Transition Advisory Group

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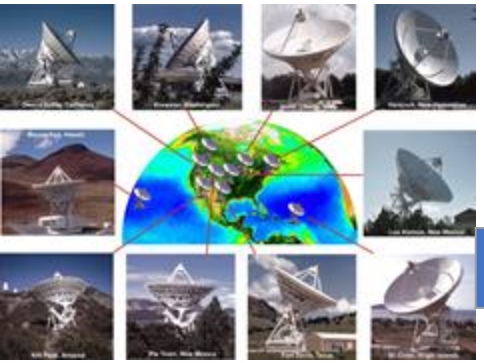
next generation Very Large Array Transition

2025 - VLA and VLBA operating robustly



2034 - ngVLA science operations beginning

2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
	PDR		FDR	Construction					Early Science					Ops

ngVLA Transition Advisory Group

Guided by the scientific opportunities planned for the coming decade, the VLA/VLBA to ngVLA Transition Advisory Group (TAG) is charged to develop, quantitatively assess, and evaluate a finite number of possible VLA/VLBA to ngVLA transition options that can be prioritized on their scientific promise, cost and technical/personnel impacts.

Stefi Baum
Alessandra Corsi *(Co-Chair)*
Simona Giacintucci
George Heald
Patricia Henning *(ex officio)*
Ian Heywood
Daisuke Iono
Megan Johnson
Michael Lam
Joseph Lazio *(Co-Chair)*
Adam Leroy
Laurent Loinard
Leslie Looney
Lynn Matthews
Ned Molter
Eric Murphy *(ex officio)*
Eva Schinnerer
Alex Tetarenko
Grazia Umana
Alexander van der Horst

Charge to Transition Advisory Group

- **Identify scientific opportunities** in the coming decade that will critically benefit from complementary and/or unique observations at radio wavelengths.
- **Define the relevant stakeholders** affected by the transition (e.g., NSF, NRAO staff, astronomy community, etc.).
- **Identify the relevant parameters of interest** to critically compare transition options (e.g., VLA and VLBA observational capabilities, scientific areas impacted, archival science opportunities, staff load/sharing, etc.).
- **Identify the necessary metrics** by which to quantify the impact of different transition options.
- **Submit a set of transition options** to NRAO (i.e., the Internal Technical Analysis Team [ITAT]) for detailed (quantitative) costing/impact analysis.
- **Write up findings** as part of the "VLA/VLBA to ngVLA Transition Option Concepts" report that includes a prioritized list of transition options.

"VLA/VLBA to ngVLA Transition Option Concepts" report to be provided to NRAO/ngVLA Project (and NSF)

Report Status

VLA/VLBA to ngVLA TAG Report
Technical Report
2025 January

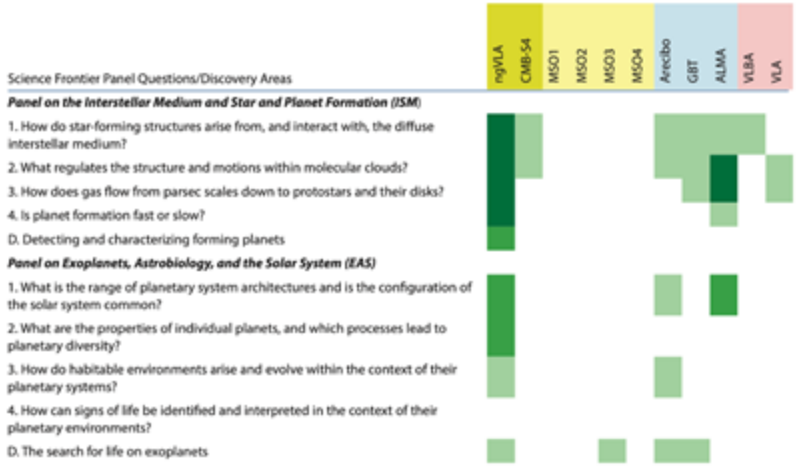
Contents

Version for community comment
Some of this material is pre-decisional information and for planning and discussion only.

