

# HIFI Data Inspection

NHSC DP workshop  
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UNIVERSITY OF  
**WATERLOO**

[uwaterloo.ca](http://uwaterloo.ca)

Sylvie F Beaulieu PhD  
[astro.uwaterloo.ca/HIFI/](http://astro.uwaterloo.ca/HIFI/)



# Documentation and Tour of the data

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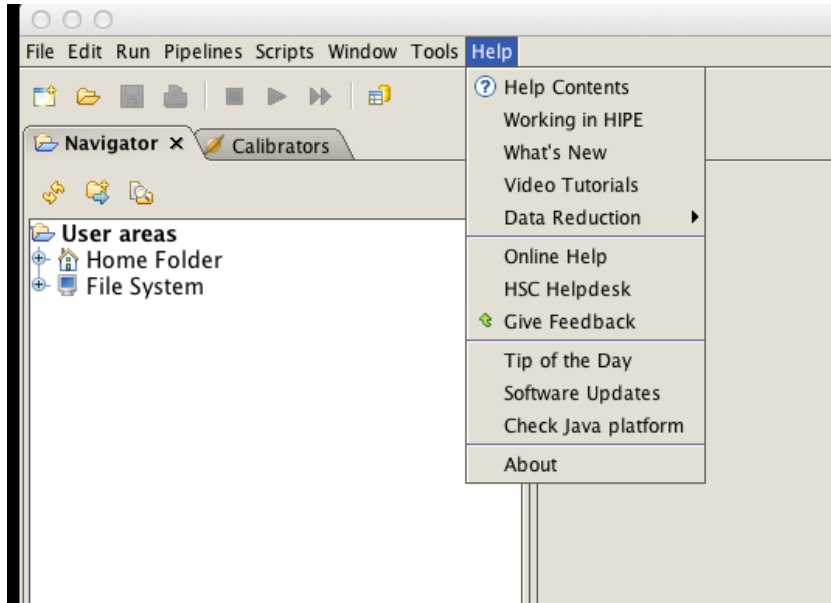
[uwaterloo.ca](http://uwaterloo.ca)



# DOCUMENTATION

Access through HIPE

Or via [http://herschel.esac.esa.int/hcss-doc-11.0/index.jsp#hifi\\_um:hifi-um](http://herschel.esac.esa.int/hcss-doc-11.0/index.jsp#hifi_um:hifi-um)



HIPI Instrument and Calibration www:  
Known Issues, What's New in HIPE,  
Calibration information...

A screenshot of the HIPE documentation website. The 'Table of Contents' is visible, with several items circled in red: 'Data Analysis Guide', 'Scripting Guide', 'The HIPI Data Reduction Guide', 'HIPI Pipeline Specification', 'HIPI Instrument and Calibration Page', 'HIPI User's Reference Manual', and 'HCSS User's Reference Manual'. A blue arrow points from the 'HIPI Instrument and Calibration Page' entry to the text box on the left. The main content area shows '1. Welcome' with a list of sections from 2 to 22.

There is much more to HIPE than is contained in

- If you want to learn more about graphical to
- If you want to learn the scripting language u  
[Guide](#).

# TOUR OF THE DATA

- **Opening the Observation Context**
  - Tour of the various products
- **Common Issues**
  - Baseline offsets and slopes
  - Standing Waves
  - Spurs
  - Emission in the off position
- HIFI Data Reduction Guide**
- Data Analysis Guide**

# ObservationContext

Recall

Various layers of science data, auxiliary data, and other information in a tree-like structure

**Products:** are like directories (and subdirectories)

**Datasets:** are the files in the directories

`obs = getObservation("1342190183", poolName="1342190183")`

(or from the Navigator window)

Then, select a product (double left-click)

HIPE GUI broken up into sections (with a menu (top bar))

- Summary
- Meta data
- Dataset display tool

# Select your product called "obs" (double left-click)

Recall

The screenshot displays a software interface with several panels. The main panel shows the 'ObservationContext for HIFI data of observation 1342190183'. It includes a summary section with the following details:

- AOR label:** Calibration\_PM\_1-Aot2\_P\_FastDBS\_1b\_CO5-4\_LDN1157
- Instrument:** HIFI
- Obs. ID:** 1342190183
- Object:** LDN1157-B1
- Obs. Date:** 2010-02-04T03:47:06Z
- AOT:** Single Point
- Obs. Mode:** DBS fastChop
- RA Nominal:** 20h 39m 10.2s
- Dec. Nominal:** 68° 1' 10.5"
- SPG Version:** SPG v9.1.0
- Operational Day:** 266

Below the summary is a 'Meta Data' table:

name	value	unit	description
type	OBS		Product Type Identification
creator	SPG v9.1.0		Generator of this product
creationDate	2012-11-24T07:15:52Z		Creation date of this product
description	ObservationContext for HIFI data of observation 13421...		Name of this product
instrument	HIFI		Instrument attached to this product
modelName	FLIGHT		Model name attached to this product
startDate	2010-02-04T03:47:06Z		Start date of this product
endDate	2010-02-04T04:32:26Z		End date of this product

The 'Data' section shows a tree view with 'obs' selected. The console at the bottom displays the following commands and output:

```
HIPE> obs=getObservation(1342190183, poolName='1342190183')
getObservation is retrieving the observation from pool '1342190183' at: '/Users/sfbeaulieu/.hcss/lstore/1342190183'
HIPE>
```

Other panels include 'Tasks' (Applicable, By Category, All), 'Variables' (Observations: obs, Other Variables), and 'Outline' (obs, History, auxiliary, browseImageProduct, browseProduct, calibration, level0, level0\_5, level1).

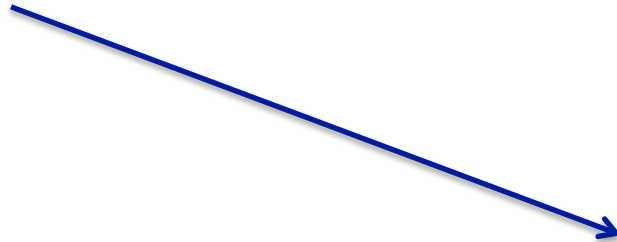
# The browse products: a quick look at the data

Automated extraction from the results of the standard pipeline.

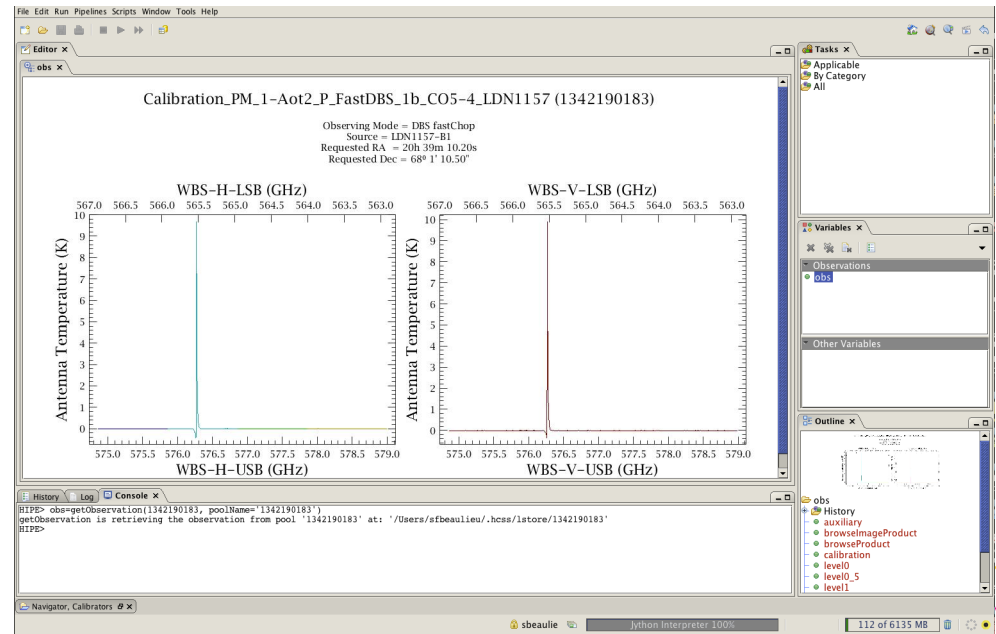
**Mapping Mode:** - a sets of map-averaged Level 2 spectra + the integrated maps, for each subband

