ALMA Cycle 10 Proposal Preparation Workshop

Presented by Allegro Fellows

Aida Ahmadi
Ashley Bemis
Alex Hygate
Andrés Pérez-Sánchez

EUROPEAN ARC
ALMA Regional Centre || Allegro

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ALMA Cycle 10

- ALMA Science portal:
  - https://almascience.eso.org/
- Proposers guide:
  - https://almascience.eso.org/proposing/proposers-guide#c10cap
- Technical handbook:
  - https://almascience.eso.org/documents-and-tools/cycle10/alma-technical-handbook

Planned 12-m Array, cycle 10 **configuration schedule**

Start date	Configuration	Longest baseline	LST for best observing conditions
2023 October 1	C-8	8.5 km	~ 22—10 h
2023 October 20	C-7	3.6 km	~ 23—11 h
2023 November 10	C-6	2.5 km	~ 1—13 h
2023 December 1	C-5	1.4 km	~ 2—14 h
2023 December 20	C-4	0.78 km	~ 4—15 h
2024 January 10	C-3	0.50 km	~ 5—17 h
2024 February 1	*No observations due to maintenance*		
2024 March 1	C-1	0.16 km	~ 8—21 h
2024 March 26	C-2	0.31 km	~ 9—23 h
2024 April 20	C-3	0.50 km	~ 11—0 h
2024 May 10	C-4	0.78 km	~ 12—2 h
2024 May 31	C-5	1.4 km	~ 13—4 h
2024 June 23	C-6	2.5 km	~ 15—6 h
2024 July 28	C-5	1.4 km	~ 17—7 h
2024 August 18	C-4	0.78 km	~ 19—8 h
2024 September 10	C-3	0.50 km	~ 20—9 h

Table 3: Planned 12-m Array Configuration Schedule for Cycle 10. Configuration properties are given in Section A.2.

Observing time available for the different array configurations.

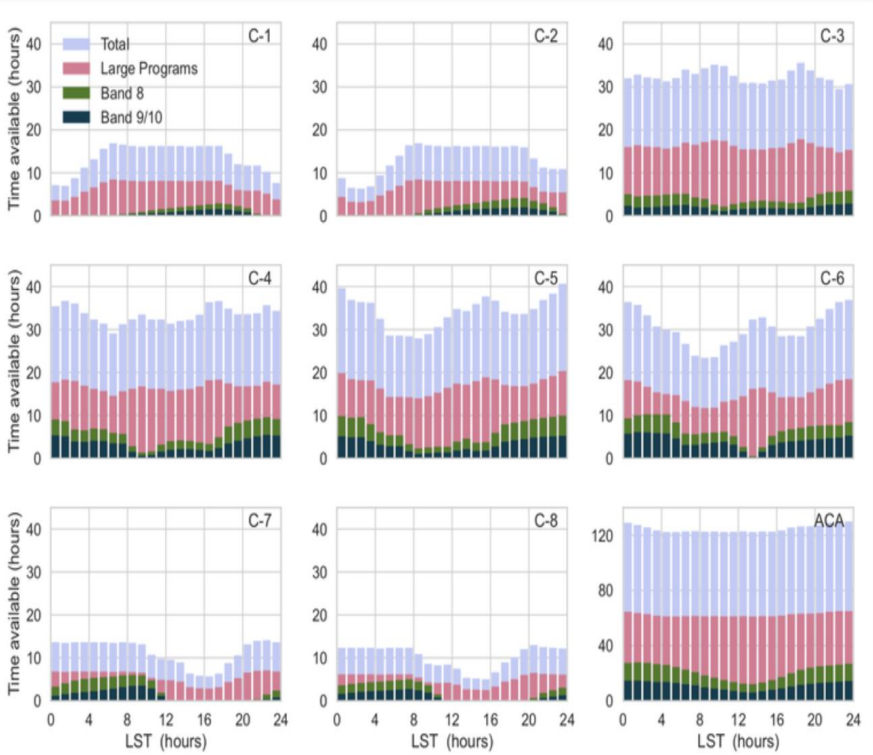


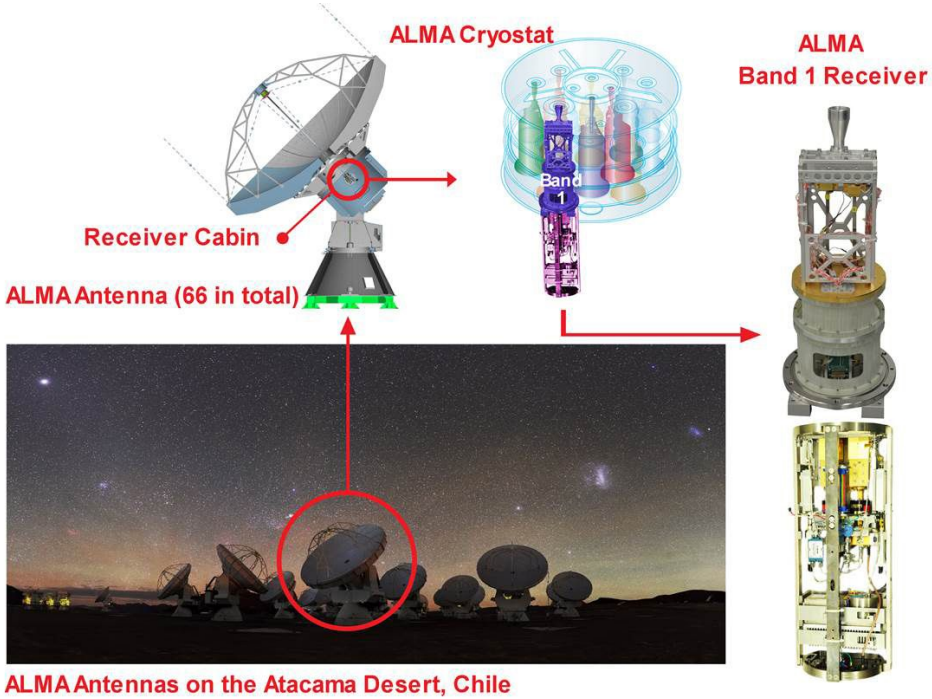
Figure 5: Estimated observing time available per configuration for executing PI projects, based on precipitable water vapor (PWV) only. For example, approximately 30 hours are expected to be available in C-4 at LST 05 h for all observations and up to 15 hours of those may be allocated to Large Programs. The time available for Large Programs is shown in pink and time for high-frequency observations in green and dark blue. The configuration schedule and, consequently, the total number of hours available per configuration may change in response to proposal pressure (Section 4.3.3). The data files containing these histograms are available here.

