

NRAO Call for Proposals: Semester 2020A

2 July 2019



The National Radio Astronomy Observatory (NRAO) invites scientists to participate in the Semester 2020A Call for Proposals for the Karl G. Jansky Very Large Array (VLA) and the Very Long Baseline Array (VLBA), High Sensitivity Array (HSA), and Global 3mm VLBI Array (GMVA).

The submission deadline for Semester 2020A proposals is Thursday, 1 August 2019, at 17:00 EDT (21:00 UTC).

The NRAO especially wishes to highlight a new opportunity to submit **Extra-Large proposals**. See the [Extra-Large proposal page \(https://science.nrao.edu/observing/call-for-proposals/2020a/extra-large-proposals\)](https://science.nrao.edu/observing/call-for-proposals/2020a/extra-large-proposals) for details.

Proposal preparation and submission are handled via the NRAO Proposal Submission Tool (PST) available at [NRAO Interactive Services \(http://my.nrao.edu/\)](http://my.nrao.edu/). Proposers who need assistance with proposal preparation or have questions regarding the Call for Proposals or NRAO telescope capabilities should contact Observatory staff via the NRAO [Helpdesk \(https://help.nrao.edu/\)](https://help.nrao.edu/). Note that using these tools (both the PST and the Helpdesk) requires registration.

News & Opportunities

Joint NRAO and GBO Telescope Time Allocation Process

Proposals to the National Radio Astronomy Observatory ([NRAO \(https://science.nrao.edu/observing/\)](https://science.nrao.edu/observing/)) and the Green Bank Observatory ([GBO \(http://greenbankobservatory.org/\)](http://greenbankobservatory.org/)) for the scientific use of its telescopes are evaluated on the basis of scientific merit and technical feasibility using a [panel-based proposal review system \(https://science.nrao.edu/observing/proposal-types/proposal-review-system\)](https://science.nrao.edu/observing/proposal-types/proposal-review-system). This joint process is run by the NRAO in accordance with its [policy of non-discrimination and inclusion. \(https://info.nrao.edu/do/odi/nrao-diversity\)](https://info.nrao.edu/do/odi/nrao-diversity)

The NRAO 2020A Call for Proposals is for observations with the VLA and VLBA/HSA/GMVA; the corresponding call for the GBT can be found at the [GBO Call for Proposals \(https://greenbankobservatory.org/science/gbt-observers/proposals/2020a-call-for-proposals/\)](https://greenbankobservatory.org/science/gbt-observers/proposals/2020a-call-for-proposals/).

New Opportunities

Extra-Large Proposals

The NRAO especially wishes to highlight a new opportunity to submit Extra-Large proposals. See the [Extra-Large proposal page \(https://science.nrao.edu/observing/call-for-proposals/2020a/extra-large-proposals\)](https://science.nrao.edu/observing/call-for-proposals/2020a/extra-large-proposals) for details.

Extra NRAO Staff Help for VLBA Observation Setup and Data Reduction

NRAO is now offering extra staff assistance with VLBA observational setup and data reduction for new or novice users. See the [VLBA, HSA, and GMVA Proposal Guide \(https://science.nrao.edu/observing/call-for-proposals/2020a/vlba-proposal-guide\)](https://science.nrao.edu/observing/call-for-proposals/2020a/vlba-proposal-guide) page for details.

Continuing Opportunities

Joint Observing program

Access to the Joint Observing program will continue for the VLA, VLBA and GBT for semester 20A. This includes joint observations with the XMM-Newton Project, the Chandra X-ray Observatory, the Hubble Space Telescope (HST), the Swift Gamma-Ray Burst Mission, and the Fermi Gamma-ray Space Telescope. For more details see the [Joint Proposal page \(https://science.nrao.edu/observing/call-for-proposals/2020a/joint-proposals\)](https://science.nrao.edu/observing/call-for-proposals/2020a/joint-proposals).

Director's Discretionary Time Including Education and Public Outreach

Proposals for Director's Discretionary Time (DDT) may be submitted at any time. They must be submitted through the [PST \(https://my.nrao.edu/\)](https://my.nrao.edu/). DDT proposals are intended to address [targets of opportunity \(https://science.nrao.edu/observing/proposal-types/too\)](https://science.nrao.edu/observing/proposal-types/too), high-risk/high-return [exploratory time \(https://science.nrao.edu/observing/proposal-types/exploratoryproposals\)](https://science.nrao.edu/observing/proposal-types/exploratoryproposals), or other science opportunities deemed sufficiently urgent to justify prompt action.

DDT proposals may also be submitted for the purpose of education and public outreach - for example, to image an iconic source or to support an educational opportunity for students. Such proposals should clearly justify the requirements for the requested time allocation and observing mode on any given instrument, and should describe the anticipated impact of the observation.

While there is not an *a priori* limit to time that can be requested via DDT, it is expected that no more than 5% of the observing time on each telescope will be allocated for this purpose.

Other Proposal Opportunities

The NRAO would like to make users aware that there are additional proposal opportunities as follows:

- **High Risk Proposals:** As a means of maximizing its scientific impact through cutting-edge observations, the Observatory encourages the submission of high-risk/high-reward proposals.
- **Commensal Observing:** NRAO telescopes and backends are sufficiently flexible in many cases to allow two experiments to run commensally. To the degree that this enhances science return from the telescopes, NRAO wishes to support commensal projects subject to resource and scheduling constraints.
- **Filler Programs:** Some programs are not time critical, strongly dependent on array configuration, or require highly subscribed LST ranges. Such programs may be able to take advantage of "filler" time.

Further information about each of these programs can be found on the [Proposal Opportunities](https://science.nrao.edu/observing/proposal-types/proposal-opportunities) (<https://science.nrao.edu/observing/proposal-types/proposal-opportunities>) page.

Extra-Large Proposals

Introduction

NRAO and GBO invites submissions of Extra-Large observing proposals (X-proposals for short) for the 1 August proposal submission deadline. This opportunity is open for observers seeking to use the VLA, VLBA and/or GBT. Extra-Large proposals are defined as those requesting a total of more than 1000 hours of telescope time and/or extending over four or more observing semesters (see below for capabilities and restrictions). Note that the earliest that successful Extra-Large projects could be scheduled is the start of Semester 2020B in August 2020. The opportunity to submit Extra-Large proposals will likely not be repeated for at least three years. A joint proposal with external facilities (e.g., HST) may be included in an Extra-Large proposal, but the total time available for the external facility is limited (see the [Joint Proposals \(https://science.nrao.edu/observing/call-for-proposals/2020a/joint-proposals\)](https://science.nrao.edu/observing/call-for-proposals/2020a/joint-proposals) page for details).

Regular and Large proposals continue to be encouraged for Semesters 2020A and beyond. At least 50% of open skies science time on each of the VLA, VLBA and GBT will continue to be made available for Regular and Large proposals from Semester 2020B. (The maximum amount of time that can be requested through a Large proposal will be capped at 1000 hours starting from Semester 2020B.)

