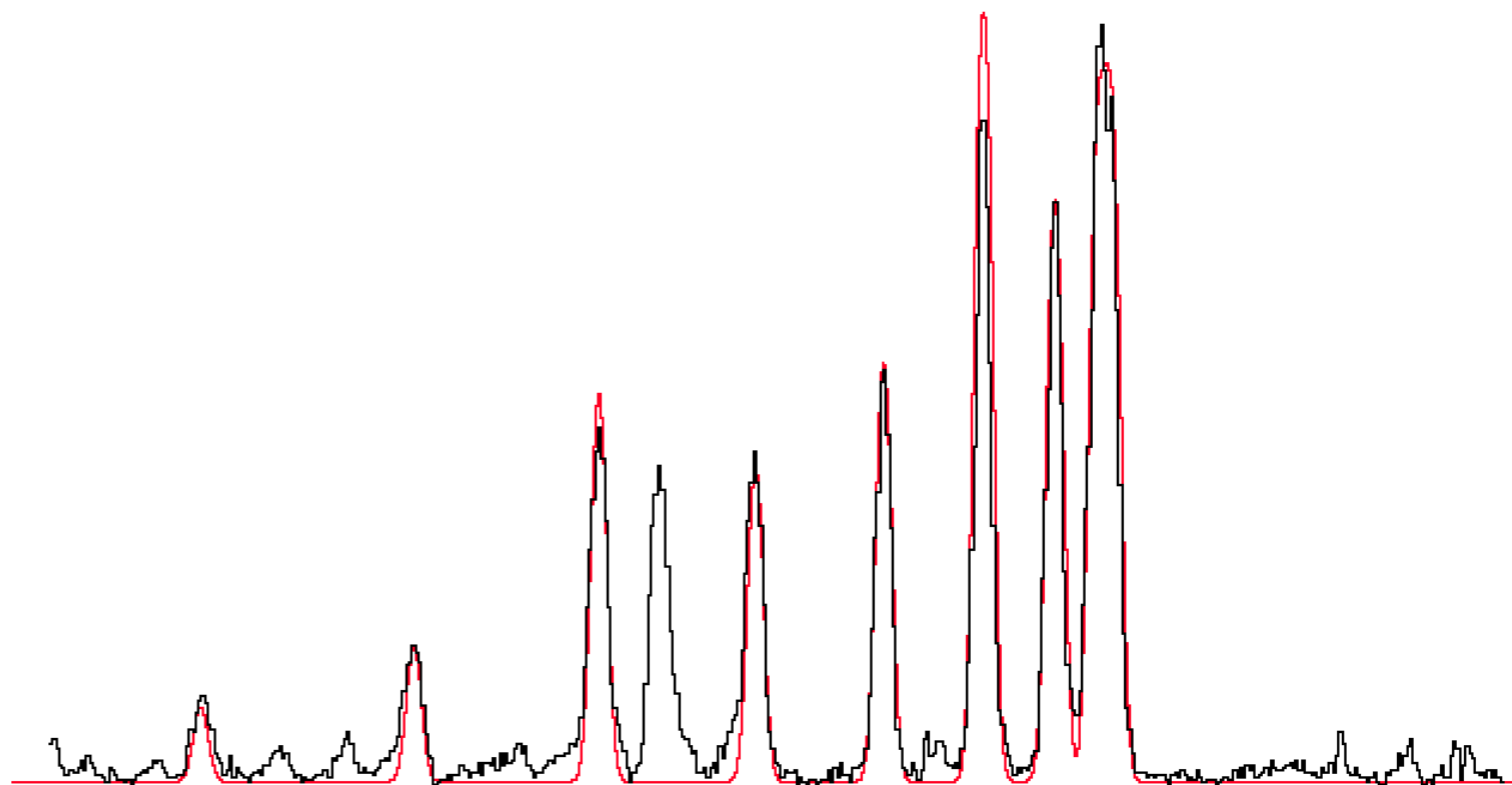


# Introduction to CASSIS

Andrew Barr



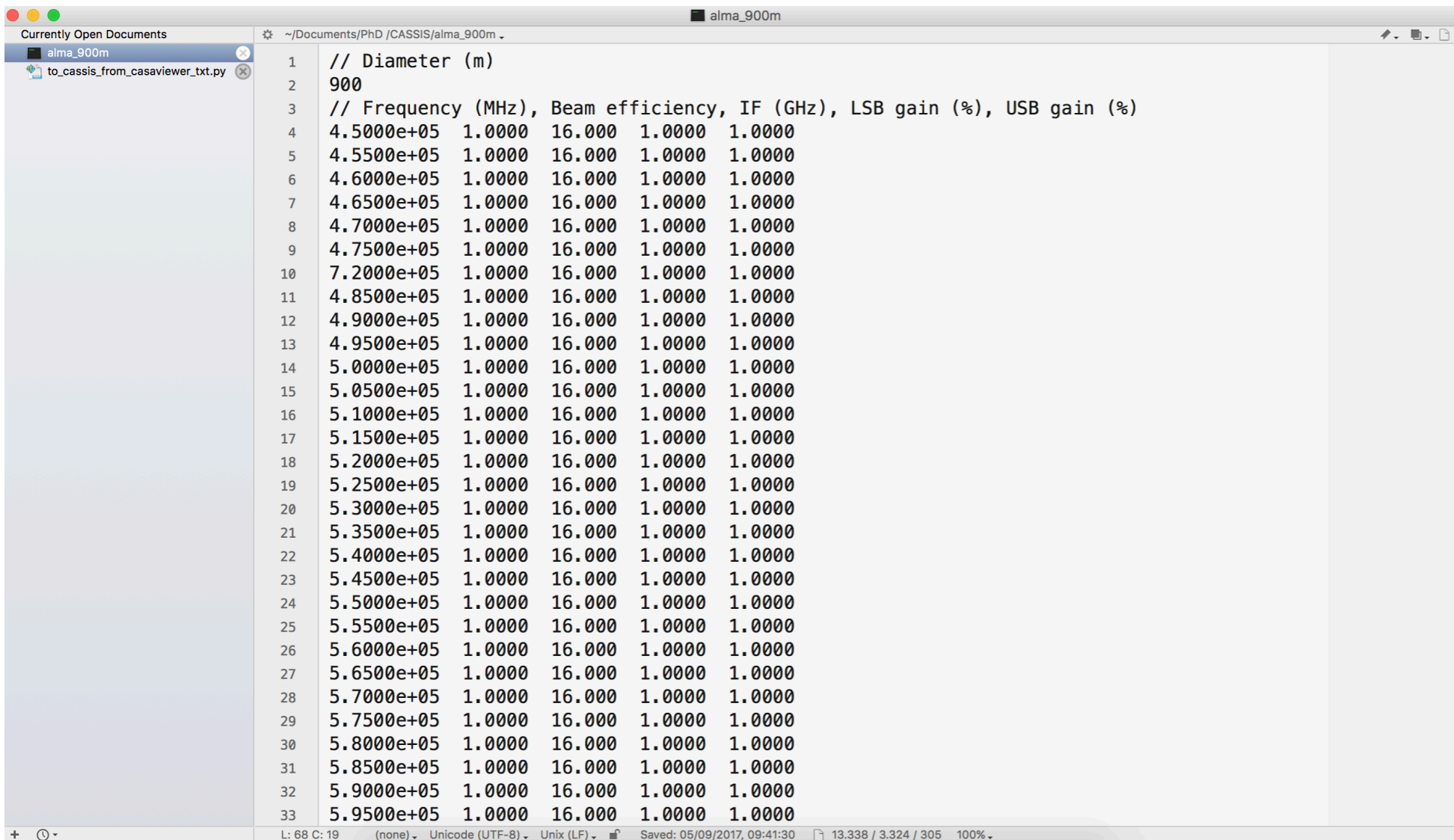
# Change From ASCII to CASSIS

```
~/Documents/PhD /CASSIS/to_cassis_from_casaviewer_txt.py
write_file

1 import numpy as np
2 from astropy.table import Table
3 import astropy.units as u
4 import astropy.constants as c
5 import os
6
7 #TODO identify gaps in the spectra
8
9 #####
10 # user parameters
11 # fill in before running script
12
13 path = '/path/to/folder/'
14 file_spectra = 'casaviewer_spectral_profile.txt'
15 # Vlsr of source
16 vlsr = -52 * u.km/u.s
17 # name of output file
18 outfile = 'cassis_spectrum_file.fus'
19
20 #####
21 # Reading the text file with the frequency and flux
22 names_spectra = ['freq', 'flux',]
23 units_spectra = [u.GHz, u.Kelvin]
24 def read_data(infile, colnames, colunits):
25     # read table
26     data = Table.read(infile,
27                       format='ascii.fast_basic',
28                       comment='#',
29                       fast_reader={'parallel': True, 'use_fast_converter': True},
30                       guess=False,
31                       names=colnames,
32                       data_start=0,
33                       )
```