Cycle 10 new capabilities

- **Band 1** on the 12-m Array and for Stokes I only (no Stokes Q/U/V), anticipated to be available **from March 2024.**
- **Spectral scans** with the Total Power array. (**B1, B3-B8**)
- **4x4-bit spectral modes** for improved sensitivity on the 12-m Array (dual polarization).
- **Solar observations in full polarization** in Band 3 using only the 12-m Array. (C-1 & C-4)
- **Phased array mode** in Bands 1, 3, 6 and 7 (the total time available for this mode is expected to be capped at approximately 50 hours).
- **VLBI in Bands 1, 3, 6 and 7,** including flexible tuning for spectral lines.
- **Band-to-Band mode** is possible for **high frequencies** with the 12-m and ACA. (B7 - B10)

New in Cycle 10: ALMA Band 1

- Frequency range 35-50 GHz
- Access to sources in the southern hemisphere at high sensitivity, high resolution



Credit: ASIAA/NAOJ/ESO/S. Guisard

ALMA Band 1

- Anticipated from March 2024:
  - Configs 1 - 6
  - Only Stokes I
  - Only 12m
- **Future:** observations with multiple arrays (e.g. ACA+12m)

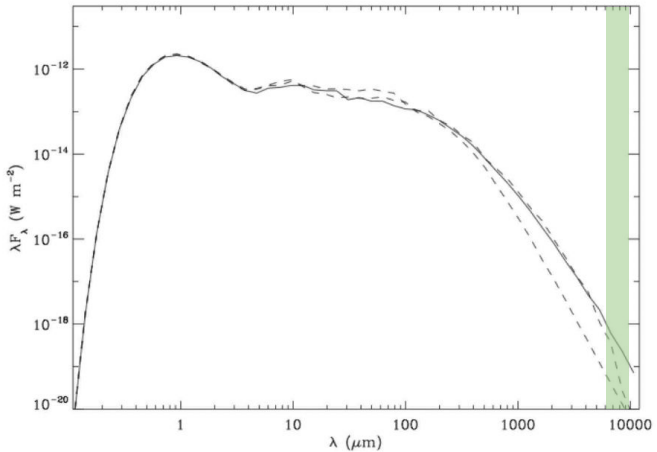
Start Date	Config.	Longest baseline	LST: Best
2024 March 1	C-1	0.16 km (~8.45")	~ 8—21 h
2024 March 26	C-2	0.31 km (~5.75")	~ 9—23 h
2024 April 20	C-3	0.50 km (~3.55")	~ 11—0 h
2024 May 10	C-4	0.78 km (~2.30")	~ 12—2 h
2024 May 31	C-5	1.4 km (~1.38")	~ 13—4 h
2024 June 23	C-6	2.5 km (~0.78")	~ 15—6 h
2024 July 28	C-5	1.4 km	~ 17—7 h
2024 August 18	C-4	0.78 km	~ 19—8 h
2024 September 10	C-3	0.50 km	~ 20—9 h

See ALMA Cycle 10 Proposer's Guide for full schedule

Two Main Science Goals of Band 1 (Di Francesco+2013, arxiv:1310.1604)

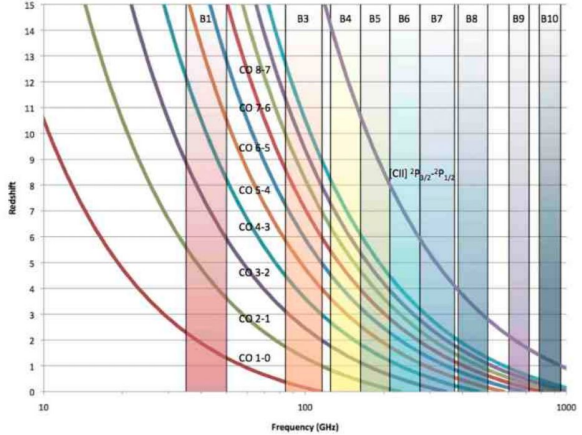
I: Evolution of Grains in Disks Around Stars

- Coverage of 6-8.5mm, crucial for studying grain grown to ~1 cm size
- Can study the coagulation processes of dust grains to centimeter sizes in protoplanetary disks



II: Molecular gas in galaxies during the era of re-ionization

- Will allow for the detection of molecular gas from high-redshift galaxies (6 < z < 10)
- Can get CO 2-1 out to z~6 with B1, compared to z<2 with B3

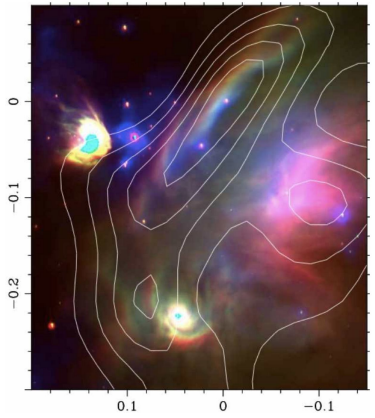


Science Cases for Band 1 Receiver: Continuum

(Di Francesco+2013, arxiv:1310.1604)

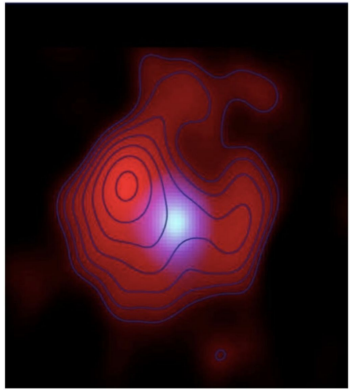
- The Sunyaev-Zel'dovich Effect
- Very Small Grains and Spinning Dust
- Jets from Young Stars
- Spatial and Flaring Studies of Sgr A*
- Acceleration Sites in Solar Flares
- Pulsar Wind Nebulae
- Radio Supernovae
- X-ray Binaries

Also see Huang+2016, arxiv: 1612.00893



rho-Oph W PDR (Casassus et al. 2008)