**SScan:** a single sideband solution after deconvolution of the Level 2 WBS spectra

**Point Mode:** 2 plots (H- and V-pol) of unstitched Level 2 WBS spectra



Note: Intensity scale is  $T_A$   
(not in  $T_{MB}$ )



- CalibrationContext:**
- the data passed to the pipeline for calibration (*Downlink*)
  - the calibration files created by the pipeline (*Pipeline-out*)
  - the information about how the data was carried out (*Uplink*)

**HIFI Generic Pipeline Product**

Summary

Meta Data

Data

obs212115.refs["calibration"].product.refs["Downlink"].prod...Efficiency-H"

Index	band	frequency [GHz]	eta_mb
0	1a	489.0	0.755
1	1a	512.0	0.755
2	1a	548.0	0.754
3	1b	564.0	0.754
4	1b	595.0	0.753
5	1b	627.0	0.752
6	2a	641.0	0.752
7	2a	677.0	0.751
8	2a	710.0	0.75
9	2b	724.0	0.75
10	2b	756.0	0.749
11	2b	792.0	0.748
12	3a	809.0	0.747
13	3a	830.0	0.747
14	3a	850.0	0.746
15	3b	868.0	0.746
16	3b	910.0	0.744
17	3b	945.0	0.743
18	4a	959.0	0.742
19	4a	1006.0	0.741
20	4a	1052.0	0.739
21	4b	1064.0	0.738
22	4b	1086.0	0.738
23	4b	1112.0	0.737
24	5a	1118.0	0.639
25	5a	1179.0	0.637
26	5a	1240.0	0.635
27	5b	1148.0	0.638
28	5b	1207.0	0.636
29	5b	1268.0	0.634
30	6a	1431.0	0.722
31	6a	1503.0	0.718
32	6a	1574.0	0.714
33	6b	1579.0	0.713
34	6b	1637.0	0.71

auxiliary

browseImageProduct

browseProduct

calibration

Downlink

Eng

Generic

Spurs

apertureEfficiency-H

apertureEfficiency-V

beamEfficiency-H

0

beamEfficiency-H

beamEfficiency-V

beamWidth-H

beamWidth-V

chopperPositions

chopperThrows

couplingEfficiency-H

couplingEfficiency-V

forwardEfficiency-H

forwardEfficiency-V

mixerCurrentTolerances

sidebandGainIF-H

sidebandGainIF-V

sidebandGainLO-H

sidebandGainLO-V

smoothOffWidth-H

smoothOffWidth-V

HRS-H

HRS-V

Level0

WBS-H

WBS-V

Uplink

pipeline-out



# HifiUplinkParameters Table

Provide information on how the observation was carried out  
 You will also find information on e.g. the predicted noise, goal RMS etc...

The screenshot shows a software interface with a tree view on the left and a table on the right. The tree view includes folders like 'History', 'auxiliary', 'AcmsTelemetryProduct', 'EventsLogProduct', 'HifiUplinkProduct', and 'HifiUplinkParameters' (which is selected). The table on the right lists 26 parameters with their values, units, and descriptions.

Index	name	value	unit	type	description
0	dbChopFrequency	0.25	Hz	java.lang.Double	Chop frequency
1	dbChopPhase	2.0	s	java.lang.Double	Chop phase length
2	hrsParMode	none		java.lang.String	HRS in parallel
3	loSettings	107		java.lang.Long	Number LO settings
4	loRangeStart	487.55359999999996	GHz	java.lang.Double	Actual LO range start
5	loRangeEnd	553.43909999999999	GHz	java.lang.Double	Actual LO range end
6	scanNoiseRefFrequency	520.49635	GHz	java.lang.Double	Noise reference frequency in scan range
7	noiseDSBMin	0.074	K	java.lang.Double	Predicted DSB Noise at minimum bandwidth
8	noiseDSBMax	0.03	K	java.lang.Double	Predicted DSB Noise at maximum bandwidth
9	noiseSSBMin	0.026	K	java.lang.Double	Predicted Deconvolved SSB Noise at minimum bandwidth
10	noiseSSBMax	0.011	K	java.lang.Double	Predicted Deconvolved SSB Noise at maximum bandwidth
11	noiseMinWidth	1.617	MHz	java.lang.Double	Minimum bandwidth for noise prediction
12	noiseMaxWidth	10.517	MHz	java.lang.Double	Maximum bandwidth for noise prediction
13	tmbReference	123.0	K	java.lang.Double	Temperature (main beam) at noise reference frequency
14	noiseRefFrequency	520.0	GHz	java.lang.Double	Noise reference frequency
15	observingTime	5459	s	java.lang.Long	Observing time
16	offTime	365.9	s	java.lang.Double	Off source time
17	overheadTime	4727.1	s	java.lang.Double	Overhead
18	totTimeEfficiency	13.4	%	java.lang.Double	Total time efficiency
19	totNoiseEfficiency	3.1	%	java.lang.Double	Total noise efficiency
20	driftNoiseContrib	6.08	%	java.lang.Double	Drift noise contribution
21	dbSContinuum	false		java.lang.Boolean	DBS continuum timing
22	goalNoise	0.02	K	java.lang.Double	Goal rms baseline noise
23	fastChop	false		java.lang.Boolean	DBS fast chop
24	oneGHzReference	true		java.lang.Boolean	One GHz noise estimation bandwidth
25	doingTime	false		java.lang.Boolean	Time estimation is based on observing

# Quality Reports: quality flags, logs, and control report history

You should worry about "SEVERE"

The screenshot displays a software interface with a left-hand navigation pane and a main content area. The navigation pane lists various data categories under 'Data', including 'obs\_sscan', 'History', 'auxiliary', 'browseImageProd', 'browseProduct', 'calibration', 'level0', 'level0\_5', 'level1', 'level2', 'level2\_5', 'logObsContext', 'quality', 'comments', 'History', 'logs', and 'trendAnalysis'. The 'quality' category is selected.