To be accepted, Extra-Large proposals should demonstrate outstanding science impact, a high level of scientific and technical readiness, and excellent legacy science value (the potential to generate high science impact from community use of archival data and data products).

The scientific review process for Extra-Large proposals will be different from the normal NRAO Science Review Panel (SRP) / Time Allocation Committee (TAC) process. The Science Review Panels will assess the scientific potential of each Extra-Large proposal in their science area, providing comments and a coarse grading. A new X-Proposal Science Assessment Committee (XSAC) appointed by the NRAO and GBO Directors will assess the Extra-Large proposals for their scientific merit and likely legacy science value, taking into account the initial assessments from the SRPs. Observatory staff will assess each proposal for technical readiness, and the final selection of proposals will involve a face to face scientific, technical, and operations readiness review in Spring 2020.

Preference will be given to proposals which demonstrate substantial engagement with astronomers at U.S. institutions. Preference may be given to proposals with lower requirements for observatory support, and lower operational impact. The progress of Extra-Large projects that are accepted will be monitored through NRAO Program Management Department processes.

The deadline for submissions is 1 August 2019, the same as for Semester 2020A regular and large proposals. The announcement of successful Extra-Large proposals is anticipated to occur in July 2020.

Proposal Submission

Submission of Extra-Large proposals will be via the usual NRAO Proposal Submission Tool (PST) with the same 10-page limit for the Scientific Justification as for Large proposals. There is no "Extra-Large" option for proposal type so instead please just select "Large". **To distinguish Extra-Large proposals from Large proposals the text "X-Proposal" must be included at the end of the title.** Extra-Large proposals may request time on one or more of the VLA, VLBA, and GBT telescopes. Proposals requesting more than one telescope should submit the same scientific justification to each telescope through the PST, but include

telescope-specific resources, sources, and sessions with each submission. A representative set of sources/resources/sessions should be entered into the PST with the correct total time and LST range, but a complete source list is not required at this stage.

The following additional material is also required for Extra-Large proposals and should be submitted by emailing a PDF file to x-proposals@nrao.edu by the same 1 August deadline:

- *Data Management:* The data management and delivery plan, including computing resource requirements.
- *Project Schedule:* A set of major project milestones and schedule.
- *Team Resources:* The team resources (including plans for resident scientists at the Observatory).

Proposers are also encouraged to address the following:

- *Project Feasibility:* The demonstrated feasibility of the project (strongly suggested).
- *Special Requirements:* Any special requirements (such as scheduling, calibration, scanning, data processing).
- *Community Engagement:* How the U.S. astronomical community will be engaged in this project.
- *Observing Plan:* A detailed observing plan.

The ability of the proposing team to execute the data management plan, as well as the feasibility for NRAO to accommodate any requests made of it in the data management plan, will be evaluated as part of the review process. Information that assists Observatory staff to assess likely operational and NRAO/GBO support implications will be welcomed as part of the additional material. This will be the focus of the final face to face technical and operations readiness reviews with the highest ranked proposal teams.

Capabilities and restrictions for Extra-Large proposals requesting VLA time

Extra-Large proposals requesting VLA time may request a subset of VLA General Observing capabilities, with the following restrictions:

- No Shared Risk or Resident Shared Risk capabilities.
- Maximum number of triggers per year, per proposal: 50
- Minimum response time for triggers or coordinated observations: 1 week
- Minimum cadence for monitoring: 2 weeks, with a flexibility of at least 1 week on individual observations
- Maximum correlator output data rate: 25MB/s
- Minimum scan length: 10s
- No moving sources (including Solar and planetary observations).
- No fixed date observing.
- No phased array for VLBI.
- No pulsar modes.
- No subarrays.
- No mixed 3/8-bit samplers.
- No On-The-Fly mosaicing.

- Proposers should plan a science program that can be successfully executed with 85% of the full correlator (54 baseline board pairs).
- It must be possible to complete all projects within 2 configuration cycles (32 months).
- The availability of observing time will be limited by the constraint that at least 50% of the open science time will remain available for Regular and Large proposals, also taking into account ongoing observing for the VLA Sky Survey, and the amount of good weather available for Ku-band and higher frequencies. Over two configuration cycles the total number of hours available for Extra-Large proposals is 5900. Of those 5900 hours, the number of hours for which the observing conditions are expected to be suitable for the following bands is as follows:

Band(s)	Total number of hours over 2 configuration cycles	Total number of hours in each of A,B,C,D configurations, over 2 configuration cycles
P/L/S/C/X	5900	1475
Ku	1000	250 (NB: includes all observing conditions suitable for Ku+K+Ka+Q)
K	900	225 (NB: includes all observing conditions suitable for K+Ka+Q)
Ka	700	175 (NB: includes all observing conditions suitable for Ka+Q)
Q	500	125

- Extra-Large proposal observations at Ku through Q band may only be carried out at night. Proposers aiming to use these bands should take care to evaluate whether their targets are night-time targets in the configuration(s) needed to execute their science goals. The number of hours per LST hour (number of passes) for which the observing conditions are expected to be suitable for the following bands in each of the A,B,C,D configurations over 2 configuration cycles is as follows:

Band(s)	Total number of passes in each of A,B,C,D configurations over 2 configuration cycles
P/L/S/C/X	84
Ku	38 (NB: includes all passes suitable for Ku+K+Ka+Q)
K	32 (NB: includes all passes suitable for K+Ka+Q)
Ka	26 (NB: includes all passes suitable for Ka+Q)
Q	18

Capabilities and restrictions for Extra-Large proposals requesting VLBA time

Extra-Large proposals requesting VLBA time may request a subset of VLBA General Observing capabilities, with the following restrictions:

- No Shared Risk or Resident Shared Risk capabilities.
- Maximum number of triggers per year, per proposal: 50
- Minimum response time for triggers or coordinated observations: 1 week
- Minimum cadence for monitoring: 2 weeks, with a flexibility of at least 1 week on individual observations
- Maximum number of correlator passes: 2
- Maximum number of phase centers per correlator pass: 100
- Maximum number of source changes per hour: 200
- Maximum number of observing modes per scheduling block: 4

- Maximum correlator output data rate: 25MB/s
- No moving sources.
- No fixed date observing.
- No High Sensitivity Array observing.
- No 3mm observing.
- The availability of observing time will be limited by the constraint that at least 50% of the open science time will remain available for Regular and Large proposals, and the amount of good weather at 2cm, 1cm and 7mm. The total number of hours available for Extra-Large proposals per semester will be 650. Of those 650 hours, the number of hours for which the observing conditions are suitable for the following bands is as follows:

Wavelength	Number of hours per semester
90cm-4cm	650
2cm	240 (NB: includes all observing conditions suitable for 2cm+1cm+7mm)
1cm	200 (NB: includes all observing conditions suitable for 1cm+7mm)
7mm	120

- PIs of Extra-Large proposals should note the availability of 4Gbps advertised for semester 2020A. At present the media pool supports only a limited number of hours at 4Gbps, so 2Gbps should be assumed when writing Extra-Large proposals. However, proposers may indicate how their science goals or observing strategy would change if 4Gbps were available for their project.