- ➔ Draft report produced by Transition Advisory Group
- ➔ Transmitted to NRAO Internal Technical Analysis Team (ITAT) for detailed (quantitative) costing/impact analysis
- ➔ NRAO ITAT analysis provided to Transition Advisory Group
- ➔ Transition report revised
- ➔ **Draft Transition report posted on arXiv:2501.06333 for community comment.** Please submit your feedback at **ngvla-transition-feedback@listmgr.nrao.edu**
- ➔ Feedback received by **March 15** will be incorporated into final report to NRAO, updated on arXiv

Science Priorities

TABLE M.1 High-Priority Science Questions Versus RMS Facilities



- Used Decadal Survey assessment of priorities
  - No need to re-invent the assessment process
    - also consulted VLA-VLBA-ngVLA science use cases, ngVLA Science Book, NRAO press releases
- Used assessment from Panel on Radio, Millimeter, and Submillimeter Observations from the Ground (RMS)

Science Priorities

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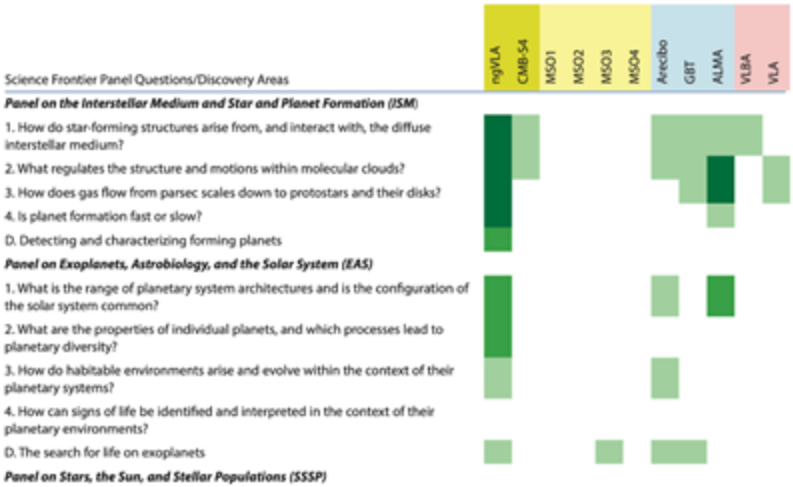

VLA-VLBA Roles in the Next Decade

1) "Irreplaceable and unique" contribution to addressing a science question;
2) "Very significant contribution in addressing a science question but would not be sufficient to address that question by itself"; and
3) "An impact in addressing a science question, but would be one of several facilities playing supporting roles."

Science Priorities

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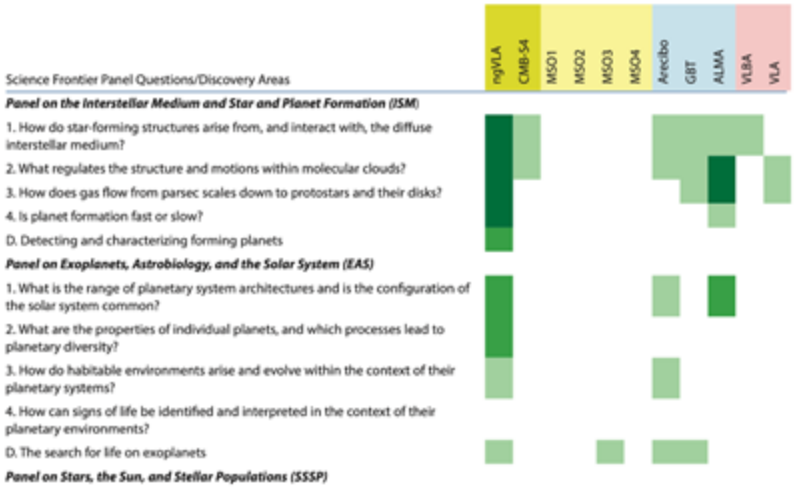


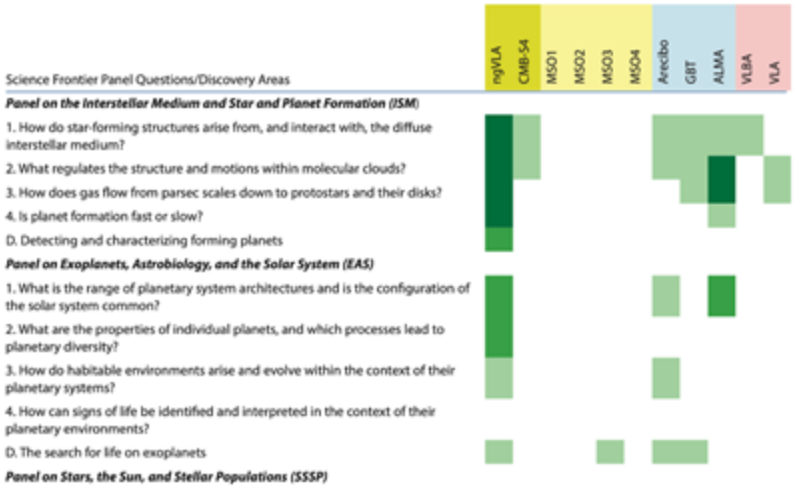
Scientific Areas with VLA/VLBA Very Significant Contribution*

- What would stars look like if we could view them like we do the Sun?
- What powers the diversity of explosive phenomena across the electromagnetic spectrum?
- Why do some compact objects eject material in nearly-light-speed jets, and what is it made of?

