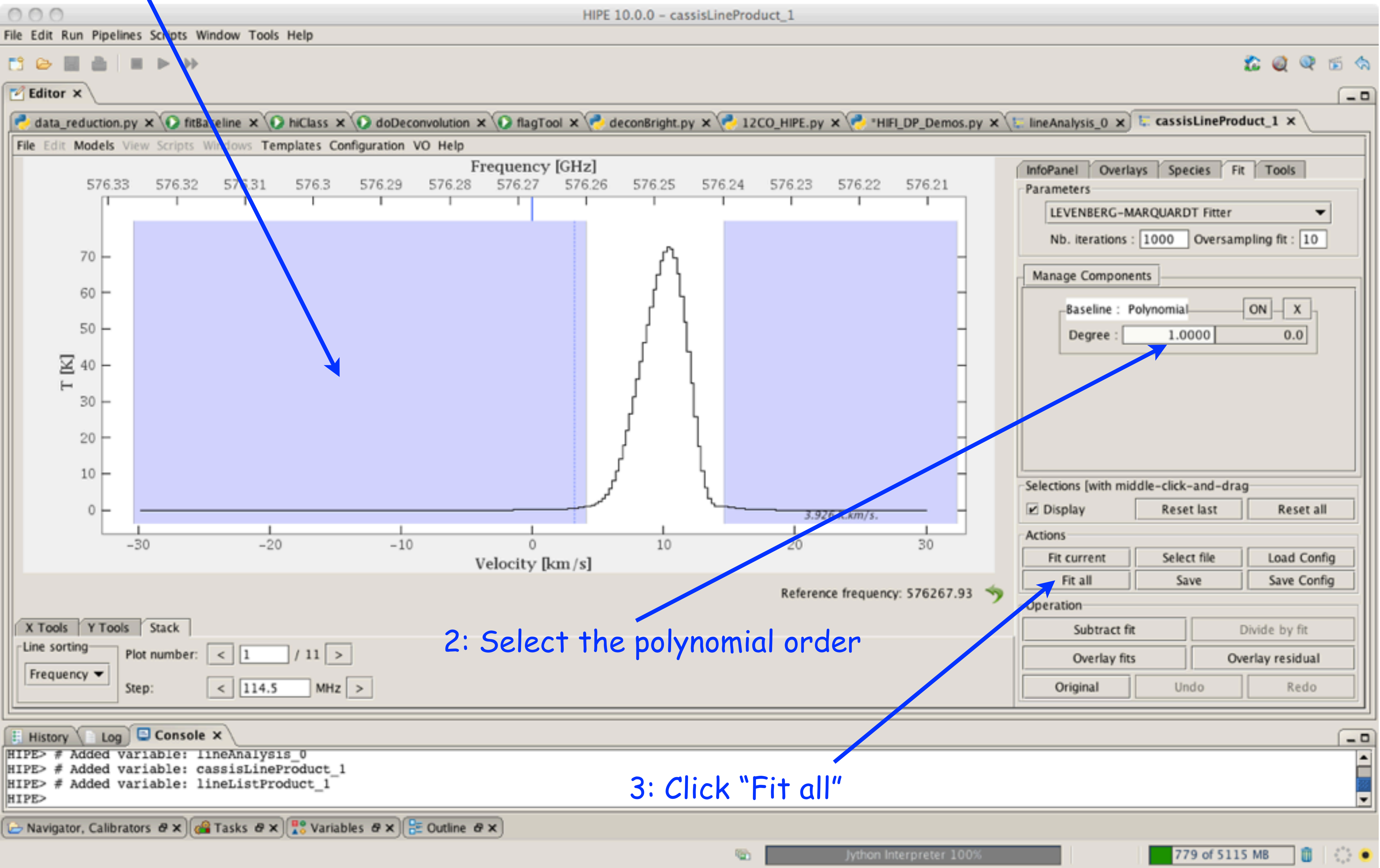
Double-Click on 1 of the transition



Manage Component, Add Baseline, Polynomial



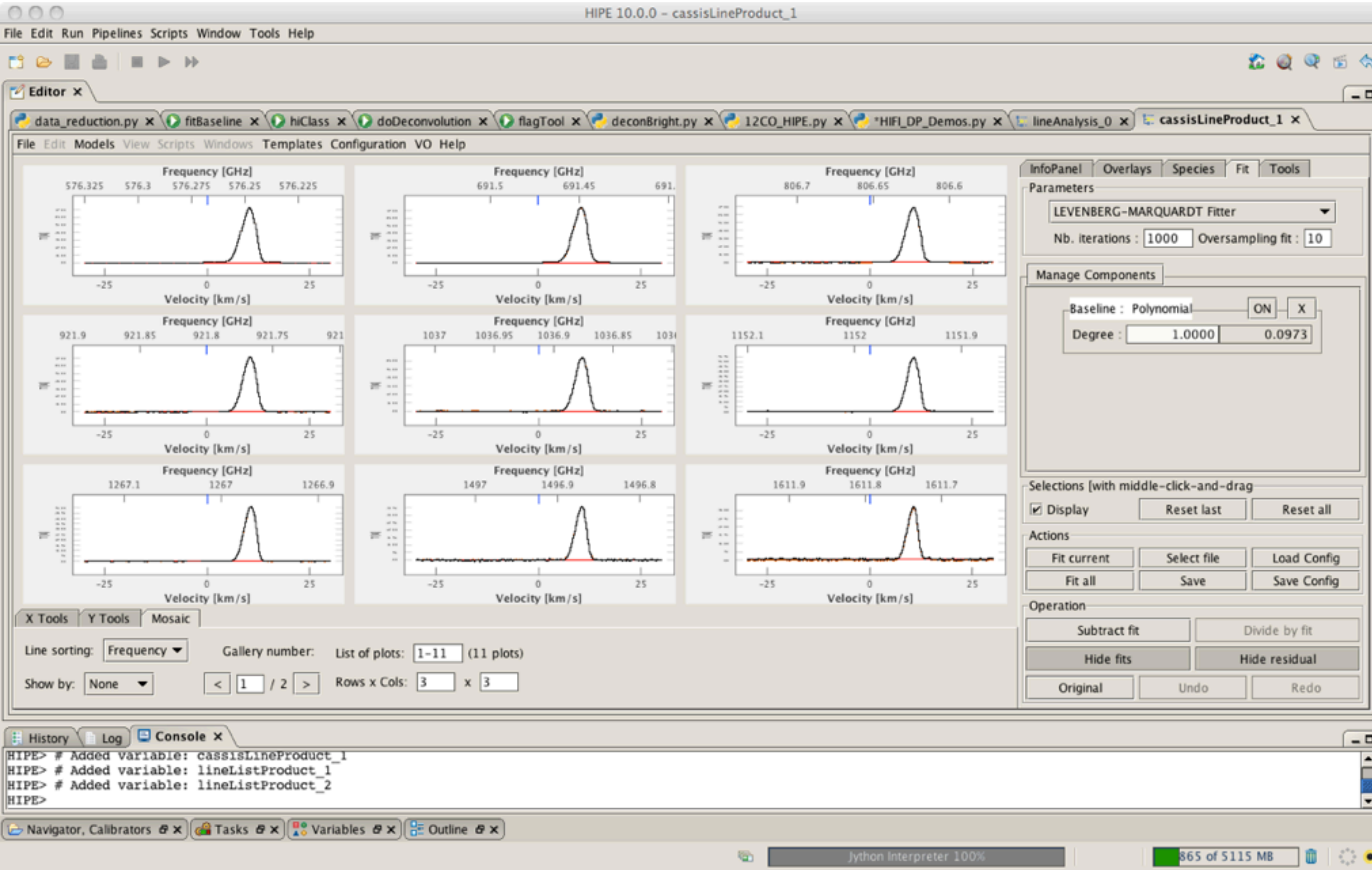
1: Use your mouse (middle-click, or alt-left click if you don't have a mouse) to select the area to be fitted (here in blue). You must avoid all the lines.



