

The HiFi Single Point Observation AOT

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Overview:

- **Full information about pointed modes are contained in the “HIFI Observers’ Manual v1.0.”**
- All point observation modes have the following
 - **Full frequency range of all available HIFI mixer bands.**
 - **All available resolutions of the High Resolution Spectrometer (HRS). Note: At high frequencies the highest resolution mode is redundant.**
 - **Wide band (WBS) and high resolution (HRS) spectrometers can be used in parallel (up to 3 resolutions).**
 - **Target, LO frequency and position of subbands of the HRS always selectable for all modes.**
 - **All pointed observations provide dual sideband data only.**
- Timing of sequence of observations/pointings for pointed observing modes based on time or noise and required resolution requested by user.
 - **Timing based on system stability times for the given band.**
 - **Time between load calibrations is 1800 secs (500 secs for bands 6 and 7)**

HIFI Pointed Observing Modes Available

- Basically a choice of reference (ON – OFF) schemes.
- *Dual Beam Switch (DBS)* – uses chopped positions either side of target for reference.
- *Position switch* – uses single position within 2 degrees of the target (no chopper).
- *Frequency switch* – uses neighbouring frequency as a reference (120, 240 MHz frequency throw).
- *Load Chop* – uses internal load for reference.

Dual Beam Switch (DBS)

- Purpose:

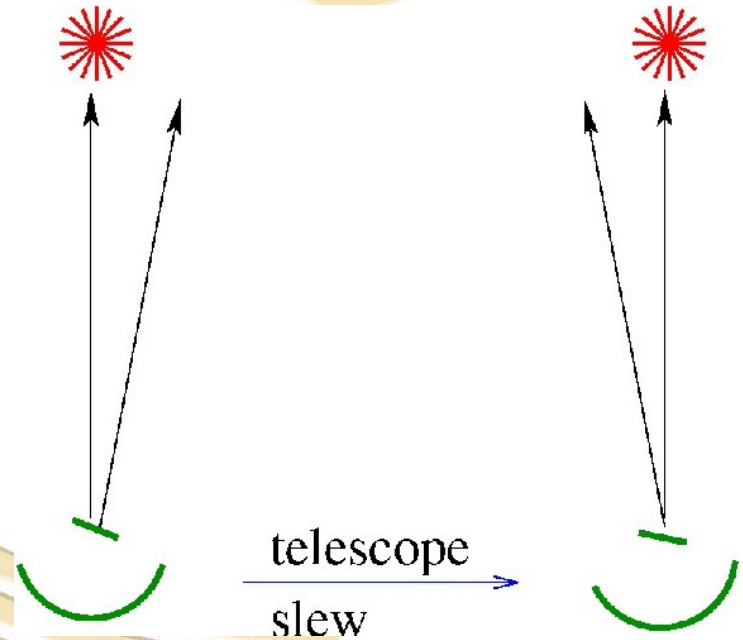
Used for spectral line or continuum measurements of isolated point sources.

- Description:

Chopper is used in two positions to look at target plus position offset 3', for a number of chopper cycles

Telescope slew then to place target in second of chopper positions and chopping sequence repeated.

Combination (double difference) allows for removal of standing waves (e.g., due to light path differences) and linear instrumental drifts.



