

Part 2: spectral setup, receivers and correlator



German ARC: ALMA community days (March 2015)

Outline

Part 1: by S. Burkutean

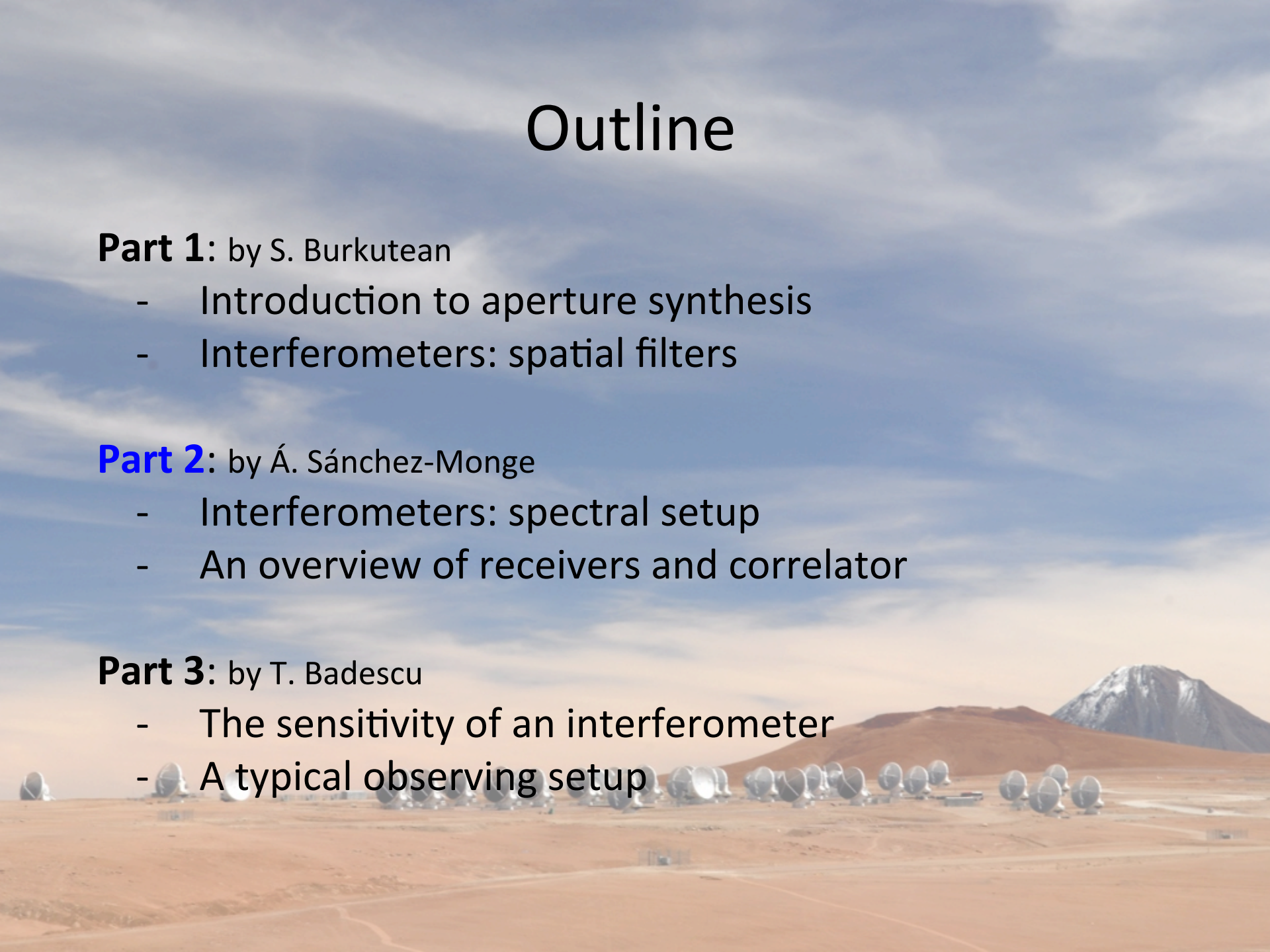
- Introduction to aperture synthesis
- Interferometers: spatial filters

Part 2: by Á. Sánchez-Monge

- Interferometers: spectral setup
- An overview of receivers and correlator

Part 3: by T. Badescu

- The sensitivity of an interferometer
- A typical observing setup



Spectral setup in the almaOT

The screenshot displays the ALMA Observing Tool (Cycle3) interface. The main window is titled "ALMA Observing Tool (Cycle3-Patchtests2) - Project". The interface is divided into several sections:

- Project Structure:** A tree view on the left showing the project hierarchy: Project > Proposal > Planned Observations > Science Goals > General > Field Set > Spectral > Calibration > Technical.
- Editors:** A tabbed interface with three tabs: Spectral, Spatial, and Field Setup. The Field Setup tab is currently active.
- Field Setup Tab:** This tab contains the following configuration options:
 - Source:** A text input field for the source name, with a "Resolve" button to the right.
 - Choose a Solar System Object?:** A checkbox, currently unchecked. The "Name of object" dropdown is set to "Unspecified".
 - Source Coordinates:** Fields for System (FK5 J2000), Sexagesimal display? (checked), Parallax (0.00000 mas), RA (00:00:00.0000), PM RA (0.00000 mas/yr), Dec (00:00:00.000), and PM DEC (0.00000 mas/yr).
 - Source Radial Velocity:** Fields for velocity (0.000 km/s), units (km/s), reference frame (lsrk), redshift (z = 0.000000000), and Doppler Type (RADIO).
 - Target Type:** Radio buttons for "Individual Pointing(s)" (selected) and "1 Rectangular Field".
 - Expected Source Properties:** Fields for Peak Continuum Flux Density per Synthesized Beam (0.00000 Jy), Continuum Polarization Percentage (0.0%), Peak Line Flux Density per Synthesized Beam (0.00000 Jy), Line Width (0.00000 km/s), and Line Polarization Percentage (0.0%).
 - Field Center Coordinates:** Fields for Custom Mosaic (unchecked), PointingPattern (Offset, checked), Offset Unit (arcsec), and #Pointings (1).

Spectral setup in the almaOT

ALMA Observing Tool (Cycle3)

ALMA Observing Tool (Cycle3-Patchtests2) - Project

File Edit View Tool Search Help

Project Structure

Editors

Spectral Spatial **Field Setup**

Input source details and mapping info or use the Visual Editor on the spatial tab.
You must choose between checking 1 Rectangular Field on all sources or none.
Check 1 Rectangular Field on the first source before adding others to put rectangular mosaics around multiple sources.

SinglePoint

Source

Source Name Resolve

Choose a Solar System Object? Name of object Unspecified

System FKS J2000 Sexagesimal display? Parallax 0.00000 mas

Source Coordinates RA 00:00:00.0000 PM RA 0.00000 mas/yr
Dec 00:00:00.0000 PM DEC 0.00000 m/yr

Source Radial Velocity 0.000 km/s lsrk z 0.000000000 Doppler type RADIO

Target Type Individual Pointing(s) 1 Rectangular Field

Expected Source Properties

Peak Continuum Flux Density per Synthesized Beam 0.00000 Jy

Continuum Polarization Percentage 0.0 %

Peak Line Flux Density per Synthesized Beam 0.00000 Jy

Line Width 0.00000 m/s

Line Polarization Percentage 0.0 %

Field Center Coordinates

Custom Mosaic:

PointingPattern: Offset

Offset Unit arcsec

#Pointings 1

WE ALREADY KNOW HOW TO FILL THIS

Spectral setup in the almaOT

The screenshot displays the ALMA Observing Tool (Cycle3) interface. The main window is titled "ALMA Observing Tool (Cycle3-Patchtests2) - Project" and shows the "Field Setup" tab for a "SinglePoint" source. The "Project Structure" tree on the left has "Spectral" circled in red. The "Field Setup" panel includes fields for "Source Name", "System" (FK5 J2000), "RA", "Dec", "Source Radial Velocity", and "Target Type". A large blue diagonal watermark reads "WE ALREADY KNOW HOW TO FILL THIS".

SPECTRAL SETUP

WE ALREADY KNOW HOW TO FILL THIS

Spectral setup in the almaOT

The screenshot displays the ALMA Observing Tool (Cycle3) interface. The title bar shows "ALMA Observing Tool (Cycle3-Patchtests2) - Project" and the system tray includes the date "Sat Mar 21 14:09" and the user name "Alvaro Sanchez". The menu bar contains "File", "Edit", "View", "Tool", "Search", and "Help". The toolbar includes icons for file operations and navigation.

The interface is divided into two main panes: "Project Structure" on the left and "Editors" on the right. The "Project Structure" pane shows a tree view with "Unsubmitted Proposal" expanded, containing "Project", "Proposal", "Planned Observations", "Science Goals", "General", "Field Set", "Spectral", "Calibration", "Control", and "Technical". The "Editors" pane has tabs for "Spectral", "Spatial", and "Spectral Setup", with "Spectral Setup" selected.

The "Spectral Setup" pane contains the following information:

In the table below, it is possible to define up to 16 spectral windows, 4 per baseband as long as the total Fraction per baseband is no more than 1. Each baseband is 2GHz wide and can be separately configured i.e. each spectral window can have a different bandwidth and resolution. Note that for bands 3, 4, 6, 7 and 8, it is not possible to put 3 basebands in one sideband and the fourth one in the other.

Spectral Type [?] [-]

Spectral Line
 Single Continuum
 Spectral Scan

Polarization products desired XX DUAL FULL

Spectral Setup Errors
No spectral window in the list. No suitable receiver band for the range :[0.0 GHz, 0.0 GHz]

Spectral Line [?] [-]

Baseband-1 [?] [-]

Fraction	Center Freq (Rest)	Center Freq (Sky)	Transition	Bandwidth, Resolution (smoothed)	Spec Avg.	Representative Window

Select Lines to Observe in Baseband-1...

Baseband-2

Select Lines to Observe in Baseband-2...

Baseband-3

Spectral setup in the almaOT

The screenshot shows the ALMA Observing Tool (Cycle3) interface. The title bar indicates the application is running on a Mac, with system status icons for network, Bluetooth, and battery, and the date/time 'Sat Mar 21 14:09' and user 'Alvaro Sanchez'. The main window title is 'ALMA Observing Tool (Cycle3-Patchtests2) - Project'. The menu bar includes 'File', 'Edit', 'View', 'Tool', 'Search', and 'Help'. The toolbar contains various icons for file operations and navigation. The 'Project Structure' pane on the left shows a tree view with 'Project' expanded to 'Planned Observations' > 'Science Goals' > 'Spectral'. The 'Editors' pane at the top has tabs for 'Proposal', 'Program', 'Spectral', 'Spatial', and 'Spectral Setup', with 'Spectral' highlighted in red. The main content area displays the 'Spectral Setup' configuration. It includes a text box explaining that up to 16 spectral windows can be defined, 4 per baseband, with a total fraction per baseband not exceeding 1. Below this, the 'Spectral Type' is set to 'Spectral Line'. The 'Polarization products desired' are set to 'DUAL'. A red error message states: 'No spectral window in the list. No suitable receiver band for the range :[0.0 GHz, 0.0 GHz]'. The 'Spectral Line' section shows a table for 'Baseband-1' with columns for Fraction, Center Freq (Rest), Center Freq (Sky), Transition, Bandwidth, Resolution (smoothed), Spec Avg., and Representative Window. Below the table are buttons for 'Select Lines to Observe in Baseband-1...', 'Add', and 'Delete'. Similar sections are visible for 'Baseband-2' and 'Baseband-3'.

ALMA Observing Tool (Cycle3)

ALMA Observing Tool (Cycle3-Patchtests2) - Project

File Edit View Tool Search Help

Project Structure Editors

Proposal Program **Spectral** Spatial Spectral Setup

Unsubmitted Proposal

Project

Proposal

Planned Observations

Science Goals

General

Field Set

Spectral

Calibration

Control

Technical

In the table below, it is possible to define up to 16 spectral windows, 4 per baseband as long as the total Fraction per baseband is no more than 1. Each baseband is 2GHz wide and can be separately configured i.e. each spectral window can have a different bandwidth and resolution. Note that for bands 3, 4, 6, 7 and 8, it is not possible to put 3 basebands in one sideband and the fourth one in the other.

Spectral Type

Spectral Type

Spectral Line

Single Continuum

Spectral Scan

Polarization products desired XX DUAL FULL

Spectral Setup Errors

No spectral window in the list. No suitable receiver band for the range :[0.0 GHz, 0.0 GHz]

Spectral Line

Baseband-1

Fraction	Center Freq (Rest)	Center Freq (Sky)	Transition	Bandwidth, Resolution (smoothed)	Spec Avg.	Representative Window
----------	--------------------	-------------------	------------	----------------------------------	-----------	-----------------------

Select Lines to Observe in Baseband-1... Add Delete

Baseband-2

Select Lines to Observe in Baseband-2... Add Delete

Baseband-3

Spectral setup in the almaOT

ALMA Observing Tool (Cycle3)

ALMA Observing Tool (Cycle3-Patchtests2) - Project

File Edit View Tool Search Help

Project Structure

- Unsubmitted Proposal
 - Project
 - Proposal
 - Planned Observations
 - Science Goals
 - General
 - Field Setup
 - Spectral
 - Calibration
 - Control
 - Technical

Editors

Spectral Spatial Spectral Setup

Visualisation

In the table below, it is possible to define up to 16 spectral windows, 4 per baseband as long as the total Fraction per baseband is no more than 1. Each baseband is 2GHz wide and can be separately configured i.e. each spectral window can have a different bandwidth and resolution. Note that for bands 3, 4, 6, 7 and 8, it is not possible to put 3 basebands in one sideband and the fourth one in the other.

Left/right click to zoom in/out, grab sliding bar to pan
Note: Moving LO1 here is for experimentation only - actual setup determined by the windows

Observed Frequency

Rest Frequency

Overlays: Receiver Bands Transmission Overlay Lines DSB Image [Select Lines to Overlay](#)

Water Vapour Column Density: Automatic Choice Manual Choice 5.186mm (7th Octile)

Viewport: [Pan to Line](#) [Zoom to Band](#) [Reset](#)

Spectral Type

Spectral Type Spectral Line Single Continuum Spectral Scan

Polarization products desired XX DUAL FULL

Spectral setup in the almaOT

ALMA Observing Tool (Cycle3)

ALMA Observing Tool (Cycle3-Patchtests2) - Project

File Edit View Tool Search Help

Project Structure

- Unsubmitted Proposal
 - Project
 - Proposal
 - Planned Observations
 - Science Goals
 - General
 - Field Setup
 - Spectral
 - Calibration
 - Control
 - Technical

Editors

Spectral Spatial **Spectral Setup**

Visualisation

In the table below, it is possible to define up to 16 spectral windows, 4 per baseband as long as the total Fraction per baseband is no more than 1. Each baseband is 2GHz wide and can be separately configured i.e. each spectral window can have a different bandwidth and resolution. Note that for bands 3, 4, 6, 7 and 8, it is not possible to put 3 basebands in one sideband and the fourth one in the other.

Left/right click to zoom in/out, grab sliding bar to pan
Note: Moving LO1 here is for experimentation only - actual setup determined by the windows

Observed Frequency

Rest Frequency

Overlays: Receiver Bands Transmission Overlay Lines DSB Image [Select Lines to Overlay](#)

Water Vapour Column Density: Automatic Choice Manual Choice 5.186mm (7th Octile)

Viewport: [Pan to Line](#) [Zoom to Band](#) [Reset](#)

Spectral Type

Spectral Line
 Single Continuum
 Spectral Scan

Polarization products desired XX DUAL FULL

Spectral setup in the almaOT

The screenshot shows the ALMA Observing Tool (Cycle3) interface. The title bar indicates the application is running on a Mac, with the system clock showing Saturday, March 21, 2014, at 14:09. The window title is "ALMA Observing Tool (Cycle3-Patchtests2) - Project".

The interface is divided into several panels:

- Project Structure:** A tree view on the left showing the project hierarchy: Unsubmitted Proposal > Project > Proposal > Planned Observations > Science Goals > Spectral.
- Editors:** A tabbed interface with "Spectral Setup" selected.
- Spectral Setup Panel:**
 - Text:** "In the table below, it is possible to define up to 16 spectral windows, 4 per baseband as long as the total Fraction per baseband is no more than 1. Each baseband is 2GHz wide and can be separately configured i.e. each spectral window can have a different bandwidth and resolution. Note that for bands 3, 4, 6, 7 and 8, it is not possible to put 3 basebands in one sideband and the fourth one in the other."
 - Spectral Type:** Radio buttons for Spectral Line (selected), Single Continuum, and Spectral Scan.
 - Polarization products desired:** Radio buttons for XX, DUAL (selected), and FULL.
 - Spectral Setup Errors:** A red message: "No spectral window in the list. No suitable receiver band for the range :[0.0 GHz, 0.0 GHz]".
 - Spectral Line Table:** A table for Baseband-1 with columns: Fraction, Center Freq (Rest), Center Freq (Sky), Transition, Bandwidth, Resolution (smoothed), Spec Avg., and Representative Window. The table is currently empty.
 - Buttons:** "Select Lines to Observe in Baseband-1...", "Add", and "Delete".
 - Baseband-2 and Baseband-3:** Similar sections for other basebands, also currently empty.

Spectral setup in the almaOT

ALMA Observing Tool (Cycle3)

ALMA Observing Tool (Cycle3-Patchtests2) - Project

File Edit View Tool Search Help

Project Structure

Editors

Spectral Spatial Spectral Setup

Unsubmitted Proposal

- Project
 - Proposal
 - Planned Observations
 - Science Goals
 - General
 - Field Set
 - Spectral
 - Calibration
 - Control
 - Technical

In the table below, it is possible to define up to 16 spectral windows, 4 per baseband as long as the total Fraction per baseband is no more than 1. Each baseband is 2GHz wide and can be separately configured i.e. each spectral window can have a different bandwidth and resolution. Note that for bands 3, 4, 6, 7 and 8, it is not possible to put 3 basebands in one sideband and the fourth one in the other.

Spectral Type

Spectral Type

- Spectral Line
- Single Continuum
- Spectral Scan

Continuum or line ?

Polarization products desired XX DUAL FULL

Spectral Setup Errors

No spectral window in the list. No suitable receiver band for the range :[0.0 GHz, 0.0 GHz]

Spectral Line

Baseband-1

Fraction	Center Freq (Rest)	Center Freq (Sky)	Transition	Bandwidth, Resolution (smoothed)	Spec Avg.	Representative Window

Select Lines to Observe in Baseband-1... Add Delete

Baseband-2

Select Lines to Observe in Baseband-2... Add Delete

Baseband-3

Spectral setup in the almaOT

ALMA Observing Tool (Cycle3)

ALMA Observing Tool (Cycle3-Patchtests2) - Project

File Edit View Tool Search Help

Project Structure

Editors

Spectral Spatial Spectral Setup

Unsubmitted Proposal

Project

Proposal

Planned Observations

Science Goals

General

Field Set

Spectral

Calibration

Control

Technical

In the table below, it is possible to define up to 16 spectral windows, 4 per baseband as long as the total Fraction per baseband is no more than 1. Each baseband is 2GHz wide and can be separately configured i.e. each spectral window can have a different bandwidth and resolution. Note that for bands 3, 4, 6, 7 and 8, it is not possible to put 3 basebands in one sideband and the fourth one in the other.

Spectral Type

Spectral Type

Polarization products desired

Spectral Setup Errors

No spectral window in the list. No suitable receiver band for the range :[0.0 GHz, 0.0 GHz]

Spectral Line

Baseband-1

Fraction	Center Freq (Rest)	Center Freq (Sky)	Transition	Bandwidth, Resolution (smoothed)	Spec Avg.	Representative Window

Select Lines to Observe in Baseband-1... Add Delete

Baseband-2

Select Lines to Observe in Baseband-2... Add Delete

Baseband-3

Continuum or line ?

Polarization products ?

Spectral setup in the almaOT

ALMA Observing Tool (Cycle3)

ALMA Observing Tool (Cycle3-Patchtests2) - Project

File Edit View Tool Search Help

Project Structure

Proposed Program

Unsubmitted Proposal

Project

Proposal

Planned Observations

Science Goals

General

Field Set

Spectral

Calibration

Control

Technical

Editors

Spectral Spatial Spectral Setup

In the table below, it is possible to define up to 16 spectral windows, 4 per baseband as long as the total Fraction per baseband is no more than 1. Each baseband is 2GHz wide and can be separately configured i.e. each spectral window can have a different bandwidth and resolution. Note that for bands 3, 4, 6, 7 and 8, it is not possible to put 3 basebands in one sideband and the fourth one in the other.

Spectral Type

Spectral Type

Polarization products desired

Spectral Setup Errors

No spectral window in the list. No suitable receiver band for the range :[0.0 GHz, 0.0 GHz]

Spectral Line

Baseband-1	Fraction	Center Freq (Rest)	Center Freq (Sky)	Transition	Bandwidth, Resolution (smoothed)	Spec Avg.	Representative Window

Select Lines to Observe in Baseband-1... Add Delete

Baseband-2

Select Lines to Observe in Baseband-2... Add Delete

Baseband-3

Continuum or line ?

Polarization products ?

Rest frequency ?

Spectral setup in the almaOT

ALMA Observing Tool (Cycle3)

ALMA Observing Tool (Cycle3-Patchtests2) - Project

File Edit View Tool Search Help

Project Structure

Editors

Spectral Spatial Spectral Setup

In the table below, it is possible to define up to 16 spectral windows, 4 per baseband as long as the total Fraction per baseband is no more than 1. Each baseband is 2GHz wide and can be separately configured i.e. each spectral window can have a different bandwidth and resolution. Note that for bands 3, 4, 6, 7 and 8, it is not possible to put 3 basebands in one sideband and the fourth one in the other.

Spectral Type

Spectral Type

Continuum or line ?

Polarization products desired

Polarization products ?

Spectral Setup Errors

No spectral window in the list. No suitable receiver band for the range :[0.0 GHz, 0.0 GHz]

Spectral Line

Fraction	Center Freq (Rest)	Center Freq (Sky)	Transition	Bandwidth, Resolution (smoothed)	Spec Avg.	Representative Window

Select Lines to Observe in Baseband-1... Add Delete

Baseband-2

Select Lines to Observe in Baseband-2... Add Delete

Baseband-3

Rest frequency ?

Bandwidth, spectral resolution ?

What do we need to know?

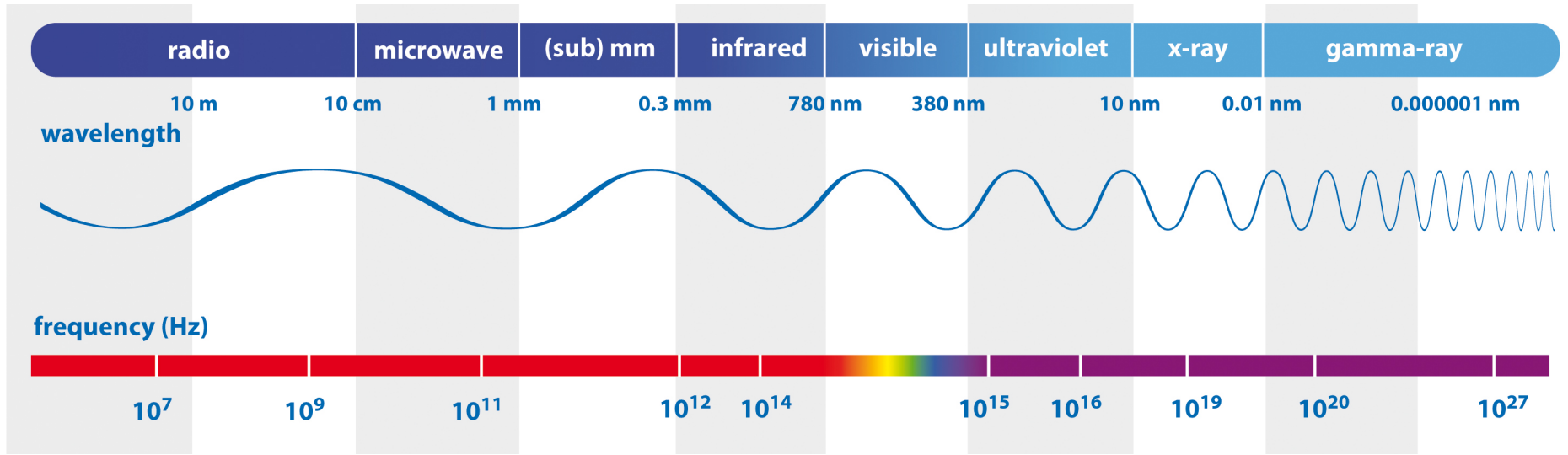
- continuum or line (both?)
- frequency of the lines to observe
- velocity / redshift of the source
- bandwidth / velocity coverage
- spectral resolution
- polarization products
- ...