- Only need to change name of file and velocity of source

# Telescope File

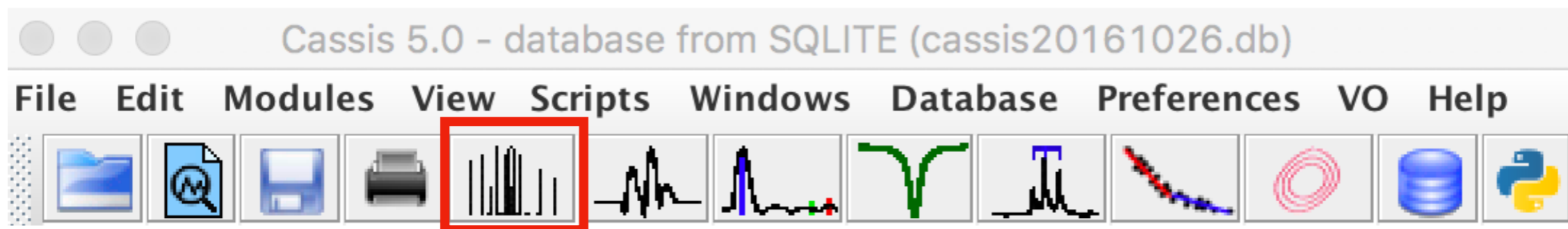


```
1 // Diameter (m)
2 900
3 // Frequency (MHz), Beam efficiency, IF (GHz), LSB gain (%), USB gain (%)
4 4.5000e+05 1.0000 16.000 1.0000 1.0000
5 4.5500e+05 1.0000 16.000 1.0000 1.0000
6 4.6000e+05 1.0000 16.000 1.0000 1.0000
7 4.6500e+05 1.0000 16.000 1.0000 1.0000
8 4.7000e+05 1.0000 16.000 1.0000 1.0000
9 4.7500e+05 1.0000 16.000 1.0000 1.0000
10 7.2000e+05 1.0000 16.000 1.0000 1.0000
11 4.8500e+05 1.0000 16.000 1.0000 1.0000
12 4.9000e+05 1.0000 16.000 1.0000 1.0000
13 4.9500e+05 1.0000 16.000 1.0000 1.0000
14 5.0000e+05 1.0000 16.000 1.0000 1.0000
15 5.0500e+05 1.0000 16.000 1.0000 1.0000
16 5.1000e+05 1.0000 16.000 1.0000 1.0000
17 5.1500e+05 1.0000 16.000 1.0000 1.0000
18 5.2000e+05 1.0000 16.000 1.0000 1.0000
19 5.2500e+05 1.0000 16.000 1.0000 1.0000
20 5.3000e+05 1.0000 16.000 1.0000 1.0000
21 5.3500e+05 1.0000 16.000 1.0000 1.0000
22 5.4000e+05 1.0000 16.000 1.0000 1.0000
23 5.4500e+05 1.0000 16.000 1.0000 1.0000
24 5.5000e+05 1.0000 16.000 1.0000 1.0000
25 5.5500e+05 1.0000 16.000 1.0000 1.0000
26 5.6000e+05 1.0000 16.000 1.0000 1.0000
27 5.6500e+05 1.0000 16.000 1.0000 1.0000
28 5.7000e+05 1.0000 16.000 1.0000 1.0000
29 5.7500e+05 1.0000 16.000 1.0000 1.0000
30 5.8000e+05 1.0000 16.000 1.0000 1.0000
31 5.8500e+05 1.0000 16.000 1.0000 1.0000
32 5.9000e+05 1.0000 16.000 1.0000 1.0000
33 5.9500e+05 1.0000 16.000 1.0000 1.0000
```

- Needs to be made yourself in accordance with your observations

# Open CASSIS

- In terminal run: `cassis 2048 &`
- Then open spectra with 'Spectrum Analysis'



# Load Spectrum

- Before you can load the spectrum you need to include the correct corresponding telescope file
- Then click display