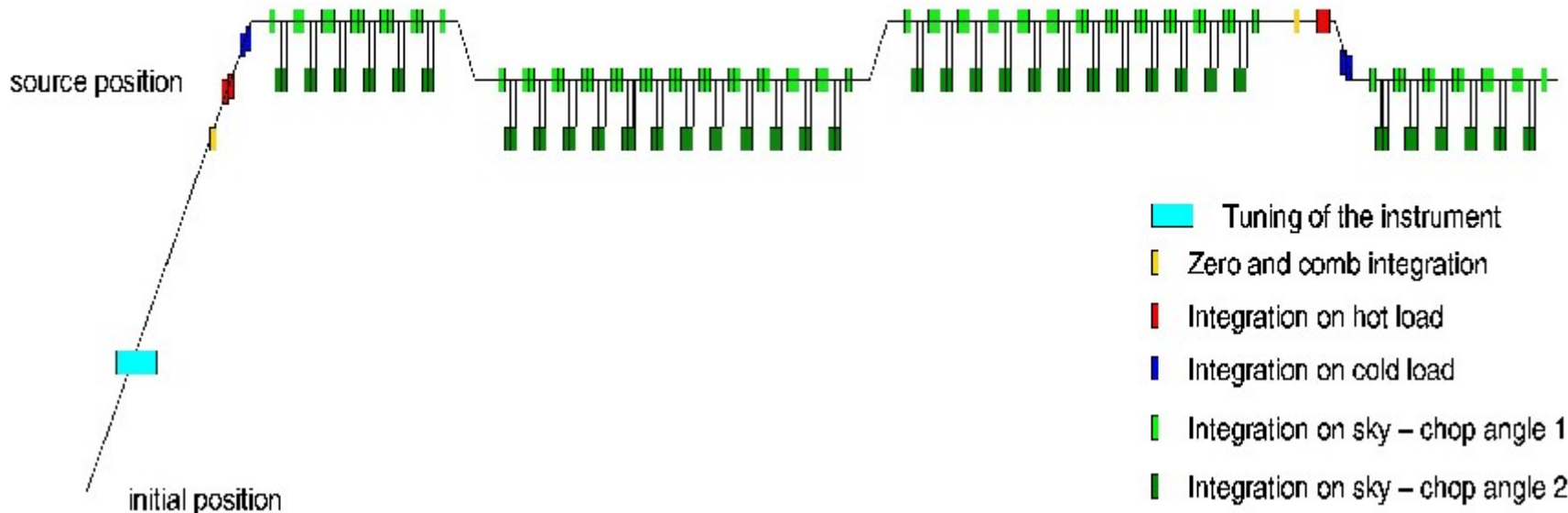
Timeline for DBS Observations

- Mode User Options:

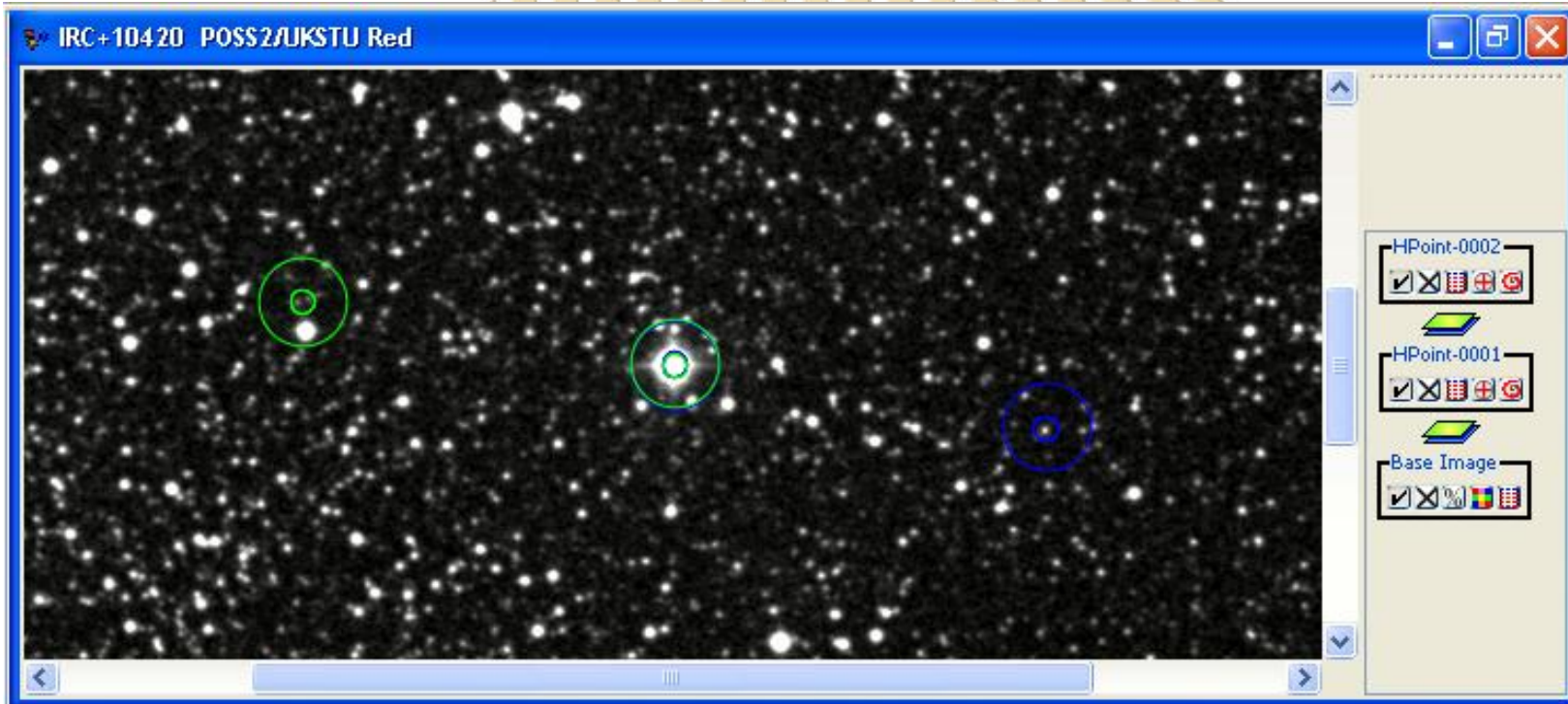
User has options for

- **Continuum measurements** (telescope slews more frequently – better standing wave removal).
- **Faster chopper switch** (necessary for cases where stability– Allan – times are < 1 second, e.g. low spectral resolutions).

Telescope:



- Tuning of the instrument
- Zero and comb integration
- Integration on hot load
- Integration on cold load
- Integration on sky – chop angle 1
- Integration on sky – chop angle 2



Position Switch Observations

- **Purpose:**
- For spectral line or continuum measurements for objects that are in regions of extended emission ($> 3'$ across).
- **Description:**
- Instrument integrated on the target with continuous data dumps to the satellite.
- After a period of time, based on the instrument stability, an OFF reference is made at a second telescope position.
- [Calibration is done against internal hot/cold load measurements – taken during slews.]
- **Mode User Options:**
- User MUST choose a reference OFF position – either by RA/Dec offset or RA/Dec (2000) position.

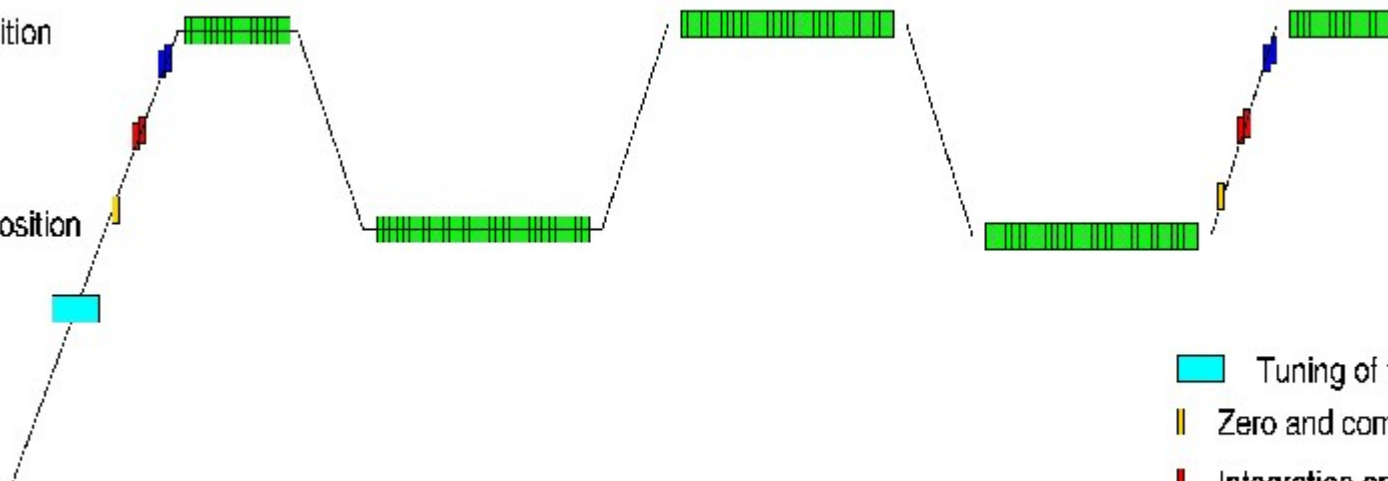
Timeline for the Position Switch Observing Mode

Telescope:

OFF position

source position

initial position



- Tuning of the instrument
- Zero and comb integration
- Integration on hot load
- Integration on cold load
- Integration on sky

Frequency Switch (w/OFF)

- **Purpose:**
- Efficient mode for emission-line source measurements. No continuum information.
- **Description:**
- Reference is made between two observations at slightly different LO frequency settings.
 - Requires stability of the gain such that there is little to no difference created by the slight change in LO frequency.
 - Since the LO frequency settings are close together the target source is effectively always in view while on the source.
- Accurate baseline measurements need the use of an OFF reference position, that is viewed at both LO frequencies.
 - OFF measurements are used for baseline calibration and can be smoothed → reduced time on OFF versus ON target.
- Double differencing gives most accurate baselines but at a cost in terms of time.