Capabilities and restrictions for Extra-large proposals requesting GBT time

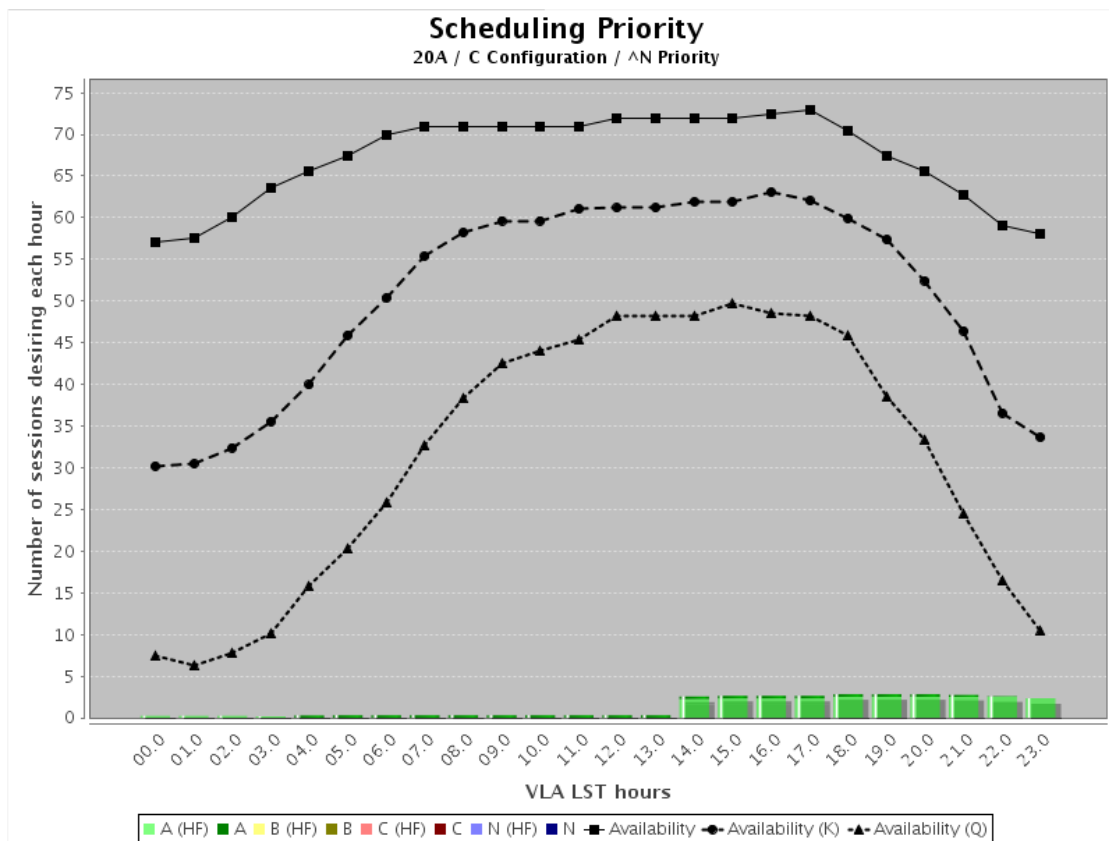
Please see the [GBO Call for Proposals \(http://greenbankobservatory.org/science/gbt-observers/proposals/2020a-extra-large-proposals\)](http://greenbankobservatory.org/science/gbt-observers/proposals/2020a-extra-large-proposals) for the GBT capabilities and restrictions for Extra-Large proposals.

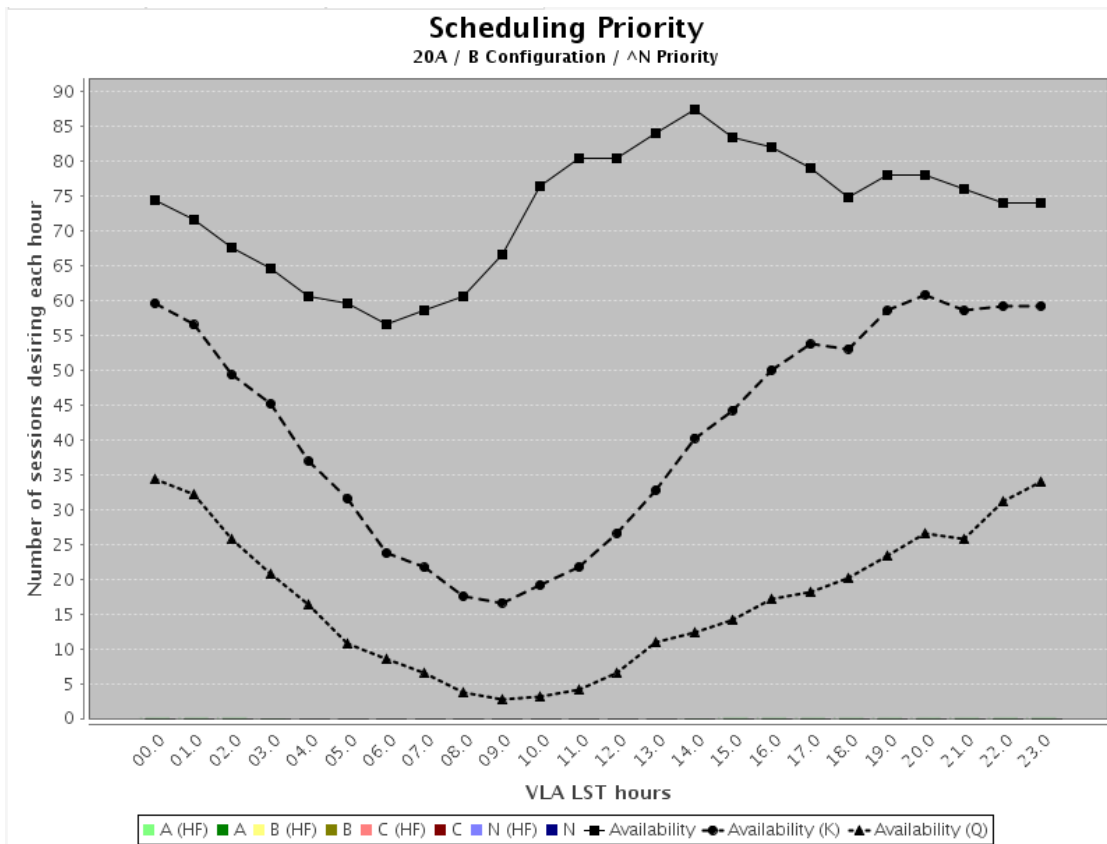
VLA Proposal Guide

VLA Configuration Plans and Science Time Available

The 1 August 2019 deadline covers the observing period February 13, 2020 through October 5, 2020 (Semester 2020A), encompassing the C and B configurations of the VLA. Multi-configuration proposals that include this configuration may also be submitted. Additionally, proposals requesting only configurations that will fall in semester 2020B (or later) may be submitted if the Principal Investigator is a graduate student. NRAO offers this service to provide scientific and technical feedback for students, and to provide them with an opportunity to re-submit their proposals for their principal semester with this information in hand. Students should ensure that their status is up to date and correct in the NRAO User Database. Please refer to the [VLA Configuration Plans \(http://go.nrao.edu/vla-plan\)](http://go.nrao.edu/vla-plan) for details and availability of upcoming configurations.