Spectrum Analysis 1

Data

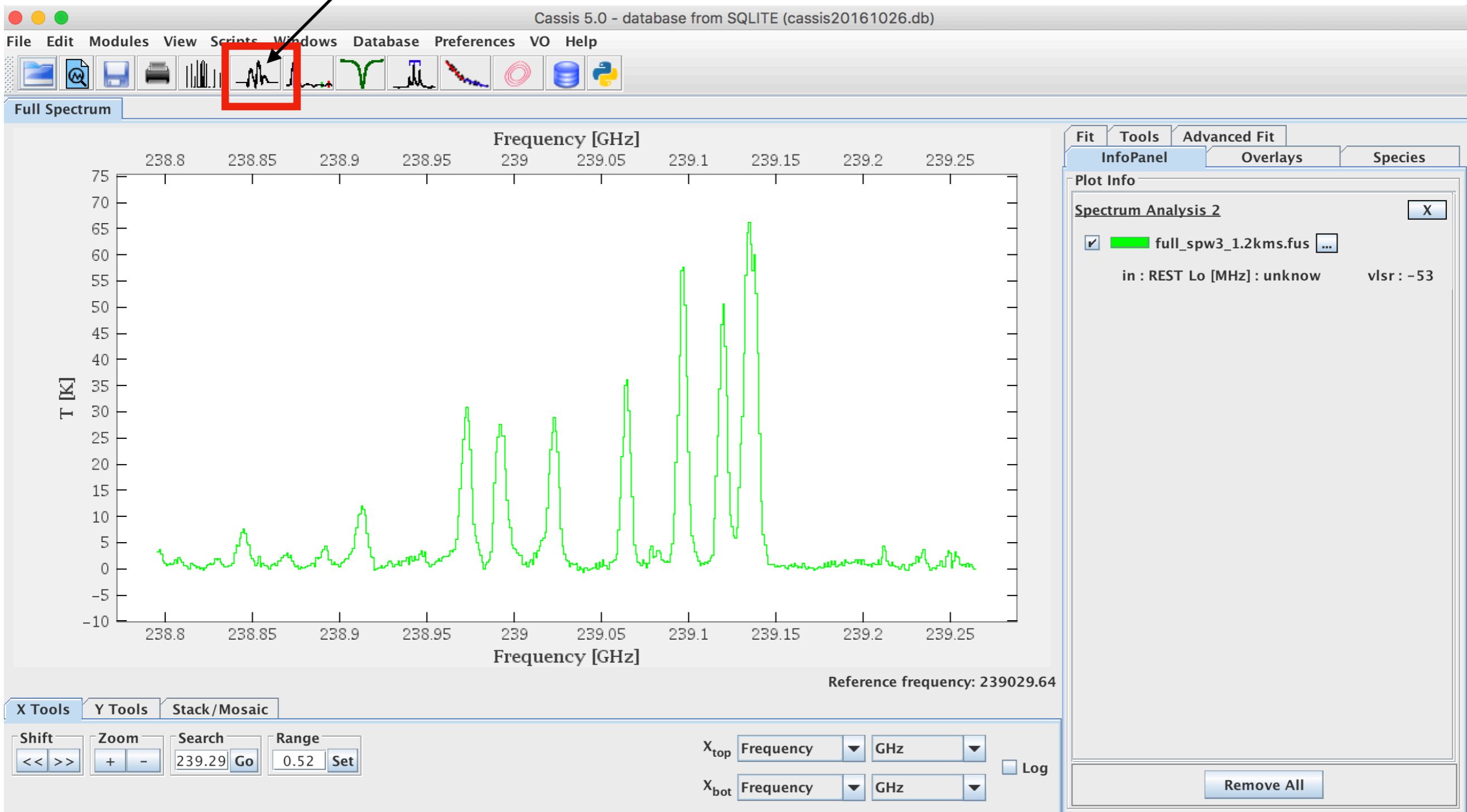
iS/full\_spw3\_1.2kms.fus Vlsr data: -53.0 km/s in: REST Telescope: ???

Tuning

Range min: 238.795685 max: 239.263589 GHz

# CASSIS Interface

LTE Radex opens up line identification



# LTE Radex

Important to change telescope file

The screenshot shows the LTE + RADEX 1 software interface. Several key settings are highlighted with red boxes:

- Tuning:** Range min: 115.0, max: 116.0 GHz, dv: 0.1 MHz.
- Telescope:** apex.
- Threshold:** Eup min: 0.0, max: 150.0 K, Aij min: 0.0.
- Parameters:** Telescope: apex.
- Mode:** Full LTE.
- Molecules:** -- Operations --.
- Velocity:**  $V_{lsr}$ : 0.0 km/s.

Arrows point to the 'Telescope' dropdown and the 'Species' column header in the table below. The table header is as follows:

Species	Tag	Database	Compute	N(Sp) (cm <sup>-2</sup> )	Abundance (/H <sub>2</sub> )	Tex (K)	FWHM (km/s)	Size (")
---------	-----	----------	---------	---------------------------	------------------------------	---------	-------------	----------

Various line lists

# LTE Radex

- Double click headers to change entire column

**Tuning**

Range min: 238.0 max: 240.0 GHz dv 0.1 MHz

Line: 115.5 Bandwidth: 4.0 GHz DSB LSB LO freq: 119.5 Telescope: alma\_900m

**Threshold**

Eup min: 0.0 max: 800.0 K Aij min: 1E-6 max: \*

Jup min: \* max: \* Kup min: \* max: \* Lup min: \* max: \* Mup min: \* max: \*

**LTE-RADEX**

**Parameters**

Telescope: alma\_900m Tmb->Ta \* alma\_900m

Noise rms: 0.0 mK

Frequency Scale Rest. frequency

**Component 1**

Mode: Full LTE  Interacting

Molecules: Massive\_star\_for... Geometry: Sphere Tbg [K]: 2.73 N(H<sub>2</sub>) [cm<sup>-2</sup>]: 7.5E22