The main content area is divided into two sections. The top section, titled 'obs\_sscan.refs["quality"].product', contains a table with the following data:

Category	Message
obs_sscan.refs["quality"].product	The state of HF_AH2_D_FIF2_C is 'VIOLATION'
obs_sscan.refs["quality"].product	The state of HF_AH2_D_FIF2_V is 'VIOLATION'
obs_sscan.refs["quality"].product	The state of HF_AH2_D_SIF1_C is 'VIOLATION'
obs_sscan.refs["quality"].product	The state of HF_AH2_D_SIF1_V is 'VIOLATION'
obs_sscan.refs["quality"].product	The state of HF_AH2_D_SIF2_C is 'VIOLATION'
obs_sscan.refs["quality"].product	The state of HF_AH2_D_SIF2_V is 'VIOLATION'
obs_sscan.refs["quality"].product	The state of HF_AH2_D_SIF3_C is 'VIOLATION'
obs_sscan.refs["quality"].product	The state of HF_AH2_D_SIF3_V is 'VIOLATION'

The bottom section, titled 'Logs', shows a log viewer for 'JQCLogProductPanel'. It includes a search filter, a level dropdown set to 'WARNING', and buttons for 'detach' and 'save'. The log entries are as follows:

Category	Source	Message
JQCLogProductPanel	herschel.ia.spg.ops.AuxPluginQualityFlags.writeLog(...)	Event report
JQCLogProductPanel	herschel.ia.spg.ops.AuxPluginQualityFlags.writeLog(...)	LINE 001: Report identified for observation: 1342181161 [Subtype: 1, ID: 16427
JQCLogProductPanel	herschel.ia.spg.ops.AuxPluginQualityFlags.writeLog(...)	LINE 002: time: 1627846012528717, Description: AccAsw TM_5_1_16427 - Nev
JQCLogProductPanel	herschel.ia.spg.ops.AuxPluginQualityFlags.writeLog(...)	Event report
JQCLogProductPanel	herschel.ia.spg.ops.AuxPluginQualityFlags.writeLog(...)	LINE 001: Report identified for observation: 1342181161 [Subtype: 1, ID: 29186
JQCLogProductPanel	herschel.ia.spg.ops.AuxPluginQualityFlags.writeLog(...)	LINE 002: time: 1627846028900330, Description: CdmuAsw Event 5-1 Class A
JQCLogProductPanel	herschel.ia.spg.ops.AuxPluginQualityFlags.writeLog(...)	Event report
JQCLogProductPanel	herschel.ia.spg.ops.AuxPluginQualityFlags.writeLog(...)	LINE 001: Report identified for observation: 1342181161 [Subtype: 1, ID: 16441
JQCLogProductPanel	herschel.ia.spg.ops.AuxPluginQualityFlags.writeLog(...)	LINE 002: time: 1627846030014969, Description: AccAsw TM_5_1_16441 - Mo
JQCLogProductPanel	herschel.ia.spg.ops.AuxPluginQualityFlags.writeLog(...)	Event report
JQCLogProductPanel	herschel.ia.spg.ops.AuxPluginQualityFlags.writeLog(...)	LINE 001: Report identified for observation: 1342181161 [Subtype: 1, ID: 29186
JQCLogProductPanel	herschel.ia.spg.ops.AuxPluginQualityFlags.writeLog(...)	LINE 002: time: 1627846030904541, Description: CdmuAsw Event 5-1 Class A
JQCLogProductPanel	herschel.ia.spg.ops.AuxPluginQualityFlags.writeLog(...)	Event report
JQCLogProductPanel	herschel.ia.spg.ops.AuxPluginQualityFlags.writeLog(...)	LINE 001: Report identified for observation: 1342181161 [Subtype: 1, ID: 29185
JQCLogProductPanel	herschel.ia.spg.ops.AuxPluginQualityFlags.writeLog(...)	LINE 002: time: 1627846046902496, Description: CdmuAsw Event 5-1 Class A
JQCLogProductPanel	herschel.ia.spg.ops.AuxPluginQualityFlags.writeLog(...)	Event report
JQCLogProductPanel	herschel.ia.spg.ops.AuxPluginQualityFlags.writeLog(...)	LINE 001: Report identified for observation: 1342181161 [Subtype: 1, ID: 29186

## Level 2.5

You will find this level in two of the three observing modes:

**Mapping mode** – in the form of data cubes called *cubesContexts*

**SScan** (Spectral Scan) – in the form of a deconvolution Context called *myDecon*

**Point mode** do not have a Level 2.5

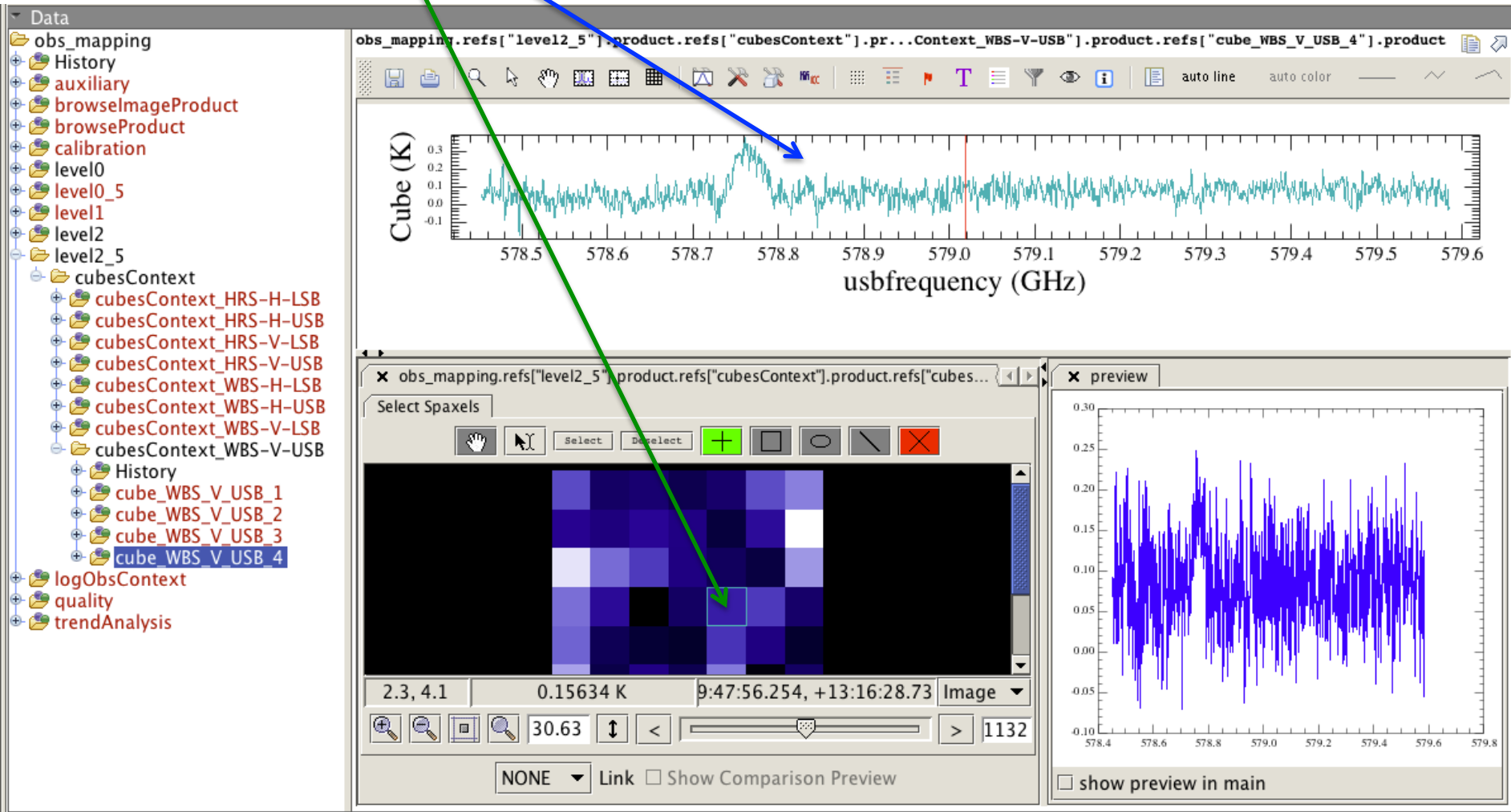
**Note** that corrections such as standing waves and baseline drifts are not performed through the pipeline. These must be performed at the Level 2 by you, and then, you must perform **doGridding** (for Mapping Mode) and **doDeconvolution** (for SScan) to obtain your corrected cubesContext and myDecon Context. (*demo of doGridding and doDeconvolution later today*)