31 GHz emission contoured on IR



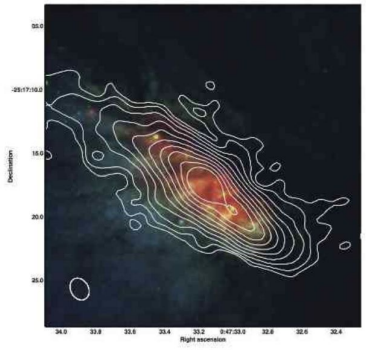
SNR 1986J
5GHz emission

Science Cases for Band 1 Receiver: Spectral Line

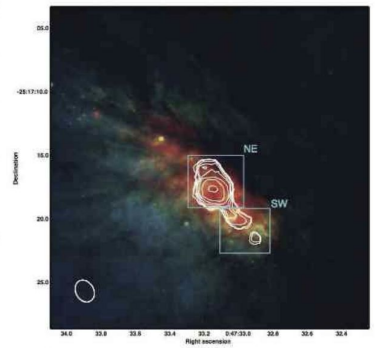
(Di Francesco+2013, arxiv:1310.1604)

- Fine Structure of Chemical Differentiation in Cloud Cores
- Complex Carbon Chain Molecules
- Radio Recombination Lines
- Maser Science
- Magnetic Field Strengths from Zeeman Measurements
- Molecular Outflows from Young Stars
- Co-Evolution of Star Formation and Active Galactic Nuclei
- The Molecular Gas Content of Star-Forming Galaxies at z ~ 2

Also see Huang+2016, arxiv: 1612.00893

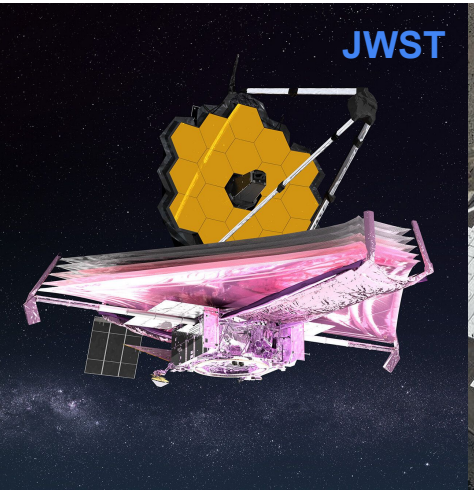


NGC 253
1cm cont.



NGC 253
RRL H58α

Joint Proposals



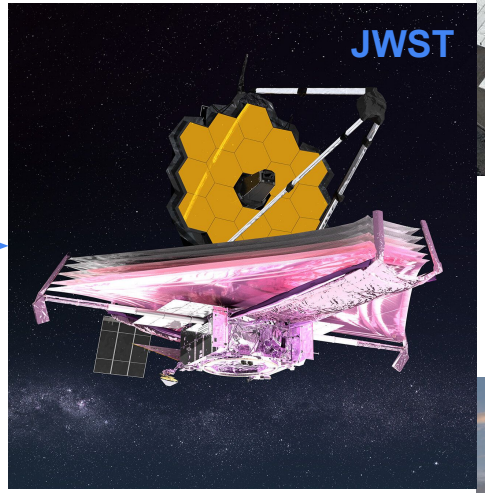
Credit: NASA GSFC/CIL/Adriana Manrique Gutierrez

Credit: ESO/G.Hüdepohl(atacamaphoto.com)

Credit: NRAO/AUI/NSF

Bilateral agreements

Credit: ESO/C. Malin (christophmalin.com)



Credit: NASA GSFC/CIL/Adriana Manrique Gutierrez

Credit: ESO/G.Hüdepohl(atacamaphoto.com)

Credit: NRAO/AUI/NSF

Why submit a joint proposal?

To answer a question that requires multiple telescopes

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To answer a question that requires multiple telescopes

From the ALMA proposer's guide: "The intent of Joint Proposals is to facilitate programs that require observations from multiple facilities to achieve the stated science aims, and the need for the requested data must be described in the Scientific Justification."

Where to submit?

1) ALMA is the longest time -> submit to ALMA

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2) Partner observatory is the longest time -> submit to partner observatory
   - JWST
   - VLA
   - VLT

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2) Partner observatory is the longest time -> submit to partner observatory
   - JWST
   - VLA
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Available time at partner observatories

Partner	Maximum time ALMA can allocate on partner observatory
JWST	115 hours
VLA	5% of available time
VLT	50 hours

Restrictions

- No restrictions on ALMA proposals when ALMA in the main observatory
- But note that partner observatories have their own restrictions

Example proposals

ALMA	JWST	VLA	VLT
10 hours	1 hour		

ALMA is the longest time -> submit to ALMA

Example proposals

ALMA	JWST	VLA	VLT
2 hours	12 hours		

JWST is the longest time -> submit to the next JWST call

Example proposals

ALMA	JWST	VLA	VLT
40 hours	1 hour	3 hours	4 hours

ALMA is the longest time -> submit to ALMA

Example proposals

ALMA	JWST	VLA	VLT
60 hours	3 hours		

No restrictions on ALMA setup -> submit to ALMA

Example proposals

ALMA	JWST	VLA	VLT
1 hour	1 hour	20 hours	5 hours

Not possible! -> refactor your proposal

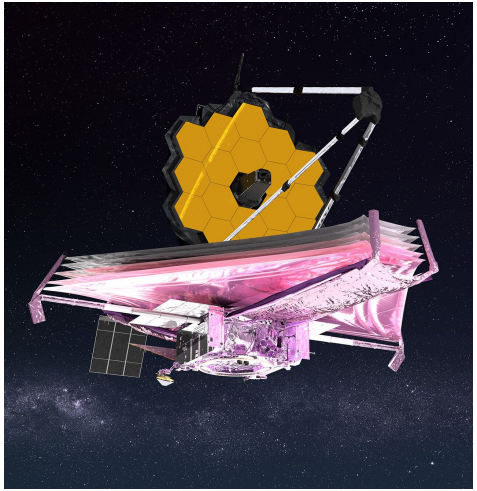
Example proposals

ALMA	JWST	VLA	VLT
100 hours			60 hours

Not possible! -> ALMA can only allocate 50 hours of VLT time

JWST

- JWST exposure time calculator: https://jwst.etc.stsci.edu/
- ALMA proposer's guide
- JWST helpdesk: https://stsci.service-now.com/jwst
- Joint proposals requesting JWST time may request standard JWST observing modes.