V<sub>lsr</sub>: -53.0 km/s

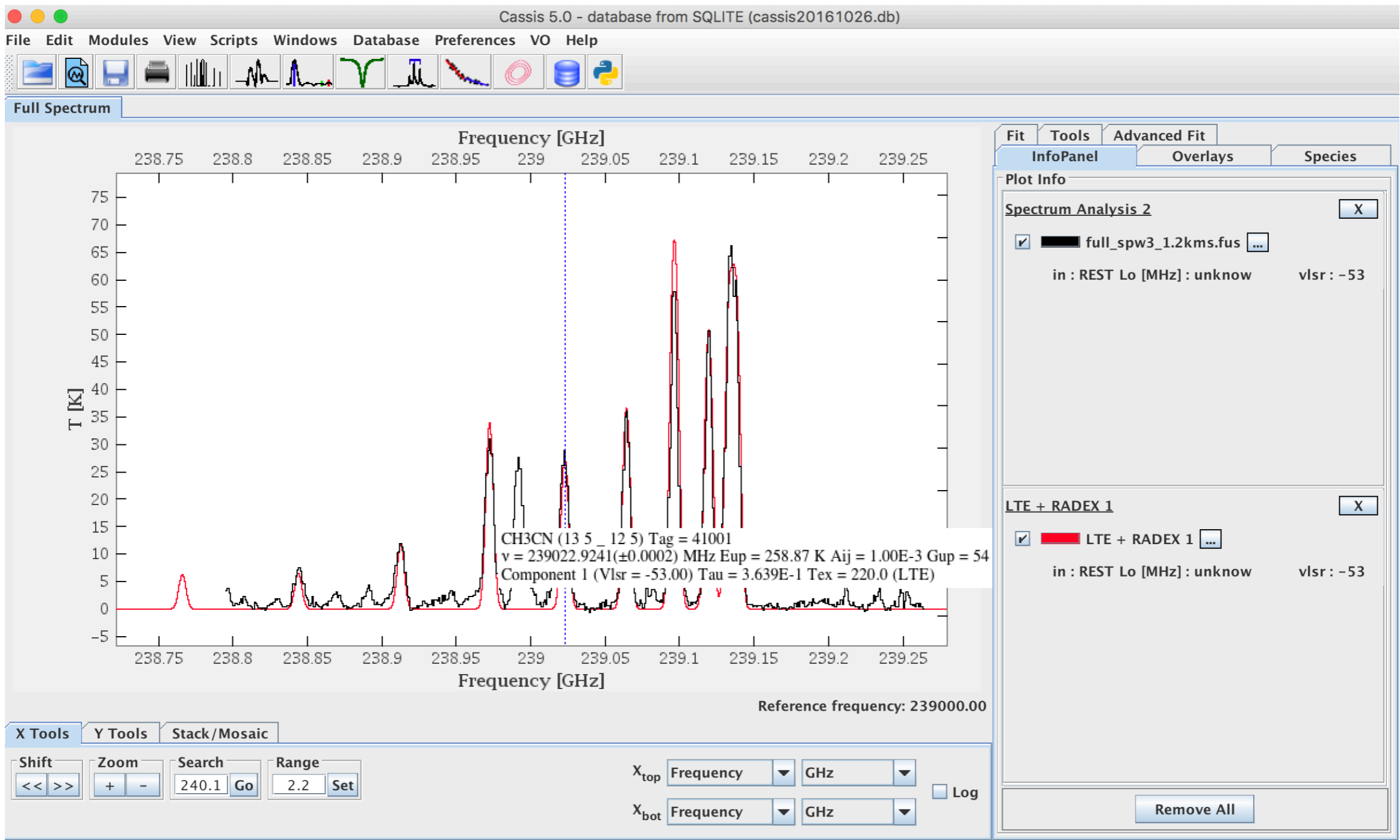
Continuum Continuum 0 [K]

Species	Tag	Database	Compute	N(Sp) (cm <sup>-2</sup> )	Abundance (/H <sub>2</sub> )	Tex (K)	FWHM (km/s)	Size (")
CH+	13003	JPL	<input type="checkbox"/>	5.00E16	5.00E7	220.00	7.00	0.30
CH <sub>2</sub>	14501	CDMS	<input type="checkbox"/>	5.00E16	4.17E7	220.00	7.00	0.30
CH <sub>2</sub> (OH)CHO	60501	CDMS	<input type="checkbox"/>	5.00E16	8.20E6	220.00	7.00	0.30
CH <sub>2</sub> CO	42002	JPL	<input type="checkbox"/>	5.00E16	4.86E6	220.00	7.00	0.30
CH <sub>2</sub> NH	29003	JPL	<input type="checkbox"/>	5.00E16	5.21E15	220.00	7.00	0.30
CH <sub>3</sub> CN	41001	JPL	<input checked="" type="checkbox"/>	5.00E16	2.02E6	220.00	7.00	0.30
CH <sub>3</sub> NH <sub>2</sub>	31008	JPL	<input type="checkbox"/>	5.00E16	3.33E4	220.00	7.00	0.30
CH <sub>3</sub> OCH <sub>3</sub>	46008	JPL	<input type="checkbox"/>	5.00E16	2.62E5	220.00	7.00	0.30
CS-33, v=0,1	45502	CDMS	<input type="checkbox"/>	5.00E16	4.38E6	220.00	7.00	0.30