**Level 2:** science data calibrated but...

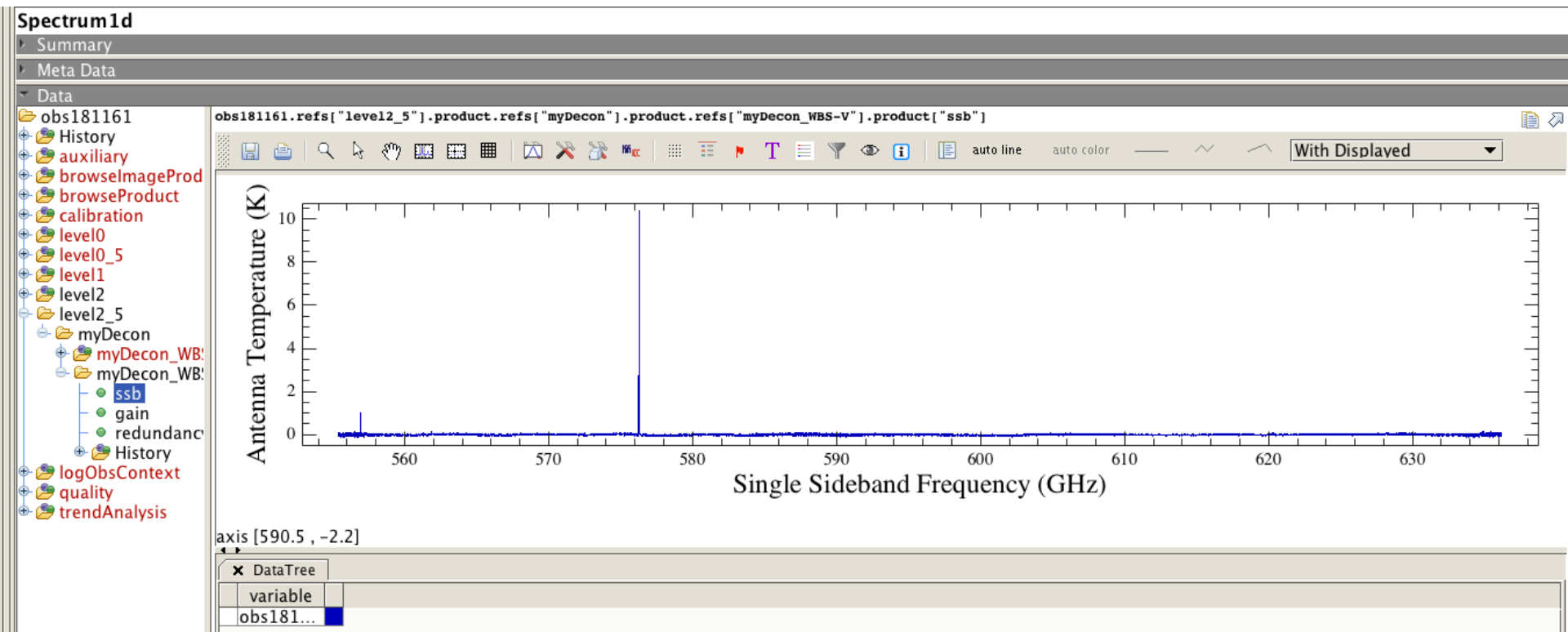
Must perform flagging, if needed, removal of standing waves, baseline fit (for drifts)... (*demo later today*)