Timeline for Frequency Switch Observations

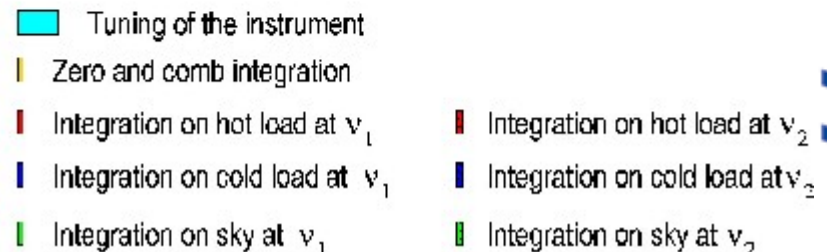
- Mode User Inputs:
 - Frequency throw (120, 240MHz)
 - OFF position

Telescope:

OFF position

source position

initial position



Load Chop (w/OFF)

- Purpose:
- Spectra of single sources, particularly where no nearby reference OFF position is readily available and short stability times.
- Description:
- Similar to the frequency switch mode except that the cold internal calibration source is viewed instead of a second, nearby, LO frequency.
- Double differencing (by similar data taking on an OFF position) allows for accurate baseline determination at the expense of observing time.
- If spectral line resolution \ll resolution for standing waves then the OFF position may be omitted.

Timeline for Load Chop Observations

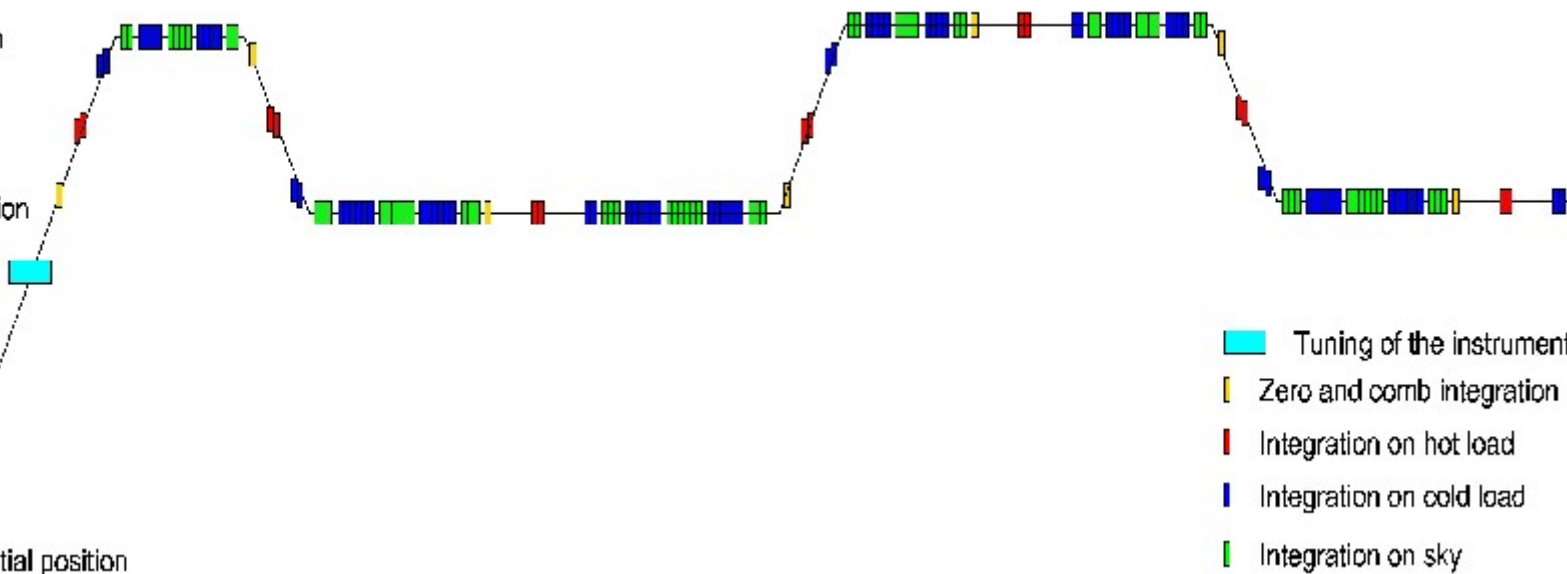
- Mode User Inputs:
 - Only an OFF position (if needed) additional information for mode.