Plots of estimated available observing hours as a function of LST for the C and B configurations in semester 2020A are shown below. In these plots, engineering, maintenance, testing cause the solid (upper) line to be less than the total number of LST days in the configuration; such activities occur predominantly during daytime.





Estimated science time available per LST hour is shown by the solid (upper) black line for all frequencies, the dashed (middle) line for K-band conditions, and dotted (lower) line for Q-band conditions. The colored bars show pre-committed time from previous proposal deadlines, where green represents priority A, yellow priority B, and red priority C. For the net available time in either configuration per LST hour subtract the bars of the pre-committed time from the black curve.

Observing Capabilities for Semester 2020A

For the 2020A observing semester, we are offering the same General Observing (GO) program as in the 2019B semester. Details are given in the [Offered VLA Capabilities during the Next Semester \(http://go.nrao.edu/vla-capabilities\)](http://go.nrao.edu/vla-capabilities) section of the [Observational Status Summary \(http://go.nrao.edu/vla-oss\)](http://go.nrao.edu/vla-oss) (OSS) and are summarized in the following table. Several additional capabilities are available to proposers through the Shared Risk Observing (SRO) and Resident Shared Risk Observing (RSRO) programs, as described below.

Capability	Description
8-bit samplers	<p>Standard default setups for:</p> <ul style="list-style-type: none"> • 2 GHz bandwidth continuum observations at S/C/X/Ku/K/Ka/Q bands (16 × 128 MHz subbands) • 1 GHz bandwidth continuum observations at L-band (16 × 64 MHz subbands) • 256 MHz bandwidth continuum observations at P-band (16 × 16 MHz subbands) <p>Flexible setups for spectroscopy, using two, independently tunable, 1 GHz baseband pairs, each of which can be split into up to 16 flexibly tunable subbands</p> <p>Single, dual, and full polarization products</p>
3-bit samplers	<p>Standard default setups for:</p> <ul style="list-style-type: none"> ◦ 8 GHz bandwidth continuum observations at K/Ka/Q-bands ◦ 6 GHz bandwidth at Ku-band ◦ 4 GHz bandwidth at C/X-bands <p>Flexible setups for spectroscopy, using four, independently tunable, 2 GHz baseband pairs, each of which can be split into up to 16 flexibly tunable subbands</p> <p>Single, dual, and full polarization products</p>
Mixed 3-bit and 8-bit samplers	Allows more flexibility for simultaneous continuum and high-resolution spectral line observing
Subarrays	Up to 3 independent subarrays using standard 8-bit continuum setups
Phased array for VLBI	See VLBA Call for Proposals (https://science.nrao.edu/observing/call-for-proposals/2020a/vlba-proposal-guide)
Solar observing	All solar observing except the L-band reverse-coupled system
On-The-Fly Mosaicing (OTF)	P-, L-, S-, and C-bands only; no subarrays
Pulsar	Phase-binned pulsar observing
Frequency averaging	Frequency averaging in the correlator by a factor of two or four (only available for single subarray and non-OTF observations)

Both single pointing and mosaics with discrete, multiple field centers are supported. Data rates up to 60 MB/s (216 GB/hour). [Correlator integration time limits per band and per array configuration \(http://go.nrao.edu/tim-res\)](http://go.nrao.edu/tim-res) also apply as described in the OSS. The data rate and total data volume required by a proposal will be a consideration in its technical evaluation.

There are some [limitations on frequency settings and tuning ranges \(http://go.nrao.edu/vla-frq\)](http://go.nrao.edu/vla-frq), especially at Ka-band; please consult the OSS for further details. Additionally, the [Exposure Calculator \(http://go.nrao.edu/ect\)](http://go.nrao.edu/ect) has been updated and other special tools are available to assist users with the development of correlator setups for the proposal deadline (see [VLA Proposal Submission Guidelines \(http://go.nrao.edu/vla-steps\)](http://go.nrao.edu/vla-steps)). All antennas employ electronics and receiver systems that provide continuous frequency coverage from 1–50 GHz in the following observing bands: 1–2 GHz (L-band); 2–4 GHz (S-band); 4–8 GHz (C-band); 8–12 GHz (X-band); 12–18 GHz (Ku-band); 18–26.5 GHz (K-band); 26.5–40 GHz (Ka-band); and 40–50 GHz (Q-band). In

addition to these, all VLA antennas are equipped with 224-480 MHz (P-band) and 54-86 (4-band) receivers near the prime focus. For details see the Low Frequency Observing section below.

We continue to offer shared risk programs to our user community for those who would like to push the capabilities of the VLA beyond those offered for general use.

VLA Shared Risk Observing

The VLA Shared Risk Observing (SRO) program allows users access to capabilities that can be set up via the Observation Preparation Tool (OPT) and run through the dynamic scheduler without intervention, but are not as well tested as GO capabilities. The following capabilities are offered under the SRO program during the 2020A semester:

- On-the-Fly (OTF) mosaicing for X-, Ku-, K-, Ka-, and Q-bands (used when each pointing on the sky is no more than a few seconds), but not using subarrays;
- pulsar observations using the YUPPI system; and
- P-band (224-480 MHz) polarization observations.

See the [VLA Proposal Submission Guidelines \(http://go.nrao.edu/vla-steps\)](http://go.nrao.edu/vla-steps) web page for information about tools and other advice on proposing for Shared Risk observing capabilities.

VLA Resident Shared Risk Observing

The VLA Resident Shared Risk Observing (RSRO) program provides access to extended capabilities of the VLA that require additional testing. This access is provided in exchange for a period of residence to help commission those capabilities. Examples of capabilities that would fall under the RSRO program in the 2020A semester include:

- correlator dump times shorter than 50 msec, including integration times as short as 5 msec for transient detection;
- data rates above 60 MB/s;
- recirculation beyond a factor of 64 in the correlator;
- 4-band system (54–86 MHz; see Low Frequency Observing section below);
- more than 3 subarrays, or subarrays with the 3-bit system;
- complex phased array observations (e.g., pulsar and complex VLBI observing modes);
- Frequency averaging by more than a factor of 4.

A detailed description of the VLA RSRO program for semester 2020A and beyond is available at the [VLA Proposal Submission Guidelines \(http://go.nrao.edu/vla-steps\)](http://go.nrao.edu/vla-steps) web page.