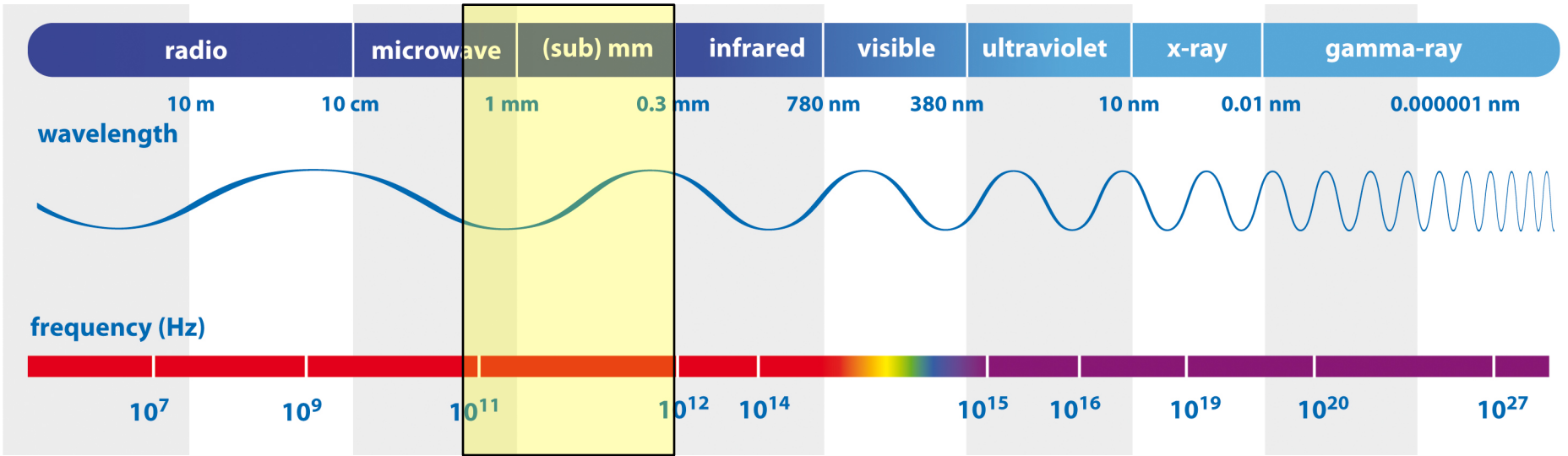


What do we need to know?

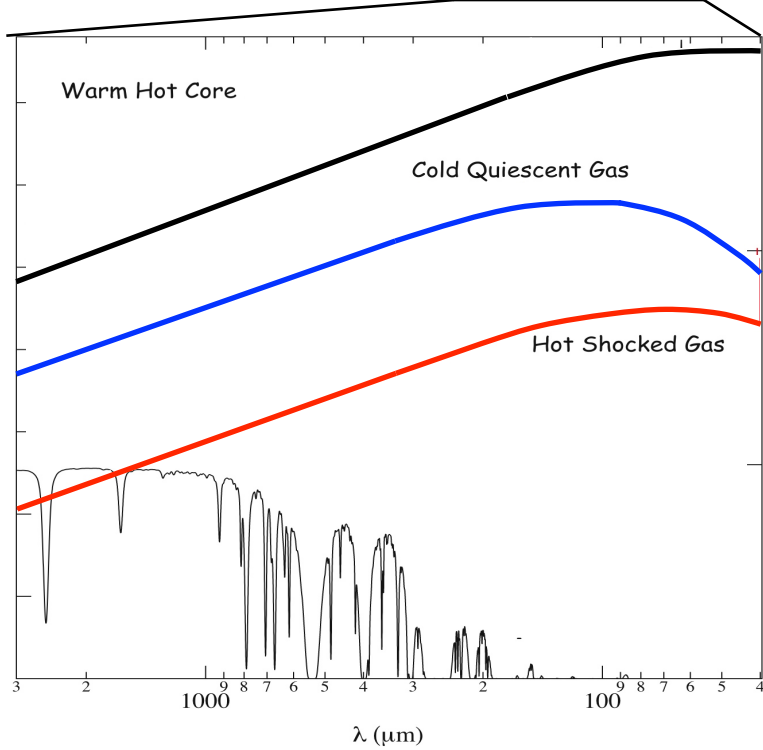
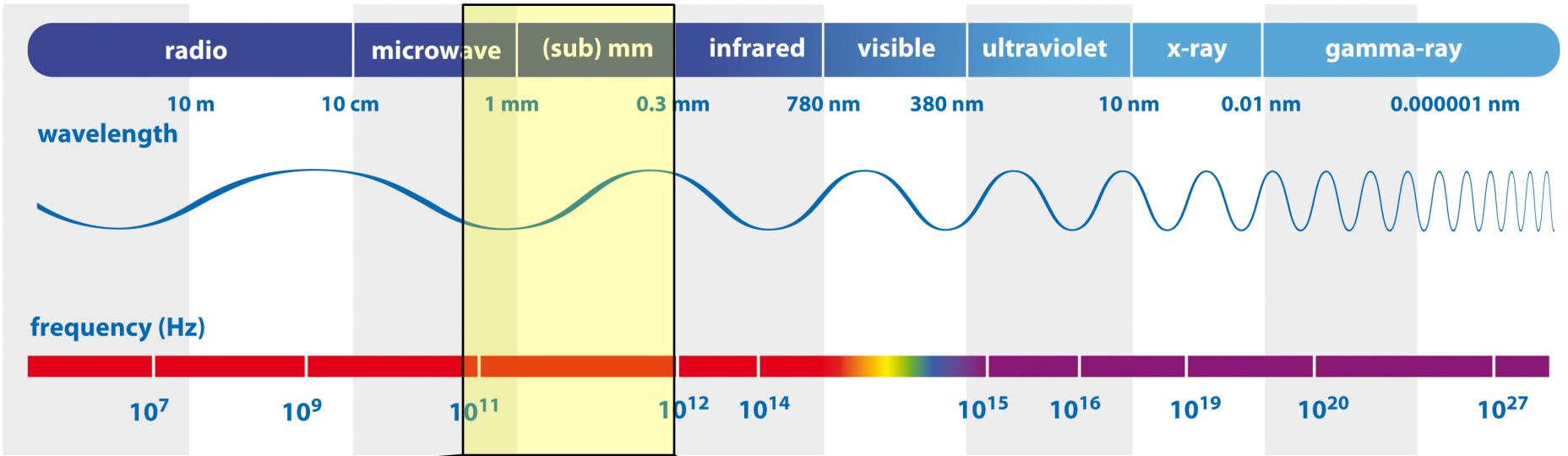
- **continuum or line (both?)**
- frequency of the lines to observe
- velocity / redshift of the source
- bandwidth / velocity coverage
- spectral resolution
- polarization products
- ...



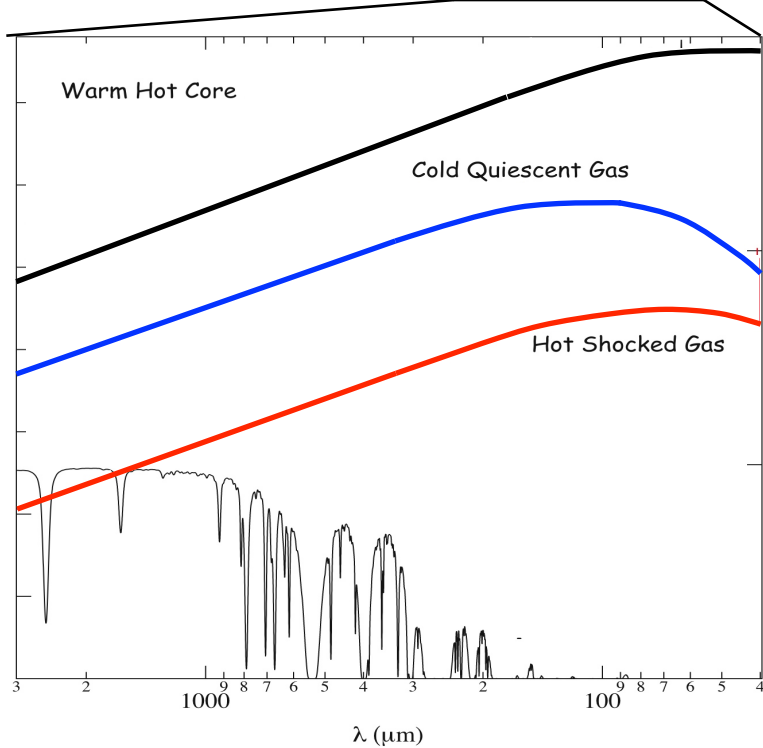
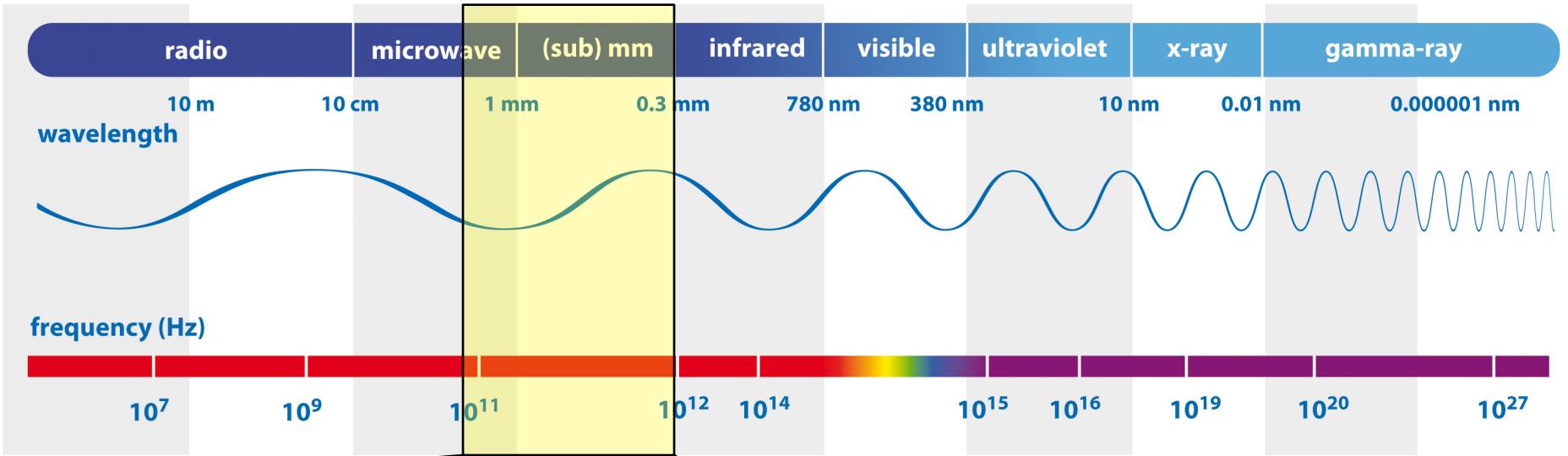




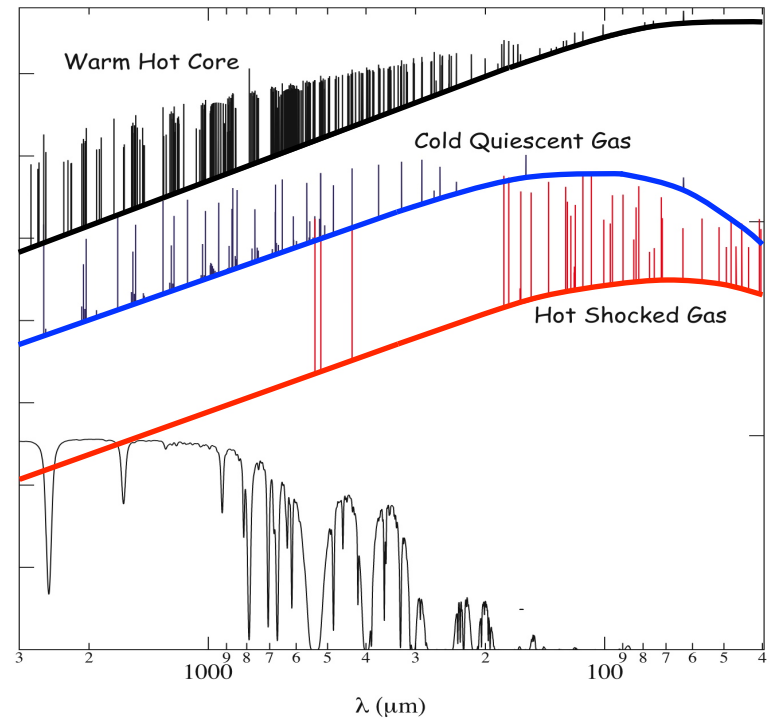
ALMA observable range
“Cold Universe”



continuum emission



continuum emission



line emission

What do you want to observe?

continuum emission

line emission

both (continuum and line)

What do you want to observe?

continuum emission

which frequency/wavelength (**band**)

intensity of the source (**rms**) [see next Section]

spatial distribution (**beam, LAS**) [see previous Section]

line emission

both (continuum and line)

What do you want to observe?

continuum emission

which frequency/wavelength (**band**)

intensity of the source (**rms**) [see next Section]

spatial distribution (**beam, LAS**) [see previous Section]

line emission

which line (**frequency, band**)

intensity of the source (**rms**) [see next Section]

spatial distribution (**beam, LAS**) [see previous Section]

line shape (**bandwidth, spectral resolution**)

both (continuum and line)

What do we need to know?

- continuum or line (both?)
- **frequency of the lines to observe**
- velocity / redshift of the source
- bandwidth / velocity coverage
- spectral resolution
- polarization products
- ...



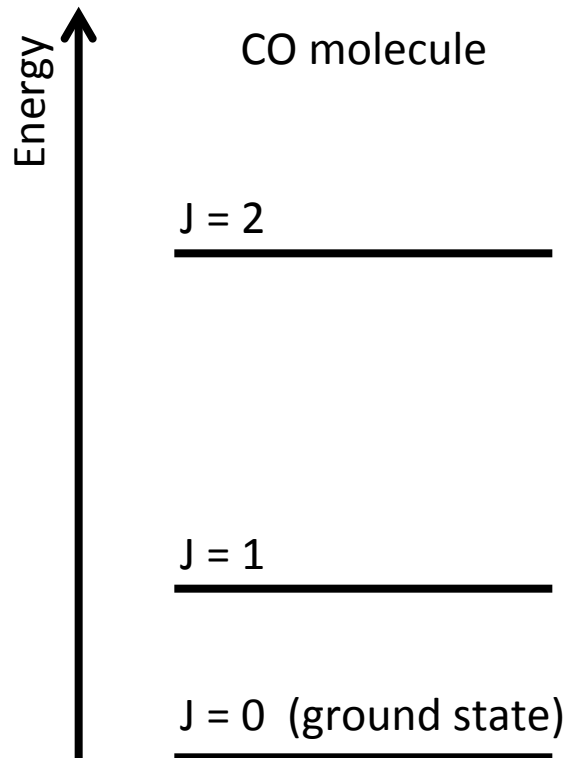
Basic concepts of spectral line observations

Rest frequency

Basic concepts of spectral line observations

Rest frequency

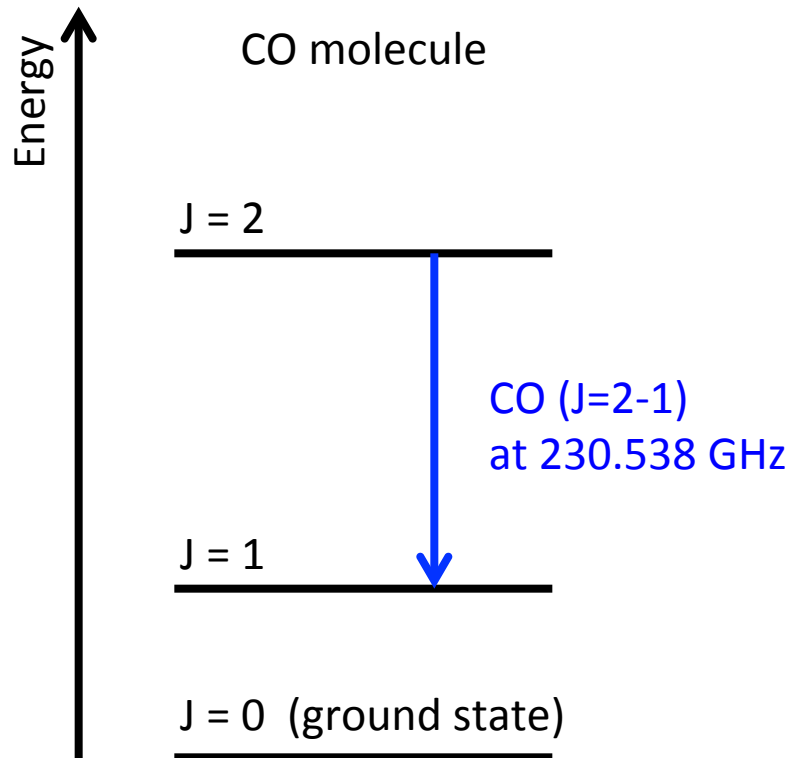
spectral line: transition between two different energy levels of a molecule, atom or ion



Basic concepts of spectral line observations

Rest frequency

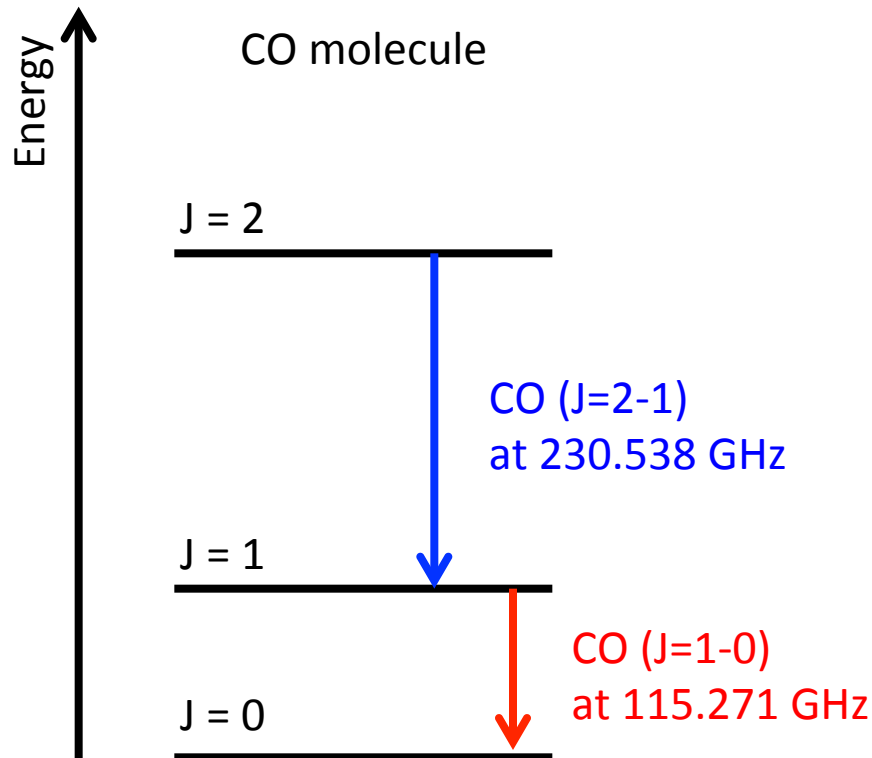
spectral line: transition between two different energy levels of a molecule, atom or ion



Basic concepts of spectral line observations

Rest frequency

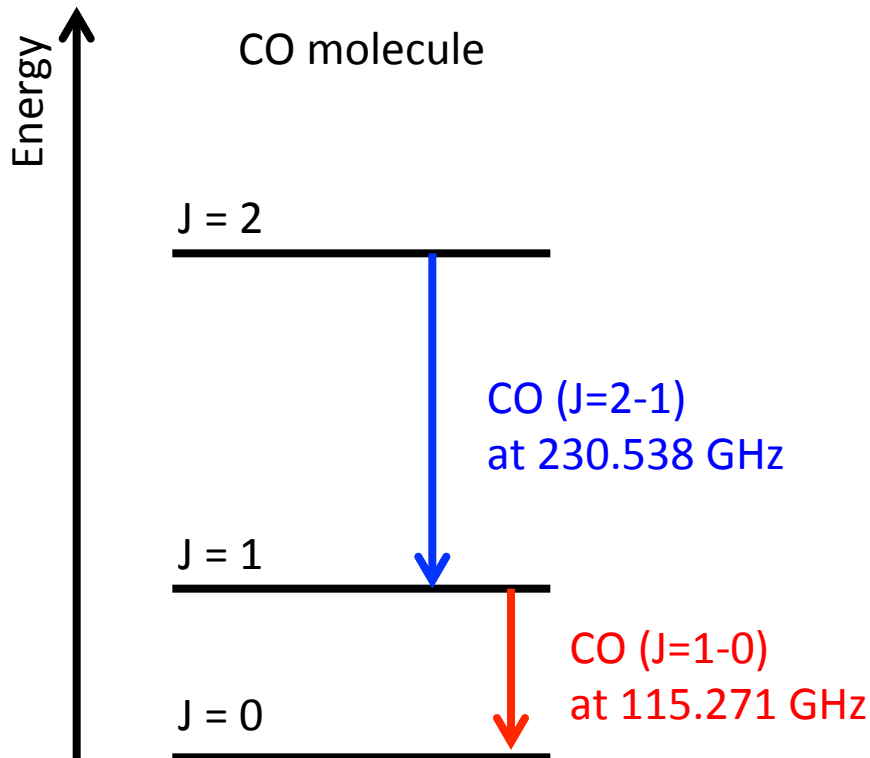
spectral line: transition between two different energy levels of a molecule, atom or ion



Basic concepts of spectral line observations

Rest frequency

spectral line: transition between two different energy levels of a molecule, atom or ion



Rest frequencies can be found in molecular databases:

CDMS

www.astro.uni-koeln.de/cdms

JPL

spec.jpl.nasa.gov

Splatalogue

www.splatalogue.net

What do we need to know?

- continuum or line (both?)
- frequency of the lines to observe
- **velocity / redshift of the source**
- bandwidth / velocity coverage
- spectral resolution
- polarization products
- ...