2: Select the polynomial order

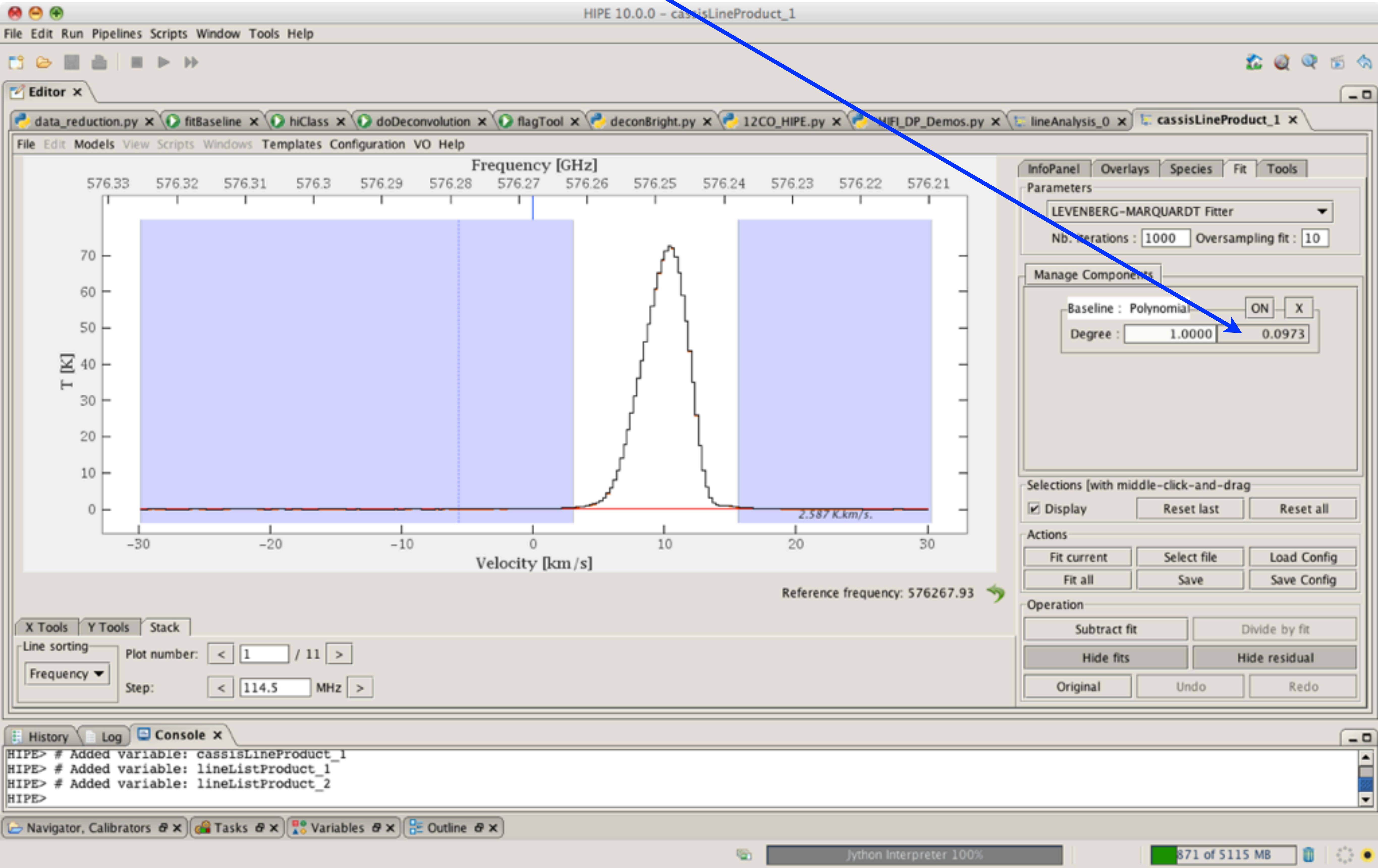
3: Click "Fit all"

Follow the same steps as in Slides 7 and 8.

