# **Frequently Asked Questions**

# AM, EL, JB Italian ARC, Tutorial per ALMA Cycle 2 21 November 2013, Bologna

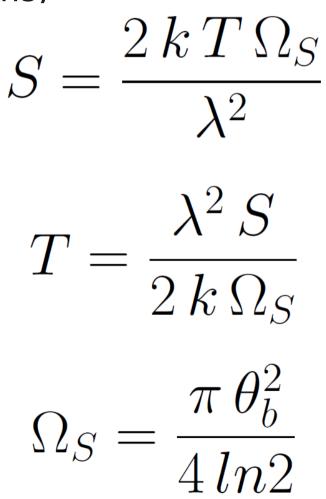
# AIM

- Provide tips to fill in the Observing Tool Fields
  - Field Setup: expected source properties
    - Peak continuum flux density per beam
    - Peak line flux density per beam
  - Control and performance
    - Largest angular scale
    - Use of ACA
  - Spectral line issues

Shortest baseline (L <sub>min</sub> ) 0.041 km	0.014 km
Maximum recoverable scale (0.6\lambda/L <sub>min</sub> ) 3.045 arcsec	8.716 arcsec
Desired Performance	
Desired Angular Resolution	3.00000 arcsec 🗸
argest Angular Structure in source	○ Point Source
Desired sensitivity per pointing	0.01000 Jy 🗸 equivalent 0.01510 K
andwidth used for Sensitivity	User Frequency With 25.00000 km/s
Oo you request complementary ACA Observations?	⊖ Yes   ● No Suggest
cience goal integration time estimate	Time Estimate

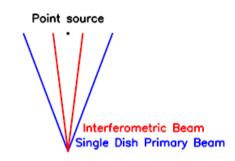
# Flux and Brightness Temperature

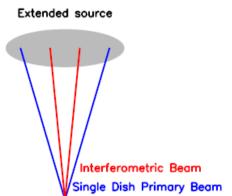
- Temperature and Fluxes (Rayleigh-Jeans)
  - S = Flux density (Jy, Jy per beam)
  - T = brightness temperature (K)
  - k Boltzmann constant
  - $\Omega_s$  solid angle (steradian)
  - $\theta_{\rm b}$  HPBW of a gaussian

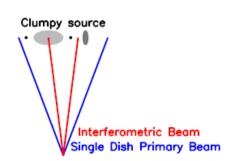


# **Peak Flux estimation**

- From observations at different resolution
  - Point source:
    - Flux (Jy or Jy/beam) independent of the Beam
    - $T(K) \propto 1/BeamSize^2$
  - Extended uniform source
    - T independant of the beam
    - Flux (Jy /beam)  $\propto$  BeamSize<sup>2</sup>
      - [if brightness is uniform over the source]
    - Largest recoverable angular scale !
      - Flux loss because a part extended emission is filtered out by the interferometer
  - Fragmented/Clumpy source
    - Number of clumps, size, relative strength, positions ?

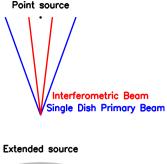


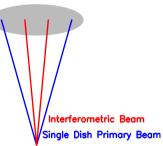




# Peak Flux estimation single dish vs. interferometry

From Single Dish (10") to Interferometry (1")
 T<sub>mb</sub> = 1 K in 10" @ 300 GHz
 Flux = 7.36 Jy in 10" @ 300 GHz





## Point source

- Flux is constant!  $F_{int} = F_{SD}$
- $T_{int} = T_{SD}^* (Beam_{SD}^{}/Beam_{int}^{})^2$ 
  - F = 7.36 Jy/beam
  - T<sub>MB</sub>= 100K

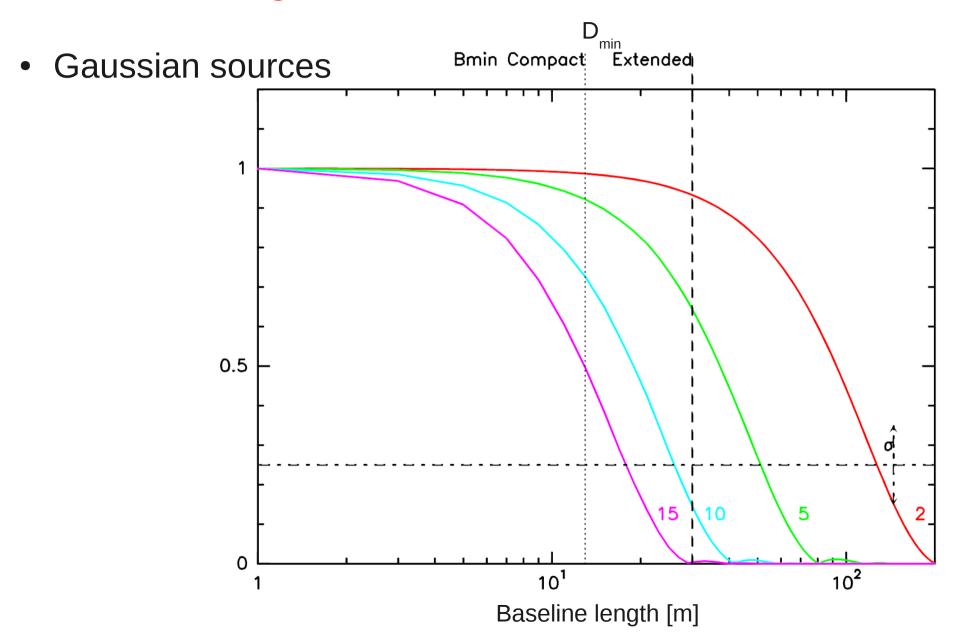
- Extended (uniform) source
  - T is constant