Basic concepts of spectral line observations

Velocity (V_{lsr}) / redshift (z)

Basic concepts of spectral line observations

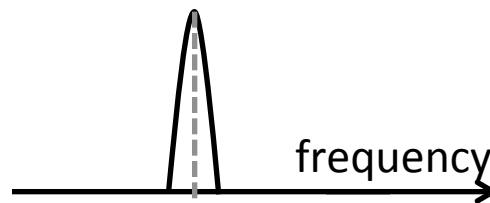
Velocity (V_{lsr}) / redshift (z)

... from rest to sky frequencies (“**doppler effect**”)

Basic concepts of spectral line observations

Velocity (V_{lsr}) / redshift (z)

... from rest to sky frequencies ("**doppler effect**")



230.538 GHz
Band 6



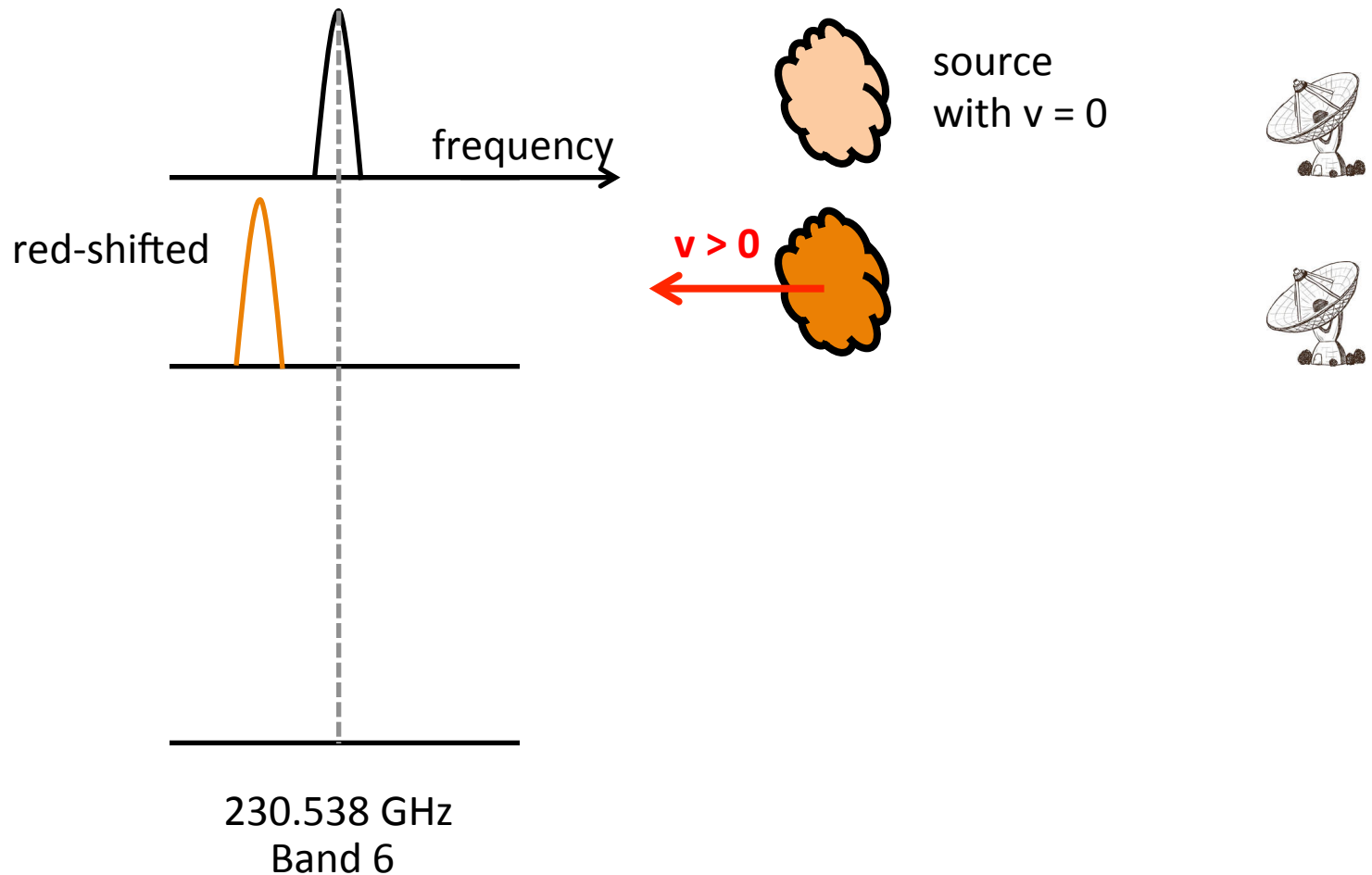
source
with $v = 0$



Basic concepts of spectral line observations

Velocity (V_{lsr}) / redshift (z)

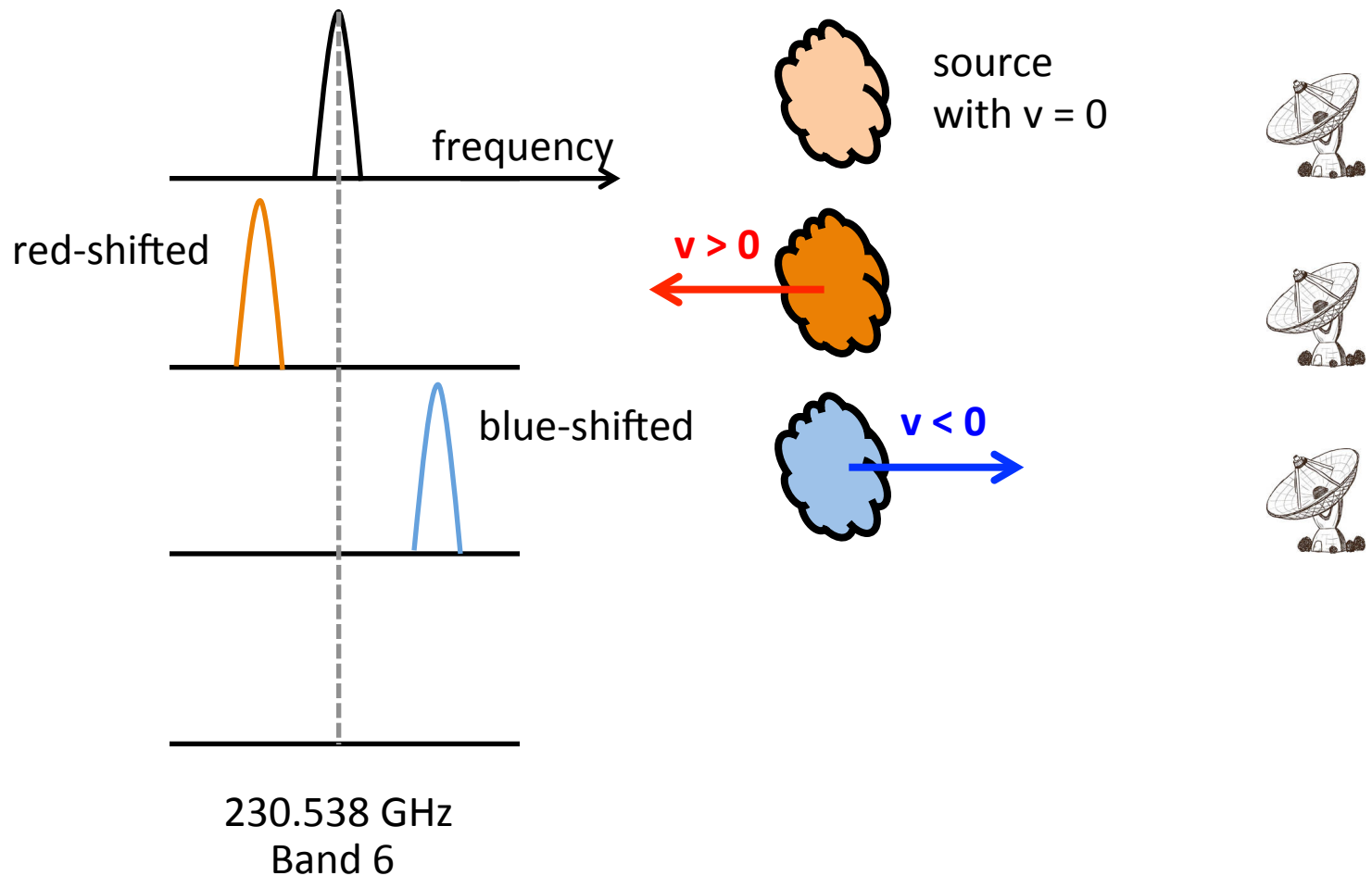
... from rest to sky frequencies (“**doppler effect**”)



Basic concepts of spectral line observations

Velocity (V_{lsr}) / redshift (z)

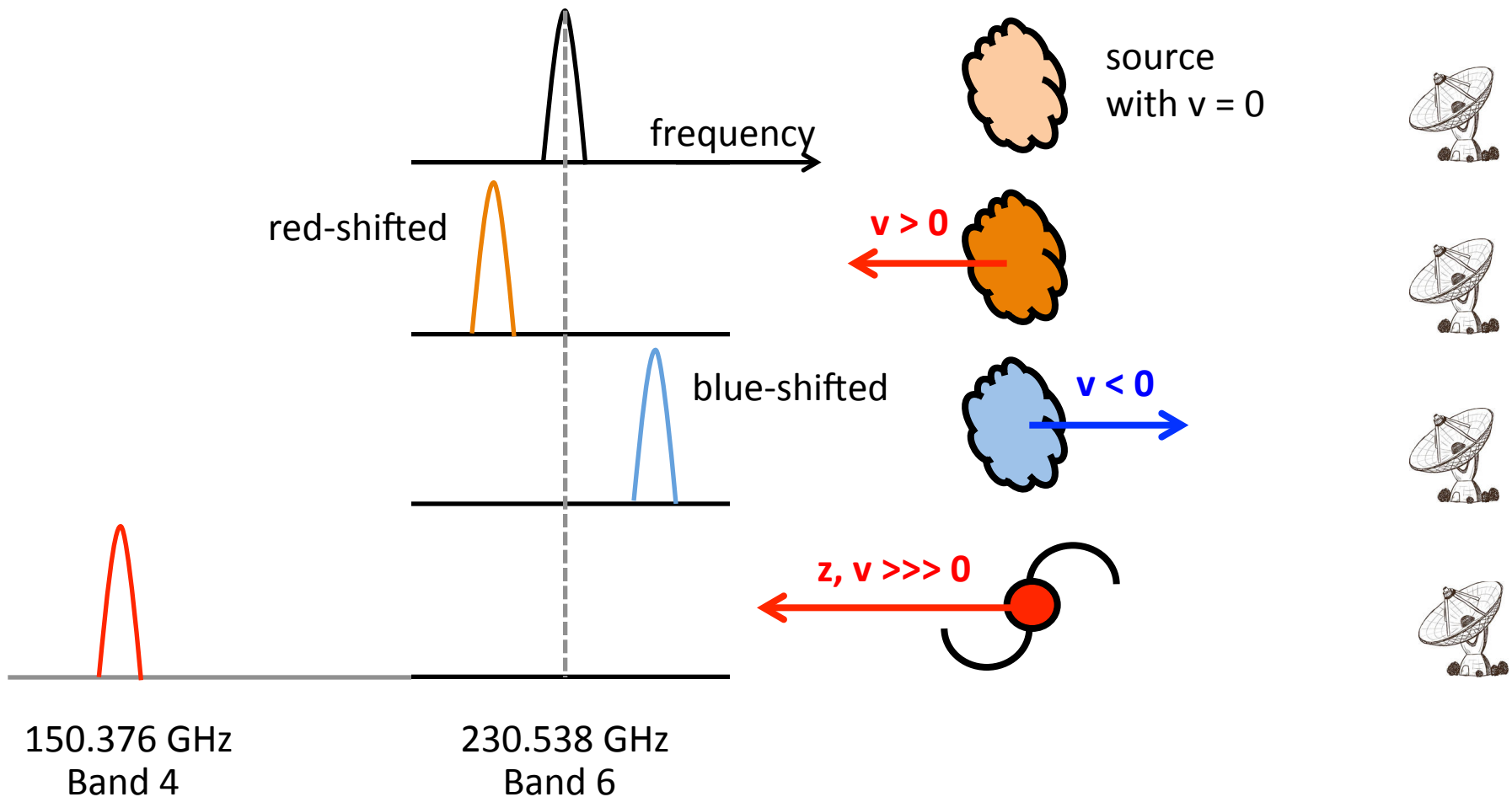
... from rest to sky frequencies (“**doppler effect**”)



Basic concepts of spectral line observations

Velocity (V_{lsr}) / redshift (z)

... from rest to sky frequencies (“**doppler effect**”)



What do we need to know?

- continuum or line (both?)
- frequency of the lines to observe
- velocity / redshift of the source
- **bandwidth / velocity coverage**
- spectral resolution
- polarization products
- ...



Basic concepts of spectral line observations

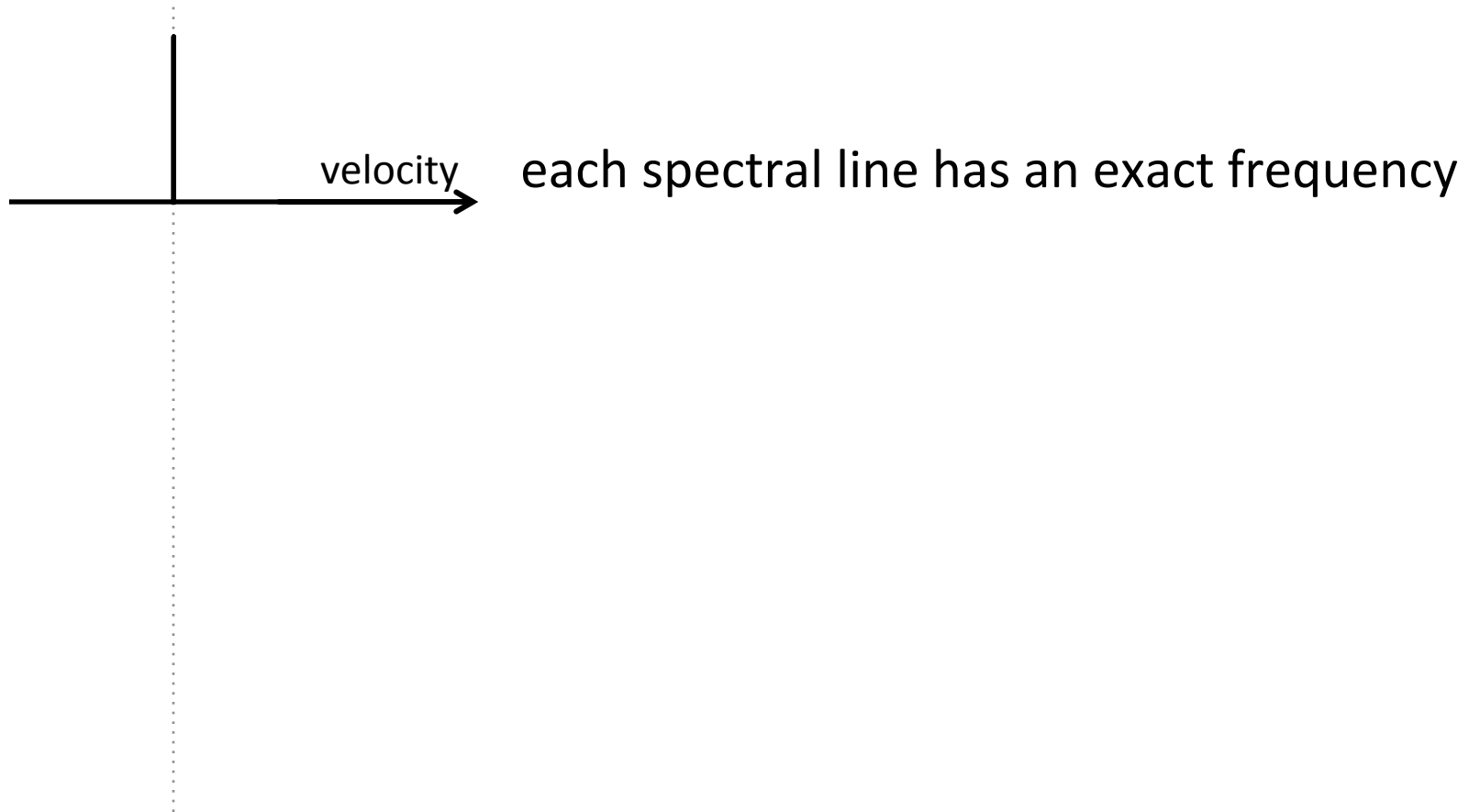
Linewidth ($\Delta\nu$)

the spectral line will have a width that depends on the properties of the object you are studying

Basic concepts of spectral line observations

Linewidth (Δv)

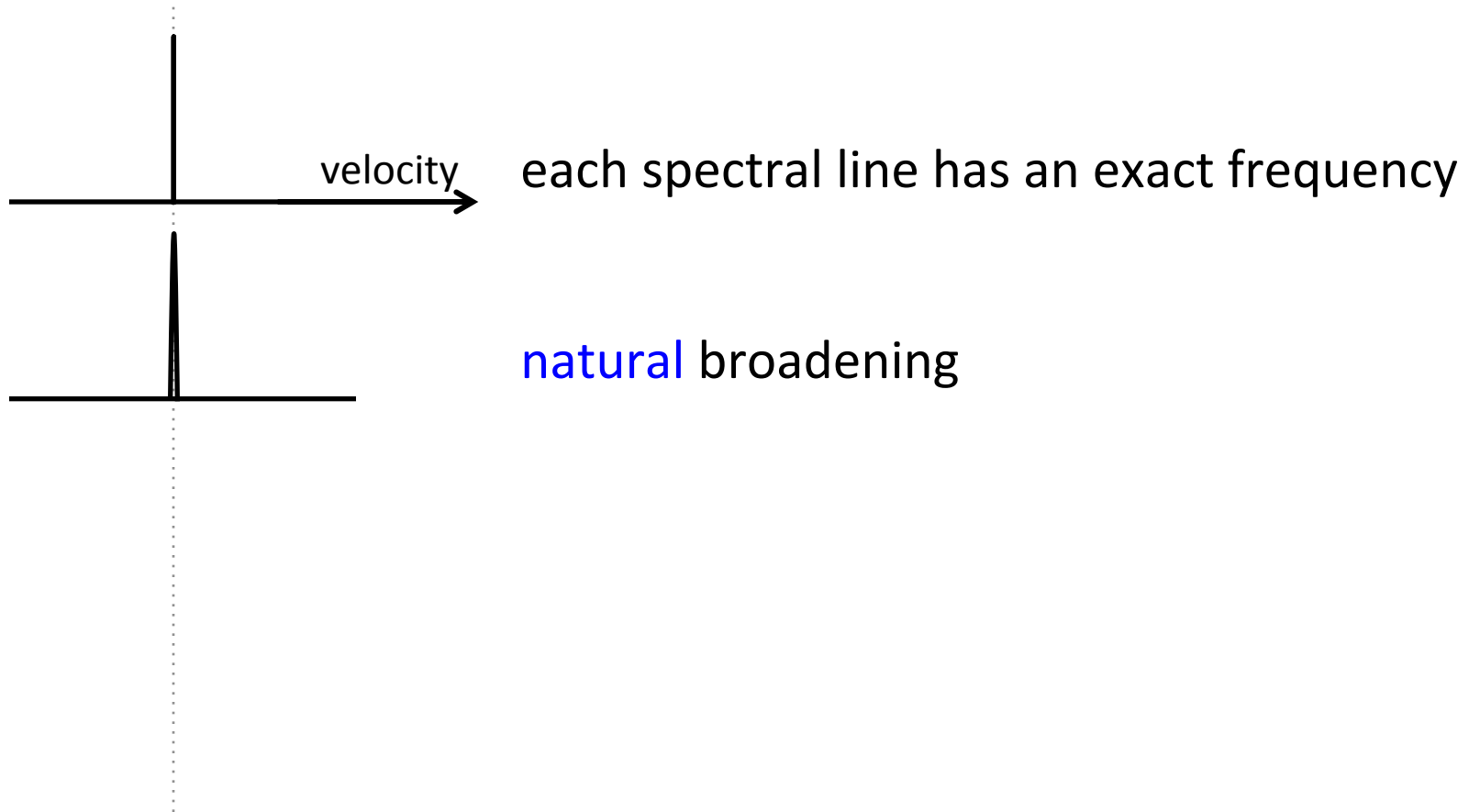
the spectral line will have a width that depends on the properties of the object you are studying



Basic concepts of spectral line observations

Linewidth (Δv)

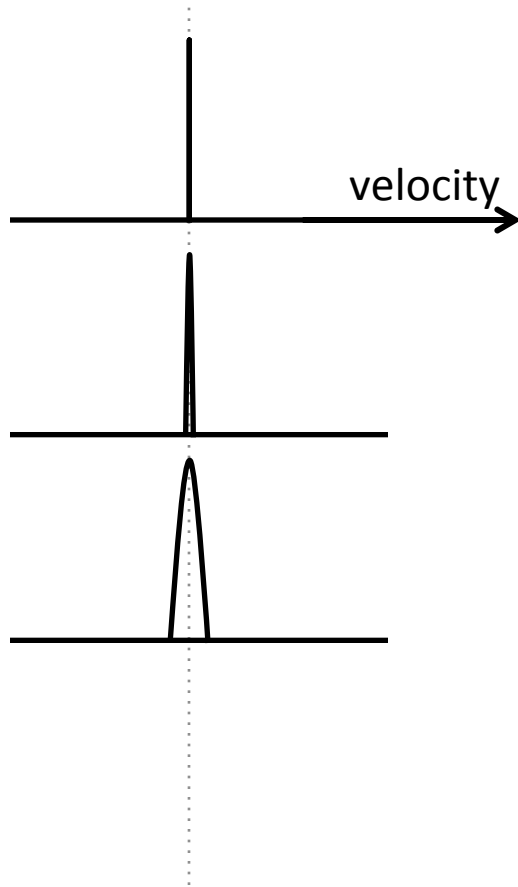
the spectral line will have a width that depends on the properties of the object you are studying



Basic concepts of spectral line observations

Linewidth (Δv)

the spectral line will have a width that depends on the properties of the object you are studying



each spectral line has an exact frequency

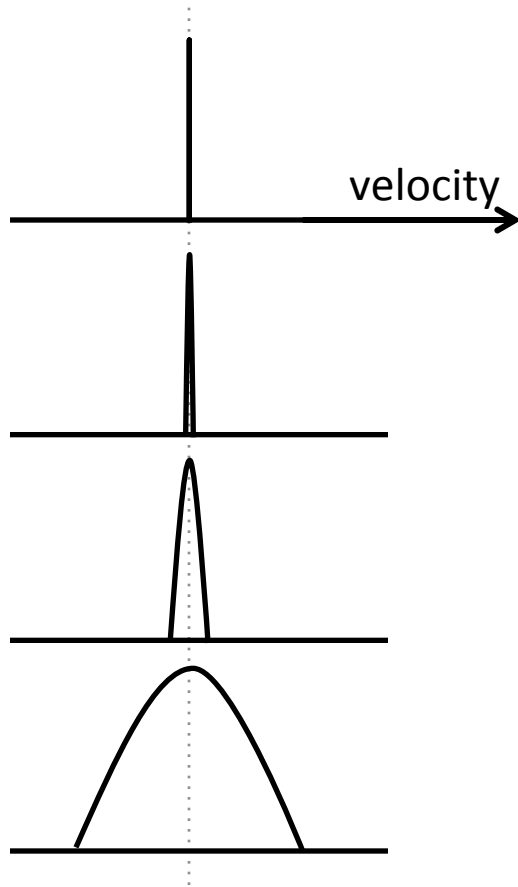
natural broadening

thermal, microturbulent, pressure broadening

Basic concepts of spectral line observations

Linewidth (Δv)

the spectral line will have a width that depends on the properties of the object you are studying



each spectral line has an exact frequency

natural broadening

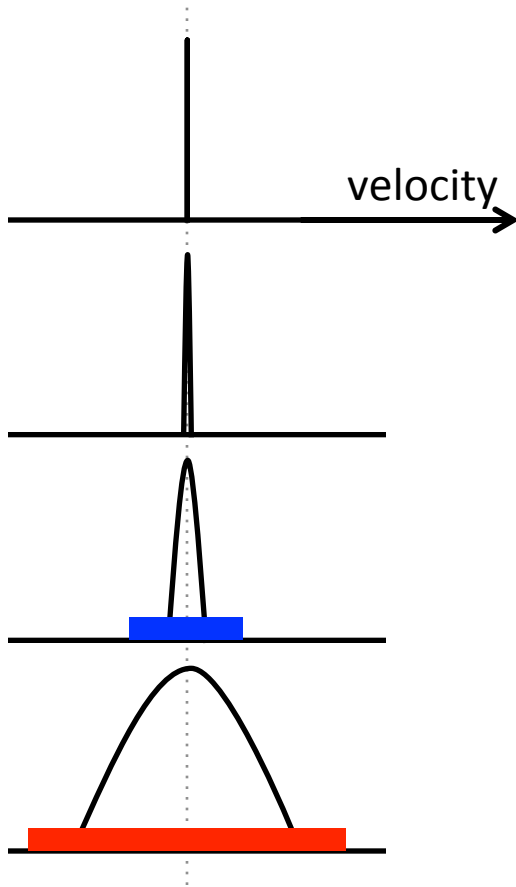
thermal, microturbulent, pressure broadening

large-scale motions broadening

Basic concepts of spectral line observations

Linewidth (Δv)

the spectral line will have a width that depends on the properties of the object you are studying

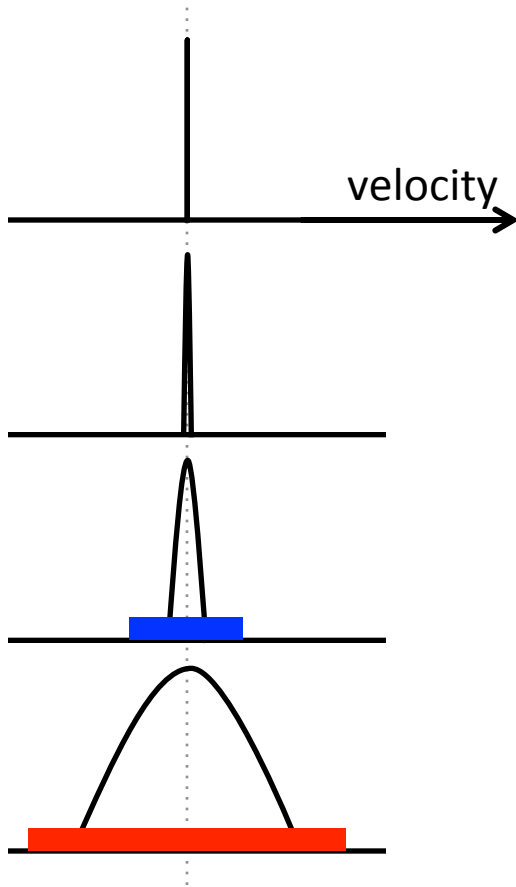


Depending on the linewidth of the line, you will cover a **narrower/broader** frequency (velocity) range

Basic concepts of spectral line observations

Linewidth (Δv)

the spectral line will have a width that depends on the properties of the object you are studying



velocity
linewidth
(km/s)

frequency
linewidth
(Hz)

$$\Delta V = -\Delta \nu \frac{c}{\nu_0}$$

Depending on the linewidth of the line,
you will cover a **narrower/broader**
frequency (velocity) range

Spectral setup in the almaOT

ALMA Observing Tool (Cycle3)

ALMA Observing Tool (Cycle3-Patchtests2) - Project

File Edit View Tool Search Help

Perspective 1

Project Structure

Proposal Program

Unsubmitted Proposal

Project

Proposal

Planned Observations

Science Goals

General

Field Set

Spectral

Calibration

Control

Technical

Editors

Spectral Spatial Spectral Setup

In the table below, it is possible to define up to 16 spectral windows, 4 per baseband as long as the total Fraction per baseband is no more than 1. Each baseband is 2GHz wide and can be separately configured i.e. each spectral window can have a different bandwidth and resolution. Note that for bands 3, 4, 6, 7 and 8, it is not possible to put 3 basebands in one sideband and the fourth one in the other.

Spectral Type

Spectral Type

● Spectral Line

○ Single Continuum

○ Spectral Scan

Polarization products desired

○ XX ● DUAL ○ FULL

Spectral Setup Errors

No spectral window in the list. No suitable receiver band for the range :[0.0 GHz, 0.0 GHz]

Spectral Line

Fraction	Center Freq (Rest)	Center Freq (Sky)	Transition	Bandwidth, Resolution (smoothed)	Spec Avg.	Representative Window

Select Lines to Observe in Baseband-1... Add Delete

Baseband-2

Select Lines to Observe in Baseband-2... Add Delete

Baseband-3

Rest frequency ?