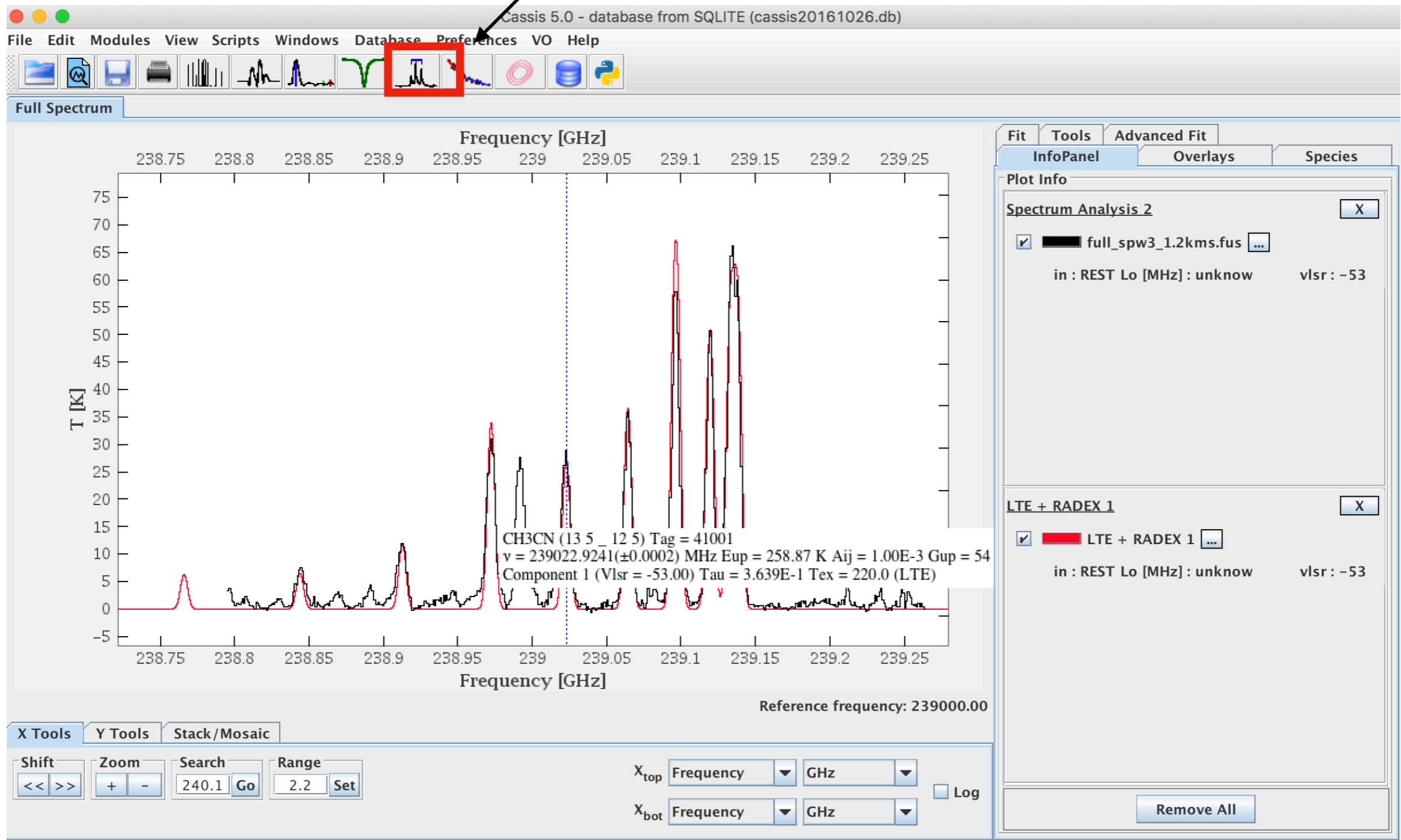
# CH<sub>3</sub>CN Model

- Can click on lines for information - especially useful for blended lines



# Line Analysis

Click 'Line analysis' to begin



# Line Analysis

Select species here now

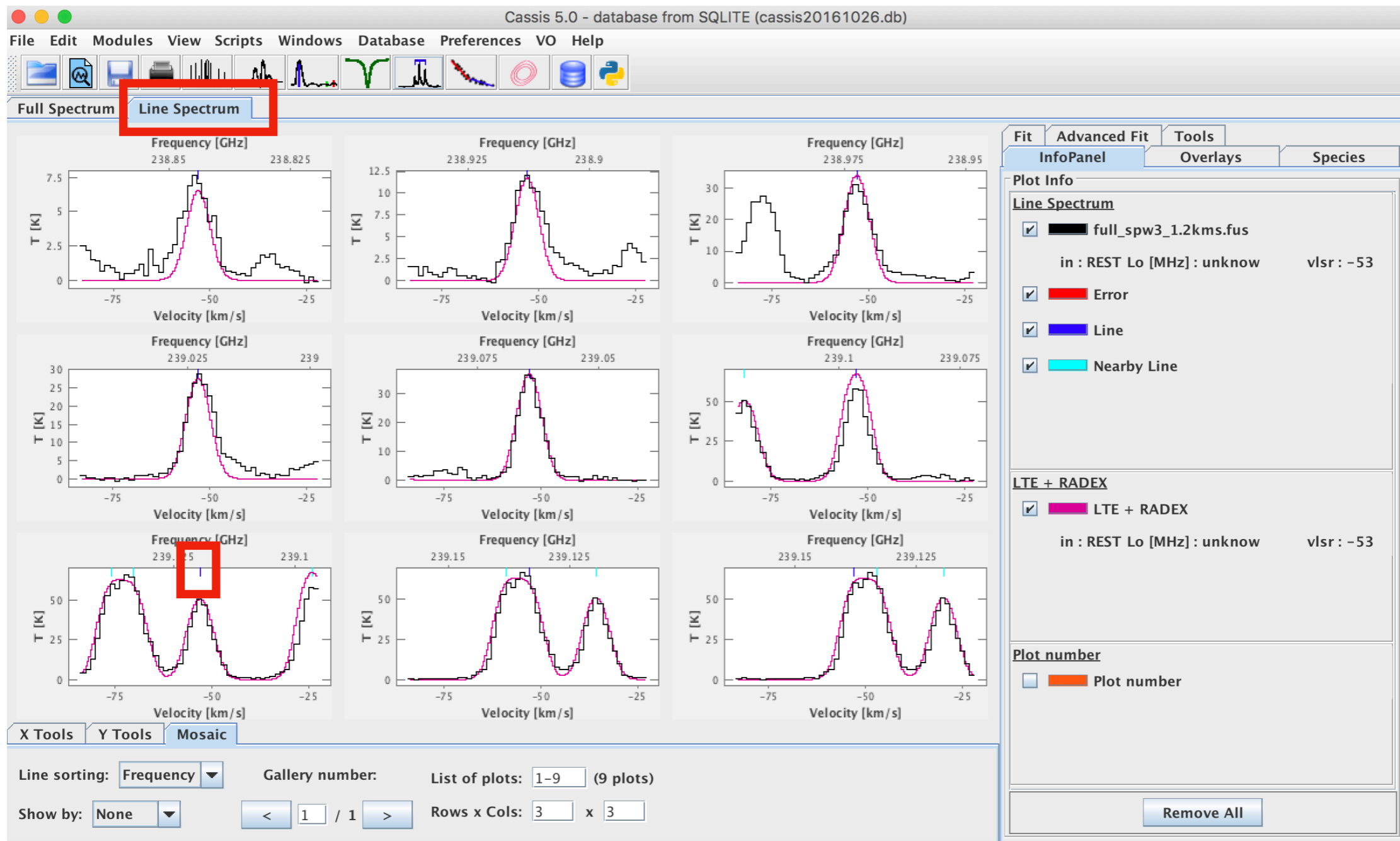
The screenshot shows the 'Line Analysis 1' software interface. Key elements are highlighted with red boxes and arrows:

- Data:** 'Load' button, file path 'IS/full\_spw3\_1.2kms.fus', 'Vlsr data: -53.0 km/s', 'Telescope: alma\_...'.
- Template:** A list of species with 'CH3CN' selected (tag 41001, checked).
- Parameters:** 'LTE-RADEX' checked, 'Telescope: alma\_900m', 'Tmb->Ta \* alma\_900m'.
- Bottom Panel:** 'Mode: Full LTE', 'Interacting' checked, 'Geometry: Sphere', 'Tbg [K]: 2.73', 'N(H<sub>2</sub>) [cm<sup>-2</sup>]: 7.5E22', 'V<sub>lsr</sub>: -53.0 km/s', 'Continuum 0 [K]'. A table below shows parameters for CH3CN: N(Sp) (cm<sup>-2</sup>), Abundance (/H<sub>2</sub>), Tex (K), FWHM (km/s), and Size (").