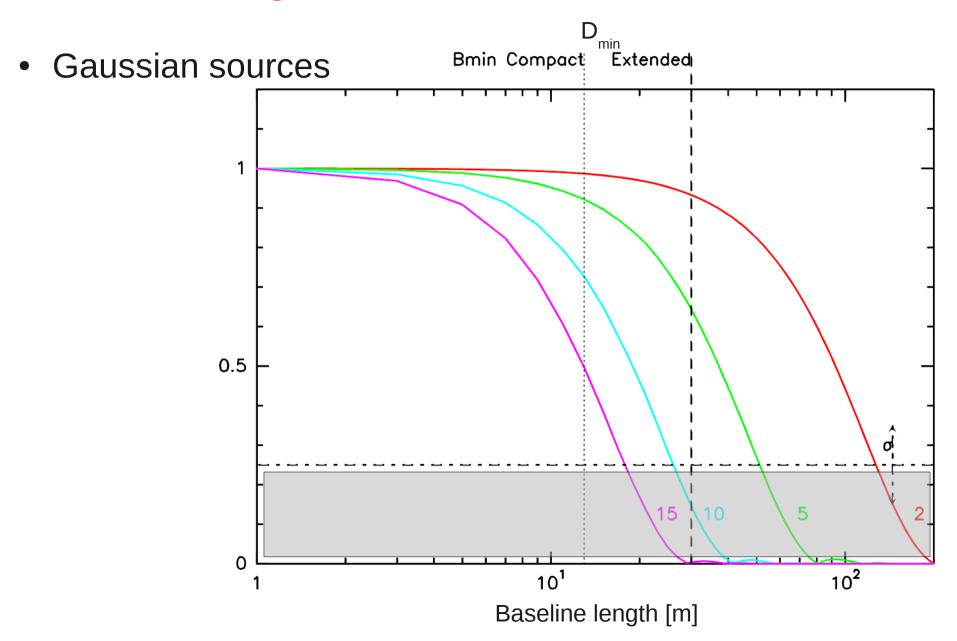
• 
$$F_{int} = F_{SD}^{*}(Beam_{int}/Beam_{SD})^{2}$$

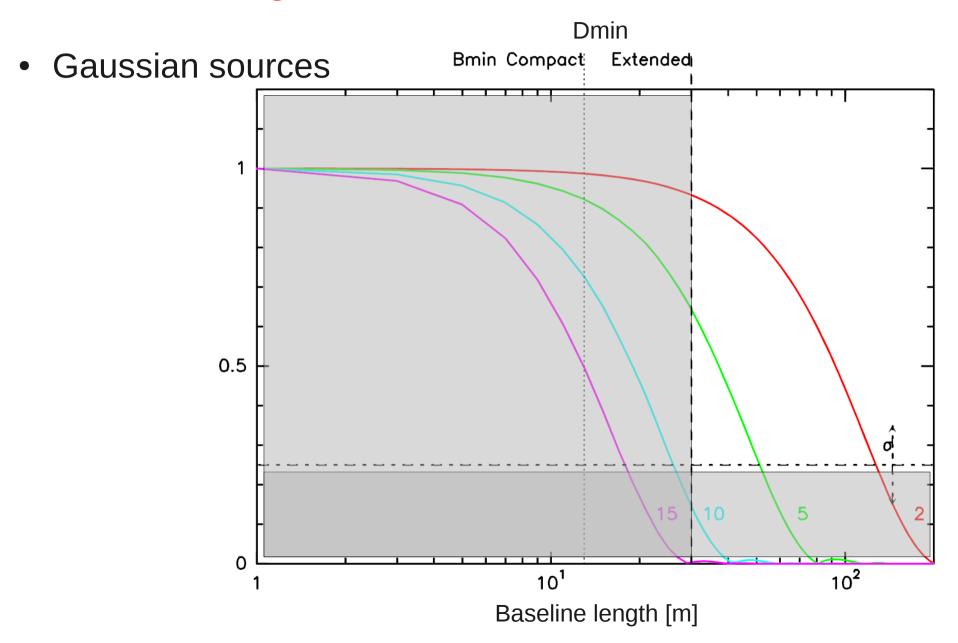
- F = 0.0736 Jy/beam
- !! Largest recoverable scale !!

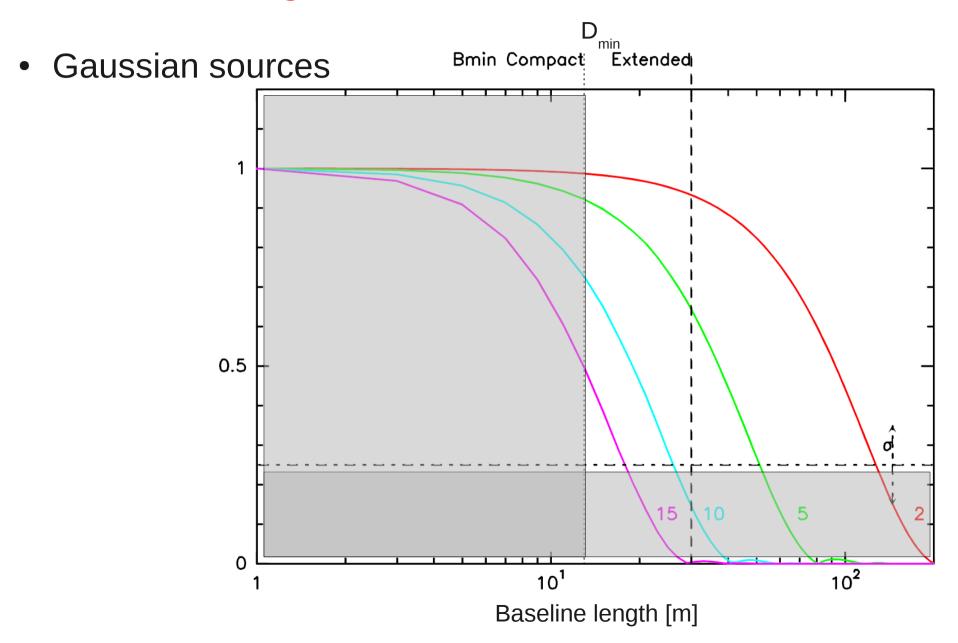
2 different assumptions lead to a factor 10000 in exp time!

- Baselines > antenna size
  - Short spacing are missing in interferometry
  - Filtering of large scale emission
- LRS [ $^{\prime}$ ] = 37200/D<sub>min</sub>[m]/v[GHz]
- ALMA (Main Array) Cycle 2 at 300 GHz
  - Compact configurations LRS ~ 7-8"
  - Most extended configurations LRS ~ 2-3"