Bandwidth, spectral resolution ?

Continuum or line ?

Polarization products ?

What do we need to know?

- continuum or line (both?)
- frequency of the lines to observe
- velocity / redshift of the source
- bandwidth / velocity coverage
- spectral resolution
- polarization products
- ...



What do we need to know?

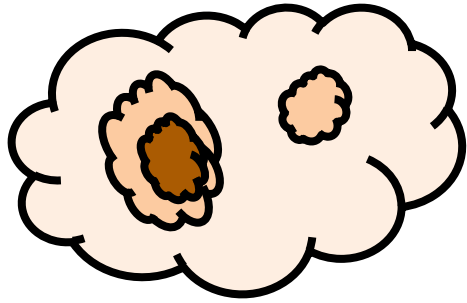
- continuum or line (both?)
- frequency of the lines to observe
- velocity / redshift of the source
- bandwidth / velocity coverage
- spectral resolution
- polarization products

Spectral observations in a radio-interferometer

- frequency bands
- receivers
- correlator



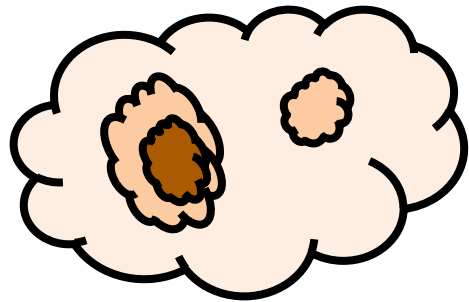
Scientific target



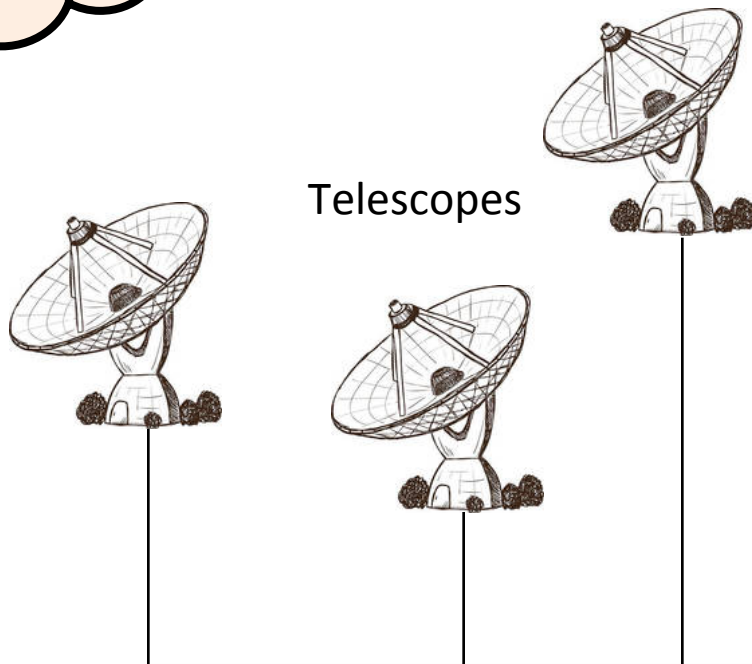
Telescopes



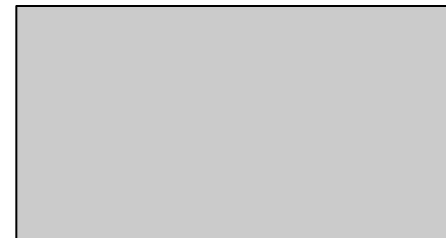
Scientific target



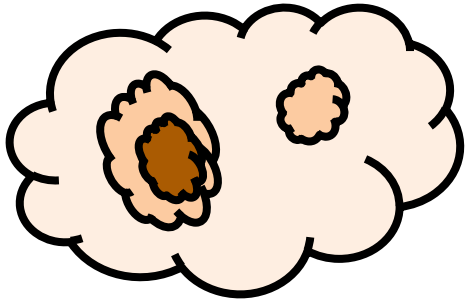
Telescopes



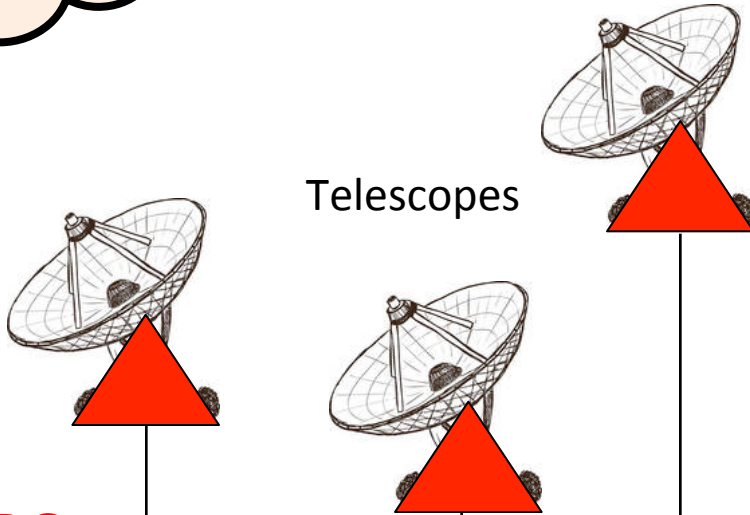
Control room



Scientific target



Telescopes

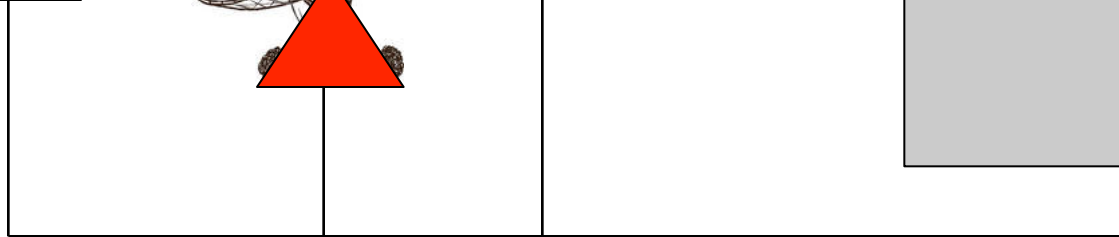


Control room

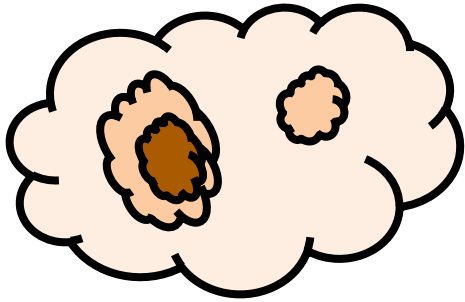


RECEIVERS

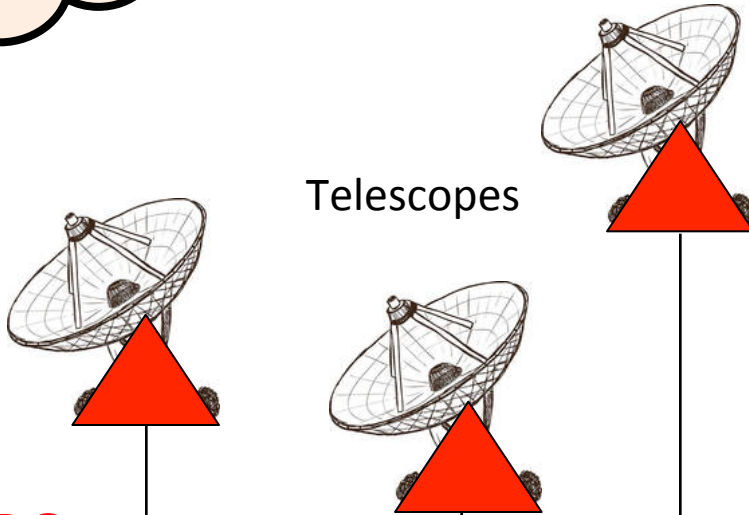
front-ends, bands



Scientific target



Telescopes

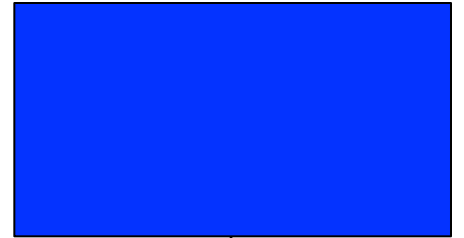


RECEIVERS

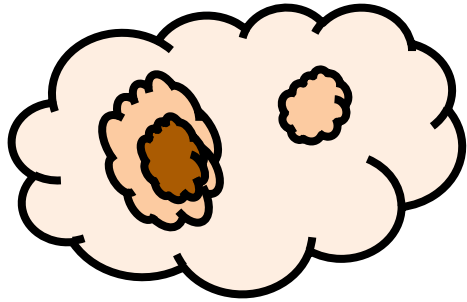
front-ends, bands

CORRELATOR
super-computer

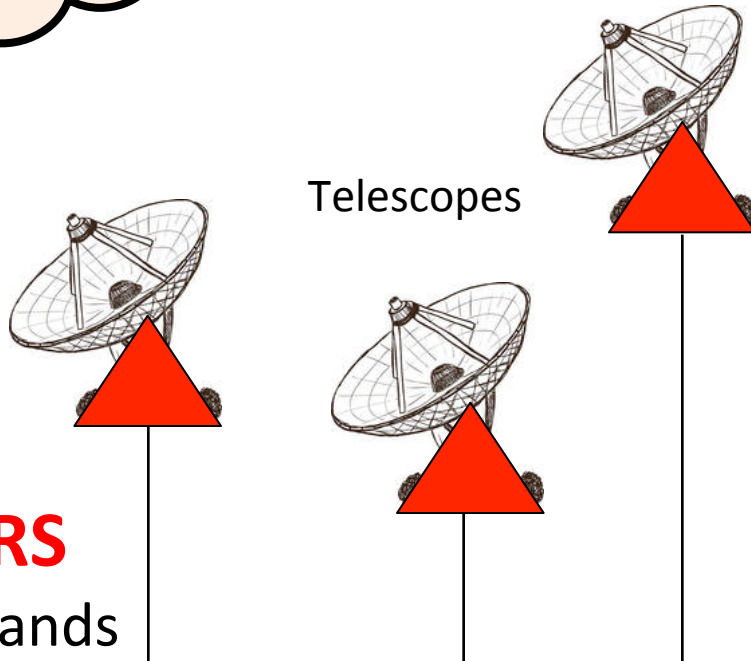
Control room



Scientific target



Telescopes



CORRELATOR
super-computer

Control room



RECEIVERS

front-ends, bands

WHAT frequencies do/can we observe?

HOW do/can we observe those frequencies?

What do we need to know?

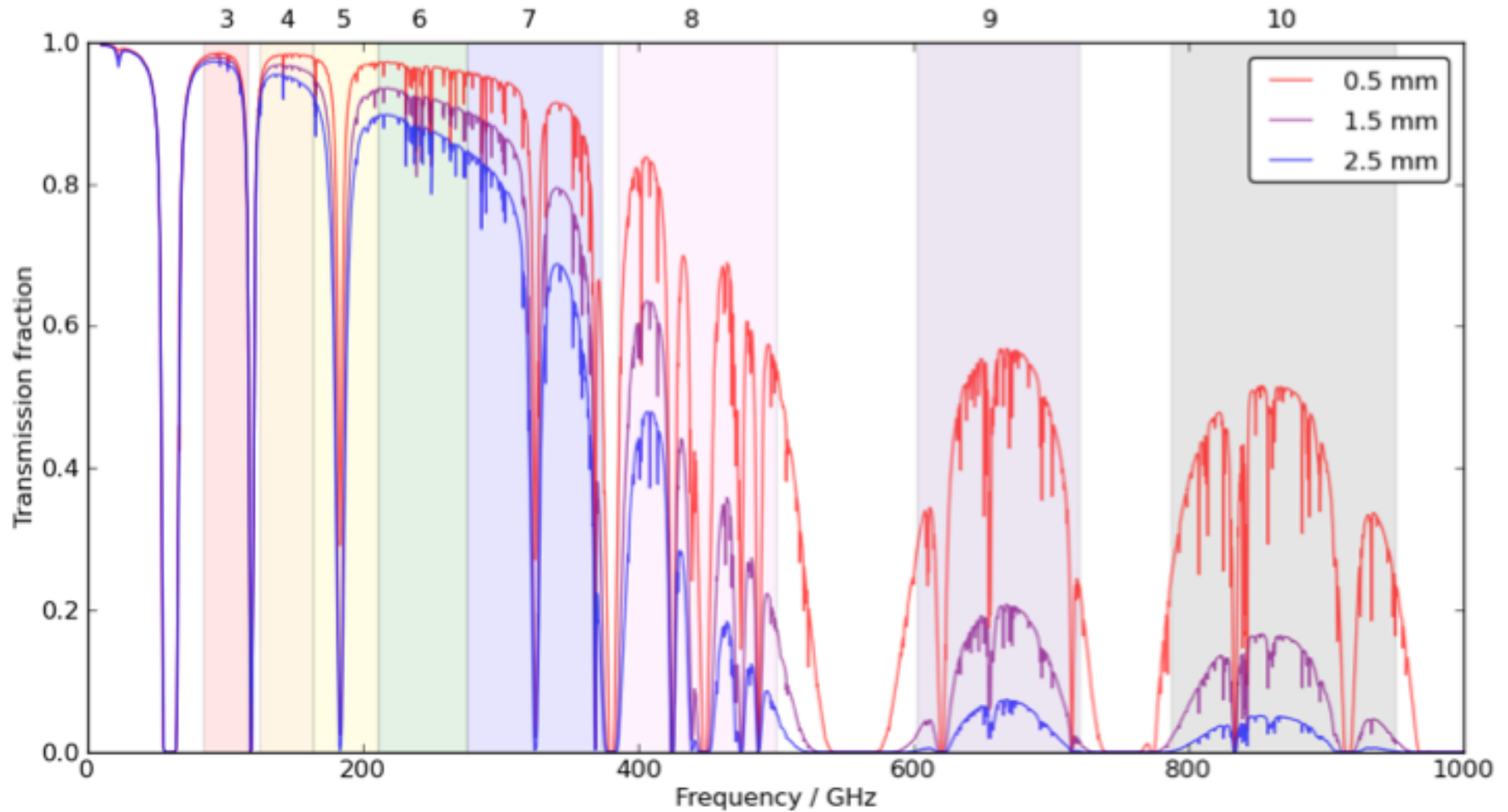
- continuum or line (both?)
- frequency of the lines to observe
- velocity / redshift of the source
- bandwidth / velocity coverage
- spectral resolution
- polarization products

Spectral observations in a radio-interferometer

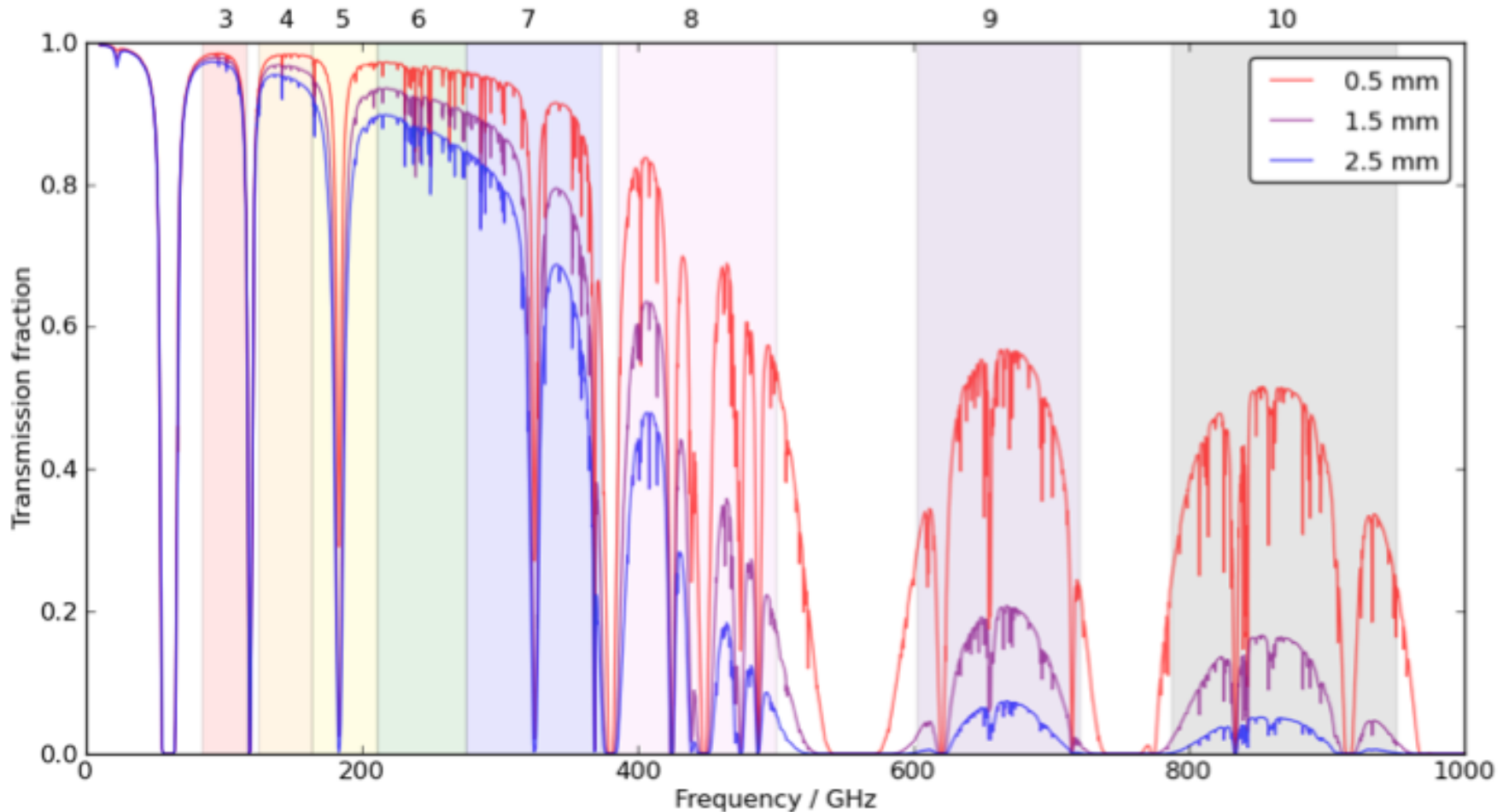
- **frequency bands**
- receivers
- correlator



ALMA frequency bands



ALMA frequency bands



Band 3: 84 – 116 GHz

Band 4: 125 – 163 GHz

Band 6: 211 – 275 GHz

Band 7: 275 – 373 GHz

Band 8: 385 – 500 GHz

Band 9/10: 602 – 720 GHz / 787 – 950 GHz

What do we need to know?

- continuum or line (both?)
- frequency of the lines to observe
- velocity / redshift of the source
- bandwidth / velocity coverage
- spectral resolution
- polarization products

Spectral observations in a radio-interferometer

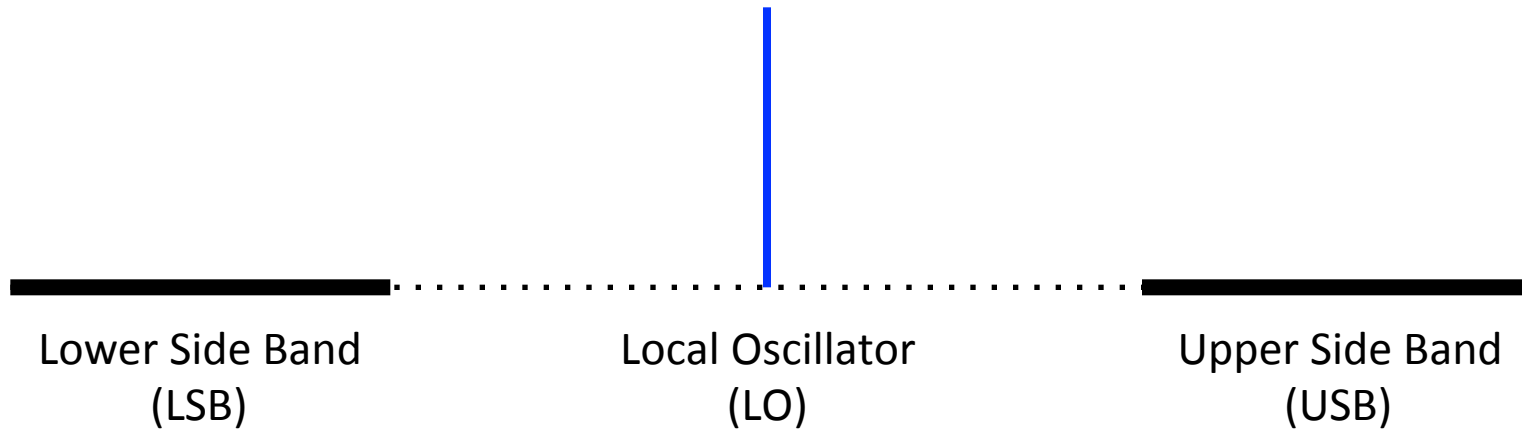
- frequency bands
- **receivers**
- correlator



ALMA receivers

Heterodyne receivers

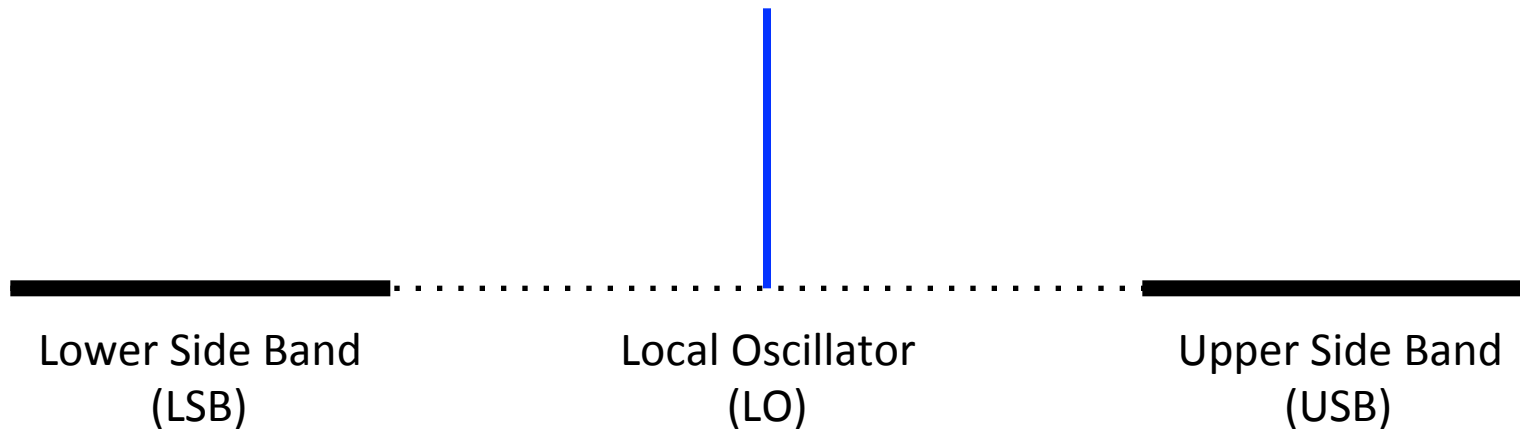
are sensitive to Lower Side Band (LSB) and Upper Side Band (USB)



ALMA receivers

Heterodyne receivers

are sensitive to Lower Side Band (LSB) and Upper Side Band (USB)



Heterodyne receivers can be:

SSB (single) outputs **LSB or USB**

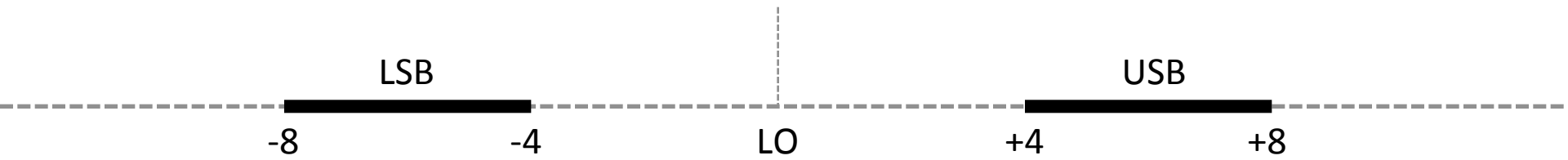
DSB (double) outputs the sum **LSB+USB** (separated in correlator)

2SB (two) outputs **LSB and USB** (separately)