Remember to tick box

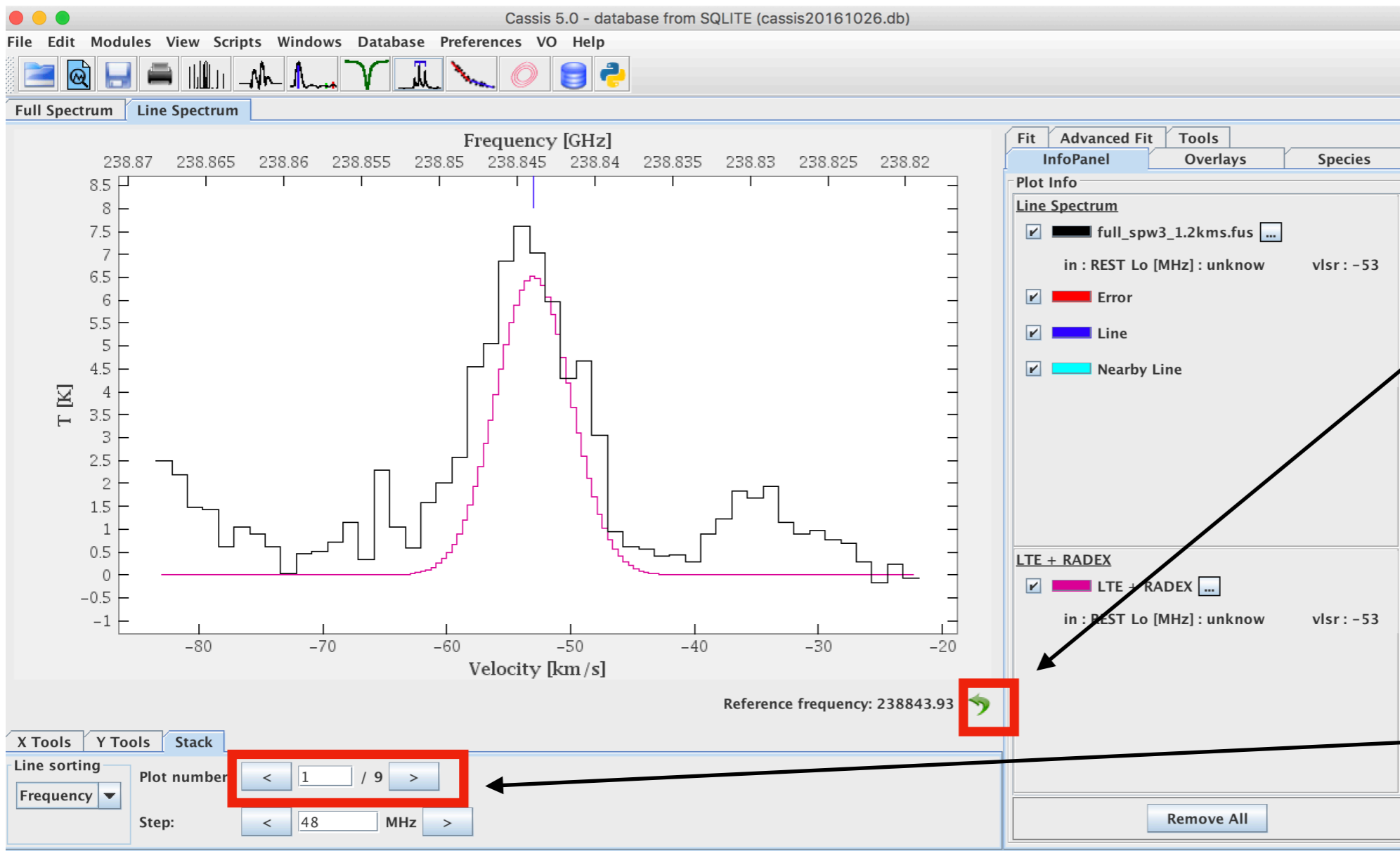
# Line Analysis

- New tab opens
- Dark blue marks frame of the line of interest



# Line Analysis

- Double clicking on a panel takes you here



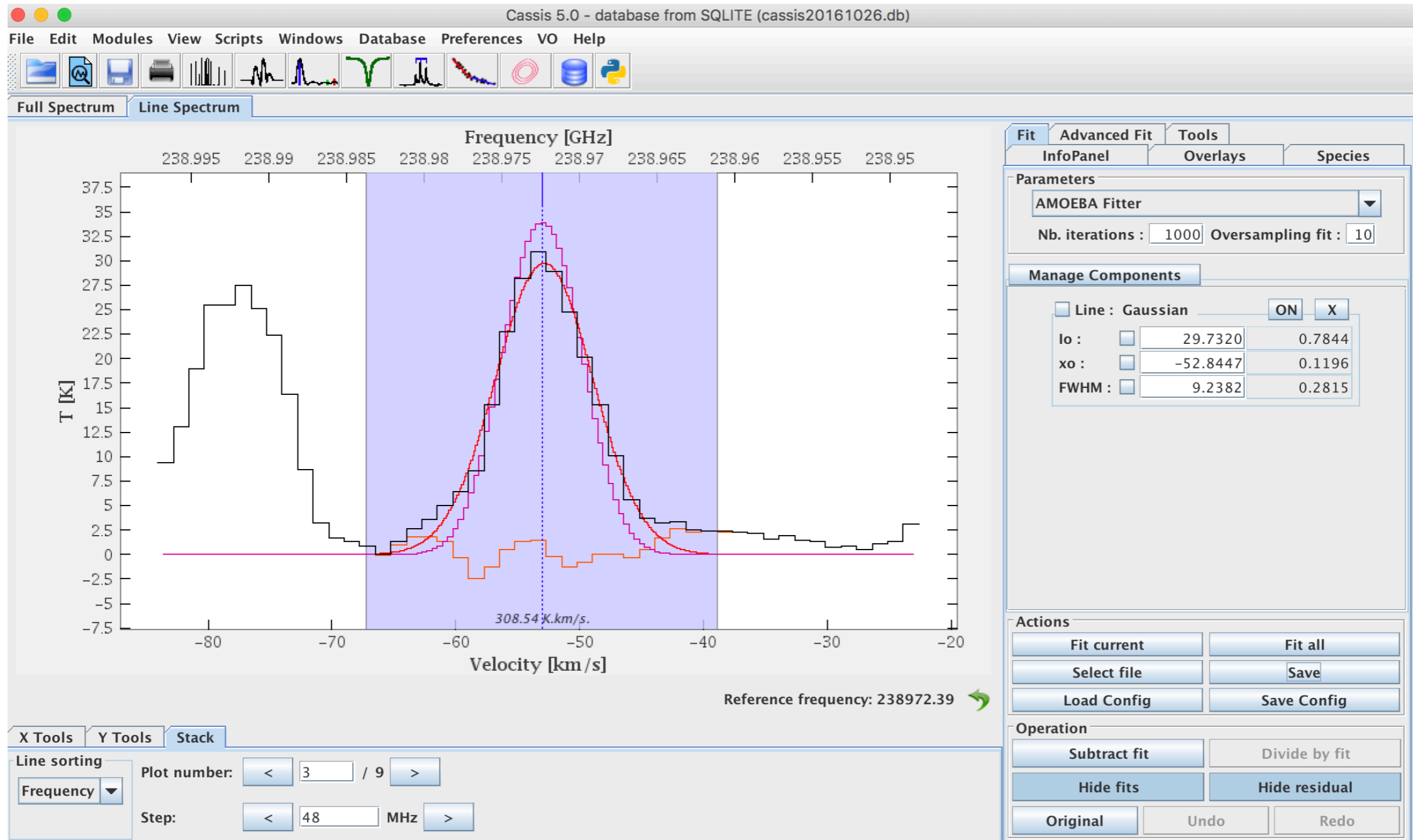
Takes you back

Change lines

# Line Fitting

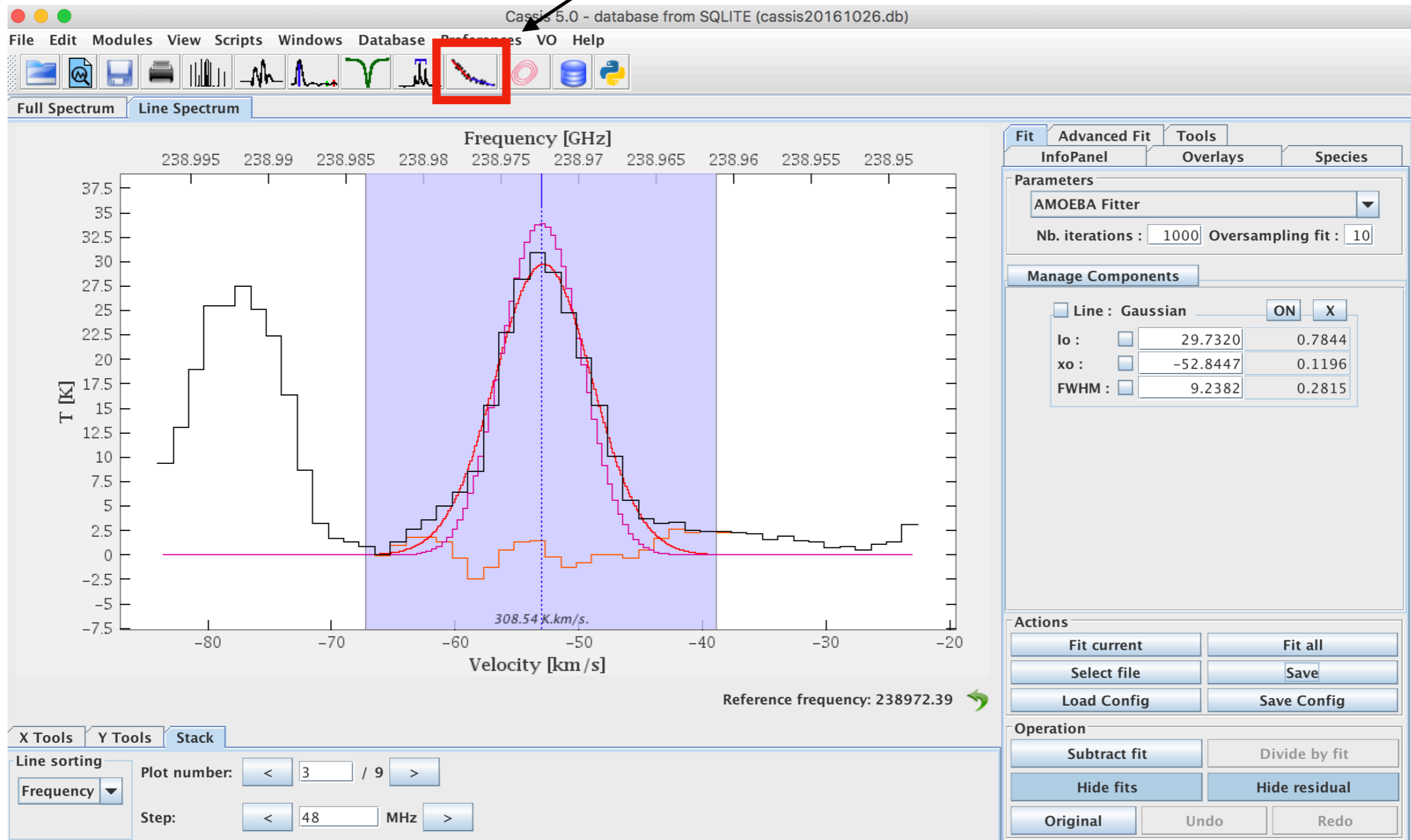
- Click on the 'fit' tab on the right
- Then click 'manage components', then 'add line' and select 'gaussian'
- Leave the box next to 'line' unchecked
- Select the line by pressing the scroll button on the mouse, and then moving it over the line. The region selected will show up after you let go of the scroll button
- Then click 'fit current'
- If you want to save the results of the fitting for input to a rotation diagram:
  - Click 'select file', then create new file
  - Then click save
  - Then go to the next line and repeat the above steps for fitting the line