*no priority order in listing

Science Priorities

TABLE M.1 High-Priority Science Questions Versus RMS Facilities



Discovery Areas Enabled by the VLA and/or VLBA

- Transforming our view of the universe by combining light, particles, and gravitational waves
  Panel on Compact Objects and Energetic Phenomena
  - Broad-band radio light curves from the VLA provide insight into dynamics, structure, and evolution of relativistic jets from multi-messenger sources
  - VLBA observations constrain viewing angles for and expansion rates of jets
- “Industrial Scale” Spectroscopy
  Panel on Stars, the Sun, and Stellar Populations

Science Priorities

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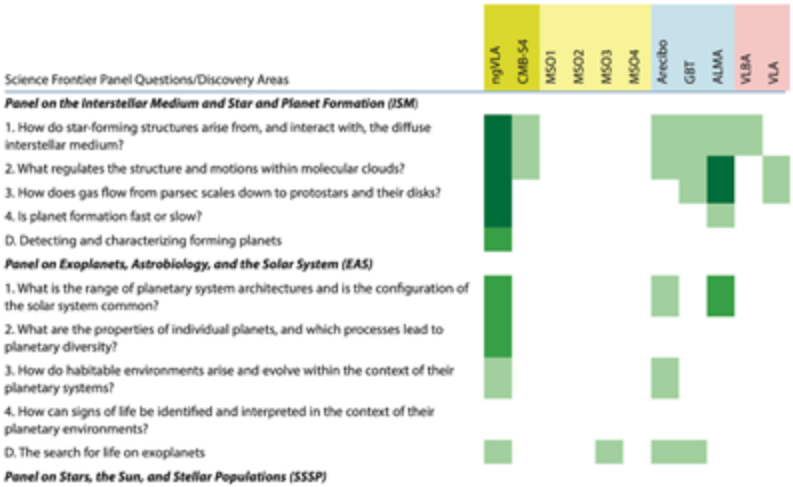
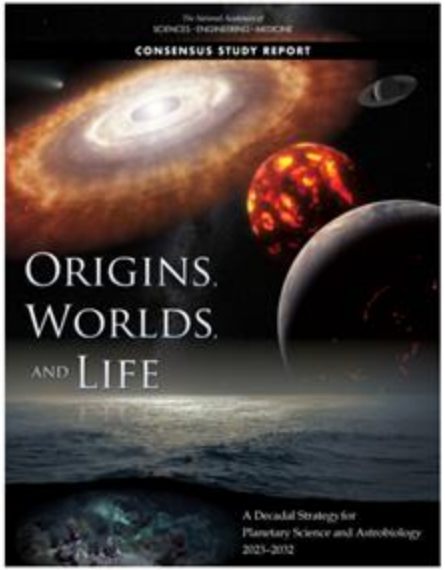
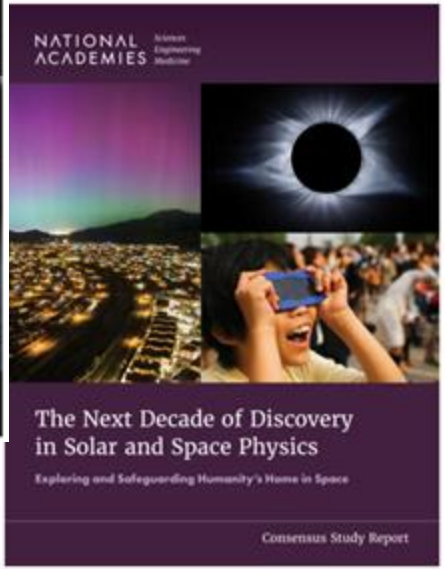


VLA and/or VLBA Support to Other Scientific Areas

- 12 scientific questions to which VLA or VLBA contribute in addressing
  - Key work: lead with VLA or VLBA contribution and provide (recent) references