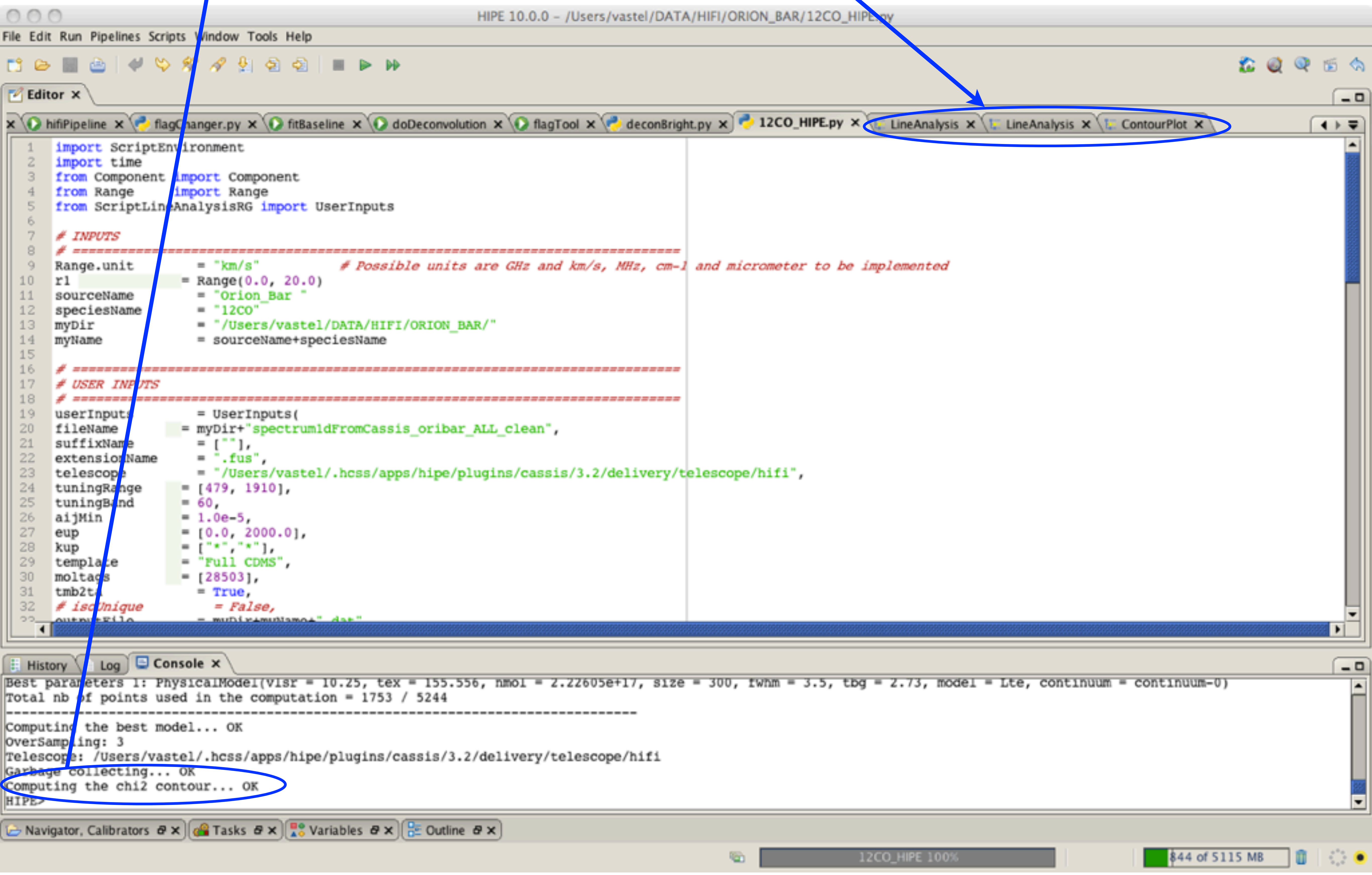


Then, double-click on each spectra and get your rms (see an example in the next slide).