Low Frequency Observing

The low frequency receiver system developed in collaboration with the Naval Research Laboratory is available for observations at P-band (224–480 MHz) through the GO and SRO programs. These receivers also work at 4-band (54–86 MHz), and new feeds have been deployed on all VLA antennas for use during the 2020A semester. Both 4-band and P-band can be observed simultaneously, but access to the 4-band system is only available through the RSRO program.

Commensal Observing Systems at the VLA

There are two commensal systems on the VLA that may take data at the same time as your proposed observation. The first is the [VLITE \(http://vlite.nrao.edu/\)](http://vlite.nrao.edu/) system, which will take data at P-band during regular observations that use bands other than P-band. The VLITE system is deployed on fifteen VLA antennas.

Observers wishing to gain access to the commensal VLITE data taken during their VLA observations should follow the instructions on the [VLITE \(http://vlite.nrao.edu/\)](http://vlite.nrao.edu/) web page for doing so. The second is the [realfast \(http://realfast.io/\)](http://realfast.io/) system, which takes data at very fast dump rates in an effort to detect Fast Radio Bursts (FRBs). This system will be fully commissioned for observing by the 2020A observing semester, and we expect it to be running at that time.

Proposal and Observation Preparation

Proposal preparation and submission are via the Proposal Submission Tool (PST) at [NRAO Interactive Services \(https://my.nrao.edu/\)](https://my.nrao.edu/). Use of the PST requires registration in the NRAO User Database. There are various tools and documentation to help users in this process. Descriptions of all updated documentation and tools, along with an outline of the steps required to write a proposal, are available at the [Guide to Proposing for the VLA \(http://go.nrao.edu/vla-prop\)](http://go.nrao.edu/vla-prop) web page.

When constructing sessions in the PST, proposers should be cognizant of their use by the Time Allocation Committee (TAC). Specifically taking into account the time available as a function of LST, software will assign an initial scheduling priority to each session in each proposal, which can be modified by the TAC if they desire. The assigned scheduling priority will depend on the linear-rank score of the proposal from its scientific review, the LSTs involved in the session (daytime is harder to accommodate than nighttime, for instance), the predicted atmospheric conditions for observing over that LST range at the time of year of the configuration, the total time requested in the session, and the competition from other proposals requesting time at similar LSTs. Please see [this description \(http://go.nrao.edu/obs-session\)](http://go.nrao.edu/obs-session) for guidance on how to set up sessions in the PST, and [this document \(http://www.aoc.nrao.edu/~schedsoc/VLAprioritizerMemo.pdf\)](http://www.aoc.nrao.edu/~schedsoc/VLAprioritizerMemo.pdf) for a complete description of the VLA Prioritizer (the software that generates the initial scheduling priorities for all sessions that are subsequently used by the TAC to derive the final priorities).

All approved VLA observations are set up using the [Observation Preparation Tool \(OPT\) \(http://go.nrao.edu/opt-doc\)](http://go.nrao.edu/opt-doc). Most, if not all, projects will be observed dynamically; users should submit scheduling blocks before the start of the configuration to maximize the opportunity of them being observed. Advice on the optimal length of scheduling blocks and other useful information may be found at the [Observing FAQ \(http://go.nrao.edu/vla-obsfaq\)](http://go.nrao.edu/vla-obsfaq) web page.

Information about VLA capabilities, proposal preparation and submission, observing strategies, and calibration overhead can be found in the [VLA Observational Status Summary \(http://go.nrao.edu/vla-oss\)](http://go.nrao.edu/vla-oss), at the [Guide to Proposing for the VLA \(http://go.nrao.edu/vla-prop\)](http://go.nrao.edu/vla-prop), and at the [Guide to Observing with the VLA \(http://go.nrao.edu/vla-obs\)](http://go.nrao.edu/vla-obs). Answers to Frequently Asked Questions are contained in these proposing and observing guides. Questions may also be directed to the [NRAO Helpdesk \(http://go.nrao.edu/obsdesk\)](http://go.nrao.edu/obsdesk).

VLBA, HSA, and GMVA Proposal Guide

Proposal submission information for the following three combinations of telescopes are detailed in individual sections below:

- [Very Long Baseline Array](https://science.nrao.edu/facilities/vlba) (<https://science.nrao.edu/facilities/vlba>) (VLBA) and [High Sensitivity Array](https://science.nrao.edu/facilities/vlba/HSA) (<https://science.nrao.edu/facilities/vlba/HSA>) (HSA) proposals requesting time in Semester 2020A (2020 February 1 - 2020 July 31) or multi-semester proposals.
- [Global mm VLBI Array](https://www3.mpifr-bonn.mpg.de/div/vlbi/globalmm/) (<https://www3.mpifr-bonn.mpg.de/div/vlbi/globalmm/>) (GMVA) proposals for 2020 Session I (Apr 23 - 28), or later sessions.

VLBA Proposals

The VLBA provides ultra-high angular resolution for astrophysical studies including:

- Non-thermal continuum emission, including polarimetry, from active galactic nuclei (AGN), Galactic micro-quasars, pulsars, and other sources.
- Maser emission lines of OH (1.7 and 6.0 GHz), CH₃OH (6.7 and 12.2 GHz), H₂O (22 GHz), SiO (43 and 86 GHz) and other molecules, and numerous thermal absorption lines, in a variety of Galactic and extragalactic circumstances.
- Multiple-phase-center surveys across the primary beam.
- Parallax and proper motion via differential astrometry of a variety of stars, star-forming regions, and nearby extragalactic objects, at accuracies as good as 10 microarcsec.
- Absolute astrometry at accuracies of ~200 microarcsec to expand the International Celestial Reference Frame.

Overall information about the VLBA is available in the [VLBA Observational Status Summary](https://science.nrao.edu/facilities/vlba/docs/manuals/oss) (<https://science.nrao.edu/facilities/vlba/docs/manuals/oss>) (OSS); specific sections relevant to various proposal types are linked below.

The VLBA operates two data systems, a Polyphase Filterbank (PFB), and a Digital Downconverter (DDC). These are described in detail in [Section 5.4](https://science.nrao.edu/facilities/vlba/docs/manuals/oss/sig-proc/rdbe) (<https://science.nrao.edu/facilities/vlba/docs/manuals/oss/sig-proc/rdbe>) of the VLBA OSS, which also includes suggestions for selecting the optimal observing system for various scientific goals.

VLBA proposals must be prepared and submitted using the NRAO Proposal Submission Tool (PST), accessible via [NRAO Interactive Services](http://my.nrao.edu/) (<http://my.nrao.edu/>). Use of the PST requires registration by all proposers, including co-investigators, in the NRAO User Database.

Proposals requiring significant additional correlator resources, such as multiple phase centers per field or multiple pulsar phase bins, should consider mechanisms to support the correlation without adversely affecting the throughput of other projects. These should be entered in the technical justification section of the proposal.