Science Priorities





- Five science questions in *Origins, Worlds, and Life* (Planetary Science & Astrobiology Decadal Survey) addressed by VLA
- *The Next Decade of Discovery in Solar and Space Physics* (Solar & Space Physics/Heliophysics Decadal Survey)
  - VLA is “major ground-based [facility]”
  - “transition from interferometric imaging at a few discrete frequencies to true radio imaging spectroscopy over broad frequency bands”

    Echoes Industrial-Scale Spectroscopy discovery area identified in *Pathways to Discovery*

Transition Matrix

What would stars look like …?	⇐ Scientific Areas with VLA/VLBA Very Significant Contribution* (*Pathways to Discovery*) *listed in no priority order
What powers the diversity of explosive phenomena …?	
Why do some compact objects eject material in nearly-light-speed jets …?	

Transition Matrix

	Reduced Receiver Suite		Restricted Array Configuration					Reduced Number of VLA Antennas	Reduced Observing Time
	Reduced Low Frequencies	Reduced High Frequencies	No D Configuration	No A Configuration	B+D Configuration	A+C Configuration	F Configuration		
What would stars look like …?	 Technical options for Transition as identified originally by NRAO Internal Technical Analysis Team								
What powers the diversity of explosive phenomena …?									
Why do some compact objects eject material in nearly-light-speed jets …?									

Transition Matrix

	Reduced Receiver Suite		Restricted Array Configuration					Reduced Number of VLA Antennas	Reduced Observing Time
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What would stars look like …?									
What powers the diversity of explosive phenomena …?									
Why do some compact objects eject material in nearly-light-speed jets …?									

Technical options assessed for effect on Science investigations

Not Acceptable N Science reduced very substantially, high-profile results likely inaccessible

Moderately Acceptable M Science return reduced substantially, but acceptable for limited duration, high-profile results likely at least partially accessible

Acceptable A Science return reduced, but high-profile results likely to remain accessible

Transition Matrix - TAG Assessment

	Reduced Receiver Suite		Restricted Array Configuration					Reduced Number of VLA Antennas	Reduced Observing Time
	Reduced Low Frequencies	Reduced High Frequencies	No D Configuration	No A Configuration	B+D Configuration	A+C Configuration	F Configuration		
What would stars look like …?	N	N	M	N	N	M	M	N	M
What powers the diversity of explosive phenomena …?	N	N	A	N	M	M	M	N	N
Why do some compact objects eject material in nearly-light-speed jets …?	N	N	A	N	N	M	M	N	M

Transition Matrix - TAG Assessment

	Reduced Receiver Suite		Restricted Array Configuration					Reduced Number of VLA Antennas	Reduced Observing Time
	Reduced Low Frequencies	Reduced High Frequencies	No D Configuration	No A Configuration	B+D Configuration	A+C Configuration	F Configuration		
What would stars look like …?									
What powers the diversity of explosive phenomena …?									
Why do some compact objects eject material in nearly-light-speed jets …?									

Reduced Receiver Suite VLA and VLBA's spectral dynamic range (> 100:1) is unique among radio facilities

Restricted Array Configuration No single distribution of VLA antennas can replicate VLA's spatial dynamic range (angular resolution and surface brightness sensitivity); ngVLA Memorandum #126

May also make maintenance more difficult

Reduced Number of VLA Antennas Reduced sensitivity, affects observations of transients ("explosive phenomena") severely

Transition Advisory Group *Current* Recommendations

A reasonable transition plan starts with a three-year interval during the initial ngVLA construction when VLA capabilities remain consistent with current capabilities; this initial phase is followed by a two-year interval during which one or both of the transition options described below could be used concurrently with ngVLA Early Science:

- The **VLA receiver suite is reduced at each antenna**, provided that **at least five of the current frequency bands are maintained** at all antennas, with the notional set being L-,S-, C-, X-,and K bands.

Should the transition option above be infeasible or insufficient, an additional option is to

- Adopt a **fixed VLA configuration**, recognizing that no single configuration has been identified that preserves a sufficient range of capabilities in angular resolution, flux density sensitivity, and surface brightness sensitivity.

The TAG recommends further that during the transition from the VLA+VLBA to the ngVLA, the **VLBA observational capabilities remain unchanged compared to current VLBA capabilities, including the full receiver suite.**

Unavoidable conclusion ➤ Any reduction in capability to the VLA or VLBA will reduce science return

Draft Transition report arXiv:2501.06333

Please submit feedback at ngvla-transition-feedback@listmgr.nrao.edu

Discussion

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ngvla
Next Generation Very Large Array