Credit: NASA GSFC/CIL/Adriana Manrique Gutierrez

VLA

- VLA exposure time calculator: https://obs.vla.nrao.edu/ect/
- ALMA proposer's guide
- NRAO helpdesk: https://help.nrao.edu/
- Proposers should familiarize themselves with the Guide to Proposing for the VLA

Credit: NRAO/AUI/NSF

VLT

- ESO exposure time calculator: https://www.eso.org/observing/etc/
- ALMA proposer's guide
- ESO helpdesk: https://support.eso.org/
- Joint proposals requiring VLT time will comply with the ESO policies and Call for Proposals
- Only Service Mode observations

Credit: ESO/G.Hüdepohl(atacamaphoto.com)

Technical justification

- Make sure to include the requested technical justification for the partner observatory/observatories!
- You must demonstrate that the partner observatory observing has been correctly planned
- Consult the guidance in the ALMA proposer's guide

JWST -Technical justification

- **Overall experimental design of the program, justifying the selection of instruments, modes, exposure times, and any constraints.**

- **Special Observational Requirements (if any):**

- **Justification of Coordinated Parallels (if any):**

- **Justification of Duplications (if any):**

JWST -Technical justification

- **Overall experimental design of the program, justifying the selection of instruments, modes, exposure times, and any constraints.**
  - The Technical Justification must describe how the observations contribute to the goals described in the scientific justification. Proposals must provide quantitative estimates of the accuracy required to achieve key science goals. The JWST ETC generally provides sufficient information to determine the necessary exposure time. For modes that require target acquisition, proposers should verify that the exposure specifications provided meet the stated criteria for success. Successful target acquisitions are crucial for the success of the specified observations, and must be verified. The description should also include the following:
- **Special Observational Requirements (if any):**
  - Justify any special scheduling requirements, including time-critical observations. Target of Opportunity observations should estimate the probability of occurrence during Cycle 2, specify whether long-term status is requested, identify whether ToOs are disruptive or ultra-disruptive, and state clearly how soon JWST must begin observing after the formal activation.
- **Justification of Coordinated Parallels (if any):**
  - Proposals that include coordinated parallel observations should provide a scientific justification for and description of the parallel observations. It should be clearly indicated whether the parallel observations are essential to the interpretation of the primary observations or the science program as a whole, or whether they address partly or completely unrelated issues. The parallel observations are subject to scientific review, and can be rejected even if the primary observations are approved.
- **Justification of Duplications (if any):**
  - as detailed in the JWST Duplicate Observations Policy. Any duplicate observations must be explicitly justified.

VLA -Technical justification

- **Justify the requested array configuration(s) and justifying the required angular resolution and largest angular scale.**
- **A description of the frequency selection.**
- **A description of the time request**
- **A description of the choice of samplers and the correlator set-up(s) requested.**
- **A description of the observing strategy.**

VLA -Technical justification

- **Justify the requested array configuration(s) and justifying the required angular resolution and largest angular scale.**
- **A description of the frequency selection.**
  - If the observations involve spectral lines, the rest frequency or sky frequency (for lines with significant redshift) should be provided.
- **A description of the time request**
  - (specifying both the on-source and total time, including overhead). If multiple array configurations are requested, the time request should be separated by configuration. The time request should be justified in terms of the required sensitivity and the appropriate observing bandwidth, describing how the sensitivity is necessary to achieve the science goals and if the resulting data will be limited by sensitivity or dynamic range.
- **A description of the choice of samplers and the correlator set-up(s) requested.**
  - For spectral line observations also provide and justify details such as the channel widths and number of channels per sub-band. For pulsar binning observations, explain how the number of bins selected is sufficient to achieve the project's goals; also verify that the frequency resolution is sufficient to avoid excessive dispersive smearing.
- **A description of the observing strategy.**
  - If the observations require mosaicking, the Technical Justification should describe the observing strategy (e.g., pointed, on-the-fly mapping) and the mosaic size. If sub-arrays are requested, the sub-arrays should be described (e.g., number of sub-arrays, numbers of antennas in each sub-array, observing setup for each sub-array).

VLT -Technical justification

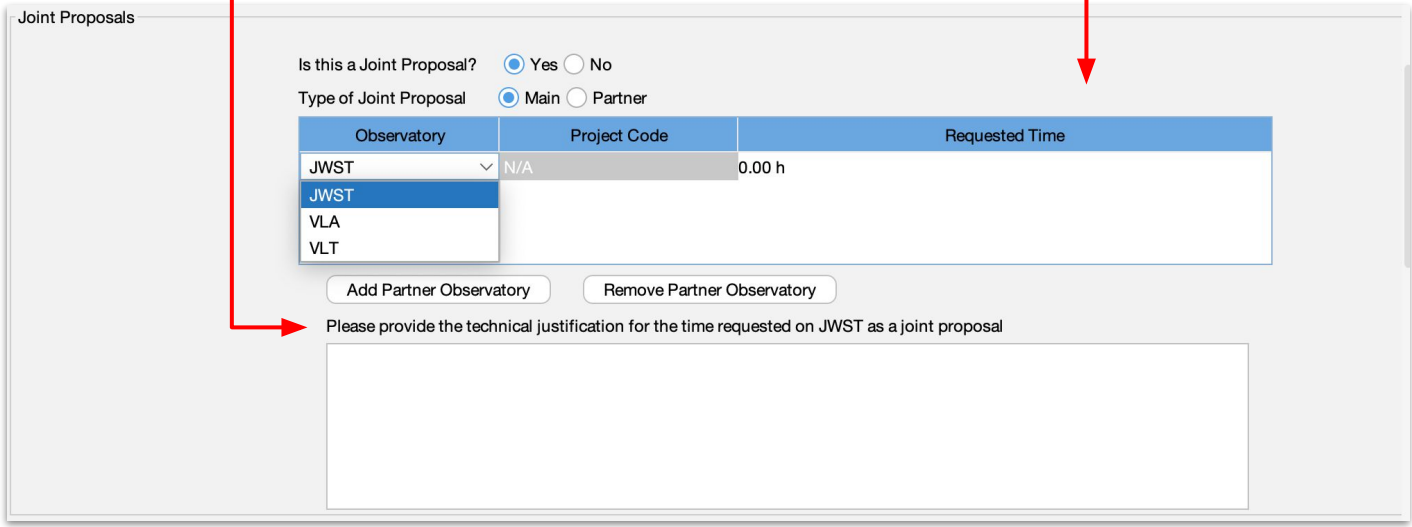
- **The number and type(s) of targets** (stars, extended sources, etc.)
- **The apparent magnitudes of targets** in appropriate/relevant filter bands
- **Instrument(s) and mode(s) requested**
- **Constraints on the observing conditions**
  - including, lunar phase, sky transparency, and seeing, with justifications for the constraints (see the ESO Phase 2 Observing conditions: definitions page for additional information)
    Any time critical aspects (e.g., monitoring or requirements for an absolute time window)
- **Justification for the total observing time request, including all overheads and a description of the parameters used in the ETC.**
- **Special calibration requests** not covered by standard instrument calibration plans