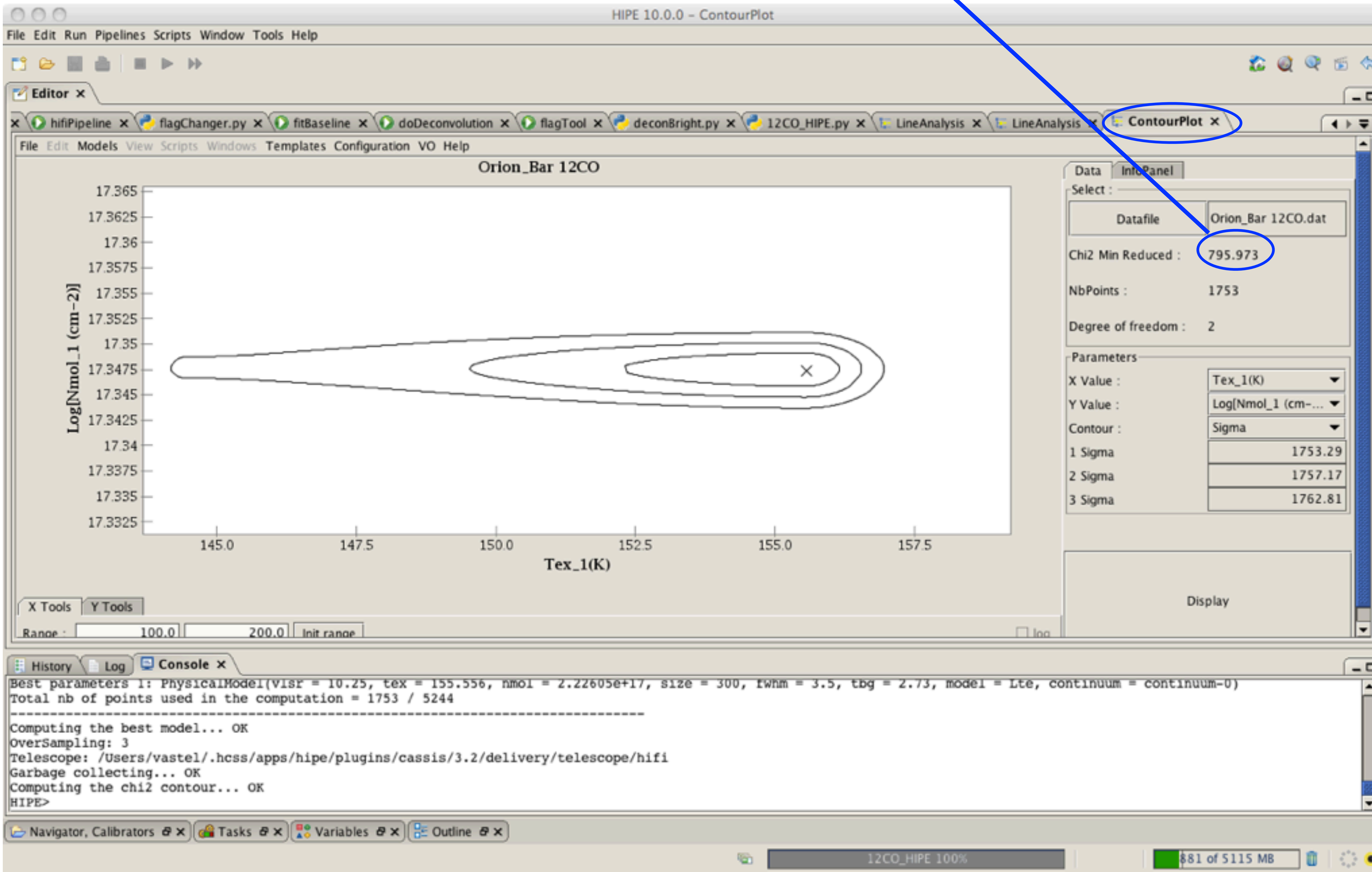
Here is your rms



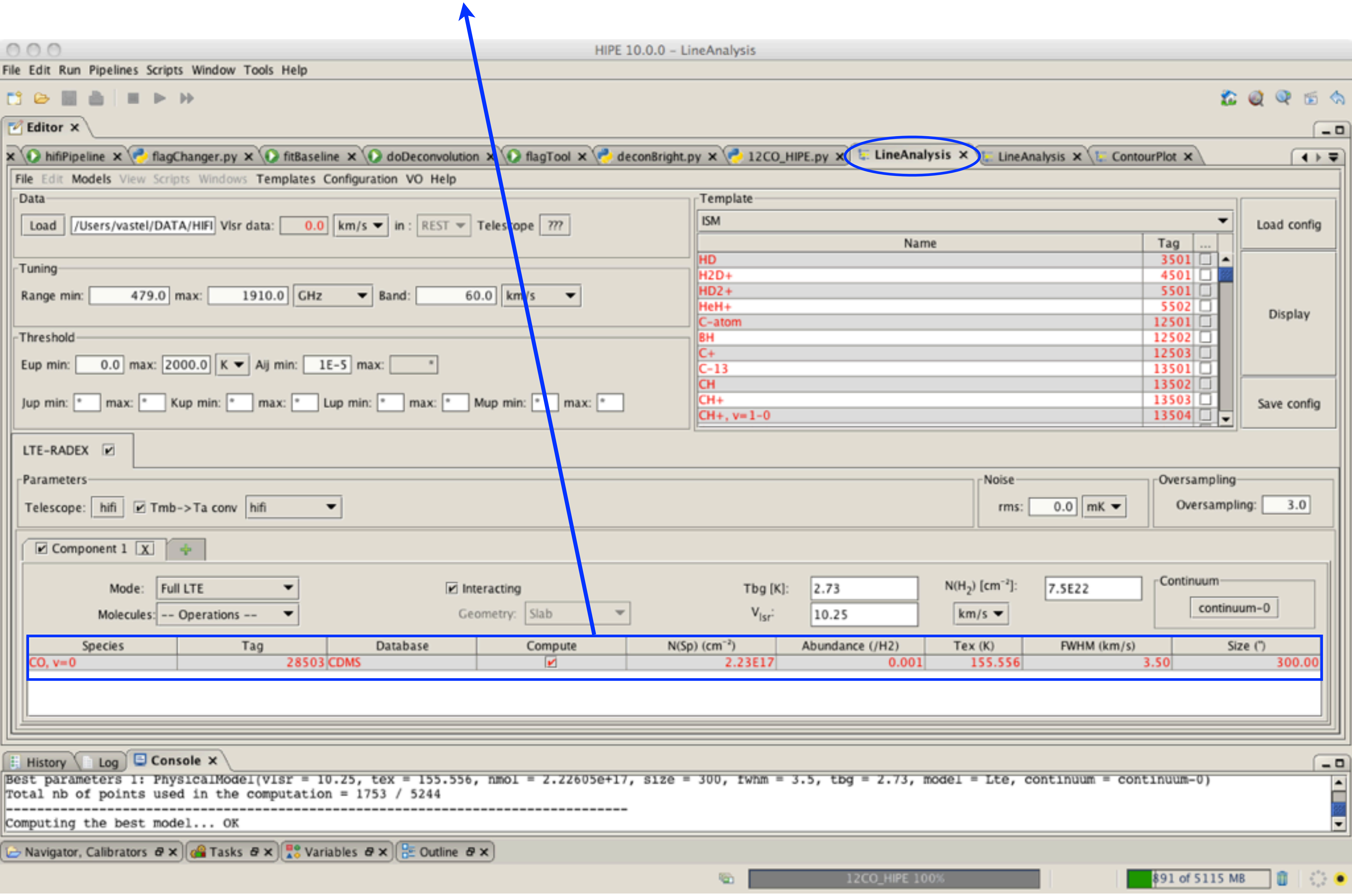
Once the Chi 2 modeling has finished, 3 tabs are opening



Not so good but we fixed fwhm and Vlsr!!!



These are the parameters found for the best χ^2 fit, as well as the fixed parameters, that are used for the LTE modeling of the transition.



These are the modeled transitions, for the best χ^2 fit. Note that we fixed the beam dilution, the FWHM as well as the Vlsr.