ALMA receivers

ALMA B3 / B4 / B5 / B7 / B8

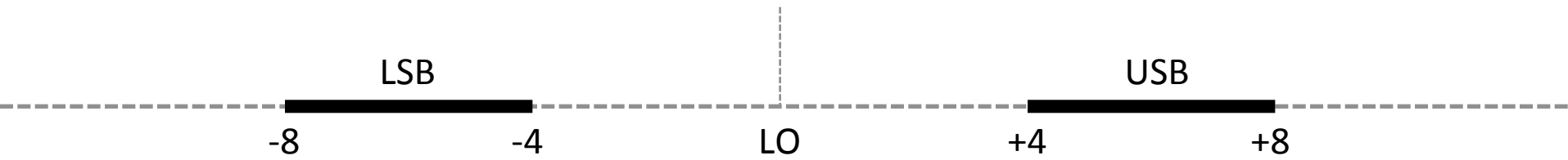
2SB receivers 4-8 GHz



ALMA receivers

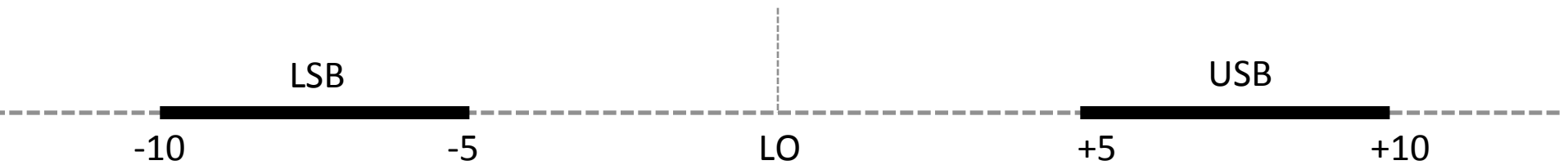
ALMA B3 / B4 / B5 / B7 / B8

2SB receivers 4-8 GHz



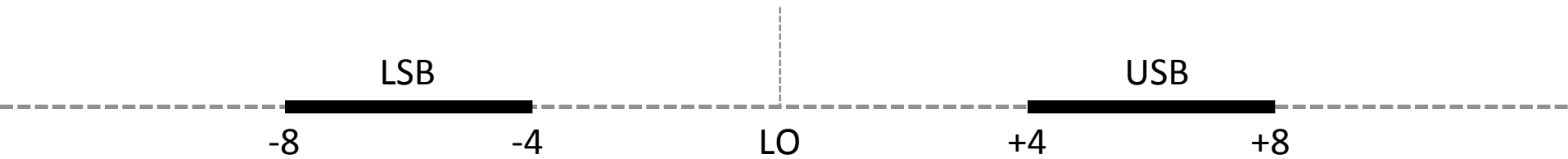
ALMA B6

2SB receivers 5-10 GHz

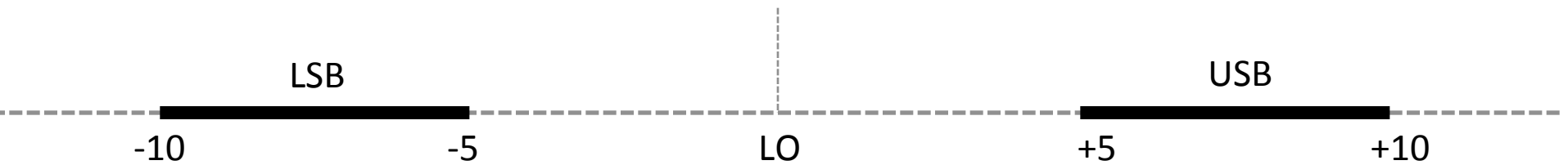


ALMA receivers

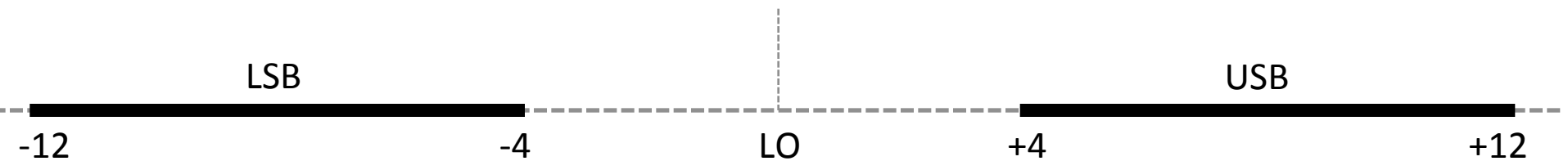
ALMA B3 / B4 / B5 / B7 / B8 2SB receivers 4-8 GHz



ALMA B6 2SB receivers 5-10 GHz



ALMA B9 / B10 DSB receivers 4-12 GHz



ALMA frequency bands & receivers

Band 3: 84 – 116 GHz

Band 4: 125 – 163 GHz

Band 6: 211 – 275 GHz

Band 7: 275 – 373 GHz

Band 8: 385 – 500 GHz

Band 9/10: 602 – 720 GHz / 787 – 950 GHz

ALMA frequency bands & receivers

Band 3: 84 – 116 GHz

Band 4: 125 – 163 GHz

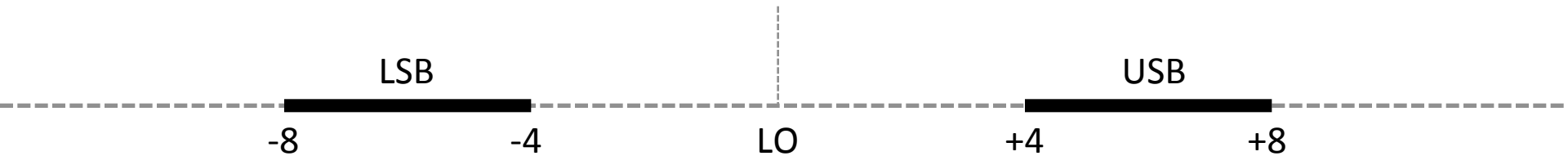
Band 6: 211 – 275 GHz

Band 7: 275 – 373 GHz

Band 8: 385 – 500 GHz

Band 9/10: 602 – 720 GHz / 787 – 950 GHz

ALMA B3 / B4 / B5 / B7 / B8 2SB receivers 4-8 GHz



ALMA frequency bands & receivers

Band 3: 84 – 116 GHz

Band 4: 125 – 163 GHz

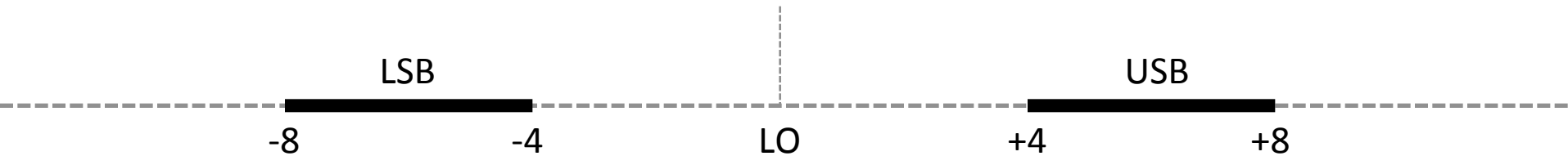
Band 6: 211 – 275 GHz

Band 7: 275 – 373 GHz

Band 8: 385 – 500 GHz

Band 9/10: 602 – 720 GHz / 787 – 950 GHz

ALMA B3 / B4 / B5 / B7 / B8 2SB receivers 4-8 GHz



Band 3



ALMA frequency bands & receivers

Band 3: 84 – 116 GHz

Band 4: 125 – 163 GHz

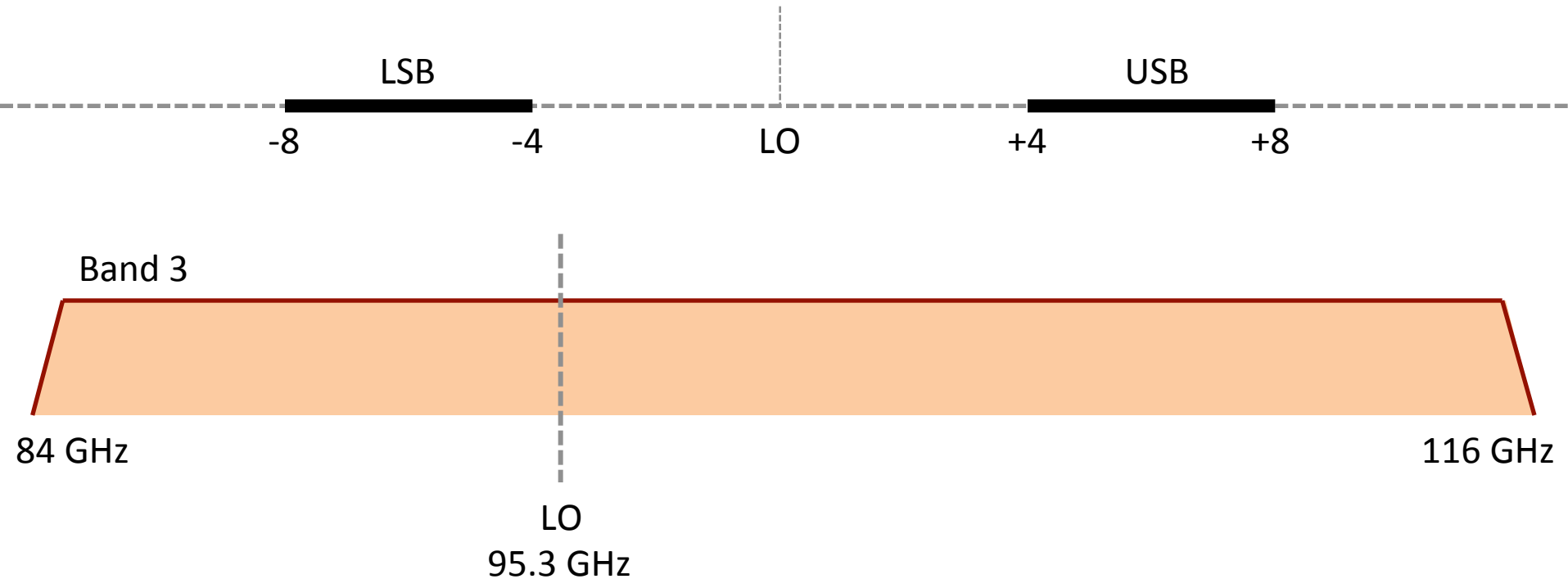
Band 6: 211 – 275 GHz

Band 7: 275 – 373 GHz

Band 8: 385 – 500 GHz

Band 9/10: 602 – 720 GHz / 787 – 950 GHz

ALMA B3 / B4 / B5 / B7 / B8 2SB receivers 4-8 GHz



ALMA frequency bands & receivers

Band 3: 84 – 116 GHz

Band 4: 125 – 163 GHz

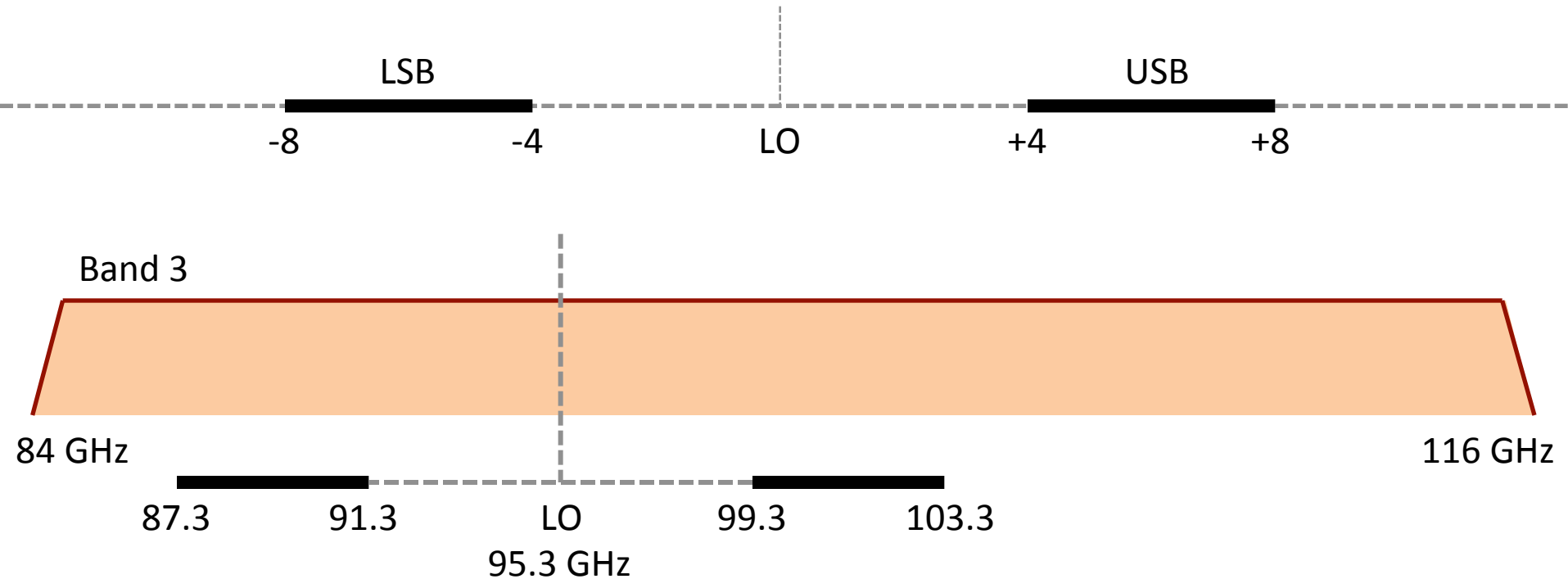
Band 6: 211 – 275 GHz

Band 7: 275 – 373 GHz

Band 8: 385 – 500 GHz

Band 9/10: 602 – 720 GHz / 787 – 950 GHz

ALMA B3 / B4 / B5 / B7 / B8 2SB receivers 4-8 GHz



ALMA frequency bands & receivers

Band 3: 84 – 116 GHz

Band 4: 125 – 163 GHz

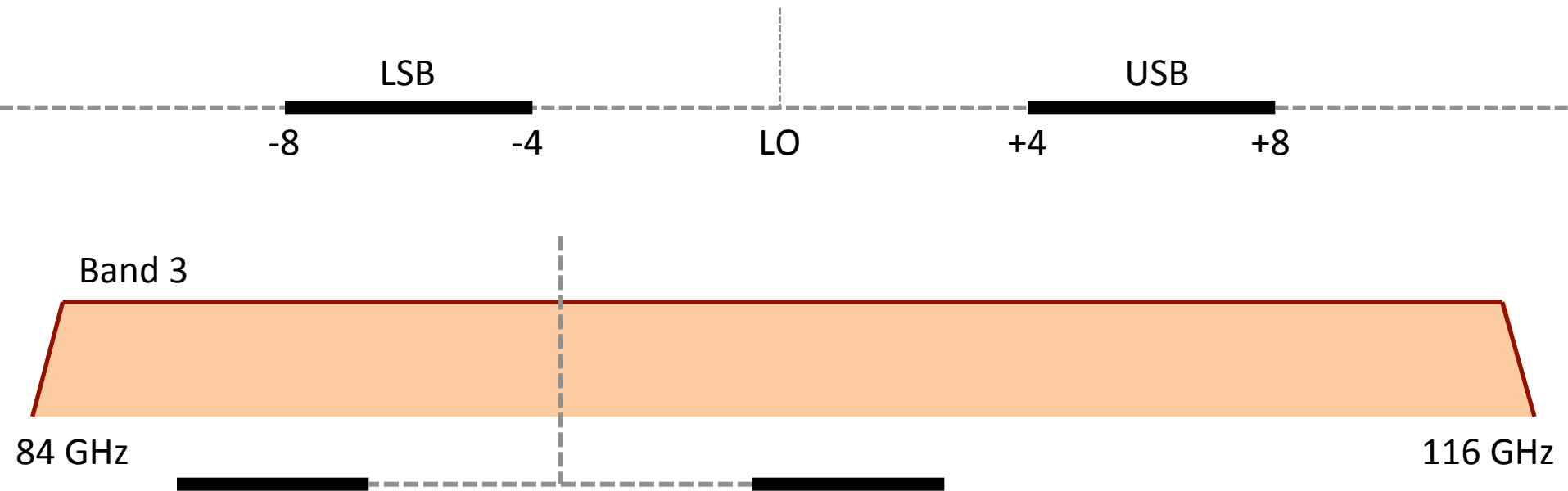
Band 6: 211 – 275 GHz

Band 7: 275 – 373 GHz

Band 8: 385 – 500 GHz

Band 9/10: 602 – 720 GHz / 787 – 950 GHz

ALMA B3 / B4 / B5 / B7 / B8 2SB receivers 4-8 GHz



ALMA frequency bands & receivers

Band 3: 84 – 116 GHz

Band 4: 125 – 163 GHz

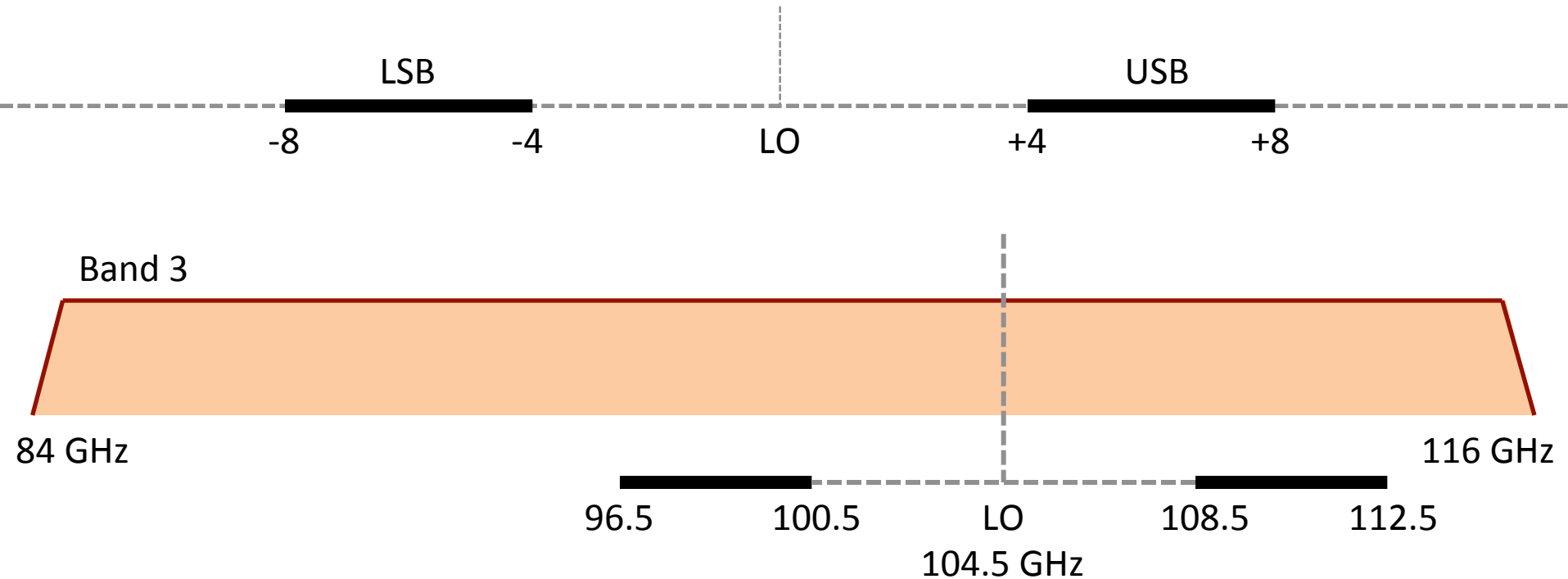
Band 6: 211 – 275 GHz

Band 7: 275 – 373 GHz

Band 8: 385 – 500 GHz

Band 9/10: 602 – 720 GHz / 787 – 950 GHz

ALMA B3 / B4 / B5 / B7 / B8 2SB receivers 4-8 GHz



What do we need to know?

- continuum or line (both?)
- frequency of the lines to observe
- velocity / redshift of the source
- bandwidth / velocity coverage
- spectral resolution
- polarization products

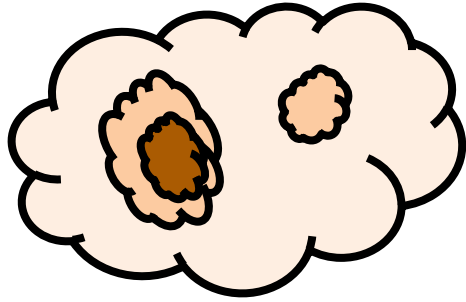
Spectral observations in a radio-interferometer

- frequency bands
- receivers
- **correlator**

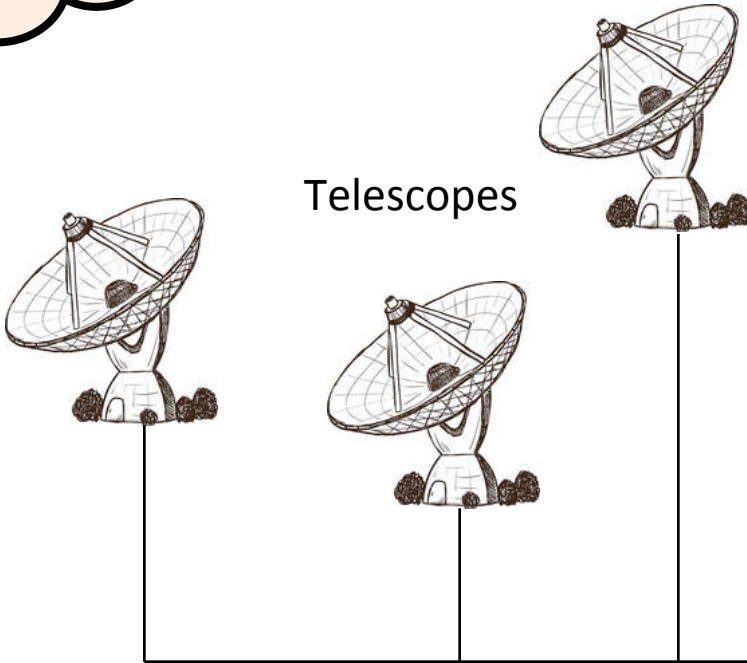


ALMA correlator

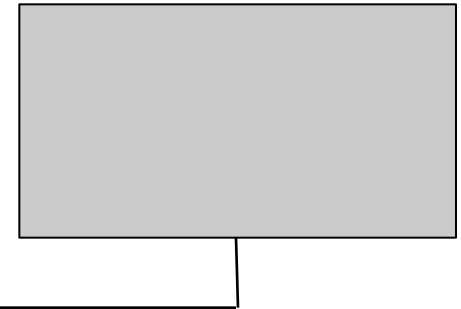
Scientific target



Telescopes

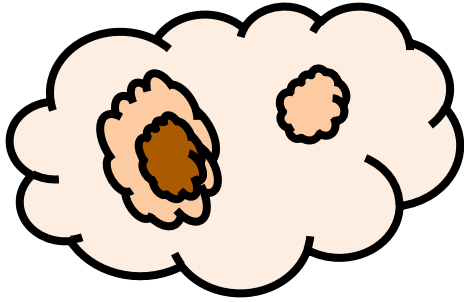


Control room

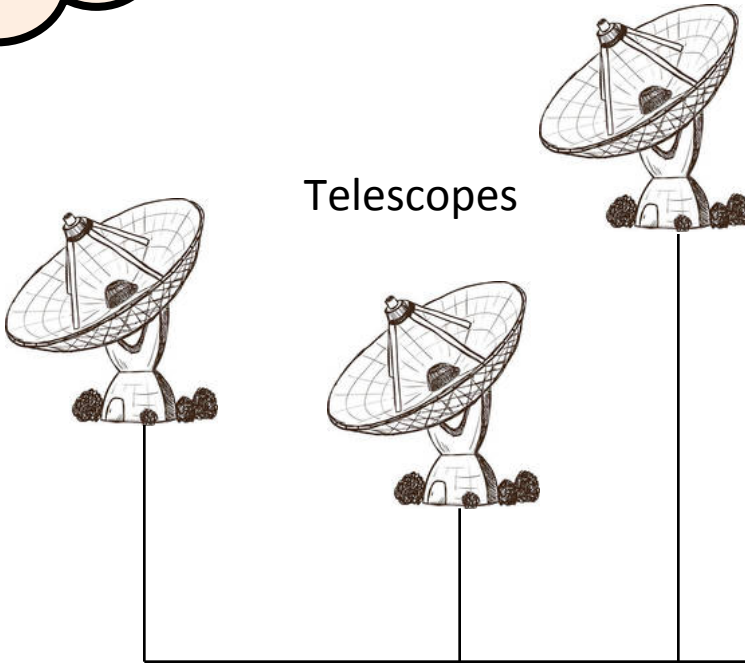


ALMA correlator

Scientific target



Telescopes

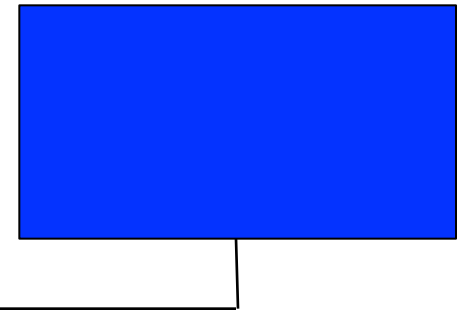


CORRELATOR:

Super-computer that accepts signals from element antennas, calculates **cross-correlation** of them, and produces **complex visibilities** that are used to synthesize images.

Keeps coherence in the complex visibilities, by providing delay and phase tracking to adjust wavefronts of received signals before correlation.

CORRELATOR



ALMA correlator



ALMA CORRELATOR:
one of the four 'quadrants' of the ALMA correlator

CORRELATOR:

Super-computer that accepts signals from element antennas, calculates cross-correlation of them, and produces complex visibilities that are used to synthesize images.

Keeps coherence in the complex visibilities, by providing delay and phase tracking to adjust wavefronts of received signals before correlation.