# Level 2.5: Mapping mode

Spectrum from a selected spaxel

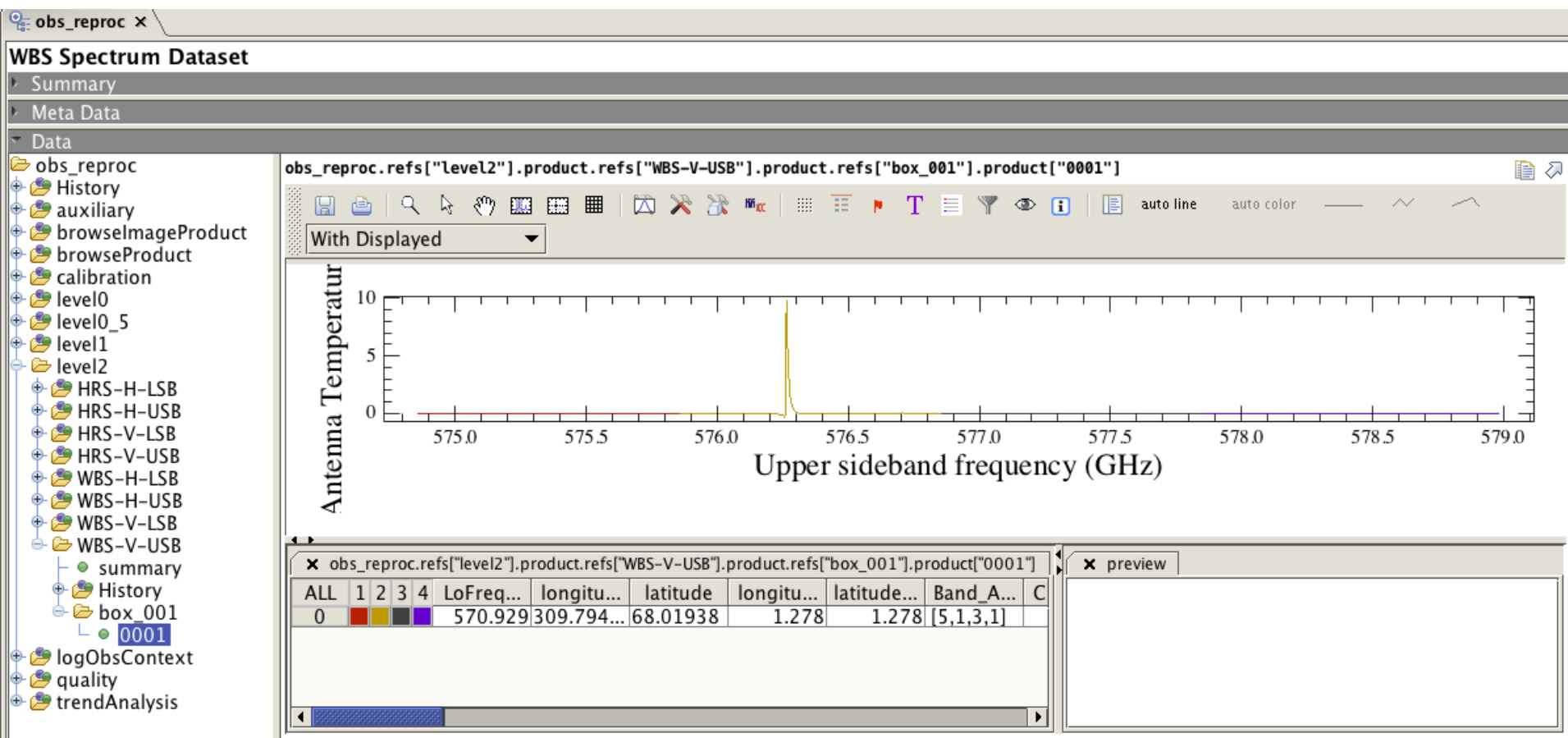


# Level 2.5: Spectral Scan (SScan) deconvolution solution



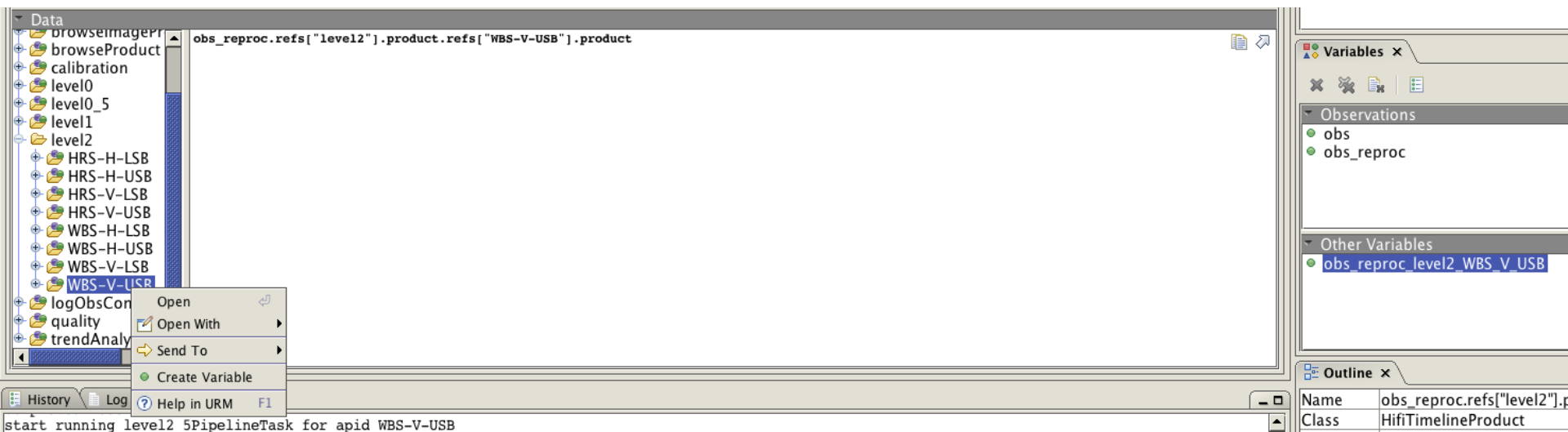
## Level 2: science data calibrated but...

flagging, if needed, removal of standing waves, baseline fit (for drifts)...  
(demo later today)



# Saving products into Variables:

- left-click to select an htp
- right-click to open the menu
- select "Create variable" with left-click



# Level 2: opening a htp with Spectrum Explorer

File Edit Run Pipelines Scripts Window Tools Help



Editor x

obs x

### Time ordered HIFI product

- Summary
- Meta Data
- Data
  - obs
    - History
    - auxiliary
    - browseImageProd
    - browseProduct
    - calibration
    - level0
    - level0\_5
    - level1
    - level2
      - HRS-H-LSB
      - HRS-H-USB
      - HRS-V-LSB
      - HRS-V-USB
      - WBS-H-LSB
      - WBS-H-USB
      - WBS-V-LSB
      - WBS-V-USB
    - logObs
    - quality
    - trendAr

obs.refs["level2"].product.refs["WBS-V-USB"].product

Select an "htp" (HifiTimelineProduct) (right-click, then left-click on SE)

- Open
- Open With
  - Context Viewer
  - Product Viewer
  - Spectrum Explorer (HifiProduct)
- Send To
- Create Variable
- Help in URM F1

Tasks x

- Applicable
- By Category
- All

Variables

- Observation
  - obs

Other Variables

Outline x

Name	Class	Package
obs.refs["	HifiTimelineProduct	hifi
summary	Summary	hifi
History	History	hifi
box_00	Box	hifi

History Log Console x

```
HIFE> obs=getObservation(1342190183, poolName='1342190183')
getObservation is retrieving the observation from pool '1342190183' at: '/Users/sfbeaulieu/.hcss/lstore/1342190183'
HIFE>
```



# Looking at your data with SpectrumExplorer

Recall

The screenshot shows the SpectrumExplorer interface. The main plot displays Antenna Temperature (K) on the y-axis (0 to 10) and Upper sideband frequency (GHz) on the x-axis (575.0 to 579.0). A sharp peak is visible at approximately 576.3 GHz. The plot is divided into subbands, each represented by a different color. A red arrow points to the plot with the text "Subbands in different colours". A blue arrow points to the plot with the text "Selecting a subband activates preview".

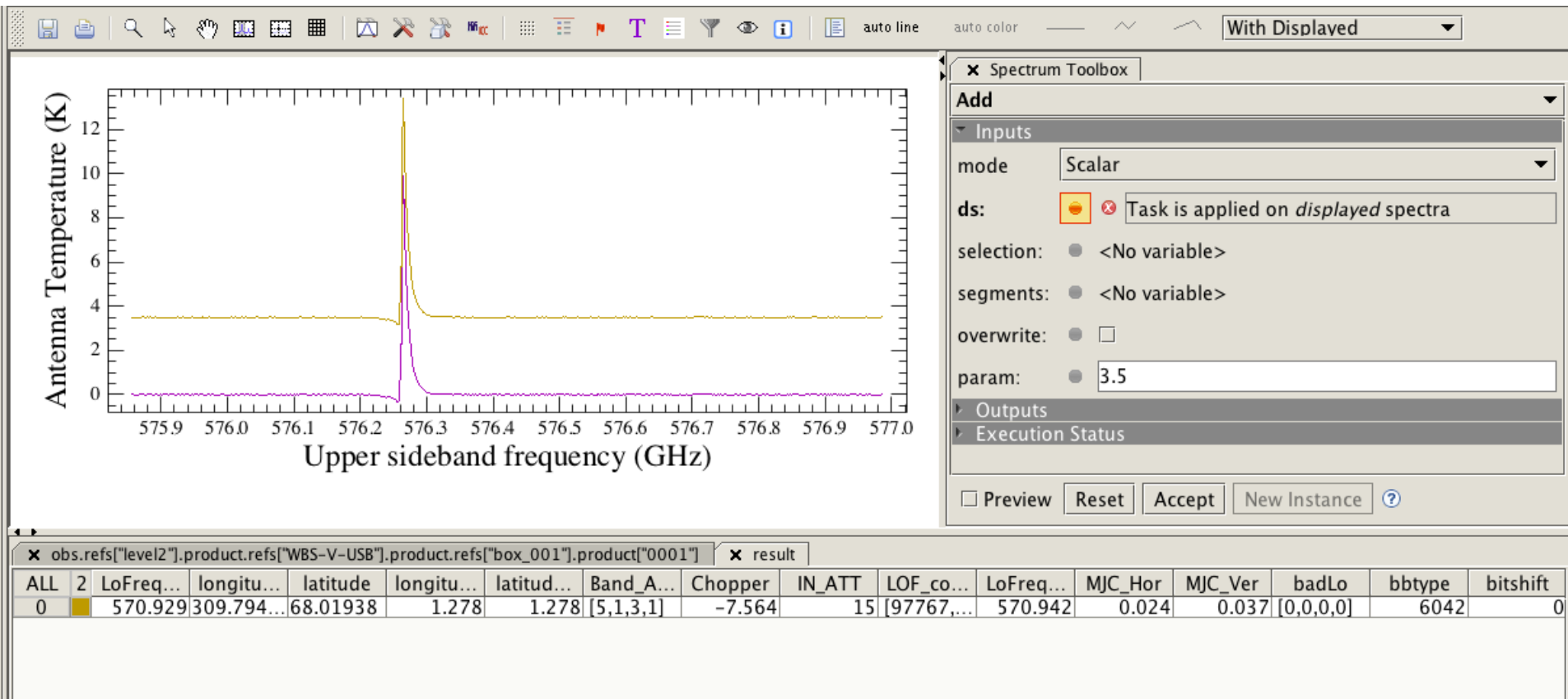
The DataTree table below the plot shows the following data:

variable	LoFreq...	longitu...	latitude	longitu...	latitud...	AOT	Band	Band_A...
obs.refs...						HifiPoint...	1b	
obs.refs...						HifiPoint...	1b	
obs.refs...						HifiPoint...	1b	
obs.refs...						HifiPoint...	1b	
product...	570.929	309.795	68.019	1.278	1.278	HifiPoint...	1b	[5,1,3,1]
[0,1]	570.929	309.795	68.019	1.278	1.278	HifiPoint...	1b	[5,1,3,1]
[0,2]	570.929	309.795	68.019	1.278	1.278	HifiPoint...	1b	[5,1,3,1]
[0,3]	570.929	309.795	68.019	1.278	1.278	HifiPoint...	1b	[5,1,3,1]
[0,4]	570.929	309.795	68.019	1.278	1.278	HifiPoint...	1b	[5,1,3,1]