Approximately 1000 to 1200 hours of VLBA observing time are expected to be available for Open Skies in observing semester 2020A. **In recent semesters, there has been less pressure in the GST range 0600 - 1800 hours as compared to 1800 - 0600 GST, and we expect this trend to continue.**

4096 Mbps Recording Rate to General Observing on the VLBA (only)

Beginning in 2020A, general observing (GO) on the VLBA (**not** the HSA) will be offered with a maximum recording rate of 4096 Mbps. During semester 20A we expect to be able to support 4096 Mbps recording for ~40% (~400 hours) of the open-skies observing time. Therefore we will allocate 4096 Mbps to the most highly-ranked proposals that request it. Your proposal should indicate whether it could be considered for allocation at 2048 Mbps, perhaps with an increased time request, or dropped from consideration altogether.

NRAO Staff Assistance with VLBA Observation Setup and Data Reduction

Beginning with the 2020A proposal call, NRAO will offer extra staff assistance with VLBA observational setups and data reduction. For the 2020A semester, this offer will pertain to proposals which request only the VLBA (i.e. no HSA, GMVA, or cm Global proposals). Additionally, this offer will be limited in scope to new or novice VLBA users, and will include both observing and data reduction assistance. There will also be limitations in some capabilities which will be supported under this program, for example which bands will be allowed. In order to request this assistance, a new checkbox/text box is available on the General page of VLBA proposals in the Proposal Submission Tool (PST), at the bottom of the page. Please check the checkbox and provide input on your proficiency and/or specific requests in the text box. Note that checking the text box and providing the requested input does not automatically mean that this service will be provided for your proposal. There will be an internal NRAO review of these requests similar to that done for RSRO proposals (see below); the proposal disposition letter will inform the proposers whether or not the service can be provided.

VLBA Filler Proposals

Filler proposals, which are scientifically useful programs which can be scheduled at a large range of GST times, with fewer than 8 stations, low-frequency weather requirements, and short (2 - 6 hours) scheduling blocks, are especially encouraged on the VLBA. Such projects can help to fill "gaps" in the dynamic observing schedule.

VLBA Extra-Large (X-)Proposals

NRAO and GBO will consider submissions of Extra-Large observing proposals (X-proposals for short) at the upcoming 1 August proposal submission deadline. This opportunity is open for observers seeking to use the VLA, VLBA and / or GBT. Extra-Large proposals will be defined as those requesting a total of more than 1000 hours of telescope time and / or extending over four or more observing semesters. Note that the earliest that successful Extra-Large projects could be scheduled is the start of Semester 2020B in August 2020. The opportunity to submit Extra-Large proposals will likely not be repeated for at least three years. Please see the [Announcement of Opportunity for Extra-Large Proposals in the NRAO Newsletter](https://science.nrao.edu/enews/12.5/index.shtml#x-proposals) (<https://science.nrao.edu/enews/12.5/index.shtml#x-proposals>). Details for proposers can be found in the [Extra-Large Proposals](https://science.nrao.edu/observing/call-for-proposals/2020a/extra-large-proposals) (<https://science.nrao.edu/observing/call-for-proposals/2020a/extra-large-proposals>) section in the 2020A Call for Proposals.

VLBA Resident Shared Risk Observing

The VLBA Resident Shared Risk Observing (RSRO) program provides users with early access to new capabilities in exchange for a period of residency in Socorro to help commission those capabilities. For example, the phased-VLA system was developed through RSRO programs. **Users are encouraged to conceive and propose innovative ideas for new VLBA capabilities.** Some staff suggestions are included at the [VLBA RSRO program](https://science.nrao.edu/facilities/vlba/rsro) (<https://science.nrao.edu/facilities/vlba/rsro>) page, along with details for submitting RSRO proposals.

Proposers should be aware that RSRO capabilities are generally not approved at priority A, owing to the level of risk associated with these observations.

High Sensitivity Array (HSA) Proposals

The [HSA \(https://science.nrao.edu/facilities/vlba/docs/manuals/oss/vlba-plus/hsa\)](https://science.nrao.edu/facilities/vlba/docs/manuals/oss/vlba-plus/hsa) comprises the VLBA, phased VLA, GBT, Effelsberg, and Arecibo telescopes. All of the HSA stations are equipped with instrumentation compatible with the VLBA observing capabilities described in [Section 5.4 \(https://science.nrao.edu/facilities/vlba/docs/manuals/oss/sig-proc/rdbe\)](#) of the VLBA OSS. Ongoing special considerations for the HSA telescopes are documented in [OSS Section 14.2 \(https://science.nrao.edu/facilities/vlba/docs/manuals/oss/vlba-plus/hsa\)](#); new features and special cases are cited here.

VLBI observations combining the VLBA with any one or more of the other four HSA stations can be requested in a single HSA proposal. However, separate proposals must be submitted for any *non-VLBI use* of any requested telescopes.

HSA proposals must be prepared and submitted using the NRAO Proposal Submission Tool (PST), accessible via [NRAO Interactive Services \(http://my.nrao.edu/\)](http://my.nrao.edu/). Use of the PST requires registration by all proposers, including co-investigators, in the NRAO User Database. The inclusion of HSA stations should be quantitatively justified in the proposal.

- **The phased Very Large Array (Y27)** will be available for HSA observing in Semester 2020A, in the **C** and **B** configurations. High frequencies (at receiver bands 22 GHz and above) have better phasing in the more compact configurations (**C** and **D**). High frequency phasing in the extended configurations in the summer can be quite difficult.
- **The Green Bank Telescope (Gb), has transitioned into a new partnership arrangement, the Green Bank Observatory (GBO).** Time available for VLBI on the GBT will be reduced compared to earlier years, and only the most highly rated proposals across all GBT observation types will be awarded time. Additionally, proposers should be aware that long scheduling blocks (more than 6 hours) will be very difficult to schedule owing to constraints coming from non-NSF [GBO \(http://www.greenbankobservatory.org/\)](http://www.greenbankobservatory.org/) partners. Proposers are encouraged to make clear in the technical justification section any constraints about how observing time could be broken into smaller pieces without adversely affecting the proposed science; include information as relevant regarding maximum elapsed time of a split schedule and minimum scheduling block lengths.

Observations using the GBT 6-cm receiver as part of the HSA must be taken, correlated, and calibrated in full Stokes mode. Due to the large cross-talk between polarizations, only total intensity (Stokes I) data will be usable.

- **The Effelsberg (Eb) 100-m telescope** supports both the PFB and DDC observing systems available on the VLBA. Consult this [web page \(https://eff100mwiki.mpifr-bonn.mpg.de/doku.php?id=information_for_astronomers:user_guide:eb-hsa\)](https://eff100mwiki.mpifr-bonn.mpg.de/doku.php?id=information_for_astronomers:user_guide:eb-hsa) for more detailed information about the Eb HSA station.
- **The Arecibo (Ar) 305-m telescope** is currently available only with the PFB observing system, but an upgrade is in progress to accommodate Mar 6 + DDC-8. The status of this project for future calls will be available on the [AO VLBI website \(https://www.naic.edu/~astro/aovlbi\)](https://www.naic.edu/~astro/aovlbi). The sensitivity of VLBI observations with Ar changed after the 2017 hurricanes at the station, due to flooding which altered the shape of a portion of the main reflector. Please use the [EVN Sensitivity Calculator \(http://www.evlbi.org/cgi-bin/EVNcalc\)](http://www.evlbi.org/cgi-bin/EVNcalc) for the most up-to-date values.