Joint Proposal Resources

- **Proposer's guide** section 3.5 Joint Proposals: https://almascience.eso.org/proposing/proposers-guide#autotoc-item-autotoc-17
- **Partner observatories**
  - JWST: https://jwst-docs.stsci.edu/jwst-opportunities-and-policies/jwst-call-for-proposals-for-cycle-2/jwst-proposal-categories#JWSTProposalCategories-jointjwstalmaproposalsJointJWST-ALMAObservingProposals
  - VLA: https://science.nrao.edu/observing/call-for-proposals/2023b/new-opportunity-joint-observations-with-alma
  - VLT: https://www.eso.org/sci/observing/phase1/JointVLT-ALMA.html
- **Exposure time calculators**
  - JWST: https://jwst.etc.stsci.edu/
  - VLA: https://obs.vla.nrao.edu/ect/
  - VLT: https://www.eso.org/observing/etc/
- **Helpdesks**
  - JWST helpdesk: https://stsci.service-now.com/jwst
  - ESO (VLT) helpdesk: https://support.eso.org/
  - NRAO (VLA) helpdesk: https://help.nrao.edu/

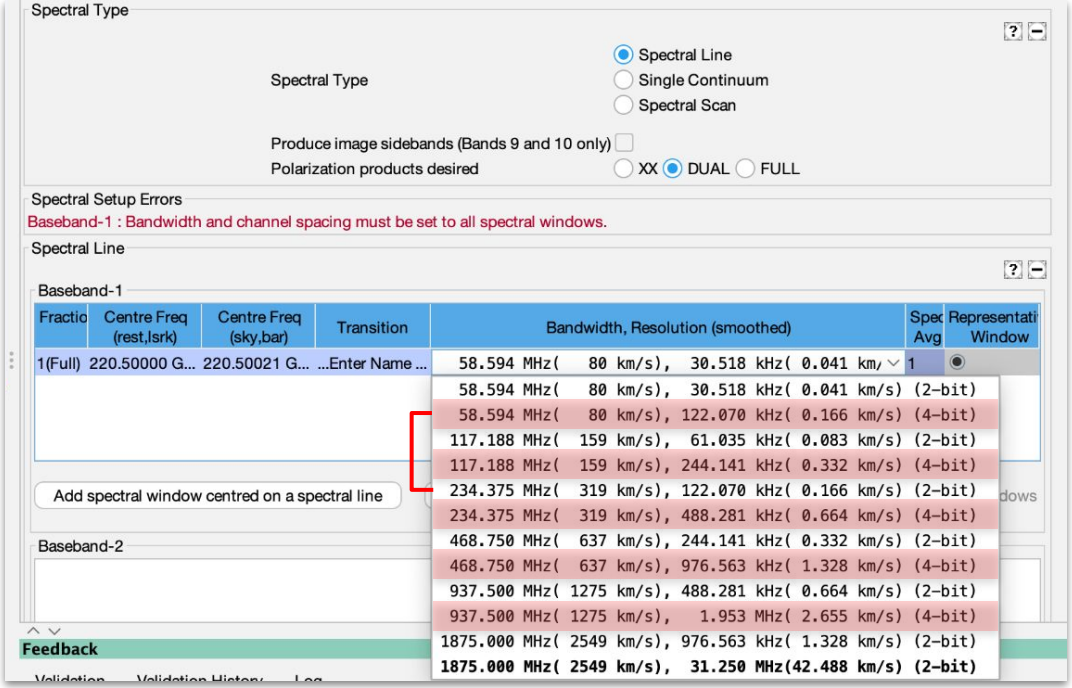
New in Cycle 10 Observing Tool

- **Joint proposals** with JWST, VLA, and/or VLT can be selected under the ‘Proposal’ node
- The requested time for observations with partner observatories must be added
- Technical justifications for the requested observations with the partner observatory needs to be summarised



New in Cycle 10 Observing Tool

- **4-bit spectral modes** available for 12-m array for dual-polarization
  - Improves sensitivity or increases efficiency
  - Loss of bandwidth for the same spectral resolution
- Can have a mix of 2-bit and 4-bit basebands
- A baseband can only have one 4-bit spectral window
- The ACA correlator does **not** have 4-bit mode



New in Cycle 10 Observing Tool

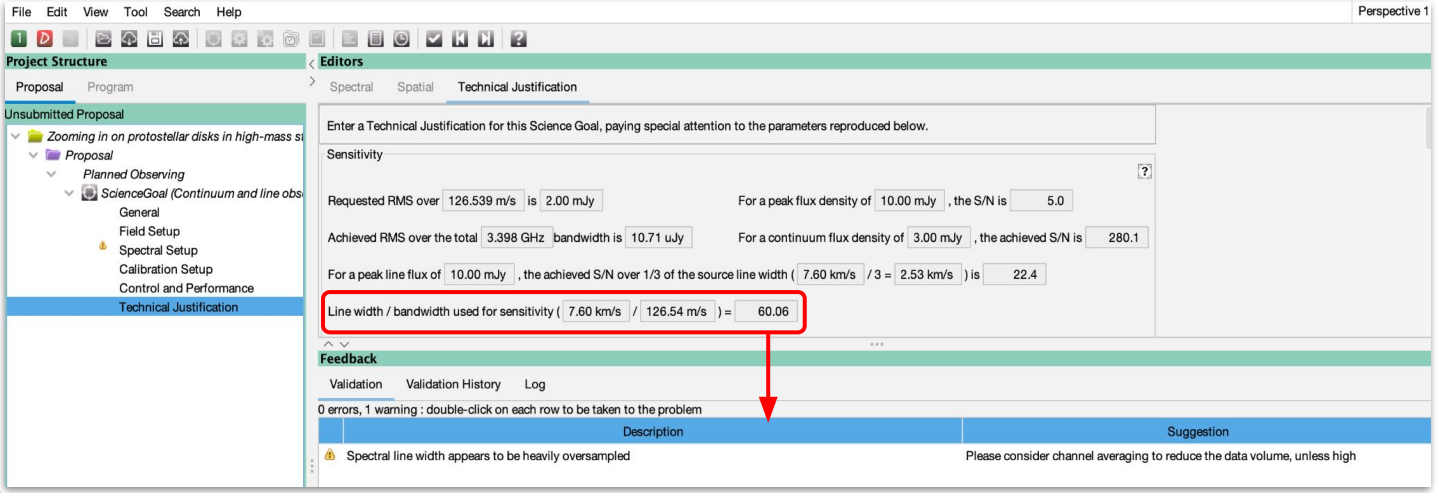
- **4-bit spectral modes** are not recommended for ‘continuum only’ observations
- The default spectral averaging of 2 is not needed in 4-bit mode
- For 2-bit modes the default spectral averaging of 2 halves the data rates for 15% coarser spectral resolution
- There will be a warning upon validation if a 4-bit spectral window is used as the representative window for sensitivity calculation