CORRELATOR



ALMA correlator



ALMA CORRELATOR:
one of the four 'quadrants' of the ALMA correlator

Physically:

- 1 correlator = 4 quadrants
- 1 quadrant = 1 baseband
- **ALMA correlator = 4 basebands**
- **Each baseband** processes
 - 64 antennas (2016 baselines)
 - 2 polarizations
 - **2 GHz** input
- Each baseband can be centered anywhere in the incoming 8 GHz

ALMA correlator / 4 basebands

basebands

information from 64 antennas

2 GHz input

up to 8192 channels

2 polarizations Horizontal / Vertical

up to 4 polarization products (HH, VV, HV, VH)

ALMA correlator / 4 basebands

basebands

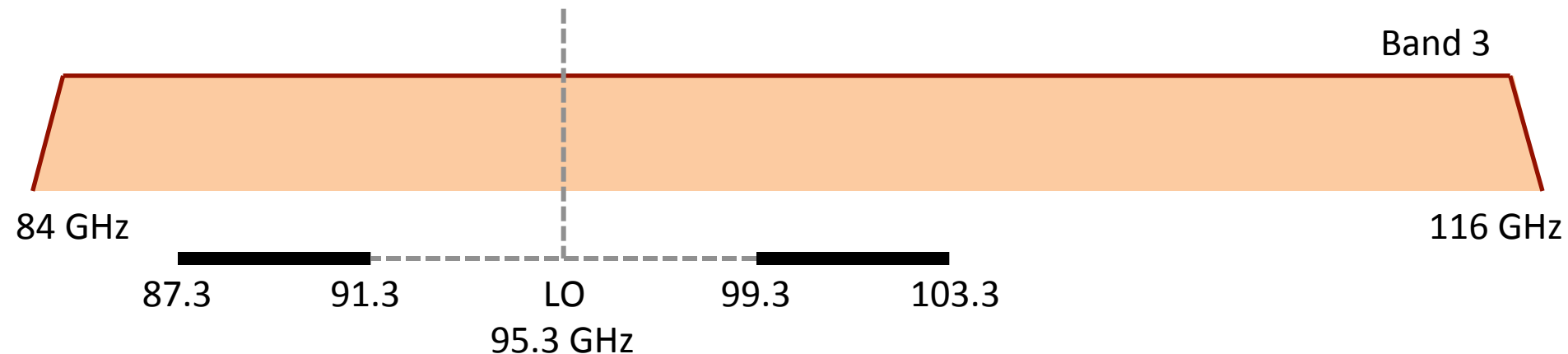
information from 64 antennas

2 GHz input

up to 8192 channels

2 polarizations Horizontal / Vertical

up to 4 polarization products (HH, VV, HV, VH)



ALMA correlator / 4 basebands

basebands

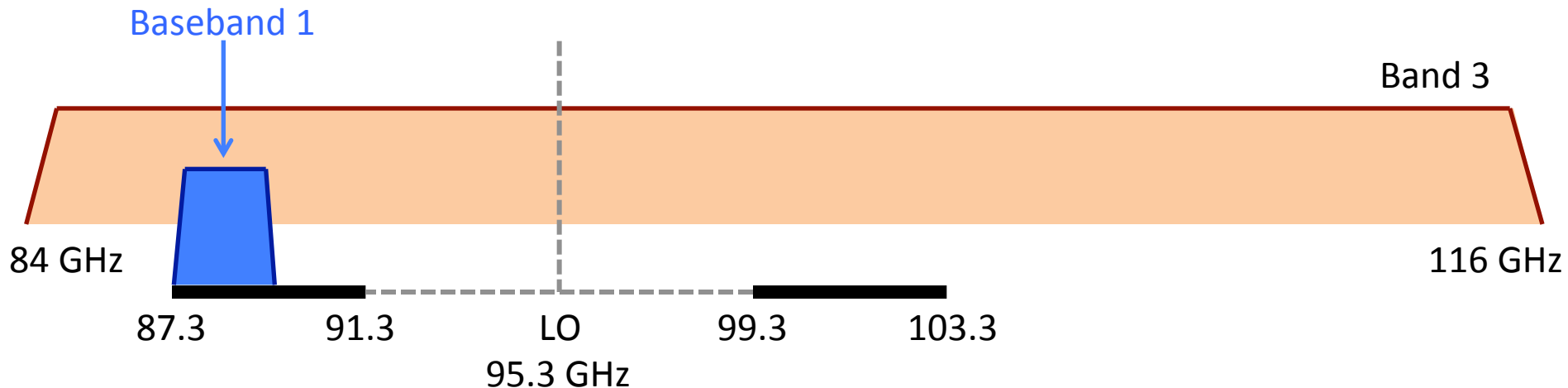
information from 64 antennas

2 GHz input

up to 8192 channels

2 polarizations Horizontal / Vertical

up to 4 polarization products (HH, VV, HV, VH)



ALMA correlator / **4 basebands**

basebands

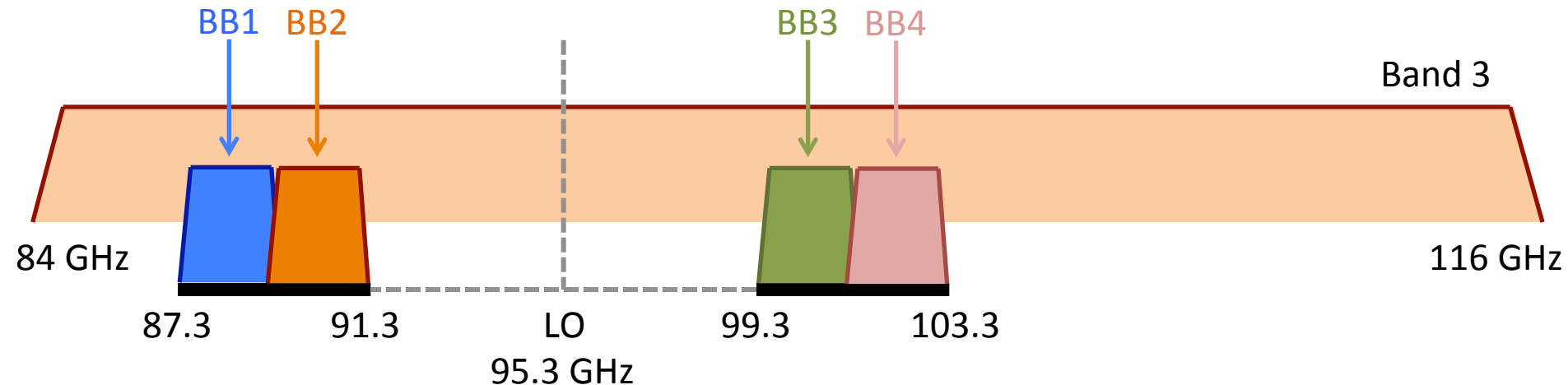
information from 64 antennas

2 GHz input

up to 8192 channels

2 polarizations Horizontal / Vertical

up to 4 polarization products (HH, VV, HV, VH)



ALMA correlator / **4 basebands**

basebands

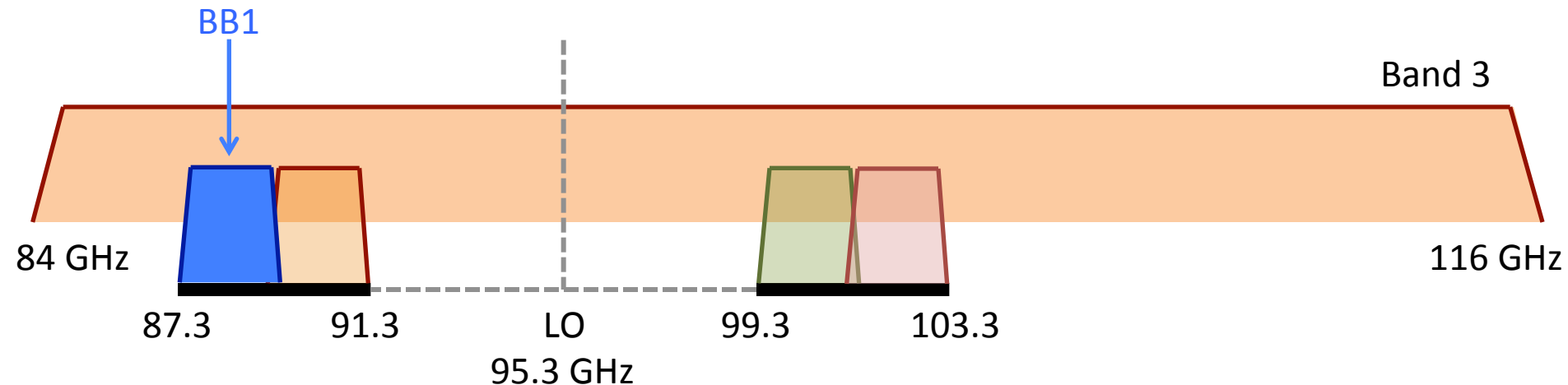
information from 64 antennas

2 GHz input

up to 8192 channels

2 polarizations Horizontal / Vertical

up to 4 polarization products (HH, VV, HV, VH)



ALMA correlator / **4 basebands**

basebands

information from 64 antennas

2 GHz input

up to 8192 channels

2 polarizations Horizontal / Vertical

up to 4 polarization products (HH, VV, HV, VH)

Baseband 1



87.3 GHz

89.3 GHz

ALMA correlator / **4 basebands**

basebands

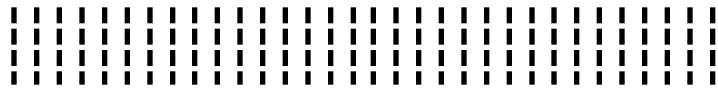
information from 64 antennas

2 GHz input

up to **8192 channels**

2 polarizations Horizontal / Vertical

up to 4 polarization products (HH, VV, HV, VH)



Baseband 1

87.3 GHz

89.3 GHz

ALMA correlator / **4 basebands**

basebands

information from 64 antennas

2 GHz input

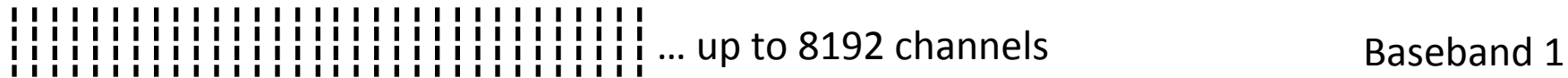
up to **8192 channels**

2 polarizations Horizontal / Vertical

up to 4 polarization products (HH, VV, HV, VH)

channel width (**spectral resolution**):

$$2 \text{ GHz} / 8192 = 244 \text{ kHz}$$



87.3 GHz

89.3 GHz

ALMA correlator / **4 basebands**

basebands

information from 64 antennas

2 GHz input

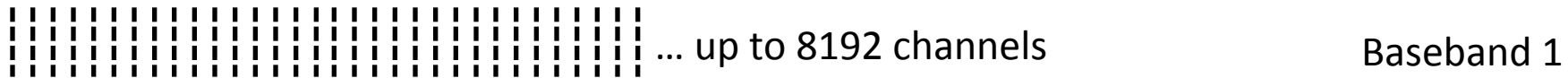
up to **8192 channels**

2 polarizations Horizontal / Vertical

up to 4 polarization products (HH, VV, HV, VH)

channel width (**spectral resolution**):

$$2 \text{ GHz} / 8192 = 244 \text{ kHz}$$



87.3 GHz

89.3 GHz

bandwidth = 2 GHz / resolution = 244 kHz ... **not fixed!**

ALMA correlator

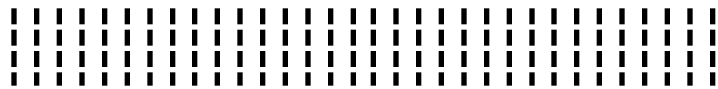
Bandwidth – Spectral resolution

BW	2 GHz	8192 channels x 1 polz	244 kHz resol.
BW	1 GHz	8192 channels x 1 polz	122 kHz resol.
BW	500 MHz	8192 channels x 1 polz	61 kHz resol.
BW	250 MHz	8192 channels x 1 polz	30 kHz resol.
BW	125 MHz	8192 channels x 1 polz	15 kHz resol.
BW	64 MHz	8192 channels x 1 polz	7.5 kHz resol.
BW	32 MHz	8192 channels x 1 polz	3.8 kHz resol.
continuum mode		256 channels x 1 polz	7.5 MHz resol.

ALMA correlator

Bandwidth – Spectral resolution

BW	2 GHz	8192 channels x 1 polz	244 kHz resol.
BW	1 GHz	8192 channels x 1 polz	122 kHz resol.
BW	500 MHz	8192 channels x 1 polz	61 kHz resol.
BW	250 MHz	8192 channels x 1 polz	30 kHz resol.
BW	125 MHz	8192 channels x 1 polz	15 kHz resol.
BW	64 MHz	8192 channels x 1 polz	7.5 kHz resol.
BW	32 MHz	8192 channels x 1 polz	3.8 kHz resol.
continuum mode		256 channels x 1 polz	7.5 MHz resol.



... up to 8192 channels

Baseband 1



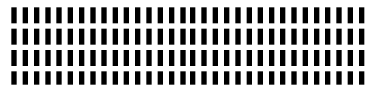
87.3 GHz

89.3 GHz

ALMA correlator

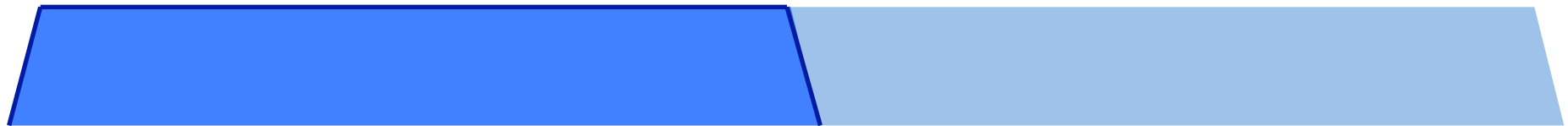
Bandwidth – Spectral resolution

BW	2 GHz	8192 channels x 1 polz	244 kHz resol.
BW	1 GHz	8192 channels x 1 polz	122 kHz resol.
BW	500 MHz	8192 channels x 1 polz	61 kHz resol.
BW	250 MHz	8192 channels x 1 polz	30 kHz resol.
BW	125 MHz	8192 channels x 1 polz	15 kHz resol.
BW	64 MHz	8192 channels x 1 polz	7.5 kHz resol.
BW	32 MHz	8192 channels x 1 polz	3.8 kHz resol.
continuum mode		256 channels x 1 polz	7.5 MHz resol.



... up to 8192 channels

Baseband 1



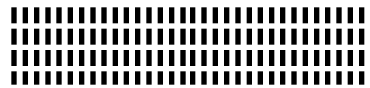
87.3 GHz

88.3 GHz

ALMA correlator

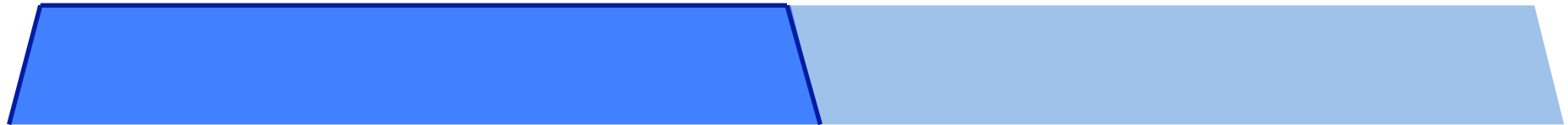
Bandwidth – Spectral resolution **1 polz (H or V)**

BW	2 GHz	8192 channels x 1 polz	244 kHz resol.
BW	1 GHz	8192 channels x 1 polz	122 kHz resol.
BW	500 MHz	8192 channels x 1 polz	61 kHz resol.
BW	250 MHz	8192 channels x 1 polz	30 kHz resol.
BW	125 MHz	8192 channels x 1 polz	15 kHz resol.
BW	64 MHz	8192 channels x 1 polz	7.5 kHz resol.
BW	32 MHz	8192 channels x 1 polz	3.8 kHz resol.
continuum mode		256 channels x 1 polz	7.5 MHz resol.



... up to 8192 channels

Baseband 1



87.3 GHz

88.3 GHz

ALMA correlator

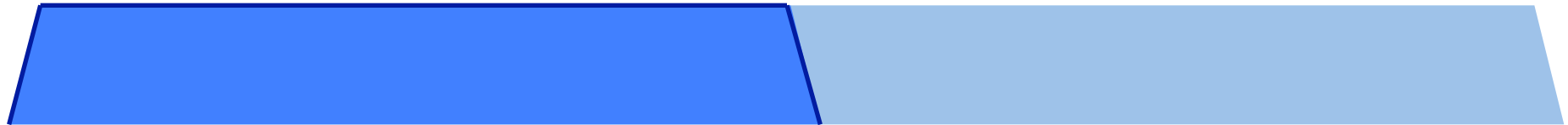
Bandwidth – Spectral resolution **2 polz (H and V)**

BW	2 GHz	4096 channels x 2 polz	488 kHz resol.
BW	1 GHz	4096 channels x 2 polz	244 kHz resol.
BW	500 MHz	4096 channels x 2 polz	122 kHz resol.
BW	250 MHz	4096 channels x 2 polz	61 kHz resol.
BW	125 MHz	4096 channels x 2 polz	30 kHz resol.
BW	64 MHz	4096 channels x 2 polz	15 kHz resol.
BW	32 MHz	4096 channels x 2 polz	7.5 kHz resol.
continuum mode		128 channels x 2 polz	15 MHz resol.



... up to **4096 channels**

Baseband 1



87.3 GHz

88.3 GHz

ALMA correlator

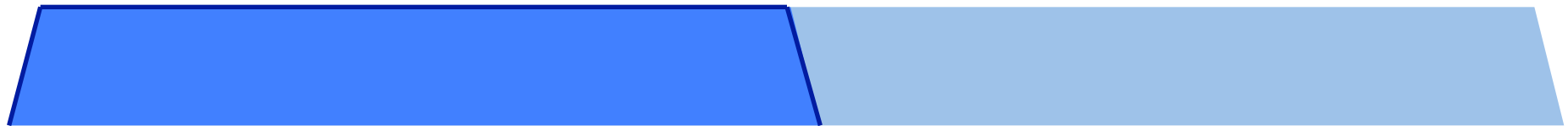
Bandwidth – Spectral resolution **4 polz (HH, VV, HV, VH)**

BW	2 GHz	2048 channels x 4 polz	976 kHz resol.
BW	1 GHz	2048 channels x 4 polz	488 kHz resol.
BW	500 MHz	2048 channels x 4 polz	244 kHz resol.
BW	250 MHz	2048 channels x 4 polz	122 kHz resol.
BW	125 MHz	2048 channels x 4 polz	61 kHz resol.
BW	64 MHz	2048 channels x 4 polz	30 kHz resol.
BW	32 MHz	2048 channels x 4 polz	15 kHz resol.
continuum mode		64 channels x 4 polz	31 MHz resol.



... up to **2048 channels**

Baseband 1



87.3 GHz

88.3 GHz

ALMA correlator

Polarization products (HH, VV, HV, VH)

the four are necessary for polarization studies

ALMA correlator

Polarization products (HH, VV, HV, VH)

the four are necessary for polarization studies

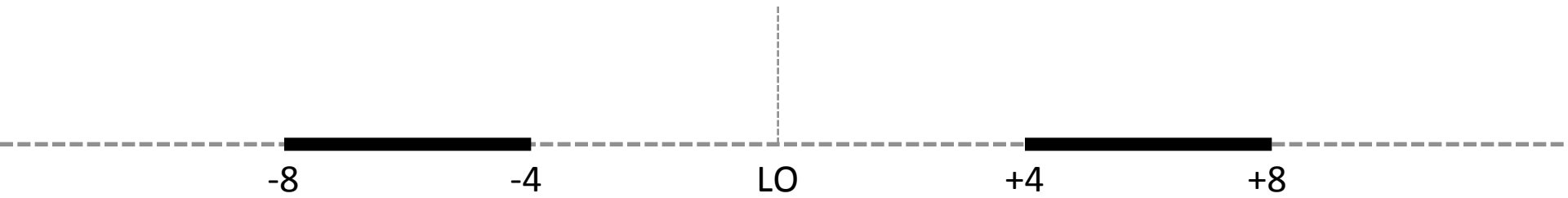
message to take home ...

	polarization	sensitivity	spectral resolution
1 polz product (HH or VV)	gray	red	green
2 polz products (HH and VV)	gray	green	orange
4 polz products (HH, VV, HV, VH)	green	green	red

ALMA correlator (examples)

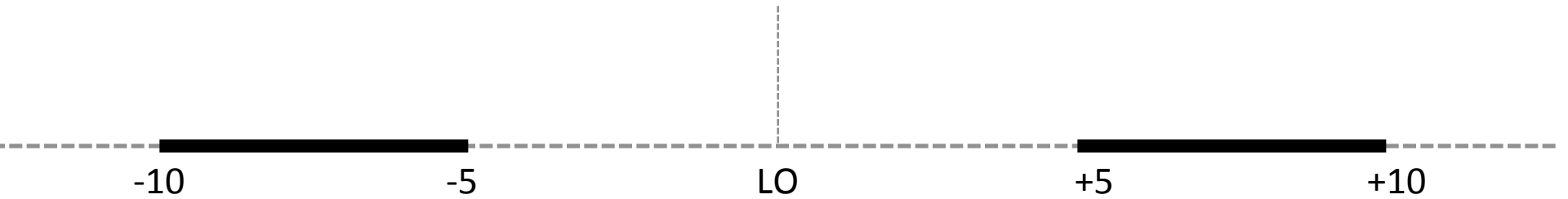
ALMA B3 / B4 / B5 / B7 / B8

2SB receivers 4-8 GHz



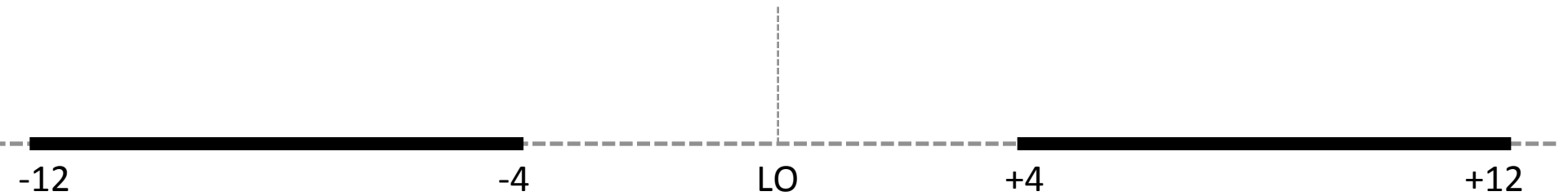
ALMA B6

2SB receivers 5-10 GHz



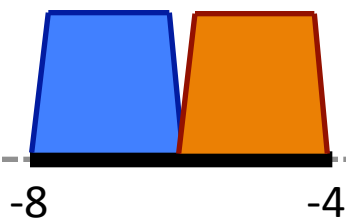
ALMA B9 / B10

DSB receivers 4-12 GHz

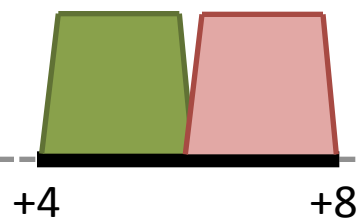


ALMA correlator (examples)

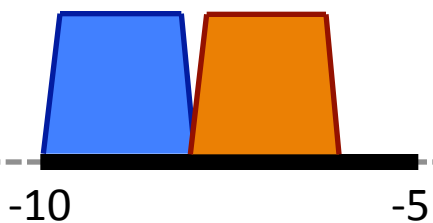
ALMA B3 / B4 / B5 / B7 / B8



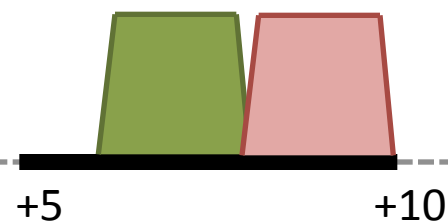
2SB receivers 4-8 GHz



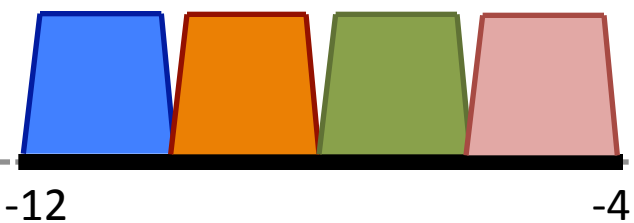
ALMA B6



2SB receivers 5-10 GHz



ALMA B9 / B10

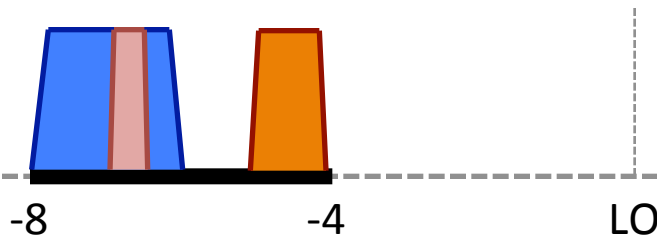


DSB receivers 4-12 GHz

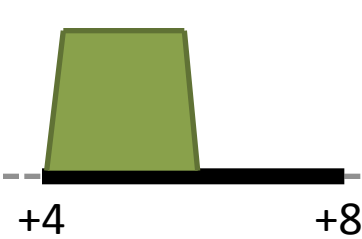


ALMA correlator (examples)

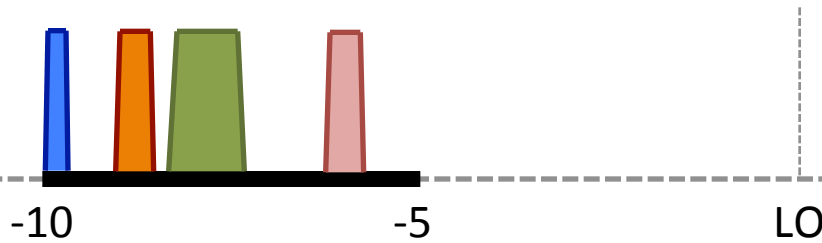
ALMA B3 / B4 / B5 / B7 / B8



2SB receivers 4-8 GHz



ALMA B6



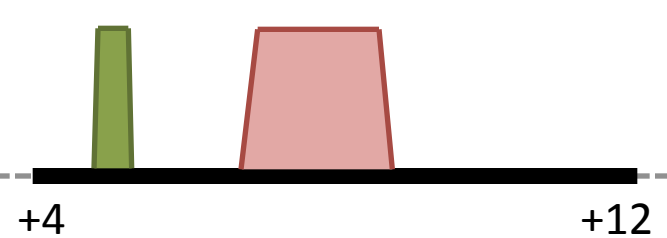
2SB receivers 5-10 GHz



ALMA B9 / B10



DSB receivers 4-12 GHz



Spectral setup in the almaOT

ALMA Observing Tool (Cycle3)

ALMA Observing Tool (Cycle3-Patchtests2) - Project

File Edit View Tool Search Help

Project Structure

Editors

Spectral Spatial Spectral Setup

In the table below, it is possible to define up to 16 spectral windows, 4 per baseband as long as the total Fraction per baseband is no more than 1. Each baseband is 2GHz wide and can be separately configured i.e. each spectral window can have a different bandwidth and resolution. Note that for bands 3, 4, 6, 7 and 8, it is not possible to put 3 basebands in one sideband and the fourth one in the other.