Global 3mm VLBI Array (GMVA) Proposals, including Phased ALMA

GMVA proposals submitted by the 2019 August 1 deadline will be considered for scheduling in 2020 Session I (Apr 23 - Apr 28), or later sessions.

Complete information on the GMVA is available at the [GMVA website \(https://www3.mpifr-bonn.mpg.de/div/vlbi/globalmm/\)](https://www3.mpifr-bonn.mpg.de/div/vlbi/globalmm/). Ongoing special considerations for the GMVA are documented in [Section 14.3 \(https://science.nrao.edu/facilities/vlba/docs/manuals/oss/vlba-plus/gmva\)](https://science.nrao.edu/facilities/vlba/docs/manuals/oss/vlba-plus/gmva) of the VLBA OSS; new features and/or special cases are cited here.

As noted in the HSA section above, GBT time available for VLBI has been reduced due to its new partnership arrangements.

GMVA proposals must be prepared and submitted using the NRAO Proposal Submission Tool (PST), accessible via [NRAO Interactive Services \(http://my.nrao.edu/\)](http://my.nrao.edu/). Use of the PST requires registration by all proposers, including co-investigators, in the NRAO User Database. The inclusion of the GBT in a GMVA proposal should be quantitatively justified. The KVN must be specified by entering "KVN" as "Other" entries in the PST.

The GMVA will record at the highest bitrate which instrumentation and resources permit. Currently all telescopes will record at 2048 Mbps. The GMVA observatories are working to increase the default recording bitrate to 4096 Mbps in the near future.

GMVA proposals requesting the phased ALMA telescope should not be submitted at the 1 Aug 2019 (semester 2020A) deadline.

Documentation and Assistance

Detailed Information about the VLBA instrument, its capabilities, observing strategies, proposal preparation and submission, and observation preparation, can be found in the [VLBA Observational Status Summary \(http://go.nrao.edu/vlba-oss\)](http://go.nrao.edu/vlba-oss), at the [Guide to Proposing for the VLBA \(https://science.nrao.edu/facilities/vlba/proposing\)](https://science.nrao.edu/facilities/vlba/proposing), and at the [Guide to Observing with the VLBA \(https://science.nrao.edu/facilities/vlba/observing\)](https://science.nrao.edu/facilities/vlba/observing). Answers to Frequently Asked Questions are contained in these proposing and observing guides. Questions may also be directed to the [NRAO Helpdesk \(http://go.nrao.edu/obshelp\)](http://go.nrao.edu/obshelp).

Joint Proposals

Joint Proposals with External Facilities

Here we list opportunities for joint proposals with several external (non-AUI) facilities. Agreements for Joint Observations with external facilities were made at different times across the boundaries when the NRAO was split into multiple observatories (NRAO, GBO, and LBO) in 2017, and when the LBO was reintegrated back into the NRAO in 2019. Therefore, the agreements below will sometime mention various combinations of the NRAO, GBO, and LBO. Regardless, access to the Joint Observing program will continue for the VLA, VLBA, and GBT for semester 20A.

Joint Observations with XMM-Newton Project

By agreement with the NRAO and GBO Observatories, detailed in a [Memorandum of Understanding \(https://science.nrao.edu/observing/call-for-proposals/nrao-gbo-lbo-xmm-newton-mou\)](https://science.nrao.edu/observing/call-for-proposals/nrao-gbo-lbo-xmm-newton-mou), the XMM-Newton Project may award up to 3% of NRAO/GBO open skies observing time. Similarly the NRAO/GBO Time Allocation Committee may award up to 150 ks of XMM-Newton time per year. See the [Joint Observations with XMM-Newton \(https://science.nrao.edu/observing/call-for-proposals/2020a/new-opportunity-joint-observations-with-xmm-newton\)](https://science.nrao.edu/observing/call-for-proposals/2020a/new-opportunity-joint-observations-with-xmm-newton) page for details.

Joint Observations with Chandra X-ray Observatory

The community has the opportunity to propose for observing time on NRAO facilities through a joint program with the Chandra X-ray Observatory. Proposers to the NRAO have the opportunity to request time on Chandra, to be awarded on the recommendation of the NRAO Telescope Allocation Committee (TAC) and approved by the NRAO Director. Up to 120 ksec will be made available to NRAO proposers annually. See the [Joint Observations with Chandra \(https://science.nrao.edu/observing/call-for-proposals/2020a/chandra\)](https://science.nrao.edu/observing/call-for-proposals/2020a/chandra) page for details.

Joint Observations with the Hubble Space Telescope (HST)

By agreement between the NRAO and the Space Telescope Science Institute, STScI can award up to 3% of the available time on NRAO's North American facilities to highly ranked proposals that request time on both HST and NRAO telescopes. In return, STScI has offered 30 orbits of HST time for allocation by the NRAO TAC per year. See the [Joint Observations with HST \(https://science.nrao.edu/observing/call-for-proposals/2020a/hubble-space-telescope\)](https://science.nrao.edu/observing/call-for-proposals/2020a/hubble-space-telescope) page for details.

Joint Observations with Swift Gamma-Ray Burst Mission

To foster correlative observations, a joint Swift/NRAO observing program has been established, detailed in a [Memorandum of Understanding \(http://swift.gsfc.nasa.gov/proposals/nrao.html\)](http://swift.gsfc.nasa.gov/proposals/nrao.html). By this agreement, the Swift Program permits NRAO to award up to 300 kiloseconds of Swift observing time per year. Similarly, NRAO permits the Swift Guest Investigator (GI) Program to award NRAO observing time. See the [Joint Observations with Swift \(https://science.nrao.edu/observing/call-for-proposals/2020a/swift\)](https://science.nrao.edu/observing/call-for-proposals/2020a/swift) page for details.

Joint Observations with Fermi Gamma-ray Space Telescope

It is possible to propose for observing time on NRAO facilities through the Fermi Gamma-ray Space Telescope Joint Proposal Opportunity or the Cooperative Proposal Opportunity. See the [Joint Observations with Fermi \(https://science.nrao.edu/observing/call-for-proposals/2020a/fermi\)](https://science.nrao.edu/observing/call-for-proposals/2020a/fermi) page for details.

Joint Proposals Between the VLA, GBT, and VLBA

Observing programs that require combinations of the GBT, VLBA, and/or the VLA should submit a proposal for each of the requested telescopes, with a clear justification for each, as has been the case to date. The

proposals will be reviewed and considered jointly by the Time Allocation Committee. VLBI proposals which request the GBT or VLA (or any other HSA telescope) as elements of the VLBI array do not need separate proposals---those telescopes can be selected as separate VLBI stations from a VLBA/HSA proposal.