The preview window shows a zoomed-in view of the selected subband, displaying a noisy signal. A blue arrow points to the preview window with the text "Selecting a subband activates preview". The preview window also has a checkbox labeled "show preview in main".

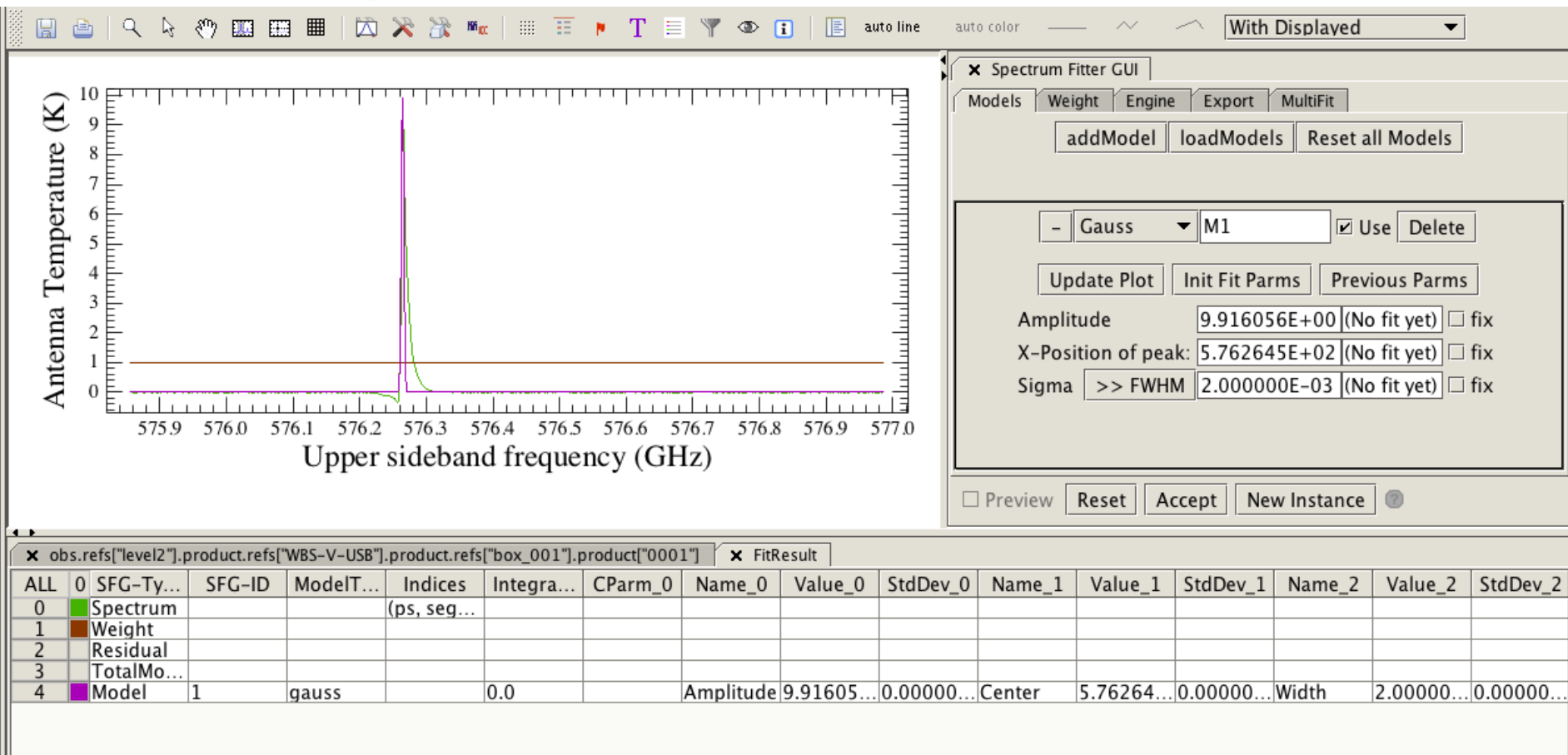
# Looking at your data with SpectrumExplorer

using the **Spectrum Toolbox**: adding a scalar



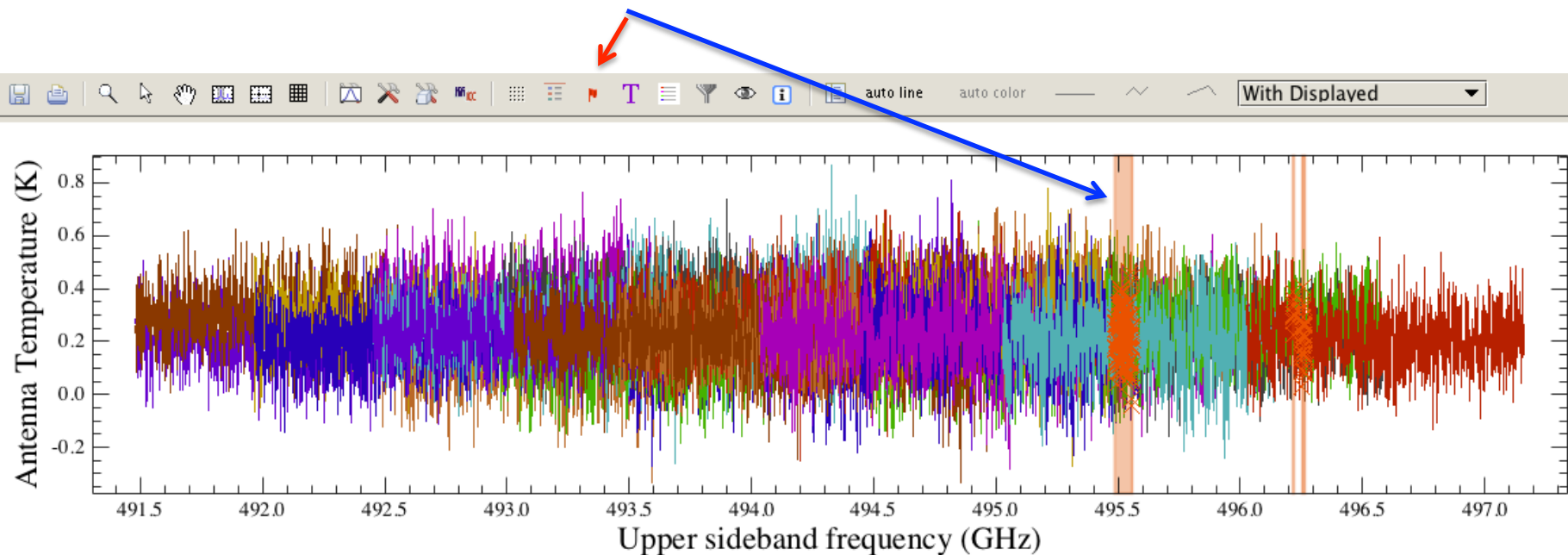
# Looking at your data with SpectrumExplorer