Spectral Type

Spectral Line
 Single Continuum
 Spectral Scan

Continuum or line ?

Polarization products desired XX DUAL FULL

Polarization products ?

Spectral Setup Errors
No spectral window in the list. No suitable receiver band for the range :[0.0 GHz, 0.0 GHz]

Spectral Line

Baseband	Fraction	Center Freq (Rest)	Center Freq (Sky)	Transition	Bandwidth, Resolution (smoothed)	Spec Avg.	Representative Window
Baseband-1							

Select Lines to Observe in Baseband-1... Add Delete

Baseband-2

Select Lines to Observe in Baseband-2... Add Delete

Baseband-3

Rest frequency ?

Bandwidth, spectral resolution ?

Spectral setup in the almaOT (**EXAMPLE**)

We want to observe three lines in our target:

HCN(1-0), HCO⁺(1-0) and H¹³CO⁺(1-0)

Spectral setup in the almaOT (EXAMPLE)

We want to observe three lines in our target:

HCN(1-0), HCO⁺(1-0) and H¹³CO⁺(1-0)

From previous observations we know the approximate linewidth:

HCN(1-0) → $\Delta v = 7$ km/s

HCO⁺(1-0) → $\Delta v = 10$ km/s

H¹³CO⁺(1-0) → $\Delta v = 3$ km/s

Spectral setup in the almaOT (EXAMPLE)

We want to observe three lines in our target:

HCN(1-0), HCO⁺(1-0) and H¹³CO⁺(1-0)

From previous observations we know the approximate linewidth:

HCN(1-0) → $\Delta v = 7$ km/s

HCO⁺(1-0) → $\Delta v = 10$ km/s

H¹³CO⁺(1-0) → $\Delta v = 3$ km/s

For our ALMA observations we would need:

Bandwidth > 20 km/s to properly cover the extend of the lines

Resolution < 0.7 km/s for the HCN and HCO⁺ lines

< 0.3 km/s for the H¹³CO⁺ line

Spectral setup in the almaOT (EXAMPLE)

The screenshot displays the ALMA Observing Tool (Cycle3) interface. The title bar shows "ALMA Observing Tool (Cycle3-Patchtests2) - Project" and the system tray includes the date "Sun Mar 22 14:16" and the user "Alvaro Sanchez". The menu bar contains "File", "Edit", "View", "Tool", "Search", and "Help". The toolbar includes icons for file operations, settings, and navigation.

The interface is divided into two main panes. The left pane, titled "Project Structure", shows a tree view of the project hierarchy: "Unsubmitted Proposal" > "Project" > "Proposal" > "Planned Observations" > "Science Goals" > "Spectral". The right pane, titled "Editors", is currently showing the "Spectral Setup" tab.

The "Spectral Setup" tab contains the following information:

- Text:** "In the table below, it is possible to define up to 16 spectral windows, 4 per baseband as long as the total Fraction per baseband is no more than 1. Each baseband is 2GHz wide and can be separately configured i.e. each spectral window can have a different bandwidth and resolution. Note that for bands 3, 4, 6, 7 and 8, it is not possible to put 3 basebands in one sideband and the fourth one in the other."
- Spectral Type:** A dropdown menu with a help icon (?) and a minus sign (-).
- Spectral Type:** Radio buttons for "Spectral Line" (selected), "Single Continuum", and "Spectral Scan".
- Polarization products desired:** Radio buttons for "XX", "DUAL" (selected), and "FULL".
- Spectral Setup Errors:** A red error message: "No spectral window in the list. No suitable receiver band for the range :[0.0 GHz, 0.0 GHz]".
- Spectral Line:** A dropdown menu with a help icon (?) and a minus sign (-).
- Baseband-1:** A table with columns: "Fraction", "Center Freq (Rest)", "Center Freq (Sky)", "Transition", "Bandwidth, Resolution (smoothed)", "Spec Avg.", and "Representative Window". Below the table are buttons: "Select Lines to Observe in Baseband-1...", "Add", and "Delete".
- Baseband-2:** A table with the same columns as Baseband-1. Below the table are buttons: "Select Lines to Observe in Baseband-2...", "Add", and "Delete".
- Baseband-3:** A table with the same columns as Baseband-1.

Spectral setup in the almaOT (EXAMPLE)

ALMA Observing Tool (Cycle3)

ALMA Observing Tool (Cycle3-Patchtests2) - Project

File Edit View Tool Search Help

Project Structure

Editors

Spectral Spatial Spectral Setup

Unsubmitted Proposal

- Project
 - Proposal
 - Planned Observations
 - Science Goals
 - General
 - Field Set
 - Spectral
 - Calibration
 - Control
 - Technical

In the table below, it is possible to define up to 16 spectral windows, 4 per baseband as long as the total Fraction per baseband is no more than 1. Each baseband is 2GHz wide and can be separately configured i.e. each spectral window can have a different bandwidth and resolution. Note that for bands 3, 4, 6, 7 and 8, it is not possible to put 3 basebands in one sideband and the fourth one in the other.

Spectral Type

Spectral Line
 Single Continuum
 Spectral Scan

Polarization products desired XX DUAL FULL

Spectral Setup Errors
No spectral window in the list. No suitable receiver band for the range :[0.0 GHz, 0.0 GHz]

Spectral Line

Baseband-1

Fraction	Center Freq (Rest)	Center Freq (Sky)	Transition	Bandwidth, Resolution (smoothed)	Spec Avg.	Representative Window

Select Lines to Observe in Baseband-1... Add Delete

Baseband-2

Select Lines to Observe in Baseband-2... Add Delete

Baseband-3

Spectral setup in the almaOT (EXAMPLE)

ALMA Observing Tool (Cycle3) Sun Mar 22 14:18 Alvaro Sanchez

ALMA Observing Tool (Cycle3-Patchtests2) - Project
Select Spectral Lines

Transition Filter

e.g. CO*2-1* or *oxide*

Include description

Frequency Filters

ALMA Band

1 2 3 4 5 6 7 8 9 10

Sky Frequency (GHz)

Min Max

Receiver/Back End Configuration

Hide unobservable lines

Filtering unobservable lines

Maximum Upper-state Energy (K)

0 20 40 60 80 100 ∞

Molecule Filter / Environment

Show

Can't find the transition you're looking for in the offline pool? Find more in the online Splatalogue.

Transitions matching your filter settings:
(double-click column header for primary sort, single-click subsequent columns for secondary sorting. Single clicks will reverse sort order of already selected transitions.)

Transition ^	Description	Rest Freq...	Sky Frequu...	Upper-state E...	Lovas Inte...	Sij μ ²
I-C5H J=35/2-33/2, Ω=3/2, F=17-16, l=f	2,4-Pentadiynylidyne	84.108 GHz	84.108 G...	71.861 K	4.7	401.709
I-C5H J=35/2-33/2, Ω=3/2, F=18-17, l=f	2,4-Pentadiynylidyne	84.108 GHz	84.108 G...	71.861 K	4.7	425.314
I-C5H J=35/2-33/2, Ω=3/2, F=17-16, l=e	2,4-Pentadiynylidyne	84.11 GHz	84.11 GHz	71.862 K		401.692
I-C5H J=35/2-33/2, Ω=3/2, F=18-17, l=e	2,4-Pentadiynylidyne	84.11 GHz	84.11 GHz	71.862 K		425.395
C4H v7 = 1 J=17/2-15/2, Ω=1/2, l=f	1,3-Butadiynyl radical	84.123 GHz	84.123 G...	211.671 K	2.1	12.771 [
CH3OH v t=1 11(10,1)-11(11,0)	Methanol	84.159 GHz	84.159 G...	1066.119 K		1.459 D ²
U-84163	UNIDENTIFIED	84.163 GHz	84.163 G...		0.06	
30SiO v=1 2-1	Silicon Monoxide	84.164 GHz	84.164 G...	1753.828 K		19.441 [
C-H13CCCH 2(1,2)-1(0,1)	Cyclopropenylidene	84.186 GHz	84.186 G...	6.331 K	0.13	17.24 D ²
U-84215	UNIDENTIFIED	84.215 GHz	84.215 G...		0.08	
SO2 v=0 32(5,27)-31(6,26)	Sulfur dioxide	84.321 GHz	84.321 G...	549.36 K	0.1	13.463 [
U-84356	UNIDENTIFIED	84.356 GHz	84.356 G...		0.07	
U-84385	UNIDENTIFIED	84.385 GHz	84.385 G...		0.08	
34SO 2(2)-1(1)	Sulfur Monoxide	84.411 GHz	84.411 G...	19.233 K	0.03	3.534 D ²
CH3OH v t=0 13(-3,11)-14(-2,13)	Methanol	84.424 GHz	84.424 G...	273.898 K		4.303 D ²
13CH3OH v t=0 13(-3,11)-12(-4,9)	Methanol	84.444 GHz	84.444 G...	269.033 K		3.267 D ²
U-84468	UNIDENTIFIED	84.468 GHz	84.468 G...		0.18	
U-84478	UNIDENTIFIED	84.478 GHz	84.478 G...		0.18	
U-84496	UNIDENTIFIED	84.496 GHz	84.496 G...		0.1	
CH3OH v t=0 5(-1,5)-4(0,4)	Methanol	84.521 GHz	84.521 G...	40.391 K		3.083 D ²
CH3OH v t=1 12(10,2)-12(11,1)	Methanol	84.54 GHz	84.54 GHz	1093.861 K		2.786 D ²
NH2CHO 4(0,4)-3(0,3)	Formamide	84.542 GHz	84.542 G...	10.158 K	0.21	52.272 [
C6H J=61/2-59/2, Ω=3/2, l=e	1,3,5-Hexatriynyl	84.55 GHz	84.55 GHz	63.662 K	0.04	1867.72
CH3OH v t=0 19(2,17)-18(-3,16)	Methanol	84.574 GHz	84.574 G...	463.489 K		0.424 D ²
C6H l=61/2-59/2, Ω=3/2, l=f	1.3.5-Hexatriynyl	84.575 GHz	84.575 G...	63.675 K	0.03	1867.56

Add to Selected Transitions

Selected transitions

Transition ^	Description	Rest Frequency ^	Sky Frequency

Remove from Selected Transitions

Spectral setup in the almaOT (EXAMPLE)

ALMA Observing Tool (Cycle3) Sun Mar 22 14:18 Alvaro Sanchez

ALMA Observing Tool (Cycle3-Patchtests2) - Project
Select Spectral Lines

File Edit

Transition Filter

e.g. CO*2-1**not**oxide*

Include description

Frequency Filters

ALMA Band

1 2 3 4 5 6 7 8

Sky Frequency (GHz)

Min Max

Receiver/Back End Configuration

Hide unobservable lines

Filtering unobservable lines

Maximum Upper-state Energy (K)

0 20 40 60 80 100 ∞

Molecule Filter / Environment

Show

Can't find the transition you're looking for in the offline pool? Find more in the online Splatalogue.

Transitions matching your filter settings:
(double-click column header for primary sort, single-click subsequent columns for secondary sorting. Single clicks will reverse sort order of already selected)

Transition ^	Description	Rest Freq... ^	Sky Freq...	Upper-state E...	Lovas Inte...	Sij μ ²
I-C5H J=35/2-33/2, Ω=3/2, F=17-16, l=f	2,4-Pentadiynylidyne	84.108 GHz	84.108 G...	71.861 K	4.7	401.709
I-C5H J=35/2-33/2, Ω=3/2, F=18-17, l=f	2,4-Pentadiynylidyne	84.108 GHz	84.108 G...	71.861 K	4.7	425.314
I-C5H J=35/2-33/2, Ω=3/2, F=17-16, l=e	2,4-Pentadiynylidyne	84.11 GHz	84.11 GHz	71.862 K		401.692
I-C5H J=35/2-33/2, Ω=3/2, F=18-17, l=e	2,4-Pentadiynylidyne	84.11 GHz	84.11 GHz	71.862 K		425.395
C4H v7 = 1 J=17/2-15/2, Ω=1/2, l=f	1,3-Butadiynyl radical	84.123 GHz	84.123 G...	211.671 K	2.1	12.771 [
CH3OH v t=1 11(10,1)-11(11,0)	Methanol	84.159 GHz	84.159 G...	1066.119 K		1.459 D ²
U-84163	UNIDENTIFIED	84.163 GHz	84.163 G...		0.06	
SiO v=1 2-1	Silicon Monoxide	84.164 GHz	84.164 G...	1753.828 K		19.441 [
U-84165	Cyclopropenylidene	84.186 GHz	84.186 G...	6.331 K	0.13	17.24 D ²
U-84165	UNIDENTIFIED	84.215 GHz	84.215 G...		0.08	
SO2 v=0 32(5,27)-31(6,26)	Sulfur dioxide	84.321 GHz	84.321 G...	549.36 K	0.1	13.463 [
U-84356	UNIDENTIFIED	84.356 GHz	84.356 G...		0.07	
U-84385	UNIDENTIFIED	84.385 GHz	84.385 G...		0.08	
34SO 2(2)-1(1)	Sulfur Monoxide	84.411 GHz	84.411 G...	19.233 K	0.03	3.534 D ²
CH3OH v t=0 13(-3,11)-14(-2,13)	Methanol	84.424 GHz	84.424 G...	273.898 K		4.303 D ²
13CH3OH v t=0 13(-3,11)-12(-4,9)	Methanol	84.444 GHz	84.444 G...	269.033 K		3.267 D ²
U-84468	UNIDENTIFIED	84.468 GHz	84.468 G...		0.18	
U-84478	UNIDENTIFIED	84.478 GHz	84.478 G...		0.18	
U-84496	UNIDENTIFIED	84.496 GHz	84.496 G...		0.1	
CH3OH v t=0 5(-1,5)-4(0,4)	Methanol	84.521 GHz	84.521 G...	40.391 K		3.083 D ²
CH3OH v t=1 12(10,2)-12(11,1)	Methanol	84.54 GHz	84.54 GHz	1093.861 K		2.786 D ²
NH2CHO 4(0,4)-3(0,3)	Formamide	84.542 GHz	84.542 G...	10.158 K	0.21	52.272 [
C6H J=61/2-59/2, Ω=3/2, l=e	1,3,5-Hexatriynyl	84.55 GHz	84.55 GHz	63.662 K	0.04	1867.72
CH3OH v t=0 19(2,17)-18(-3,16)	Methanol	84.574 GHz	84.574 G...	463.489 K		0.424 D ²
C6H l=61/2-59/2, Ω=3/2, l=f	1.3.5-Hexatriynyl	84.575 GHz	84.575 G...	63.675 K	0.03	1867.56

Add to Selected Transitions

Selected transitions

Transition ^	Description	Rest Frequency ^	Sky Frequency
Remove from Selected Transitions			

Spectral setup in the almaOT (EXAMPLE)

ALMA Observing Tool (Cycle3)

ALMA Observing Tool (Cycle3-Patchtests2) - Project

Select Spectral Lines

Transition Filter: **HCN***

Frequency Filters: Min 31.3, Max 950

Receiver/Back End Configuration: Hide unobservable lines, Filtering unobservable lines

Maximum Upper-state Energy (K): 0 to 100

Molecule Filter / Environment: Show all atoms and molecules

Can't find the transition you're looking for in the offline pool? Find more in the online Splatalogue. [Find More...](#) [Reset Filters](#)

Transitions matching your filter settings:

(double-click column header for primary sort, single-click subsequent columns for secondary sorting. Single clicks will reverse sort order of already selected transitions.)

Transition	Description	Rest Freq...	Sky Frequ...	Upper-state E...	Lovas Inte...	Sij
HCN v=0 J=1-0, F=1-1	Hydrogen Cyanide	88.63 GHz	88.63 GHz	4.254 K	9.6	2.967
HCN v=0 J=1-0	Hydrogen Cyanide	88.632 GHz	88.632 G...	4.254 K	17.2	8.911
HCN v=0 J=1-0, F=2-1	Hydrogen Cyanide	88.632 GHz	88.632 G...	4.254 K	17.2	4.946
HCN v=0 J=1-0, F=0-1	Hydrogen Cyanide	88.634 GHz	88.634 G...	4.254 K	6.8	0.989
HCN v=0 J=3-2, F=3-3	Hydrogen Cyanide	265.885 GHz	265.885 ...	25.521 K		0.989
HCN v=0 J=3-2, F=2-1	Hydrogen Cyanide	265.886 GHz	265.886 ...	25.521 K	20	5.347
HCN v=0 J=3-2	Hydrogen Cyanide	265.886 GHz	265.886 ...	25.521 K	20	26.734
HCN v=0 J=3-2, F=3-2	Hydrogen Cyanide	265.886 GHz	265.886 ...	25.521 K	20	7.913
HCN v=0 J=3-2, F=4-3	Hydrogen Cyanide	265.886 GHz	265.886 ...	25.521 K	20	11.466
HCN v=0 J=3-2, F=2-2	Hydrogen Cyanide	265.889 GHz	265.889 ...	25.521 K		0.989
HCN v=0 J=4-3	Hydrogen Cyanide	354.505 GHz	354.505 ...	42.534 K	17.4	35.645
HCN v=0 J=5-4	Hydrogen Cyanide	443.116 GHz	443.116 ...	63.8 K		44.555
HCN v=0 J=7-6	Hydrogen Cyanide	620.304 GHz	620.304 ...	119.088 K		62.379
HCN v=0 J=8-7	Hydrogen Cyanide	708.877 GHz	708.877 ...	153.109 K	48.7	71.295
HCN v=0 J=9-8	Hydrogen Cyanide	797.433 GHz	797.433 ...	191.38 K	55	80.205
HCN v=0 J=10-9	Hydrogen Cyanide	885.971 GHz	885.971 ...	233.899 K	15	89.115

Add to Selected Transitions

Selected transitions

Transition	Description	Rest Frequency	Sky Frequency
------------	-------------	----------------	---------------

Remove from Selected Transitions

Cancel

Spectral setup in the almaOT (EXAMPLE)

ALMA Observing Tool (Cycle3) Sun Mar 22 14:18 Alvaro Sanchez

ALMA Observing Tool (Cycle3-Patchtests2) - Project
Select Spectral Lines

File Edit

Transition Filter

HCN*

Include description

Frequency Filters

ALMA Band

1 2 3 4 5 6 7 8 9 10

Sky Frequency (GHz)

Min 31.3 Max 950

Receiver/Back End Configuration

Hide unobservable lines

Filtering unobservable lines

Maximum Upper-state Energy (K)

0 20 40 60 80 100 ∞

Molecule Filter / Environment

Show all atoms and molecules

Can't find the transition you're looking for in the offline pool? Find more in the online Splatalogue.

Find More...

Reset Filters

Transitions matching your filter settings:
(double-click column header for primary sort, single-click subsequent columns for secondary sorting. Single clicks will reverse sort order of already selected transitions.)

Transition ^	Description	Rest Freq...	Sky Freq...	Upper-state E...	Lovas Inte...	Sij
HCN v=0 J=1-0, F=1-1	Hydrogen Cyanide	88.63 GHz	88.63 GHz	4.254 K	9.6	2.967
HCN v=0 J=1-0	Hydrogen Cyanide	88.632 GHz	88.632 G...	4.254 K	17.2	8.911
HCN v=0 J=1-0, F=2-1	Hydrogen Cyanide	88.632 GHz	88.632 G...	4.254 K	17.2	4.946
HCN v=0 J=1-0, F=0-1	Hydrogen Cyanide	88.634 GHz	88.634 G...	4.254 K	6.8	0.989
HCN v=0 J=3-2, F=3-3	Hydrogen Cyanide	265.885 GHz	265.885 ...	25.521 K		0.989
HCN v=0 J=3-2, F=2-1	Hydrogen Cyanide	265.886 GHz	265.886 ...	25.521 K	20	5.347
HCN v=0 J=3-2	Hydrogen Cyanide	265.886 GHz	265.886 ...	25.521 K	20	26.734
HCN v=0 J=3-2, F=3-2	Hydrogen Cyanide	265.886 GHz	265.886 ...	25.521 K	20	7.913
HCN v=0 J=3-2, F=4-3	Hydrogen Cyanide	265.886 GHz	265.886 ...	25.521 K	20	11.466
HCN v=0 J=3-2, F=2-2	Hydrogen Cyanide	265.889 GHz	265.889 ...	25.521 K		0.989
HCN v=0 J=4-3	Hydrogen Cyanide	354.505 GHz	354.505 ...	42.534 K	17.4	35.643
HCN v=0 J=5-4	Hydrogen Cyanide	443.116 GHz	443.116 ...	63.8 K		44.553
HCN v=0 J=7-6	Hydrogen Cyanide	620.304 GHz	620.304 ...	119.088 K		62.379
HCN v=0 J=8-7	Hydrogen Cyanide	708.877 GHz	708.877 ...	153.109 K	48.7	71.293
HCN v=0 J=9-8	Hydrogen Cyanide	797.433 GHz	797.433 ...	191.38 K	55	80.203
HCN v=0 J=10-9	Hydrogen Cyanide	885.971 GHz	885.971 ...	233.899 K	15	89.113

Add to Selected Transitions

Selected transitions

Transition ^	Description	Rest Frequency ^	Sky Frequency

Remove from Selected Transitions

Cancel

Spectral setup in the almaOT (EXAMPLE)

ALMA Observing Tool (Cycle3)

ALMA Observing Tool (Cycle3-Patchtests2) - Project

Select Spectral Lines

Transition Filter: HCN*

Include description

Frequency Filters

ALMA Band: [Slider]

Sky Frequency (GHz): [Slider] Min: 31.3 Max: 950

Receiver/Back End Configuration

Hide unobservable lines

Filtering unobservable lines

Maximum Upper-state Energy (K): [Slider]

Molecule Filter / Environment

Show: all atoms and molecules

Can't find the transition you're looking for in the offline pool? Find more in the online Splatalogue.