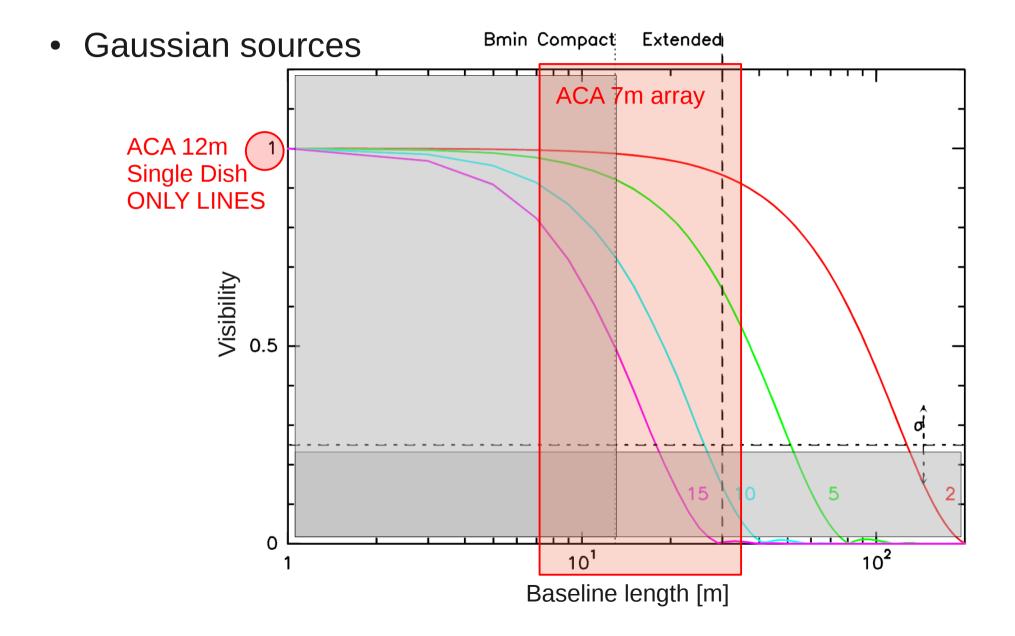








# Largest recoverable scale and ACA



# Largest Recoverable Scale and ACA

Gaussian sources at 300GHz<sup>Compact</sup> Extended

• FWHM 10" (total flux ~14Jy)

Config.	Beam "	Peak Flux Jy/beam	Total Flux Jy
1	1.4 x 1.3	0.36	~3
2	0.9 x 0.8	0.10	~1.5
4	0.6 x 0.4	0.009	~0.5
6	0.5 x 0.25	0	<0.01
ACA alone	5.8 x 5.5	5.7	~10

• FWHM 3" (total flux ~1.2 Jy)

Ocufin	Beam	Peak Flux	Total Flux
Config.		Jy/beam	Jy
1	1.4 x 1.3	0.42	~1.2
2	0.9 x 0.8	0.2	~1.1
4	0.6 x 0.4	0.05	~0.5
6	0.5 x 0.25	0.008	~0.1
ACA alone	5.8 x 5.5	1.13	~1.2

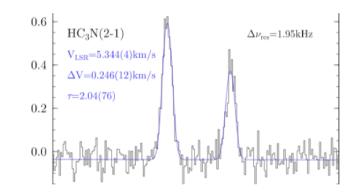
ALMA cycle 2:

-ACA cannot be directely combined with most extended config ! (More than 12 Main Array config needed) -ACA alone cannot be requested

# Spectral lines issues

- Gaussian profile
  - Area(Jy kms<sup>-1</sup>), FWHM (kms<sup>-1</sup>) → Flux Peak (Jy)
    - SN on the peak

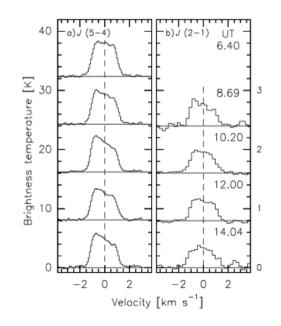
$$rms(Jy) = \frac{Area(Jy \cdot kms^{-1})}{FWHM(kms^{-1}) \cdot SN}$$



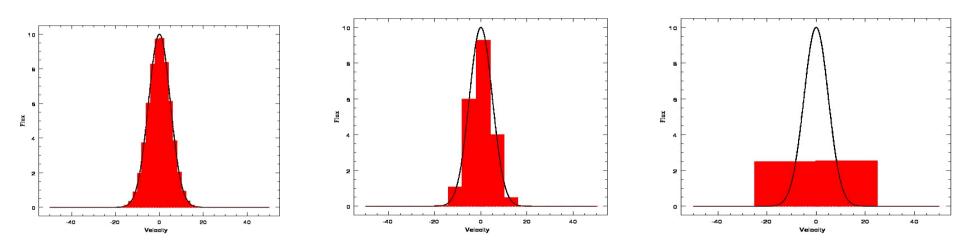
Undefinied Profile

- SN on the area (>SN on the peak)

$$rms(Jy) = \frac{Area(Jy \cdot kms^{-1})}{N_{chan}^{1/2} \cdot \Delta v(kms^{-1}) \cdot SN}$$



 Peak Flux doesn't depend on channel spacing (when FWHM > chan width)



Sensitivity depends on channel spacing

$$\Delta S \propto \frac{T_{sys}}{D^2 \left[ n_p N (N-1) \Delta v \Delta t \right]^{1/2}} W m^{-2} H z^{-1}$$

... and now a practical example

## Resolve at high frequency the continuum and molecular gas in a distant (z=2,3) lensed starburst galaxy: Cosmic Eyelash

- New ALMA observations in band 7 (312 GHz): CO (9-8) + continuum
- Previous observations:

Ext = 5 arcsec

SMA at 850 µm (Band 7) continuum:

Angular resolution:  $\theta_{_{SMA}}$ =0.2 "

Multiple components

Source angular size = 5 "

LAS = 1"

S(tot)=86 mJy

f.c= 6 mJy= 3 rms

# **Before you propose**

- A science case
- Source coordinates, radial velocity, proper motion
- Observing frequency, bandwidth, spectral resolution
- Angular resolution and LAS
- Required sensitivity
- Dynamic range

# Resolve the continuum and molecular gas in distant lensed starburst galaxy

- Previous observations: CO(3-2) with SMA, resol. ~
- Receivers: Band 7 (CO(9-8) + continuum)
- Angular resolution: 0.3 arcsec to resolve components detected by SMA.
   ACA is not needed.
- Spectral resolution: TDM --> one sideband for CO(9-8) + 3 for continuum
- Spectral sensitivity: CO(9-8) peak flux density is expected 10 mJy,

S/N~20 at the peak in 100 km/s is required

- --> rms= 0.5 mJy for line emission
  - --> average channels
    - --> rms = 70 µJy for continuum

--> S/N>15 (1 mJy continuum emission expected)

## Resolve at high frequency the continuum and molecular gas in a distant lensed starburst galaxy: Cosmic Eyelash

- New ALMA observations in band 7 (350 GHz): CO (9-8) + continuum
- Previous observations:

Ext = 5 arcsec

SMA at 850  $\mu m$  (Band 7):

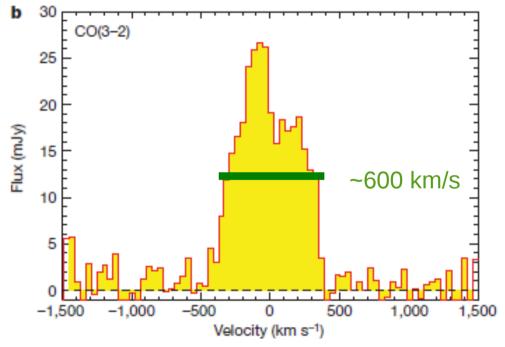
Angular resolution:  $\theta_{SMA} = 0.2$  " Multiple components Source angular size = 5 "

LAS = 1"

## Resolve at high frequency the continuum and molecular gas in a distant (z=2,3) lensed starburst galaxy: Cosmic Eyelash

#### Previous observations:

PdB at 104.5 GHz (Band 3):CO(3-2)



#### **Gaussian Profile**

**FWHM**[CO(3-2)]= 600 km s<sup>-1</sup>

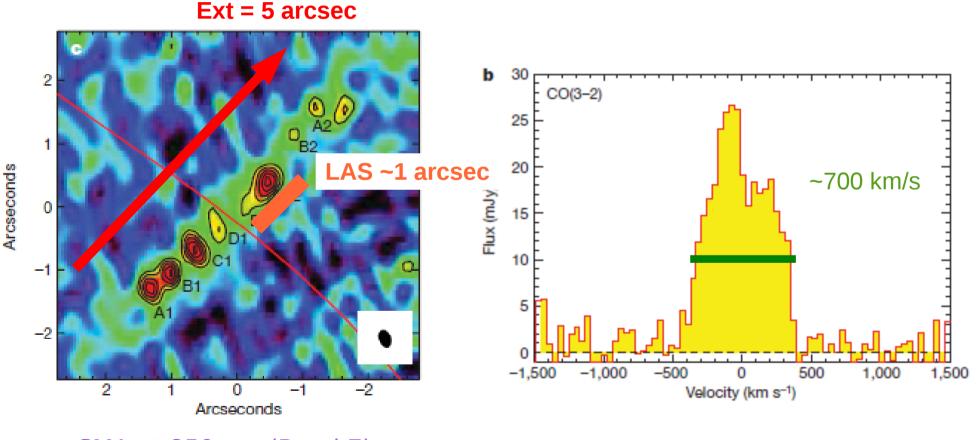
**F**[CO(3-2)]**=** 13.8 Jy km s<sup>-1</sup>

 $F_{peak}[CO(3-2)] = F[CO(3-2)] / FWHM[CO(3-2)] = 23 mJy$ 

Angular resolution:  $\theta_{PdBI} = 1$  "

## Resolve at high frequency the continuum and molecular gas in a distant lensed starburst galaxy: Cosmic Eyelash

Previous observations:



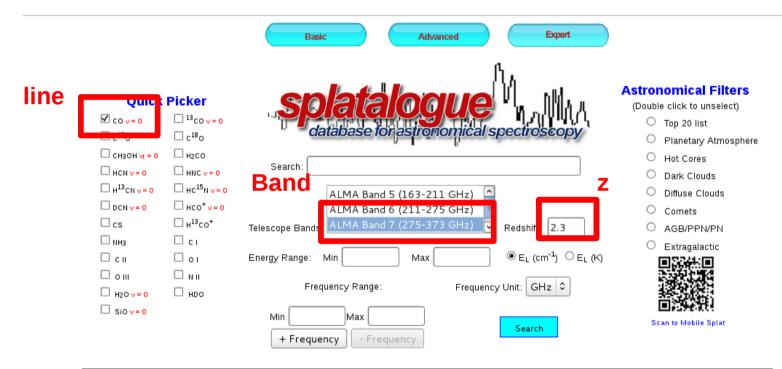
SMA at 850 µm (Band 7): 0.2 arcsec of resolution, S=86 mJy

f.c=6 mJy

PdB at 104.5 GHz (Band 3): CO(3-2)

## Which CO line at given z and band?

http://www.cv.nrao.edu/php/splat/



Found 1 lines in ALMA Band 3 (84-116 GHz), showing 1 - 1 Click on the chemical formula below for more information about that species.						
Chemical Name	Ordered Freq (GHz) (rest frame_redshifted)	Resolved QNs	CDMS/JPL Intensity	Lovas/AST Intensity	E <sub>L</sub> (cm <sup>-1</sup> )	Linelist

	Ivanie	(reschanc, reusiniteu)		intensity	intensity		
<u>CO v = 0</u>	Carbon Monoxide	345.79599, 104.78666	3-2	0.00000	70.00	11.53500	SLAIM

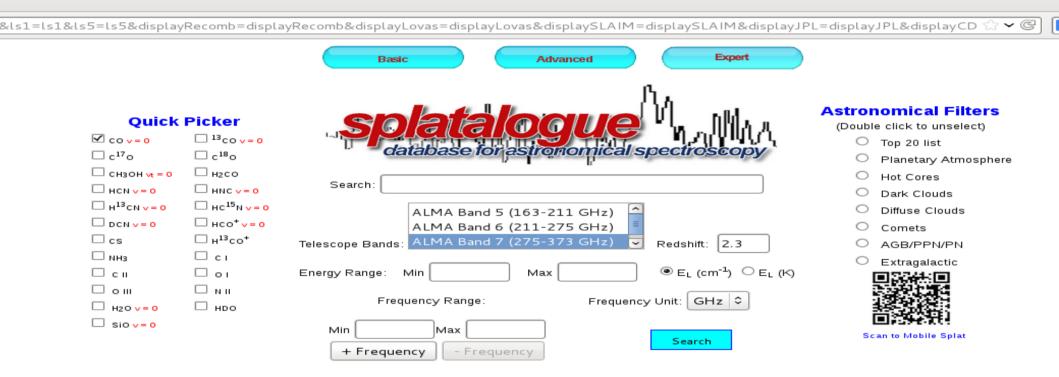
Species

1

Found 1 lines in ALMA Band 3 (84-116 GHz), showing 1 - 1

Query took 0 seconds							
Export current fields							
Export current fields without Resolved QNs							
O Export CASA fields							
Field Separator	Range						
● Tab	All Records						
○ Colon	O Current Page						
Export	_						