Alerts & Tips for Proposers

Change to the Science Categories

The ETP science category will be split into two in order to manage the increasing number of proposals received in this science area. The new categories will be:

GWT – Gravitational Waves and Energetic Transients: supernovae, gravitational wave sources, gamma-ray bursts, tidal disruption events, fast radio bursts, exotic/unknown transients.

PCO – Pulsars and Compact Objects: millisecond pulsars, cataclysmic variables, black hole and/or neutron star x-ray binaries, pulsar timing, pulsar proper motion.

All proposals submitted on or after 4 January 2019 will need to specify one of the following nine [science categories](https://science.nrao.edu/observing/proposal-types/proposal-science-categories) (<https://science.nrao.edu/observing/proposal-types/proposal-science-categories>): SSP, GWT, PCO, SFM, ISM, NGA, EGS, AGN or HIZ.

Source Lists

The Observatory requires proposers to specify their source lists in full. This enables the Observatory to identify potential conflicts between observing programs and to better understand scheduling pressure on the instruments it operates. It may be the case that the final target list has not been selected at the time a proposal is submitted. In such cases, all potential targets and fields should be listed. The only exceptions to this requirement are for Triggered proposals to observe targets that are unknown a priori. Proposal source lists are not made public by the Observatory.

Dissertation Plans

Students PROPOSING to use an NRAO telescope for their PhD dissertation **MUST** submit a "Plan of Dissertation Research" **IF THEY CHECK THE THESIS BOX ON THE PST. THE PLAN SHOULD BE** no more than 1000 words, **AND SUBMITTED** with their first proposal. This plan can be referred to in later proposals. **The Plan of Dissertation is important in the proposal review process and should be well written; it is not a placeholder.** At a minimum it should contain:

- A summary of thesis science and goals.
- The role played by NRAO observations being proposed.
- A thesis time line.
- The adviser name and institution.
- An estimate of the total NRAO telescope resources needed.

The plan provides some assurance against a dissertation being impaired by adverse referee comments on one proposal, when the referees do not see the full scope of the project. This requirement applies to all three of the NRAO major instruments: VLA, VLBA and GBT.

The Plan of Dissertation Research can be uploaded either from the Author's page or from the student's user profile at: Profile > My Profile > User Preferences. The Plan of Dissertation Research is associated with an Author which can then be used in one or more proposals. The Plan of Dissertation Research field here is only used to display the current status. For example, if there are no students listed on the proposal who are observing for their thesis the text box will display: Dissertation Research Plan(s) not required"

Tips for Proposers

The NRAO proposal evaluation and time allocation process is panel based. That is, members of the scientific community are responsible for reviewing proposals based on their scientific merit through the [Science Review Panels \(https://science.nrao.edu/observing/proposal-types/proposal-review-system\)](https://science.nrao.edu/observing/proposal-types/proposal-review-system). As a means of broadening the scientific perspective of its reviewers, and of increasing the participation of the wider astronomy and astrophysics community in the science program of NRAO facilities, SRP membership is deliberately selected to include some colleagues that are not necessarily experts in radio observational techniques. This being the case, we encourage proposers to consider the following when preparing their proposals:

1. Avoid the use of radio astronomy jargon
2. Do not assume the reader is familiar with a particular observing technique - explain it briefly
3. Do not assume the reader is familiar with an earlier rationale for a developing line of research - provide adequate historical context and connect the dots as necessary
4. Describe previous observations and publications relevant to the proposed observations
5. If a particular point source or brightness temperature sensitivity is required, justify it.

Useful Resources & Tools

Note: you must be a registered NRAO user to access some of these resources. Please go to [NRAO Interactive Services \(http://my.nrao.edu/\)](http://my.nrao.edu/). If you are already a registered user, you are encouraged to update your profile.

Proposal Submission Tool

The Proposal Submission Tool and associated documentation is accessed through [NRAO Interactive Services \(http://my.nrao.edu/\)](http://my.nrao.edu/).

Proposal Finder Tool

The [Proposal Finder Tool \(http://library.nrao.edu/proposals\)](http://library.nrao.edu/proposals) (PFT) may be used to search cover sheets of proposals approved for time on NRAO telescopes. The PFT returns the proposal's authors, title, abstract, and, if available, approved hours.

Very Large Array (VLA)

- [VLA Observational Status Summary \(http://go.nrao.edu/vla-oss\)](http://go.nrao.edu/vla-oss)
- [Guide to Proposing for the VLA \(http://go.nrao.edu/vla-prop\)](http://go.nrao.edu/vla-prop)
- [Guide to Observing with the VLA \(http://go.nrao.edu/vla-obs\)](http://go.nrao.edu/vla-obs)
- [VLA Configuration Plans and Science Time Available \(http://go.nrao.edu/vla-plan\)](http://go.nrao.edu/vla-plan)
- [VLA Exposure Calculator \(http://go.nrao.edu/ect\)](http://go.nrao.edu/ect)

Very Long Baseline Array (VLBA)

- [VLBA Observational Status Summary \(https://science.lbo.us/facilities/vlba/docs/manuals/oss\)](https://science.lbo.us/facilities/vlba/docs/manuals/oss)
- High Sensitivity Array
 - [VLBA+ Observing \(https://science.lbo.us/facilities/vlba/docs/manuals/oss/vlba-plus\)](https://science.lbo.us/facilities/vlba/docs/manuals/oss/vlba-plus)
 - [Observing with the High Sensitivity Array \(https://science.lbo.us/facilities/vlba/proposing/HSA-Tips\)](https://science.lbo.us/facilities/vlba/proposing/HSA-Tips)
 - [VLBI at the VLA \(https://science.lbo.us/facilities/vla/docs/manuals/obsguide/modes/vlbi\)](https://science.lbo.us/facilities/vla/docs/manuals/obsguide/modes/vlbi)
 - [VLBI on the GBT \(http://www.gb.nrao.edu/~fghigo/gbt/doc/vlbinfo.html\)](http://www.gb.nrao.edu/~fghigo/gbt/doc/vlbinfo.html)
- [VLBA/HSA Sensitivity \(via EVN Sensitivity Calculator\) \(https://www.evbi.org/cgi-bin/EVNcalc\)](https://www.evbi.org/cgi-bin/EVNcalc) Note that the EVN sensitivity calculator does not currently allow a computation for 4096 Mbps (Shared Risk for the VLBA only for semester 2019B). Use the calculator for 2048 Mbps and divide the sensitivity calculated by $\sqrt{2}$.
- Observing
 - [SCHED User Manual \(http://www.aoc.nrao.edu/software/sched\)](http://www.aoc.nrao.edu/software/sched)
 - [VLBA Calibrator Search Tool \(https://www.lbo.us/vlba/astro/calib/\)](https://www.lbo.us/vlba/astro/calib/)

NRAO Helpdesk

For help on any aspect of proposing or observing not found in our documentation, please file a ticket with the [NRAO helpdesk \(https://help.nrao.edu/\)](https://help.nrao.edu/).



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