New in Cycle 10 Observing Tool

- **High spectral dynamic range** (continuum flux / line RMS) must be technically justified
- Demonstrated limits are as follows:
  - Bands 1, 3, 4, 5, 6: 1000
  - Band 7: 400
  - Band 8: 250
  - Band 9: 170
  - Band 10: 150
- Proposals that request higher accuracy need to provide a feasible calibration strategy
- There are also limits on the continuum and line imaging dynamic range (typically 50)
- For more information, see Sect. A.9.3 of the Proposer's Guide

New in Cycle 10 Observing Tool

- A warning will be shown in the case of **line oversampling** when:
  - linewidth / spectral resolution > 10
- Double check the expected linewidth entered in *Field Setup*
- Try using coarser spectral resolution or use a higher spectral averaging (smoothing) in *Spectral Setup*



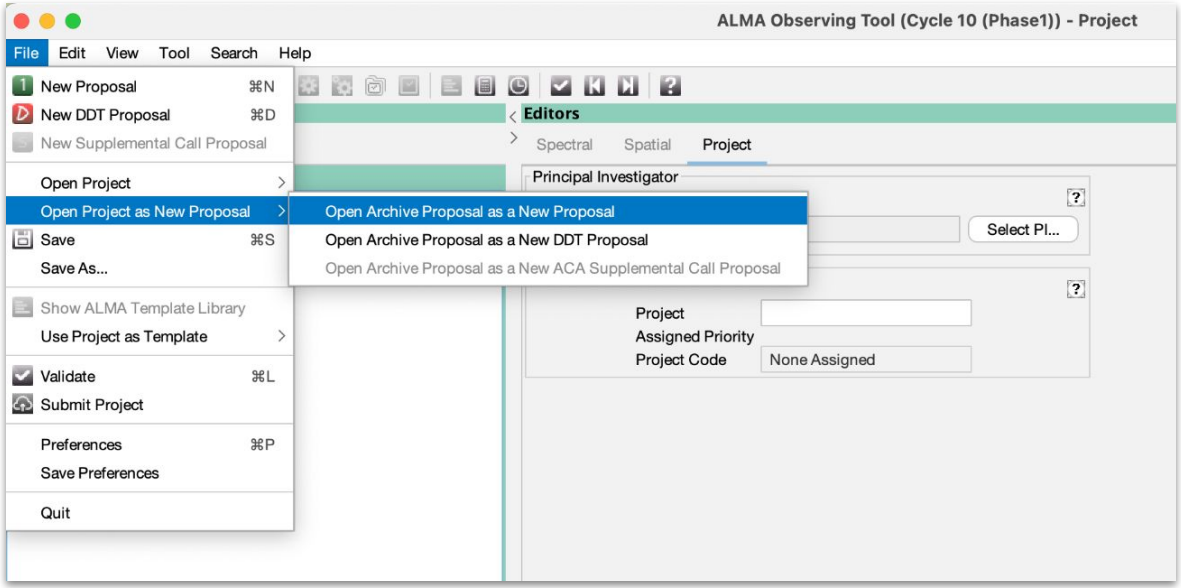
Observing Tool Tips & Tricks

- You can **change the appearance** of the OT and change font sizes via *File > Preferences*
- You can **open all nodes** of the project tree by typing *Ctrl* or *Cmd+Z*
- At most **two keywords** can be chosen for a given proposal using the Ctrl or Cmd key
- If you have **many co-Is**, you can import them from a past proposal 

- Holding the *Alt* or *Option* key while changing unit fields will **convert units**
- Double clicking on **validation errors & warnings** will take you to the cause of the issue and the messages can now be copied for reporting
- The standard *Ctrl-Z* (**undo**) and *Ctrl-Y* (**redo**) functionality now available in several fields
- **Source names** that are composed of only numbers are no longer allowed
- You can open your own FITS image in the *Field Setup* (useful for mosaic observations)

Observing Tool Tips & Tricks

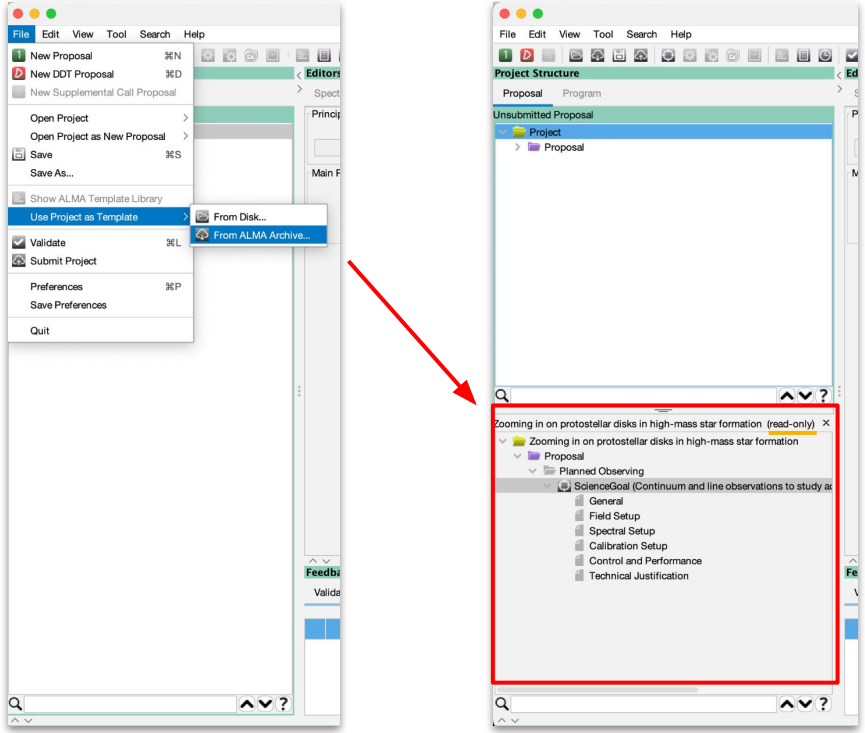
- You can **load your previous proposals** from the archive
- This is very useful once you have submitted your current proposal but still want to make changes
- It will avoid the creation of a new proposal code