### Which CO line at given z and band?



Found 3 lines	in ALMA	Band 7	(275-373 GHz),	showing	1 - 3
r ound 5 lines	IT ALMA	Dalia /	(275-575 GHZ),	, showing .	T - O

Species	Chemical Name	Ordered Freq (GHz) (rest frame, <mark>redshifted</mark> )	Resolved QNs	CDMS/JPL Intensity	Lovas/AST Intensity	E <sub>L</sub> (cm <sup>-1</sup> )	Linelist
CO v = 0	Carbon Monoxide	921.79970, 279.33324	8-7	0.00000		107.64200	SLAIM
CO v = 0	Carbon Monoxide	1036.91239, 314.21587	9-8	0.00000	17.5	138.39000	SLAIM
CO v = 0	Carbon Monoxide	1151.98544, 349.08650	10-9	0.00000		172.97800	SLAIM
			Band 7 (275 272 CHa)				
		Earlind 2 lines in Al LU	Band 7 /97E 979 / Usi	bouring 1 - 2			
		Qi	uery took 0 seconds		7		
		Export current fields					
		Export current fields	without Resolved QNs				
		Export CASA fields					
Field Separator Range							
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				5			

Export

## New ALMA observations in band 7 (312 GHz): CO (9-8) + continuum in 1 SG

#### 1 baseband for CO (9-8) + 3 basebands for continuum

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Project - Observing Tool for ALMA, version Cycle2

× Perspective 1

🖾 Elisabetta Liuzzo

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Editors Spectral Spa	atial Spectral Setup	1		
Visualisation	spectral setup			, , , , , , , , , , , , , , , , , , ,
	Each base Note that Left/right	eband is 2GHz wide and can for bands 3, 4, 6, 7 and 8, i click to zoom in/out, grab sliv	be separately configu t is not possible to pu ding bar to pan	windows, 4 per baseband as long as the total Fraction per baseband is no more than 1. ured i.e. each spectral window can have a different bandwidth and resolution. It 3 basebands in one sideband and the fourth one in the other.
		- ·	-	
	, 00 <sup>00</sup>	, , ,295,00 , , , ,	300100	Observed Frequency         305100         310100         315100         320100         1           00
				LO1
	960,00	980100	1000.00	
				Rest Frequency
		Overlays:		✓ Transmission Overlay Lines ✓ DSB Image Select Lines to Overlay
		Water Vapour Column Densi	ty:  Automatic Choic	e 🔾 Manual Choice 0.913mm (3rd Octile) 🧹
		Viewport:	Pan to Line	Zoom to Band Reset
Spectral Type				
			Spectral Typ	Spectral Line     O Single Continuum
				○ Spectral Scan
			<b>X</b> -	
			Polarization	products desired 🔾 XX 🖲 DUAL 🔿 FULL
Spectral Setup	Errors			
Spectral Line				? -
Baseband-1	Cont. 5	Combo 5		
Fraction	Center Freq (Rest)	Center Freq (Sky)	Transition	Bandwidth, Resolution (smoothed) Spec. Representative Avg. Window
1(Full)	1032.90000 GHz	313.00000 GHz c	ntinuum	2000.000 MHz( 1796 km/s), 31.250 MHz(29.931 km/s)
Select Lines	to Observe in Baseban	d-1 Add Dele	te	
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	litors								
) ( S	Spectral Spatial Spectral Setup	-							
	Polarization products desired 🔾 XX 💿 DUAL 🔿 FULL								
	Spectral Setup Errors								
8 -	- Spectral Line								
	· Baseband-1	? -							
	Eraction Conter From Conter From Space								
-	Flaction     Center Freq (Rest)     Center Freq (Sky)     Transition     Bandwidth, Resolution (smoothed)     Age     Representative Avg.       1 [Full)     1032.90000 GHz     313.00000 GHz     continuum     2000.000 MHz(1796 km/s), 31.250 MHz(29.931 km/s)     1     Image: Continuum								
-									
	Select Lines to Observe in Baseband-1 Add Delete								
2 L _	Baseband-2								
	1(Full) 1036.91239 GHz 314.21587 GHz CO v=0 9-8 2000.000 MHz(1789 km/s), 31.250 MHz(29.816 km/s) 1								
	Select Lines to Observe in Baseband-2 Add Delete								
	Baseband-3								
	1(Full) 993.30000 GHz 301.00000 GHz continuum 2000.000 MHz(1867 km/s), 31.250 MHz(31.125 km/s) 1								
	Select Lines to Observe in Baseband-3 Add Delete								
	Baseband-4								
	1 (Full) 996.60000 GHz 302.00000 GHz continuum 2000.000 MHz(1861 km/s), 31.250 MHz(31.022 km/s) 1 O								
	Select Lines to Observe in Baseband-4 Add Delete								
	Representative Frequency								
	The representative frequency is used in conjunction with the sensitivity entered on the 'Control and Performance' page to estimate the required observing time and to set the size of the antenna beam shown in the 'Spatial Visual' editor. If the transition you are most interested in does								
	not fall in the centre of the chosen spectral window, its frequency can be changed here. The sky equivalents of the representative frequency are								
	shown in the targets table below.								
	1036.91238 GHz 💌								
T]	argets								
		?							
10000000									

Phase I: Science Proposal

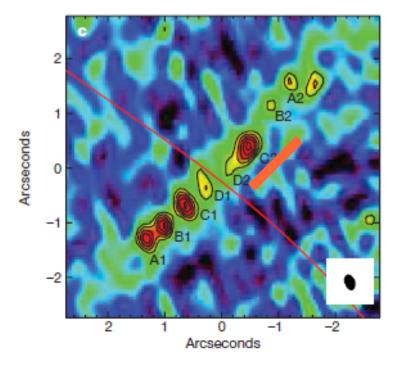
## Resolve at high frequency the continuum and molecular gas in a distant (z=2,3) lensed starburst galaxy: Cosmic Eyelash

New ALMA observations in band 7 (350 GHz): CO (9-8) + continuum

#### Required angular resolution?

In band 7, ALMA allows 0.13 – 1.19 '' -->e.g. ask  $\theta_{ALMA} \sim \theta_{SMA} = 0.2$  "

MRS permitted is 2,9 arcsec for the extended config and 8,3 arcsec for the most compact configuration --> LAS **estimated** is 1 arcsec < MRS from SMA continuum image  $\rightarrow$  ok, no ACA!