using the **Spectrum Fitter**: modeling profiles



# Looking at your data with SpectrumExplorer

Quick look at flags



variable	LoFreq...	longitu...	latitude	longitu...	latitud...	AOT	Band	Band_A
[0,1]	488.527	161.266	-59.684	0.54	0.54	HifiSSca...	1a	{6,2,4,0}
[0,2]	488.527	161.266	-59.684	0.54	0.54	HifiSSca...	1a	{6,2,4,0}
[0,3]	488.527	161.266	-59.684	0.54	0.54	HifiSSca...	1a	{6,2,4,0}
[0,4]	488.527	161.266	-59.684	0.54	0.54	HifiSSca...	1a	{6,2,4,0}
- obs_ssc...						HifiSSca...	1a	
- product...	489.105	161.265	-59.684	0.6	0.6	HifiSSca...	1a	{6,2,4,0}
[0,1]	489.105	161.265	-59.684	0.6	0.6	HifiSSca...	1a	{6,2,4,0}
[0,2]	489.105	161.265	-59.684	0.6	0.6	HifiSSca...	1a	{6,2,4,0}
[0,3]	489.105	161.265	-59.684	0.6	0.6	HifiSSca...	1a	{6,2,4,0}
[0,4]	489.105	161.265	-59.684	0.6	0.6	HifiSSca...	1a	{6,2,4,0}
- obs_ssc...						HifiSSca...	1a	

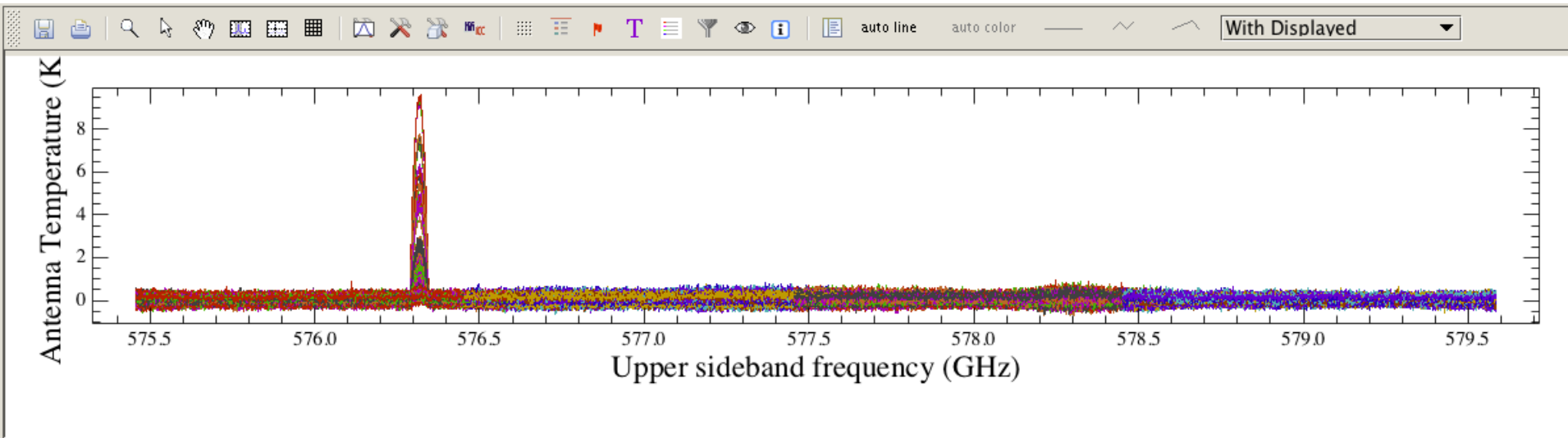
preview

# The importance of looking at your data

## Baseline drift

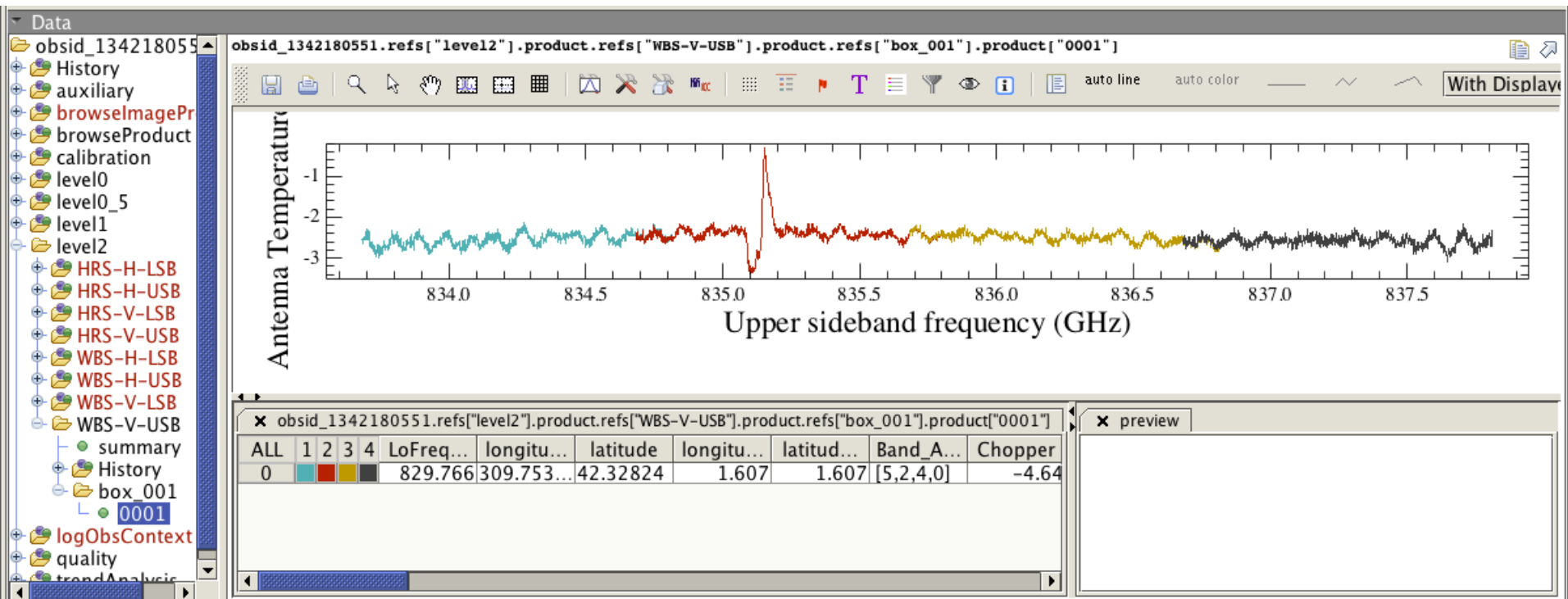
left-over of instrument instabilities: offset, slope, curve, and/or ripple