Telescope:

OFF position



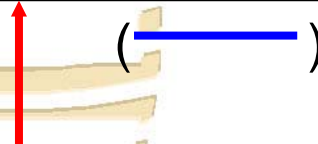


source position

initial position



- Tuning of the instrument
- Zero and comb integration
- Integration on hot load
- Integration on cold load
- Integration on sky

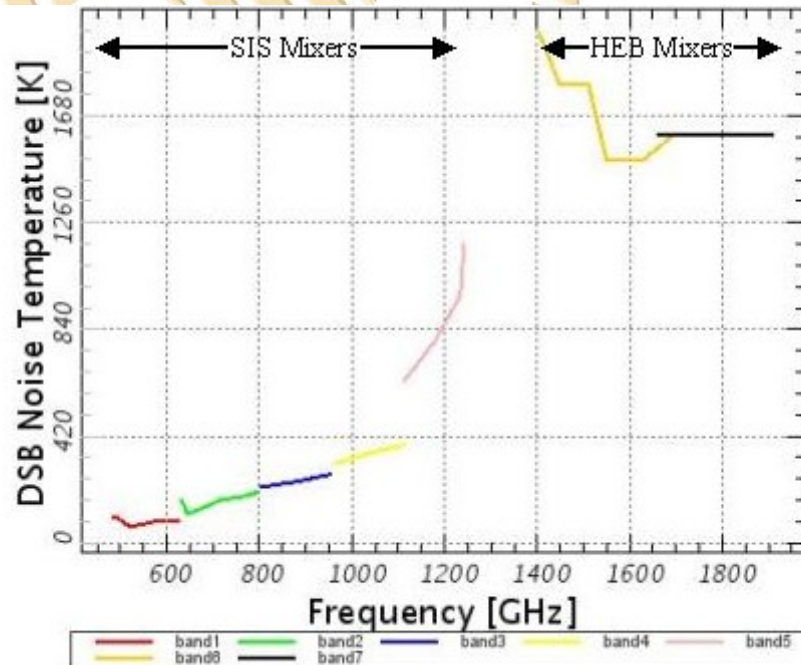


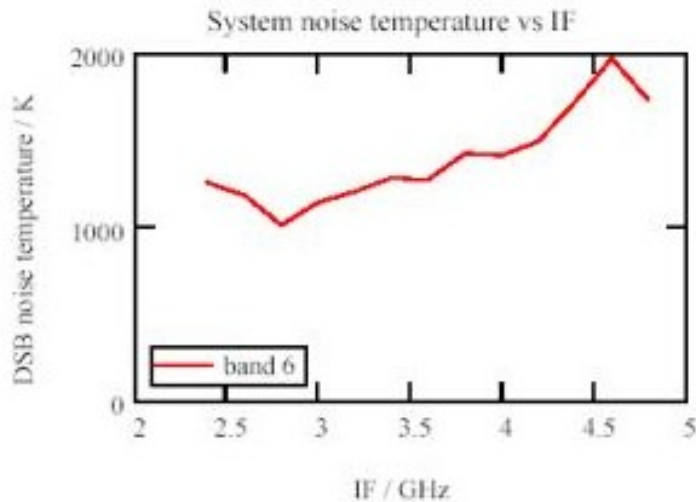
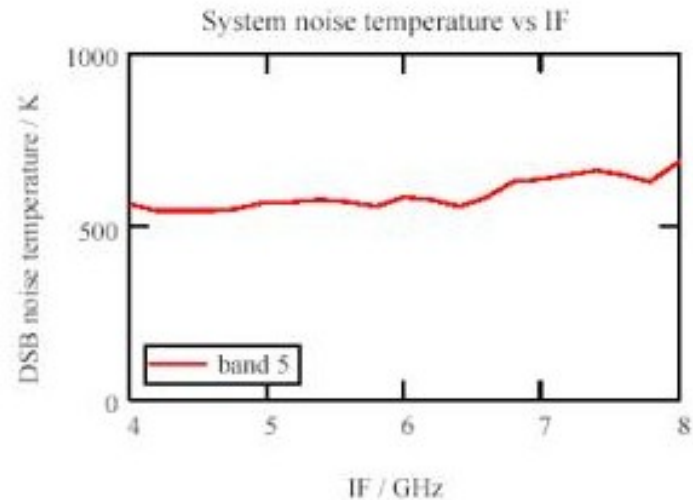
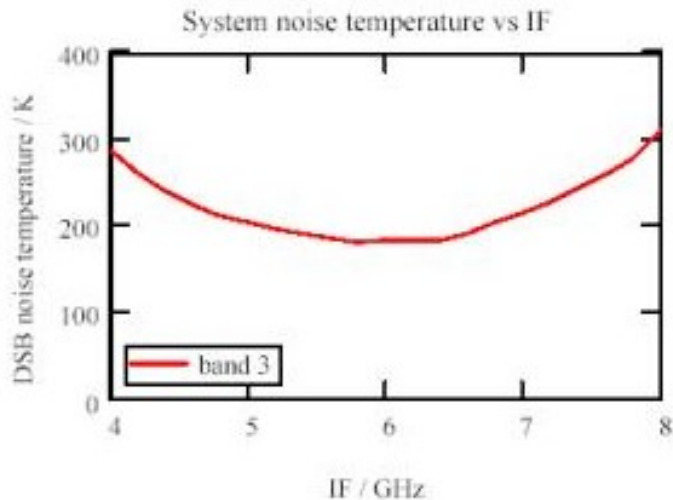
Mode	Best Used For....	Notes	Efficiency
<p><i>DBS</i> (+ <i>fast chop</i>)</p>	<p>For point sources, small extension</p>	<p>Fast chop for short stability times</p>	
<p><i>DBS</i> (<i>cont. timing</i>)</p>	<p>Improved continuum accuracy.</p>		
<p><i>Frequency Switch</i> (<i>w/OFF</i>)</p>	<p>For sources with low (narrow) line density + no near reference</p>	<p>No continuum measures</p>	
<p><i>Position switch</i></p>	<p>Basic mode – no clear nearby reference source</p>		
<p><i>Load Chop</i> (<i>w/OFF</i>)</p>	<p>For sources with high line density or broad lines + no near reference</p>	<p>Fall-back wrt position switch</p>	