Transitions matching your filter settings:

(double-click column header for primary sort, single-click subsequent columns for secondary sorting. Single clicks will reverse sort order of already selected)

Transition ^	Description	Rest Freq...	Sky Freq...	Upper-state E...	Lovas Inte...	Sij
HCN v=0 J=1-0, F=1-1	Hydrogen Cyanide	88.63 GHz	88.63 GHz	4.254 K	9.6	2.967
HCN v=0 J=1-0	Hydrogen Cyanide	88.632 GHz	88.632 G...	4.254 K	17.2	8.911
HCN v=0 J=1-0, F=2-1	Hydrogen Cyanide	88.632 GHz	88.632 G...	4.254 K	17.2	4.946
HCN v=0 J=1-0, F=0-1	Hydrogen Cyanide	88.634 GHz	88.634 G...	4.254 K	6.8	0.989
HCN v=0 J=3-2, F=3-3	Hydrogen Cyanide	265.885 GHz	265.885 ...	25.521 K		0.989
HCN v=0 J=3-2, F=2-1	Hydrogen Cyanide	265.886 GHz	265.886 ...	25.521 K	20	5.347
HCN v=0 J=3-2	Hydrogen Cyanide	265.886 GHz	265.886 ...	25.521 K	20	26.734
HCN v=0 J=3-2, F=3-2	Hydrogen Cyanide	265.886 GHz	265.886 ...	25.521 K	20	7.913
HCN v=0 J=3-2, F=4-3	Hydrogen Cyanide	265.886 GHz	265.886 ...	25.521 K	20	11.466
HCN v=0 J=3-2, F=2-2	Hydrogen Cyanide	265.889 GHz	265.889 ...	25.521 K		0.989
HCN v=0 J=4-3	Hydrogen Cyanide	354.505 GHz	354.505 ...	42.534 K	17.4	35.643
HCN v=0 J=5-4	Hydrogen Cyanide	443.116 GHz	443.116 ...	63.8 K		44.553
HCN v=0 J=7-6	Hydrogen Cyanide	620.304 GHz	620.304 ...	119.088 K		62.379
HCN v=0 J=8-7	Hydrogen Cyanide	708.877 GHz	708.877 ...	153.109 K	48.7	71.293
HCN v=0 J=9-8	Hydrogen Cyanide	797.433 GHz	797.433 ...	191.38 K	55	80.203
HCN v=0 J=10-9	Hydrogen Cyanide	885.971 GHz	885.971 ...	233.899 K	15	89.113

Selected transitions

Transition ^	Description	Rest Frequency ^	Sky Frequency
--------------	-------------	------------------	---------------

Spectral setup in the almaOT (EXAMPLE)

ALMA Observing Tool (Cycle3) Sun Mar 22 14:18 Alvaro Sanchez

ALMA Observing Tool (Cycle3-Patchtests2) - Project
Select Spectral Lines

File Edit

Transition Filter
HCN*

Include description

Frequency Filters
ALMA Band

Sky Frequency (GHz)

Min 31.3 Max 950

Receiver/Back End Configuration
 Hide unobservable lines
 Filtering unobservable lines

Maximum Upper-state Energy (K)

Molecule Filter / Environment
Show all atoms and molecules


Can't find the transition you're looking for in the offline pool? Find more in the online Splatalogue.

Transitions matching your filter settings:
(double-click column header for primary sort, single-click subsequent columns for secondary sorting. Single clicks will reverse sort order of already selected transitions)

Transition ^	Description	Rest Freq...	Sky Freq...	Upper-state E...	Lovas Inte...	Sij
HCN v=0 J=1-0, F=1-1	Hydrogen Cyanide	88.63 GHz	88.63 GHz	4.254 K	9.6	2.967
HCN v=0 J=1-0	Hydrogen Cyanide	88.632 GHz	88.632 G...	4.254 K	17.2	8.911
HCN v=0 J=1-0, F=2-1	Hydrogen Cyanide	88.632 GHz	88.632 G...	4.254 K	17.2	4.946
HCN v=0 J=1-0, F=0-1	Hydrogen Cyanide	88.634 GHz	88.634 G...	4.254 K	6.8	0.989

Selected transitions

Transition ^	Description	Rest Frequency ^	Sky Frequency
HCN v=0 J=1-0	Hydrogen Cyanide	88.632 GHz	88.632 GHz



Spectral setup in the almaOT (EXAMPLE)

ALMA Observing Tool (Cycle3) Sun Mar 22 14:18 Alvaro Sanchez

ALMA Observing Tool (Cycle3-Patchtests2) - Project
Select Spectral Lines

Transition Filter: **HCO***

Include description

Frequency Filters

Min: 31.3 Max: 950

Receiver/Back End Configuration

Hide unobservable lines

Filtering unobservable lines

Maximum Upper-state Energy (K)

Molecule Filter / Environment

Show: all atoms and molecules

Can't find the transition you're looking for in the offline pool? Find more in the online Splatalogue.

Find More...

Reset Filters

Transitions matching your filter settings:
(double-click column header for primary sort, single-click subsequent columns for secondary sorting. Single clicks will reverse sort order of already selected transitions.)

Transition ^	Description	Rest Freq...	Sky Freq...	Upper-state E...	Lovas Inte...	Sij
HCO 1(0,1)-0(0,0), J=3/2-1/2, F=1-0	Formyl Radical	86.708 GHz	86.708 G...	4.161 K	0.04	1.817
HCO 1(0,1)-0(0,0), J=1/2-1/2, F=1-1	Formyl Radical	86.777 GHz	86.777 G...	4.183 K	0.021	1.817
HCO 1(0,1)-0(0,0), J=1/2-1/2, F=0-1	Formyl Radical	86.806 GHz	86.806 G...	4.185 K	0.015	0.619
HCO+ v=0 1-0	Formylium	89.189 GHz	89.189 G...	4.28 K	10.8	15.21

Add to Selected Transitions

Selected transitions

Transition ^	Description	Rest Frequency ^	Sky Frequency
HCN v=0 J=1-0	Hydrogen Cyanide	88.632 GHz	88.632 GHz

Remove from Selected Transitions

Cancel

HCO*

Spectral setup in the almaOT (EXAMPLE)

ALMA Observing Tool (Cycle3) Sun Mar 22 14:19 Alvaro Sanchez

ALMA Observing Tool (Cycle3-Patchtests2) - Project
Select Spectral Lines

File Edit

Transition Filter
HCO⁺
 Include description

Frequency Filters
ALMA Band

Sky Frequency (GHz)

Min 31.3 Max 950

Receiver/Back End Configuration
 Hide unobservable lines
 Filtering unobservable lines

Maximum Upper-state Energy (K)

Molecule Filter / Environment
Show all atoms and molecules

Can't find the transition you're looking for in the offline pool? Find more in the online Splatalogue.
[Find More...](#)
[Reset Filters](#)

Transitions matching your filter settings:
(double-click column header for primary sort, single-click subsequent columns for secondary sorting. Single clicks will reverse sort order of already selected transitions.)

Transition ^	Description	Rest Freq... ^	Sky Freq...	Upper-state E...	Lovas Inte...	Sij
HCO+ v=0 1-0	Formylium	89.189 GHz	89.189 G...	4.28 K	10.8	15.21

[Add to Selected Transitions](#)

Selected transitions

Transition ^	Description	Rest Frequency ^	Sky Frequency
HCN v=0 J=1-0	Hydrogen Cyanide	88.632 GHz	88.632 GHz
HCO+ v=0 1-0	Formylium	89.189 GHz	89.189 GHz

[Remove from Selected Transitions](#)

[Cancel](#)

Spectral setup in the almaOT (EXAMPLE)

ALMA Observing Tool (Cycle3) Sun Mar 22 14:19 Alvaro Sanchez

ALMA Observing Tool (Cycle3-Patchtests2) - Project
Select Spectral Lines

File Edit

Transition Filter
HCO*
 Include description

Frequency Filters
ALMA Band
Sky Frequency (GHz)
Min 31.3 Max 950

Receiver/Back End Configuration
 Hide unobservable lines
 Filtering unobservable lines

Maximum Upper-state Energy (K)
0 20 40 60 80 100 ∞

Molecule Filter / Environment
Show all atoms and molecules

Can't find the transition you're looking for in the offline pool? Find more in the online Splatalogue.
Find More...
Reset Filters

Transitions matching your filter settings:
(double-click column header for primary sort, single-click subsequent columns for secondary sorting. Single clicks will reverse sort order of already selected columns)

Transition ^	Description	Rest Freq...	Sky Freq...	Upper-state E...	Lovas Inte...	Sij μ^2	Cata.
HCO+ v=0 1-0	Formylium	89.189 GHz	89.189 G...	4.28 K	10.8	15.21 D ²	Offline

Add to Selected Transitions

Selected transitions

Transition ^	Description	Rest Frequency ^	Sky Frequency
HCN v=0 J=1-0	Hydrogen Cyanide	88.632 GHz	88.632 GHz
HCO+ v=0 1-0	Formylium	89.189 GHz	89.189 GHz

Remove from Selected Transitions

Cancel Ok

Spectral setup in the almaOT (EXAMPLE)

ALMA Observing Tool (Cycle3)

ALMA Observing Tool (Cycle3-Patchtests2) - Project

File Edit View Tool Search Help

Project Structure

Proposed Program

Unsubmitted Proposal

Project

Proposal

Planned Observations

Science Goals

General

Field Set

Spectral

Calibration

Control

Technical

Editors

Spectral Spatial Spectral Setup

In the table below, it is possible to define up to 16 spectral windows, 4 per baseband as long as the total Fraction per baseband is no more than 1. Each baseband is 2GHz wide and can be separately configured i.e. each spectral window can have a different bandwidth and resolution. Note that for bands 3, 4, 6, 7 and 8, it is not possible to put 3 basebands in one sideband and the fourth one in the other.

Spectral Type

Spectral Type

Spectral Line

Single Continuum

Spectral Scan

Polarization products desired XX DUAL FULL

Spectral Setup Errors

Baseband-1 : Bandwidth and channel spacing must be set to all spectral windows.

Spectral Line

Fraction	Center Freq (Rest)	Center Freq (Sky)	Transition	Bandwidth, Resolution (smoothed)	Spec Avg.	Representative Window
1/2	88.63160 GHz	88.63160 GHz	HCN v=0 J=1...	Please select a correlator mode	1	<input checked="" type="radio"/>
1/2	89.18853 GHz	89.18853 GHz	HCO+ v=0 1-0	Please select a correlator mode	1	<input type="radio"/>

Select Lines to Observe in Baseband-1... Add Delete

Baseband-2

Select Lines to Observe in Baseband-2... Add Delete

Baseband-3

Spectral setup in the almaOT (EXAMPLE)

ALMA Observing Tool (Cycle3) Sun Mar 22 14:19 Alvaro Sanchez

ALMA Observing Tool (Cycle3-Patchtests2) - Project Perspective 1

File Edit View Tool Search Help

Project Structure: Unsubmitted Proposal, Project, Proposal, Planned Observations, Science Goals, General, Field Set, Spectral, Calibration, Control, Technical

Editors: Spectral, Spatial, Spectral Setup

In the table below, it is possible to define up to 16 spectral windows, 4 per baseband as long as the total Fraction per baseband is no more than 1. Each baseband is 2GHz wide and can be separately configured i.e. each spectral window can have a different bandwidth and resolution. Note that for bands 3, 4, 6, 7 and 8, it is not possible to put 3 basebands in one sideband and the fourth one in the other.

Spectral Type: Spectral Line, Single Continuum, Spectral Scan

Polarization products desired: XX, DUAL, FULL

Spectral Setup Errors: **Baseband-1 : Bandwidth and channel spacing must be set to all spectral windows.**

Spectral Line

Baseband-1

Fraction	Center Freq (Rest)	Center Freq (Sky)	Transition	Bandwidth, Resolution (smoothed)	Spec Avg.	Representative Window
1/2	88.63160 GHz	88.63160 GHz	HCN v=0 J=1...	58.594 MHz (198 km/s), 61.035 kHz (0.206 km/s)	1	<input checked="" type="radio"/>
1/2	89.18853 GHz	89.18853 GHz	HCO+ v=0 1-0	58.594 MHz (198 km/s), 61.035 kHz (0.206 km/s) 117.188 MHz (396 km/s), 122.070 kHz (0.413 km/s) 234.375 MHz (793 km/s), 244.141 kHz (0.826 km/s) 468.750 MHz (1586 km/s), 488.281 kHz (1.652 km/s) 937.500 MHz (3171 km/s), 976.563 kHz (3.303 km/s)	1	<input type="radio"/>

Select Lines to Observe in Baseband-1... Add

Baseband-2

Select Lines to Observe in Baseband-2... Add Delete

Baseband-3

Spectral setup in the almaOT (EXAMPLE)

ALMA Observing Tool (Cycle3)

ALMA Observing Tool (Cycle3-Patchtests2) - Project

File Edit View Tool Search Help

Project Structure

Proposed Program

Unsubmitted Proposal

Project

Proposal

Planned Observations

Science Goals

General

Field Set

Spectral

Calibration

Control

Technical

Editors

Spectral Spatial Spectral Setup

In the table below, it is possible to define up to 16 spectral windows, 4 per baseband as long as the total Fraction per baseband is no more than 1. Each baseband is 2GHz wide and can be separately configured i.e. each spectral window can have a different bandwidth and resolution. Note that for bands 3, 4, 6, 7 and 8, it is not possible to put 3 basebands in one sideband and the fourth one in the other.

Spectral Type

Spectral Type

Spectral Line

Single Continuum

Spectral Scan

Polarization products desired XX DUAL FULL

Spectral Setup Errors

Baseband-1 : Bandwidth and channel spacing must be set to all spectral windows.

Spectral Line

Baseband-1

Fraction	Center Freq (Rest)	Center Freq (Sky)	Transition	Bandwidth, Resolution (smoothed)	Spec Avg.	Representative Window
1/2	88.63160 GHz	88.63160 GHz	HCN v=0 J=1...	58.594 MHz (198 km/s), 61.035 kHz (0.206 km/s)	1	<input checked="" type="radio"/>
1/2	89.18853 GHz	89.18853 GHz	HCO+ v=0 1-0	58.594 MHz (198 km/s), 61.035 kHz (0.206 km/s) 117.188 MHz (396 km/s), 122.070 kHz (0.413 km/s) 234.375 MHz (793 km/s), 244.140 kHz (0.826 km/s) 468.750 MHz (1586 km/s), 488.280 kHz (1.652 km/s) 937.500 MHz (3171 km/s), 976.563 kHz (3.303 km/s)	1	<input type="radio"/>

Select Lines to Observe in Baseband-1... Add

Baseband-2

Select Lines to Observe in Baseband-2...

Baseband-3

bandwidth

resolution

Spectral setup in the almaOT (EXAMPLE)

The screenshot displays the ALMA Observing Tool (Cycle3) interface. The title bar shows the application name and the current project: "ALMA Observing Tool (Cycle3-Patchtests2) - Project". The menu bar includes "File", "Edit", "View", "Tool", "Search", and "Help". The toolbar contains various icons for file operations and navigation. The "Project Structure" pane on the left shows a tree view of the project files, including "Unsubmitted Proposal", "Project", "Proposal", "Planned Observations", "Science Goals", "General", "Field Set", "Spectral", "Calibration", "Control", and "Technical".

The main window is titled "Editors" and has three tabs: "Spectral", "Spatial", and "Spectral Setup". The "Spectral Setup" tab is active. It contains the following sections:

- Text:** "In the table below, it is possible to define up to 16 spectral windows, 4 per baseband as long as the total Fraction per baseband is no more than 1. Each baseband is 2GHz wide and can be separately configured i.e. each spectral window can have a different bandwidth and resolution. Note that for bands 3, 4, 6, 7 and 8, it is not possible to put 3 basebands in one sideband and the fourth one in the other."
- Spectral Type:** Includes a help icon, a "Spectral Type" label, and three radio buttons: "Spectral Line" (selected), "Single Continuum", and "Spectral Scan".
- Polarization products desired:** Includes radio buttons for "XX", "DUAL" (selected), and "FULL".
- Spectral Setup Errors:** A section for displaying errors.
- Spectral Line:** Includes a help icon and a section for "Baseband-1".

Baseband-1 Table:

Fraction	Center Freq (Rest)	Center Freq (Sky)	Transition	Bandwidth, Resolution (smoothed)	Spec Avg.	Representative Window
1/2	88.63160 GHz	88.63160 GHz	HCN v=0 J=1...	117.188 MHz(396 km/s), 122.070 kHz(0.413 km/s)	1	<input checked="" type="radio"/>
1/2	89.18853 GHz	89.18853 GHz	HCO+ v=0 1-0	117.188 MHz(394 km/s), 122.070 kHz(0.410 km/s)	1	<input type="radio"/>

Below the table are buttons: "Select Lines to Observe in Baseband-1...", "Add", and "Delete".

Baseband-2: Includes a "Select Lines to Observe in Baseband-2..." button, "Add", and "Delete" buttons.

Baseband-3: An empty section for Baseband-3.

Spectral setup in the almaOT (EXAMPLE)

The screenshot shows the ALMA Observing Tool (Cycle3) interface. The main window is titled "ALMA Observing Tool (Cycle3-Patchtests2) - Project". The "Editors" panel is active, showing the "Spectral Setup" tab. The interface includes a "Project Structure" tree on the left, a "Spectral Setup Errors" section, and a table for defining spectral windows. A red circle highlights the "Baseband-2" section, and a red box highlights the text "the same for H¹³CO⁺".

In the table below, it is possible to define up to 16 spectral windows, 4 per baseband as long as the total Fraction per baseband is no more than 1. Each baseband is 2GHz wide and can be separately configured i.e. each spectral window can have a different bandwidth and resolution. Note that for bands 3, 4, 6, 7 and 8, it is not possible to put 3 basebands in one sideband and the fourth one in the other.

Spectral Type

Spectral Line
 Single Continuum
 Spectral Scan

Polarization products desired XX DUAL FULL

Spectral Setup Errors

Baseband	Fraction	Lines	Resolution	Spec Avg.	Representative Window
1/2				1	<input checked="" type="radio"/>
1/2	89.18853 GHz	89.18853 GHz H13CO+ v=0 1-0	117.188 MHz(394 km/s), 122.070 kHz(0.410 km/s)	1	<input type="radio"/>

Select Lines to Observe in Baseband-1... Add Delete

Baseband-2

1(Full)	86.75429 GHz	86.75429 GHz H13CO+ 1-0	58.304 MHz(207 km/s), 30.518 kHz(0.105 km/s)	1	<input type="radio"/>
---------	--------------	-------------------------	--	---	-----------------------

Select Lines to Observe in Baseband-2... Add Delete

Baseband-3

Spectral setup in the almaOT (EXAMPLE)

In the table below, it is possible to define up to 16 spectral windows, 4 per baseband as long as the total Fraction per baseband is no more than 1. Each baseband is 2GHz wide and can be separately configured i.e. each spectral window can have a different bandwidth and resolution. Note that for bands 3, 4, 6, 7 and 8, it is not possible to put 3 basebands in one sideband and the fourth one in the other.

Spectral Type

Spectral Type Spectral Line Single Continuum Spectral Scan

Polarization products desired XX DUAL FULL

Spectral Setup Errors

Spectral Line

Baseband-1

Fraction	Center Freq (Rest)	Center Freq (Sky)	Transition	Bandwidth, Resolution (smoothed)	Spec Avg.	Representative Window
1/2	88.63160 GHz	88.63160 GHz	HCN v=0 J=1...	117.188 MHz(396 km/s), 122.070 kHz(0.413 km/s)	1	<input checked="" type="radio"/>
1/2	89.18853 GHz	89.18853 GHz	HCO+ v=0 1-0	117.188 MHz(394 km/s), 122.070 kHz(0.410 km/s)	1	<input type="radio"/>

Select Lines to Observe in Baseband-1...

Baseband-2

1(Full)	86.75429 GHz	86.75429 GHz	H13CO+ 1-0	58.594 MHz(207 km/s), 30.518 kHz(0.105 km/s)	1	<input type="radio"/>
---------	--------------	--------------	------------	--	---	-----------------------

Select Lines to Observe in Baseband-2...

Baseband-3

HCN
HCO⁺

H¹³CO⁺

Spectral setup in the almaOT (EXAMPLE)

ALMA Observing Tool (Cycle3)

ALMA Observing Tool (Cycle3-Patchtests2) - Project

File Edit View Tool Search Help

Project Structure Editors

Proposal Program **Spectral** Spatial Spectral Setup

Unsubmitted Proposal

- Project
 - Proposal
 - Planned Observations
 - Science Goals
 - General
 - Field Set
 - Spectral
 - Calibration
 - Control
 - Technical

In the table below, it is possible to define up to 16 spectral windows, 4 per baseband as long as the total Fraction per baseband is no more than 1. Each baseband is 2GHz wide and can be separately configured i.e. each spectral window can have a different bandwidth and resolution. Note that for bands 3, 4, 6, 7 and 8, it is not possible to put 3 basebands in one sideband and the fourth one in the other.

Spectral Type [?]

Spectral Line
 Single Continuum
 Spectral Scan

Spectral Type

Polarization products desired XX DUAL FULL

Spectral Setup Errors

Spectral Line [?]

Baseband-1

Fraction	Center Freq (Rest)	Center Freq (Sky)	Transition	Bandwidth, Resolution (smoothed)	Spec Avg.	Representative Window
1/2	88.63160 GHz	88.63160 GHz	HCN v=0 J=1...	117.188 MHz(396 km/s), 122.070 kHz(0.413 km/s)	1	<input checked="" type="radio"/>
1/2	89.18853 GHz	89.18853 GHz	HCO+ v=0 1-0	117.188 MHz(394 km/s), 122.070 kHz(0.410 km/s)	1	<input type="radio"/>

Select Lines to Observe in Baseband-1...

Baseband-2

1(Full)	86.75429 GHz	86.75429 GHz	H13CO+ 1-0	58.594 MHz(707 km/s), 30.518 kHz(0.105 km/s)	1	<input type="radio"/>
---------	--------------	--------------	------------	--	---	-----------------------

Select Lines to Observe in Baseband-2...

Baseband-3

Spectral setup in the almaOT (EXAMPLE)

ALMA Observing Tool (Cycle3) Sun Mar 22 14:20 Alvaro Sanchez

ALMA Observing Tool (Cycle3-Patchtests2) - Project

File Edit View Tool Search Help Perspective 1

Project Structure: Unsubmitted Proposal, Project, Proposal, Planned Observations, Science Goals, General, Field Settings, Spectral, Calibration, Control, Technical

Editors: Spectral, Spatial, Spectral Setup

Visualisation

In the table below, it is possible to define up to 16 spectral windows, 4 per baseband as long as the total Fraction per baseband is no more than 1. Each baseband is 2GHz wide and can be separately configured i.e. each spectral window can have a different bandwidth and resolution. Note that for bands 3, 4, 6, 7 and 8, it is not possible to put 3 basebands in one sideband and the fourth one in the other.

Left/right click to zoom in/out, grab sliding bar to pan
Note: Moving LO1 here is for experimentation only - actual setup determined by the windows

Observed Frequency
Rest Frequency

100,000 200,000 300,000 400,000 500,000 600,000 700,000 800,000 900,000 1000,000

03 04 06 07 08 09 10

LO1
HCO+ v=0 1-0
HCN v=0 J=1-0
H13CO+ 1-0

Overlays: Receiver Bands Transmission Overlay Lines DSB Image [Select Lines to Overlay](#)

Water Vapour Column Density: Automatic Choice Manual Choice 5.186mm (7th Octile)

Viewport: [Pan to Line](#) [Zoom to Band](#) [Reset](#)

Spectral Type

Spectral Type: Spectral Line Single Continuum Spectral Scan

Polarization products desired: XX DUAL FULL

Spectral setup in the almaOT (EXAMPLE)

ALMA Observing Tool (Cycle3)

ALMA Observing Tool (Cycle3-Patchtests2) - Project

File Edit View Tool Search Help

Project Structure

Unsubmitted Proposal

Project

Proposal

Planned Observations

Science Goals

General

Field Setup

Spectral

Calibration

Control

Technical

Editors

Spectral Spatial Spectral Setup

Visualisation

In the table below, it is possible to define up to 16 spectral windows, 4 per baseband as long as the total Fraction per baseband is no more than 1. Each baseband is 2GHz wide and can be separately configured i.e. each spectral window can have a different bandwidth and resolution. Note that for bands 3, 4, 6, 7 and 8, it is not possible to put 3 basebands in one sideband and the fourth one in the other.

Left/right click to zoom in/out, grab sliding bar to pan
Note: Moving LO1 here is for experimentation only - actual setup determined by the windows

Observed Frequency

Rest Frequency

100,000 200,000 300,000 400,000 500,000 600,000 700,000 800,000 900,000 1000,000

03 04 06 07 08 09 10

LO1

HCO+ v=0 1-0

HCN v=0 J=1-0

H13CO+ 1-0

Overlays: Receiver Bands Transmission Overlay Lines DSB Image

Water Vapour Column Density: Automatic Choice Manual Choice 5.186mm (7th Octile)

Viewport:

Spectral Type

Spectral Line

Spectral Type Single Continuum Spectral Scan

Polarization products desired XX DUAL FULL

Spectral setup in the almaOT (EXAMPLE)

ALMA Observing Tool (Cycle3)

ALMA Observing Tool (Cycle3-Patchtests2) - Project

File Edit View Tool Search Help

Project Structure

- Unsubmitted Proposal
 - Project
 - Proposal
 - Planned Observations
 - Science Goals
 - General
 - Field Set
 - Spectral
 - Calibration
 - Control
 - Technical

Editors

Spectral Spatial Spectral Setup

Visualisation

In the table below, it is possible to define up to 16 spectral windows, 4 per baseband as long as the total Fraction per baseband is no more than 1. Each baseband is 2GHz wide and can be separately configured i.e. each spectral window can have a different bandwidth and resolution. Note that for bands 3, 4, 6, 7 and 8, it is not possible to put 3 basebands in one sideband and the fourth one in the other.

Left/right click to zoom in/out, grab sliding bar to pan
Note: Moving LO1 here is for experimentation only - actual setup determined by the windows

Observed Frequency

Rest Frequency

Overlays: Receiver Bands Transmission Overlay Lines DSB Image [Select Lines to Overlay](#)

Water Vapour Column Density: Automatic Choice Manual Choice 5.186mm (7th Octile)

Viewport: [Pan to Line](#) [Zoom to Band](#) [Reset](#)

Spectral Type

Spectral Type Spectral Line Single Continuum Spectral Scan

Polarization products desired XX DUAL FULL

Break #2

German ARC: ALMA community days (March 2015)