SMA Band 7 continuum

θ<sub>SMA</sub>=0.2 "

LAS ~1 arcsec

## Resolve at high frequency the continuum and molecular gas in a distant lensed starburst galaxy: Cosmic Eyelash

New ALMA observations in band 7 (350 GHz): CO (9-8) + continuum

#### Required angular resolution?

In band 7, ALMA allows 0.13 – 1.19 '' -->e.g. ask  $\theta_{ALMA} \sim \theta_{SMA} = 0.2$  "

MRS permitted is 2,9 arcsec for the extended config and 8,3 arcsec for the most compact configuration --> LAS **estimated** is 1 arcsec from SMA continuum image  $\rightarrow$  ok no ACA!

#### Required sensitivity?

- for CO(9-8) line and continuum observations;

- Do estimations on CO(9-8) profile,  $\mathbf{F}_{[CO(9-8)]}$  or  $\mathbf{F}_{peak}^{[CO(9-8)]}$ , FWHM and morphology (resolved, unresolved, N components, components size, etc), SN, spectral resolution, continuum emission of the faintest component.

## Resolve at high frequency the continuum and molecular gas in a distant lensed starburst galaxy: Cosmic Eyelash

- Required sensitivity for CO(9-8) line?
  - If you **know/assume** CO(9-8) gaussian profile
  - If you know/assume CO(3-2)/CO(9-8) = 2.5, derive F[co(9-8)] = F[co(3-2)]/(2.5) = 5.52 Jy km s<sup>-1</sup>
  - If you **know/assume** derive  $FWHM[co(9-8)] \sim FWHM[co(3-2)] = 600 \text{ km s}^{-1}$ FWHM[co(9-8)] = F[co(9-8)] / FWHM[co(9-8)] = 9.2 mJy
  - if you request

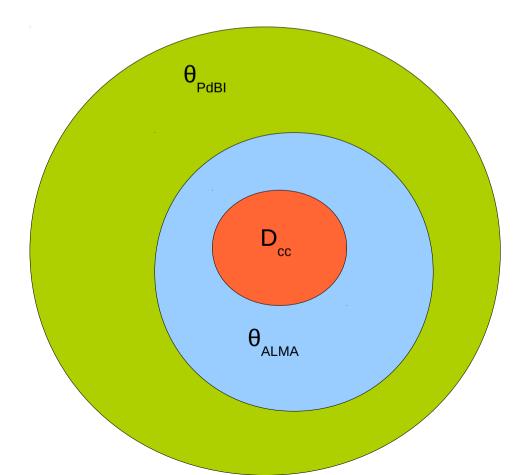
SN=20

Using the estimations: CO(9-8) **gaussian profile**, F[co(9-8)] = 5.52 Jy km s<sup>-1</sup>,  $F_{peak}[co(9-8)] = 9.2$  mJy, and requesting SN=20...

#### ...which morphology you know/assume??

- source unresolved in PdBI data and it will be **unresolved** with  $\theta_{_{ALMA}} \sim 0.2$  "

--> rms = F<sub>peak</sub>[CO(9-8)] / SN~0.5 mJy



Using the estimations: CO(9-8) **gaussian profile**, F[co(9-8)] = 0.92 Jy km s<sup>-1</sup>,  $F_{peak}[co(9-8)] = 9.2$  mJy, and requesting SN=20

#### ...what morphology you assume??

- source unresolved in PdBI data and it will be **resolved** with  $\theta_{ALMA} \sim 0.2$  " in: **1** component with angular size  $\mathbf{D}_{cc} \sim \mathbf{\theta}_{PdBL}$  and uniformly distributed in  $\mathbf{D}_{cc}$ --> rms = F<sub>peak</sub>[co(9-8)]\* R<sub>1</sub> / SN ~ 0.02 mJy where  $\mathbf{R}_{1} = (\theta_{ALMA} / \theta_{PdBI})^{2} = (0.2/1)^{2}$ θ<sub>PdBI</sub>  $\theta_{ALMA}$ 

Using the estimations: CO(9-8) **gaussian profile**, F[co(9-8)] = 0.92 Jy km s<sup>-1</sup>,  $F_{peak}[co(9-8)] = 9.2$  mJy, and requesting SN = 20

#### ...what morphology you assume??

- sourceunresolved in PdBI data and it will be **resolved** with  $\theta_{ALMA} \sim 0.2$  " in: **1** component with angular size  $\mathbf{D}_{cc} \sim \mathbf{\theta}_{PdBl}$  and uniformly distributed in  $\mathbf{D}_{cc}$ --> rms = F<sub>peak</sub>[co(9-8)]\* R<sub>1</sub> / SN ~ 0.02 mJy where  $\mathbf{R}_{1} = (\theta_{ALMA} / \theta_{PdBI})^{2} = (0.2/1)^{2}$ θ<sub>PdBI</sub> D<sub>cc</sub>  $\theta_{ALMA}$ 

Using the estimations: CO(9-8) **gaussian profile**, F[co(9-8)] = 0.92 Jy km s<sup>-1</sup>,  $F_{peak}[co(9-8)] = 9.2$  mJy, and requesting SN=20

#### ...what morphology you assume??

- source unresolved in PdBI data and it will be **resolved** with  $\theta_{ALMA} \sim 0.2$  " in: **1** component with angular size  $\mathbf{D}_{cc} \sim \mathbf{\theta}_{PdBL}$  and uniformly distributed in  $\mathbf{D}_{cc}$ --> rms = F<sub>peak</sub>[CO(9-8)]\* R<sub>1</sub> / SN ~ 0.02 mJy where  $\mathbf{R}_{1} = (\theta_{ALMA} / \theta_{PdBI})^{2} = (0.2/1)^{2}$  $\sim \theta_{PdBI}$ θ . ALMA

Using the estimations: CO(9-8) gaussian profile, F[CO(9-8)] = 0.92 Jy km s<sup>-1</sup>,  $F_{max}[CO(9-8)] = 9.2$  mJy, and requesting SN=20