- This can also be done by clicking on  in the toolbar

Observing Tool Tips & Tricks

- **Proposals can also be opened as template**, either from disk or from the ALMA Archive
- This is a useful option if working collaboratively with others or if you want to copy setups from previous proposals
- Parts of the proposal can be directly copied from the template into the new proposal (Ctrl+C/Ctrl+V)



Observing Tool Resources

https://almascience.eso.org/documents-and-tools

Document	Description
OT Quickstart	A Quick Start Guide for using the Observing Tool
OT User Manual	Describes how to use the Observing Tool for preparing ALMA proposals
OT Reference Manual	An in-depth description of the Observing Tool
Video Tutorials	Video how-to for the Observing Tool
Known OT issues	For those instances when OT problems are encountered
Phase 2 Quickstart Guide	A Quick Start Guide for approved ALMA observing proposals - the process of Phase 2
A User's Guide to ALMA Scheduling Blocks	(Cycle 4) Guide to understanding the structure and content of ALMA Scheduling Blocks (SBs) using the Observing Tool (OT)

As always, please contact us if you have any questions or issues with the OT

Cycle 10 key dates

28 June 2023: Deadline to submit reviews for the distributed peer review system

Week of July 10: ALMA Proposal Review Committee

Final checklist

- Make sure your proposals are **anonymised**
- Check the ALMA archive to ensure your proposed observations are not **duplicates**
- Designate co-Is to review proposals on your behalf if needed
  - You cannot review more than 50 proposals -> recommended number is 30
- Submit proposal by deadline of **10 May 2023 (15:00 UT)**
- **Update your expertise** on the ALMA Science Portal by **16 May 2023**: https://asa.alma.cl/UserRegistration/secure/updateAccount.jsp
- Submit your reviews by **28 June 2023**

Tips on writing effective scientific justifications and reviewing proposals

➔ I-TRAIN presentation: https://almascience.eso.org/euarcdata/itrain13/HowToWriteReview_ITRAIN.pdf

➔ I-TRAIN video: https://www.youtube.com/watch?v=FP8H-ObMMnU

ALMA 2030 Goals and Recommendations

*As summarized in the "ALMA2030" report, the ASAC recommended, **with no specific priority**, four development paths based on their long-term scientific potential:*

1. Improvements to the ALMA Archive: enabling gains in usability and impact for the observatory;

2. Larger bandwidths and better receiver sensitivity: enabling gains in speed;

3. Longer baselines: enabling qualitatively new science;

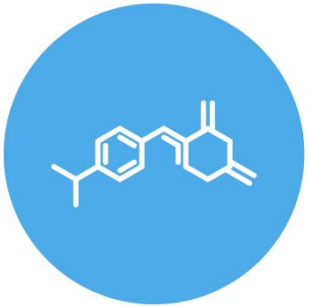
4. Increasing wide field mapping speed: enabling efficient mapping.

Image is from Carpenter et al. 2018, ALMA Memo #612, *ALMA2030 Development Vision.*

The Working Group proposes the following fundamental science drivers for ALMA developments over the next decade:

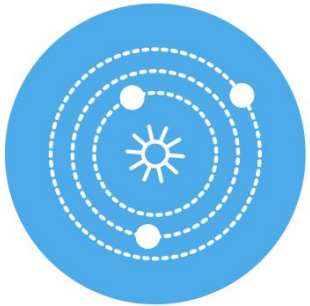
ORIGINS OF GALAXIES

Trace the cosmic evolution of key elements from the first galaxies (z>10) through the peak of star formation (z=2–4) by detecting their cooling lines, both atomic ([CII], [OIII]) and molecular (CO), and dust continuum, at a rate of 1-2 galaxies per hour.



ORIGINS OF CHEMICAL COMPLEXITY

Trace the evolution from simple to complex organic molecules through the process of star and planet formation down to solar system scales (~10-100 au) by performing full-band frequency scans at a rate of 2-4 protostars per day.