can be corrected using **FitBaseline** task

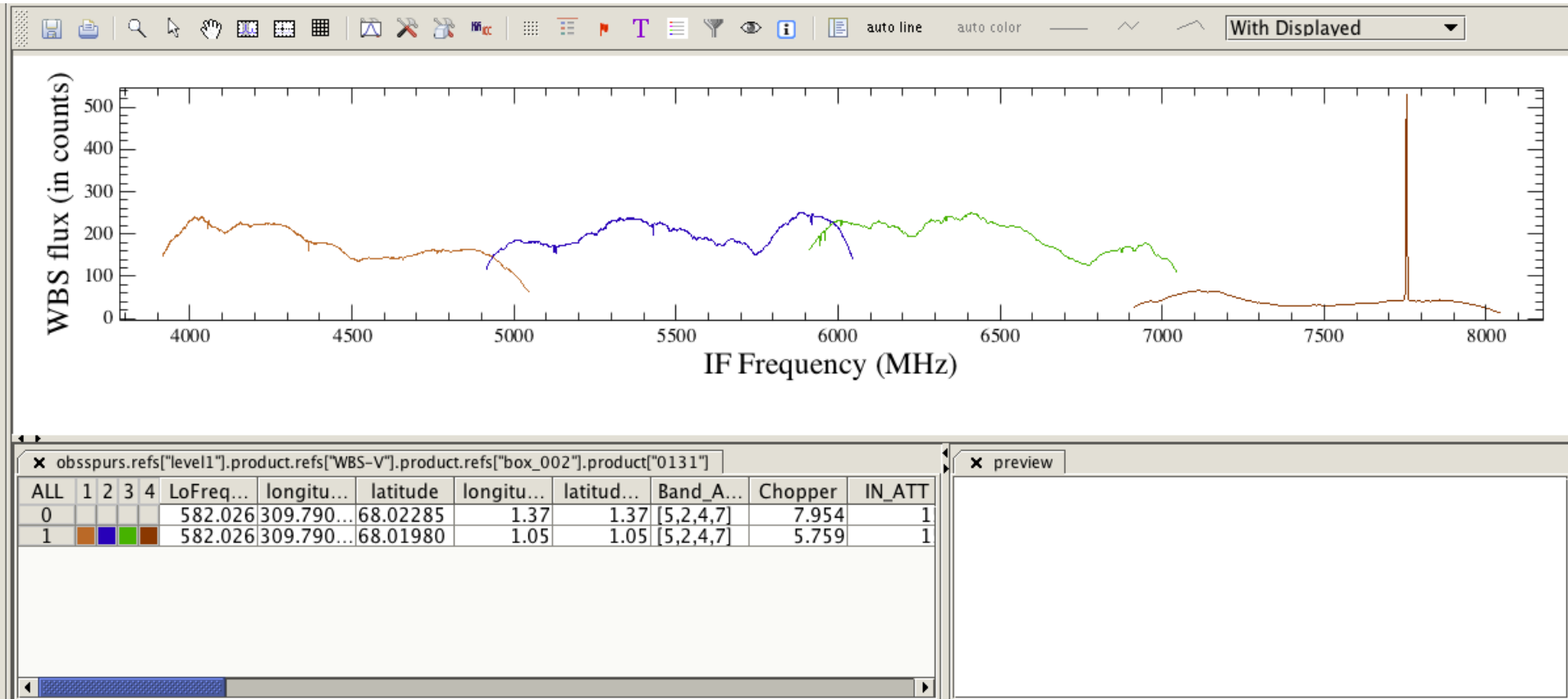


**Standing waves:** periodic signals present in all bands

A very nice example of standing waves: can be corrected using the task **FitHifiFringe**



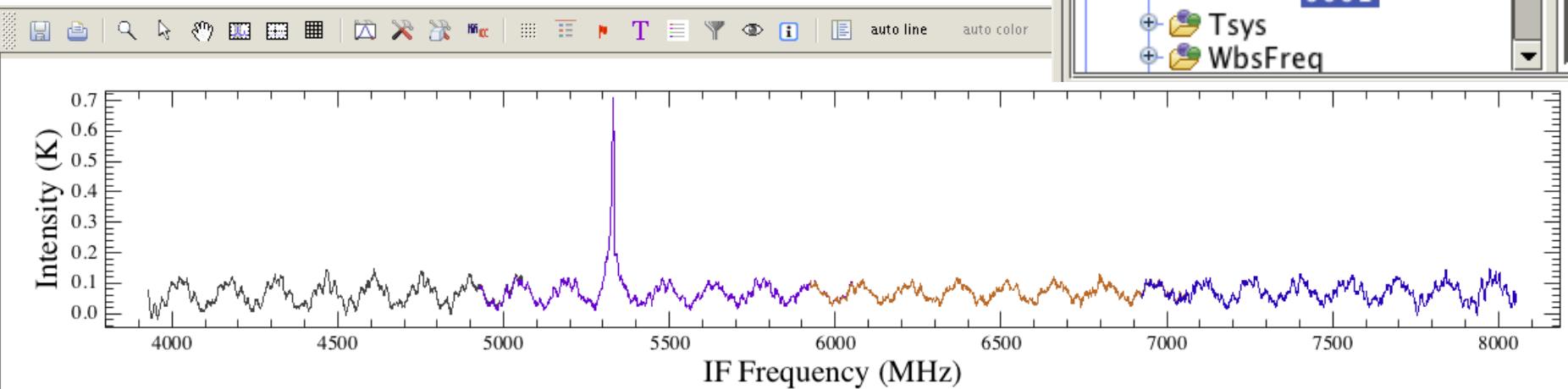
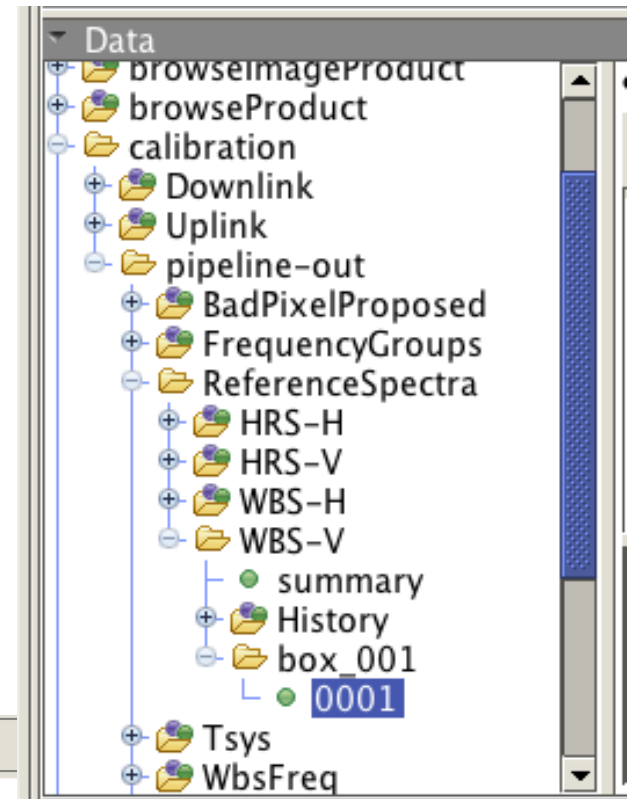
- Spurs:** - features that are gaussian in shape and narrow
- they can look like astronomical lines
  - automatic detection in calibration – check spurs table in Trend Analysis



## How to examine your reference spectra

Emission in the off position: in principle, the reference position should be devoid of any emission but for, e.g. extended sources, emission can still be present

Some discussion in the *HIFI Data Reduction Guide Cookbook* on Mapping Mode to correct for emission in chop positions.



ALL	1	2	3	4	LoFreq...	longitu...	latitude	longitu...	latitud...	Band_A...	Chopper	IN_ATT	LOF_co...	LoFreq...	MJC_Hor
0	■	■	■	■	570.929	309.794...	68.01942	1.087	1.087	[5,1,3,1]	-2.41	15	[97767,...	570.942	0.024



# Demo...

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NHSC DP workshop 29.Aug.2013