#### ...what morphology you assume??

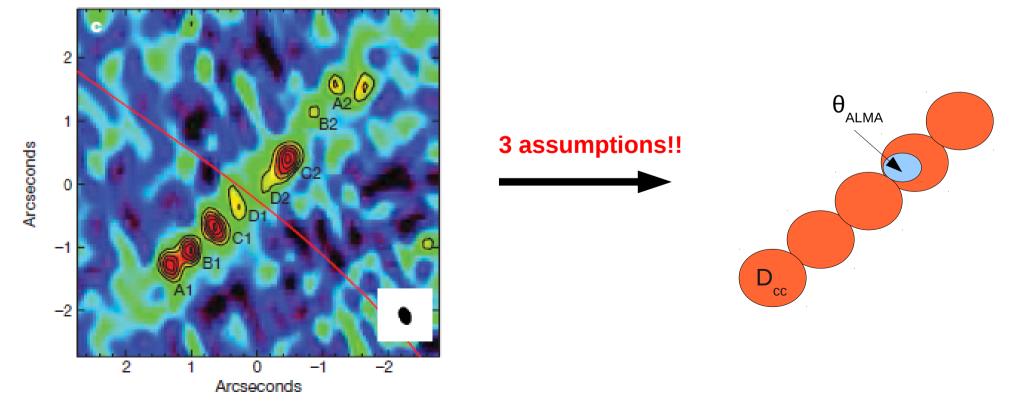
- source resolved in PdBI data and it will be **resolved** with  $\theta_{AIMA} \sim 0.2$  " in

**N** components with angular size  $\mathbf{D}_{cc} > \mathbf{\theta}_{ALMA}$ 

(From SMA data, **assumptions**: 1) CO(9-8) traces the continuum --> N = 5, 2) the estimated CO(9-8) flux is equally and uniformly distributed among them, 3) mean  $D_{cc} = 0.8$  ")

$$rms = (F_{peak}[CO(9-8)]/N) * R_N / SN \sim 0.006 mJy$$

where 
$$R_{N} = (\theta_{ALMA} / D_{cc})^{2} = (0.2/0.8)^{2}$$



Using the estimations: CO(9-8) gaussian profile, F[CO(9-8)] = 0.92 Jy km s<sup>-1</sup>,  $F_{peak}[CO(9-8)] = 9.2$  mJy, and requesting SN=20

#### What morphology you assume??

- source unresolved in PdBI data that will be **unresolved** with  $\theta_{ALMA} \sim 0.2$  "

 $--> rms = F_{peak}[CO(9-8)] / SN \sim 0.5 mJy$ 

- source unresolved in PdBI data that will be **resolved** with  $\theta_{ALMA} \sim 0.2$  " in: 1 component with angular size  $\mathbf{D}_{cc} \sim \theta_{PdBI}$  and uniformly distributed in  $\mathbf{D}_{cc}$ 

--> rms = 
$$F_{peak}[co(9-8)]^* R_1 / SN \sim 0.02 mJy$$
  
where  $R_1 = (\theta_{ALMA} / \theta_{PdBI})^2 = (0.2/1)^2$ 

- source resolved in PdBI data that will be **resolved** with  $\theta_{ALMA} \sim 0.2$  " in **N** components with angular size  $D_{cc} > \theta_{ALMA}$ 

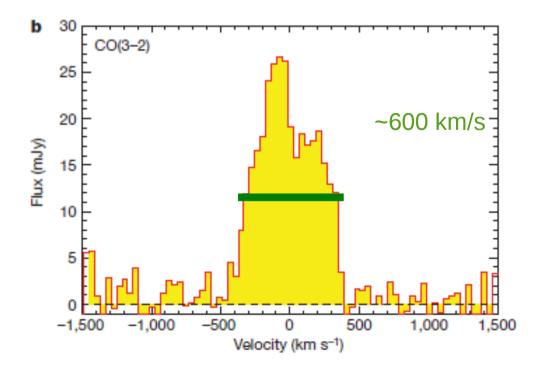
(From SMA data, **assumptions**: 1) CO(9-8) traces the continuum --> N = 5, 2) the emission line flux is equally and uniformly distributed among them, 3) mean  $D_{cc} = 0.8$  ")

rms = 
$$(F_{peak}[co(9-8)]/N) * R_N / SN ~ 0.006 mJy$$
  
where  $R_N = (\theta_{ALMA} / D_{cc})^2 = (0.2/0.8)^2$ 

## Resolve at high frequency the continuum and molecular gas in a distant lensed starburst galaxy: Cosmic Eyelash

#### bandwidth used for line sensitivity

- How many times do you want to sample the line width?
  - $\rightarrow$  it depends on your SG: mapping, kinematics, ...
  - $\rightarrow$  it depends on your estimated/known FWHM
  - $\rightarrow$  integration time on source to achieve the requested rms changes



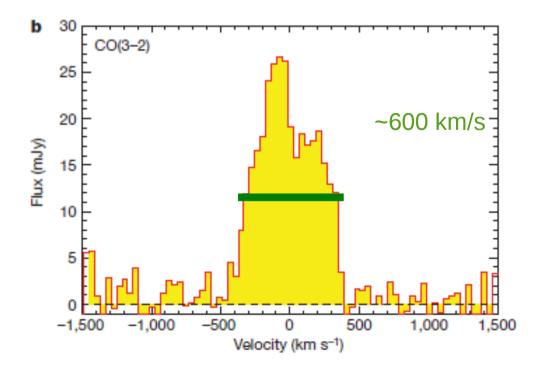
If you need 6 points  $\rightarrow$  100 km /s bandwidth

€ Ř	Editors						
	Spectral Spatial Control and Performa	nce					
	These parameters are used to control vario	es.					
	Control and Performance					?	
	Configuration Information					1	
	Antenna Beamsize(1.2 *λ/D)	12m 19.680 arcsec	7m 33.737 arcs	ec			
	Number of Antennas	12m 34	7m 9	TP 2			
00000		Most extended 12m configura	ation Most compact	12m configuration			
	Longest baseline (L <sub>max</sub> )	1.508 km	0.166 km				
	Synthesized beamsize ( $\lambda/L_{max}$ )	0.131 arcsec	1.188 arcsec				
	Shortest baseline (L <sub>min</sub> )	0.041 km	0.014 km				
	Maximum recoverable scale (0.6\/L <sub>min</sub> )	) 2.908 arcsec	8.322 arcsec				
	Desired Performance						Dequired rms
	Desired Angular Resolution	0.2	0000 arcsec	-			Required rms →
	Desired Angular Resolution	0.2					<b>1st case assumed</b>
	Largest Angular Structure in source	0	oint Source 🖲 Extende	d Source 1.00000	arcsec 🔻		
	Desired sensitivity per pointing	0.5	0000 mjy 👻 equ	ivalent to 0.15480	К		
8							
	Bandwidth used for Sensitivity	Use	r	<ul> <li>Frequency</li> </ul>	Width 100.00000	⟨m/s 🔽	
000000	Do you request complementary ACA Observa	ations?	∕es	uggest			
					٦	×.	
	Science goal integration time estimate			Time Estimate			
	Is more time required due to u,v coverage is	ssues? (must be justified) $igodot$ '	∕es ◉ No				
100000							
	Are the observations time-constrained?	0	′es 🖲 No				