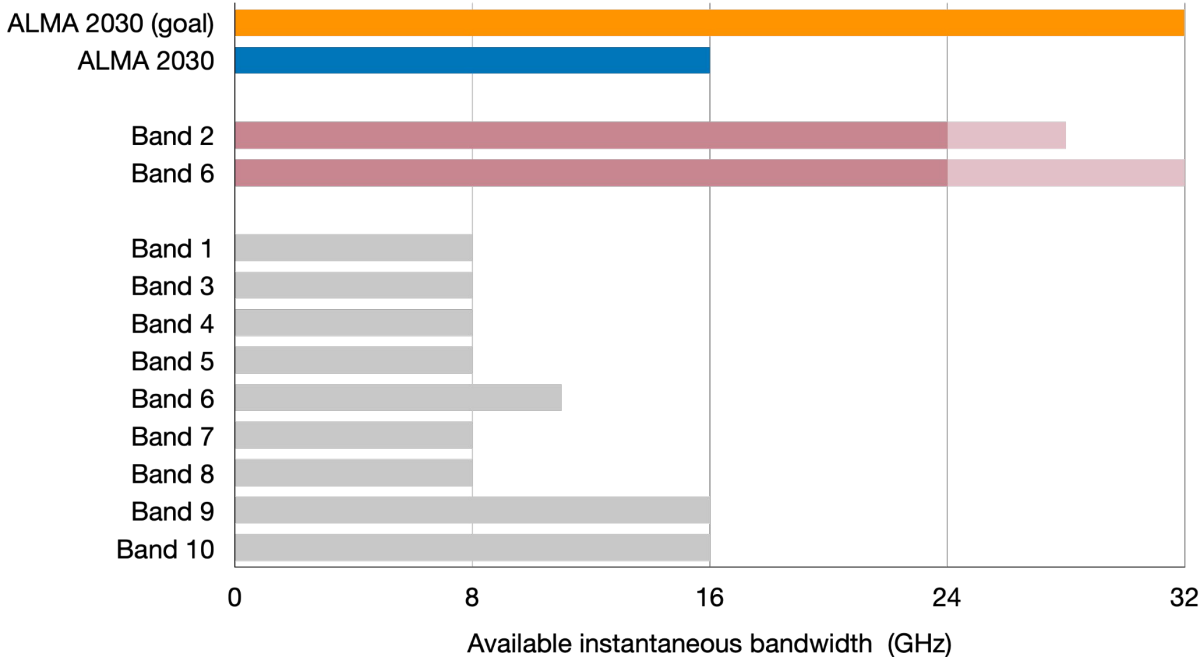


ORIGINS OF PLANETS

Image protoplanetary disks in nearby (150 pc) star formation regions to resolve the Earth forming zone (~ 1 au) in the dust continuum at wavelengths shorter than 1mm, enabling detection of the tidal gaps and inner holes created by planets undergoing formation.

Wideband Sensitivity Upgrade: Overview

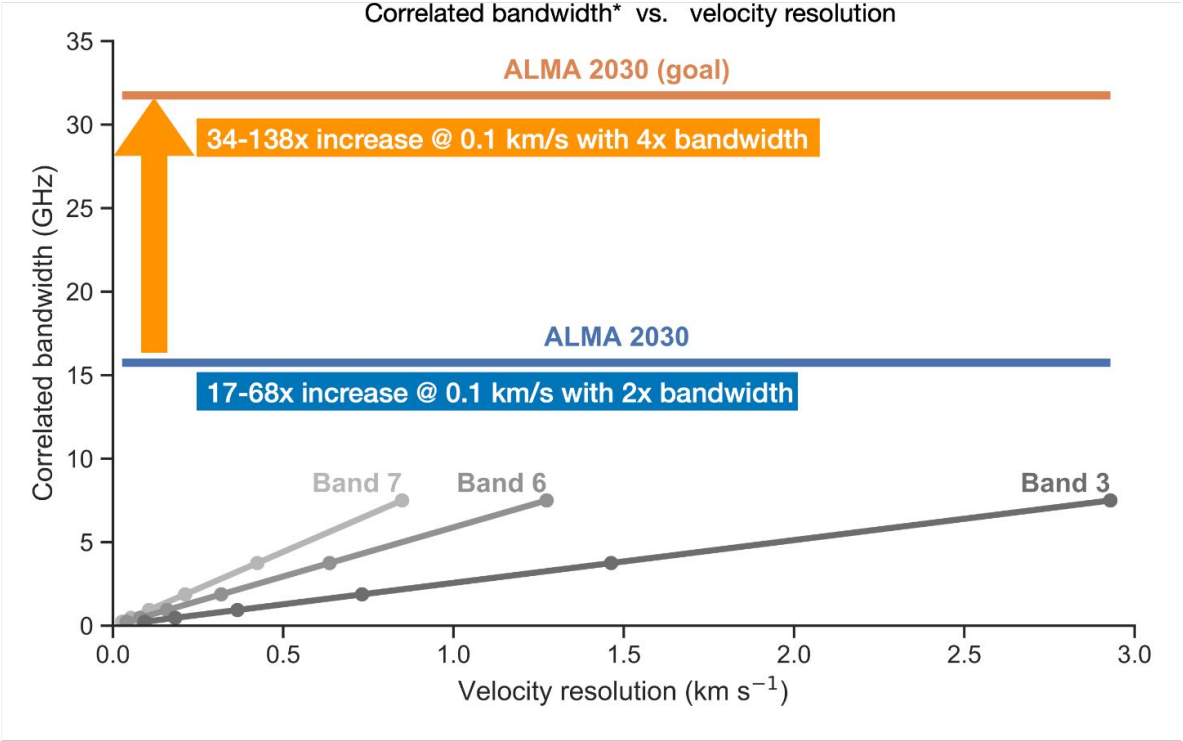
Available bandwidth
Correlated bandwidth
Observing speed



Factor of 2-4 increase in the available IF bandwidth.

Wideband Sensitivity Upgrade: Overview

- Available bandwidth
- **Correlated bandwidth**
- Observing speed



Never need to compromise spectral resolution for bandwidth again!

Wideband Sensitivity Upgrade: Overview

- Available bandwidth
- Correlated bandwidth
- **Observing speed**

Increase in Band 6 observing speed with ALMA 2030

Observing mode	Increase in speed over current system*
Continuum	4.8x (with goal of 9.6x)
Spectral line	2.25-4.7x

Increase in observing speed results from
- improved receiver temperatures
- improved digital efficiency
- wider bandwidth (continuum)

As highlighted by the last 3 slides, high spectral resolution scans will see further speed increases due to larger correlated bandwidth.

Outlook on ALMA in 10 years

Summary

- Wideband sensitivity upgrade benefits all observations

- Technical upgrades
  - Available bandwidth : factor of 2-4 increase
  - Correlated bandwidth : more than an order of magnitude increase with ~ 0.1 km / s resolution
  - Observing speed : 2.2-4.7x faster for spectral lines, 4.8x faster for continuum (Band 6 upgrade)

- Scientific impact
  - Planet formation : comprehensive studies of physical, kinematic, and chemical structure of disks
  - Star formation : efficient surveys of all stages in the star formation process
  - Galaxy formation : probe the formation and evolution of galaxies across cosmic time

More resources

- **ALMA Proposer's Guide for Cycle 10**
  https://almascience.eso.org/proposing/proposers-guide
- **ALMA Primer**
  https://almascience.eso.org/proposing/early-science-primer
- **ALMA Primer videos**
  https://almascience.eso.org/tools/alma-primer-videos
- **ALMA explained: a series of 3-minute videos**
  https://www.eso.org/sci/facilities/alma/arc/ALMA_explained_videos.html
- **ALMA Science Archive**
  https://almascience.eso.org/aq/

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Contact Allegro!

alma@strw.leidenuniv.nl

Need help?

- E-mail us your questions or request a meeting with the Allegro staff to discuss your proposal
- Dedicated drop-in sessions in our offices (HL-1122) from 14:00-16:00 on:
  - April 24
  - May 1
  - May 8
- If you are planning to submit a Large Programme, contact us early so that we can explore the many ways we can support your project and help optimise your program.

We wish you a relaxed proposal preparation time!

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