Sensitivities

- Given as single polarization, single sideband values in HSpot.
- Noise levels are for best placement within the visible 2.4 or 4GHz bandwidth of the IF band.





HiFi Single Point Observation

Unique AOR Label:

Target: None Specified

Number of visible stars for the target: None Specified

Instrument Settings

Mixer settings

Mixer band:

Low limit (GHz):

High limit (GHz):

Redshift selection

Radial Velocity:

Redshift:

Frame:

Spectrometer choice

Select the spectrometer to use:

WBS Resolution (MHz):

Separate setup for each polarisation of HRS sub-bands?:

The HRS Mode for H or both polarisations:

HRS Resolution (MHz) for H or both polarisations:

The HRS Mode for V polarisations:

HRS Resolution (MHz) for V polarisation:

Frequency Settings **Observing Mode Settings** **Time Estimator Settings**

Observing Mode Settings

Choose one of the modes below.

Dual Beam Switch

Load Chop

Frequency Switch

No mode selected Position Switch

Reference Position

Specifications

Type: By offset By position

RA offset (arcmins):

Dec offset (arcmins):

RA (degrees):

Dec (degrees):

Yes No

Time Estimator Settings

Estimate Type:

Resolution units:

LOF	Goal resolution minimum	Goal resolution maximum	Time (s)	Noise (K)
LOF 1	0.480	10.000	<input type="text" value="3000"/>	0.100

Zoomed LO frequency scale

LO frequency slider

Frequency Editor

4GHz sideband (Lower Sideband) | 4GHz sideband (Upper Sideband)

Sliders allow positioning of HRS sub-bands within 4GHz IF range

482.0GHz 484.0GHz 486.0GHz 488.0GHz 490.0GHz 492.0GHz 494.0GHz 496.0

Local Oscillator Frequency (GHz)

Redshift: 0.000000 | Reset | Reset all frequencies

Frequency Selection

Type	...	Line	Transition	U...	Observed (GHz)	USB Observed (G...	LSB Observed (G...
WBS	<input checked="" type="checkbox"/>	-No Lines-	-No Lines-	<input checked="" type="checkbox"/>		494.10	482.10
HRS 1	<input checked="" type="checkbox"/>	-No Lines-	-No Lines-	<input checked="" type="checkbox"/>		494.10	482.10
HRS 2	<input checked="" type="checkbox"/>	-No Lines-	-No Lines-	<input checked="" type="checkbox"/>		494.10	482.10

Line/transition pulldown menus

Upper/lower sideband selection for lines. Default (ticked) is upper sideband

OK | Cancel