## Resolve at high frequency the continuum and molecular gas in a distant (z=2,3) lensed starburst galaxy: Cosmic Eyelash

#### bandwidth used for line sensitivity

- How many times do you want to sample the line width?
  - $\rightarrow$  it depends on your SG: mapping, kinematics, ...
  - $\rightarrow$  it depends on your estimated/known FWHM
  - $\rightarrow$  integration time on source to achieve the requested rms changes



If you need 6 points  $\rightarrow$  100 km /s bandwidth

... for the continuum emission

 $\rightarrow$  in our case with 3 basebands

 $\rightarrow$  aggregate bandwidth --> ~6 GHz

	Fri 16:30	<ul><li>↔</li></ul>	🖾 Elisabetta Liu:
Project	- Observing Tool for ALMA, version Cycle2		
			Perspect
ditors			
Spectral Spatial Spectral Setup			
Visualisation			3
Each bas	ble 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 t seband is 2GHz wide and can be separately configured i.e. each spectral window can have a different bandwidth and resolution. at 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.	han l.	L
	t click to zoom in/out, grab sliding bar to pan oving LO1 here is for experimentation only - actual setup determined by the windows		
، ەەرە	Observed Frequency 1 295،00 , 300،00 , 305،00 , 310،00 , 310،00 , 315،00 , 320،00 , 320،00 , 320،00	07	
		07	
	<u>continuum</u>		
960100			
	Overlays: 🖉 Receiver Bands 🗹 Transmission 🗌 Overlay Lines 🗹 DSB Image 🛛 Select Lines to Overlay		
	Water Vapour Column Density: 🖲 Automatic Choice 🔾 Manual Choice 0.913mm (3rd Octile) 🤜		
	Viewport: Pan to Line Zoom to Band Reset		
Spectral Type			? -
	Spectral Line		
	Spectral Type 🛛 Single Continuum		
	Spectral Scan		
	Polarization products desired 🔾 XX 💿 DUAL 🔿 FULL		
Spectral Setup Errors			
Spectral Line			? -
Baseband-1 Fraction Center Freq	Center Freq	Spec.	Representative
(Rest) 1(Full) 1032.90000 GHz	Center Freq (Sky)         Transition         Bandwidth, Resolution (smoothed)           313.00000 GHz         continuum         2000.000 MHz(1796 km/s), 31.250 MHz(29.931 km/s)         1	Ávg.	Window
1032.90000 0H2	313.00000 GH2 [CONTINUUM [2000.000 MH2(1796 km/s), 31.230 MH2(29.931 km/s)]		
Select Lines to Observe in Baseba	nd-1 Add Delete		

## Resolve at high frequency the continuum and molecular gas in a distant (z=2,3) lensed starburst galaxy: Cosmic Eyelash

- New ALMA observations in band 7 (312 GHz): CO (9-8) + continuum
- Previous observations:

Arcseconds

2 1 LAS ~1 arcsec -1 -2 2 -2 Arcseconds

Ext = 5 arcsec

Angular resolution: θ<sub>SMA</sub>=0.2 "
Multiple components
Source angular size = 5 "
LAS = 1"
S(tot)=86 mJy
f.c= 6 mJy
--> if requested 6 times deeper observ
--> 1mJy peak flux density required

SMA at 850 µm (Band 7) continuum:

Editors		
Spectral Spatial Technical Justificat	tion	
Enter a Technical Justification for this So	cience Goal, paying special attention to the parameters	rs reproduced below.
Relevant science parameters		
		?
Sensitivity	0.50 mJy Angular Resolution	0.20 arcsec
Bandwidth for sensitivity	104.81 MHz Largest angular structure	1.00 arcsec
Representative frequency	314.22 GHz ACA	No
Expected source properties		
Continuum:		
Aggregate bandwidth	5.97 GHz Sensitivity	0.07 mJy
Peak flux density	1.00 mJy SNR	15.09
Line:		
Peak flux density	10.00 mJy SNR	20.00
Line width	400.00 km/s Resolutions per FWHM	13
Dynamic Range (cont. peak/line rms)	2.00	
Non-standard choices		
Field setup:		
Spectral Setup:		
Calibration:		
Control and Performance:		
Justification text (max 4000 characters)		
Justineation text (max rece character)		
Launch Editor		

Project - Observing Tool for ALMA, version Cycle2

Perspective

🔂 🐠 🖾 Elisabetta Liuzz

pectral   Spatial	Control and Performance	s, including the require	d antenna configurations and integration times.
ontrol and Perform	· · · · · · · · · · · · · · · · · · ·		
			?
Configuration Inform			
Antenna	ALMA OT - Information	×	C
Number 🚺	Estimated time		TP 2 2m configuration
Longest	Requested sensitivity	0.5000 mJy	Zm conliguration
	Bandwidth used for sensitivity	100.000 km/s	
Synthesi	Representative frequency (sky, first source)	314.22 GHz	
Shortest	Precipitable water vapour (all sources)	0.913mm (3rd Octile)	
Maximun	ALMA 12m Array - 34 antennas		
	Time on source per pointing (first source)	12.13 min	
Decired Pertil	Total number of pointings (all sources)	1	
esired Angul	Estimated number of tunings required	1	-
, i i i i i i i i i i i i i i i i i i i	Total time on source	- 12.13 min	
argest Angul	Total time on calibrators	19.08 min	Source 1.00000 arcsec 👻
	Total overheads	13.76 min	
esired sensi	Total 12m array time (inc. calibration & overheads)	44.97 min	alent to 0.15480 K 👻
andwidth us	Calibration Breakdown		Frequency Width 100.00000 km/s 🗸
	1 x SidebandRatio	1.68 min	
Do you reque:	3 x Pointing	54.00 s	ggest
	1 x Amplitude (inc. AtmosphericCal)	3.27 min	ggest
Science goal i	1 x Bandpass (inc. AtmosphericCal)	5.77 min	Time Estimate
	2 x Phase (inc. AtmosphericCal)	4.53 min	
Is more time r	1 x Delay	1.60 min	
	2 x Atmospheric	1.33 min	
Are the obser	Additional calibration overheads	8.13 min	
	Estimated total time for science goal	44.97 min	
	<b>OK</b>		

A. 7.

Phase I: Science Proposal