# Line Fitting



# Rotation Diagram

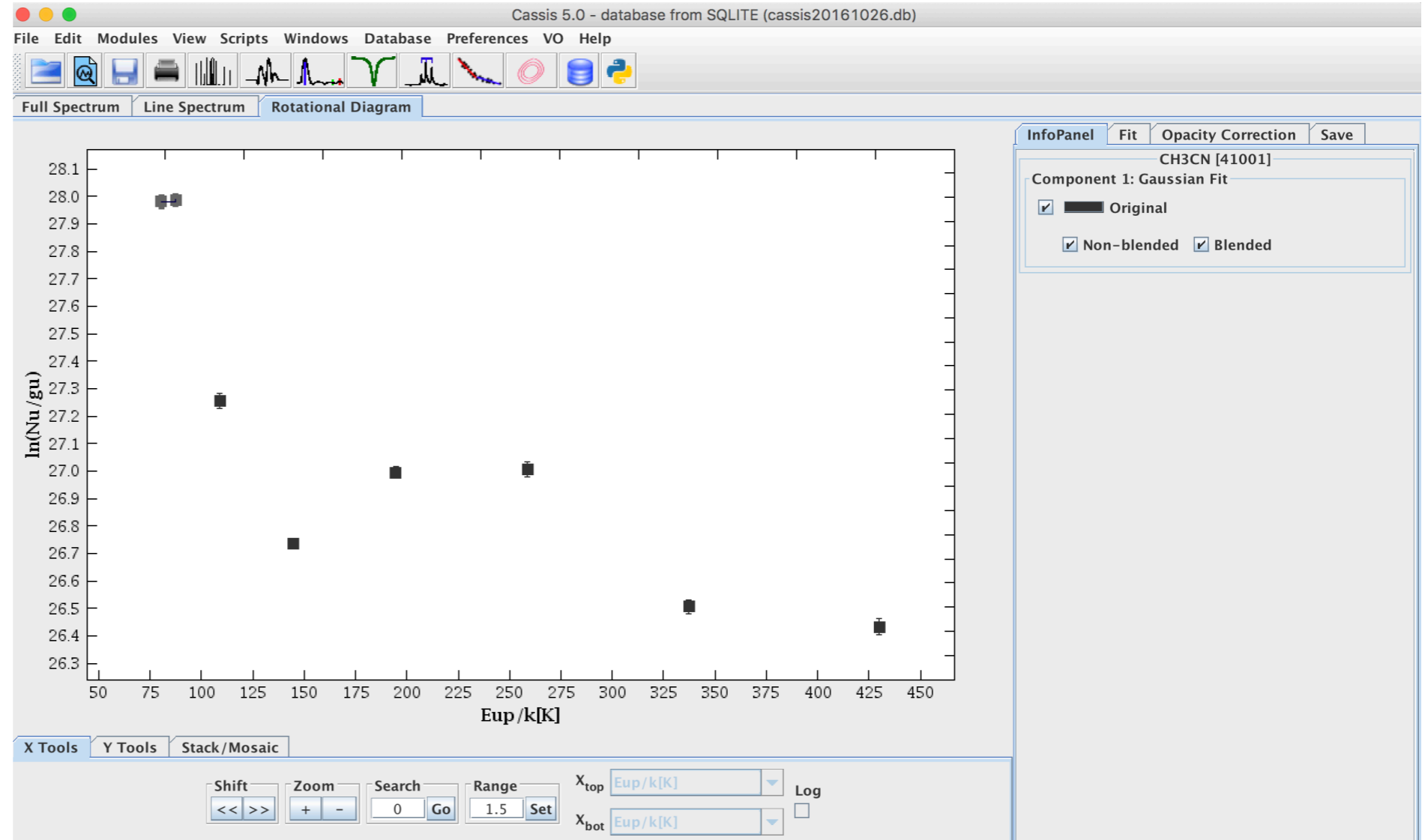
Click to start rotation diagram analysis



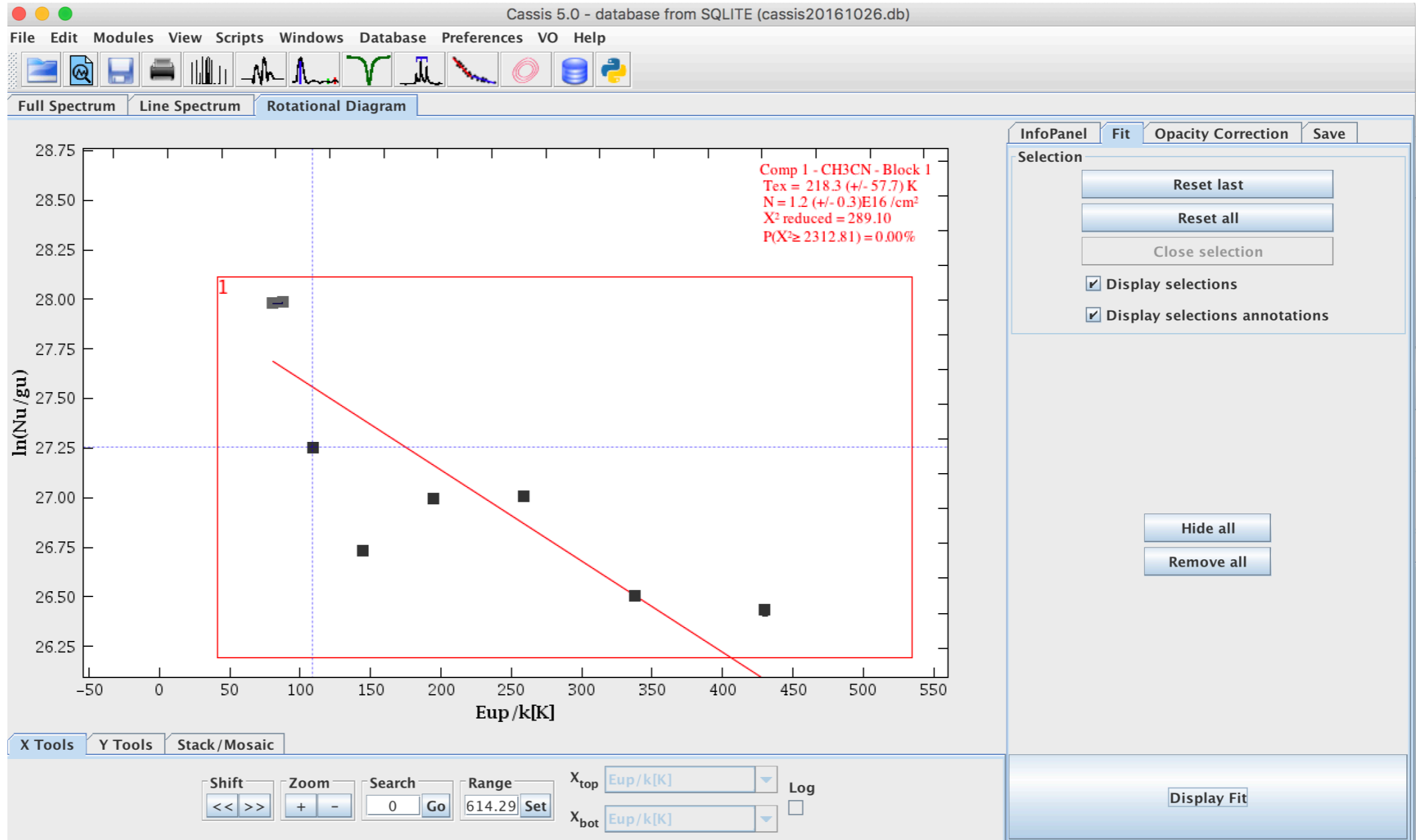


# Rotation Diagram

- Load file that has the line data saved
- Then click display
- Again using the scroll bar, select the region around the scatter plot. It will come up as a red box
- Then go to the 'fit' tab on the right
- Click 'close selection' then click 'display fit'
- Then right click the plot and chose 'save' to save the image as .png



# Rotation Diagram



# Extract Line List

- Important detail in the end, if you want to get a line list of the identified lines in the model, there is an option in the 'file' tab called 'save lines'

