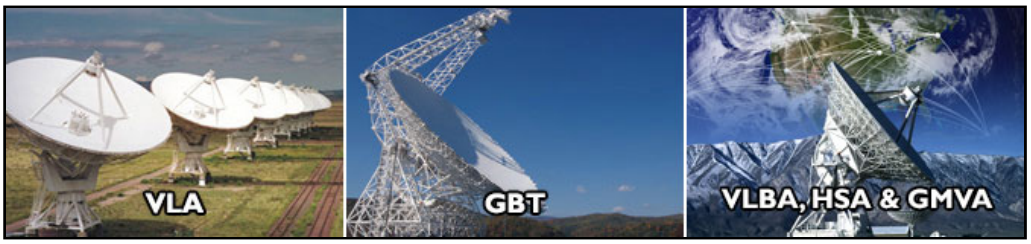
NRAO Call for Proposals: Semester 2016B

5 January 2016



The National Radio Astronomy Observatory (NRAO) invites scientists to participate in the NRAO Semester 2016B Call for Proposals for the Green Bank Telescope (GBT), Very Large Array (VLA), and Very Long Baseline Array (VLBA), High Sensitivity Array (HSA), and Global 3mm VLBI Array (GMVA).

The submission deadline for Semester 2016B proposals is Monday, 1 February 2016, at 17:00 EST (22:00 UTC).

The NRAO especially wishes to highlight continuing opportunities for joint observations with the **Chandra X-ray Observatory**, the **Hubble Space Telescope** and the **Swift Gamma-Ray Burst Mission**.

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

News & Opportunities

NRAO Time Allocation Under a New Cooperative Agreement

Beginning on October 1, 2016, the NRAO will operate under a new 10-year cooperative agreement between the National Science Foundation (NSF) and Associated Universities Inc. (AUI). The agreement includes operation of the Karl G. Jansky Very Large Array (VLA), the North American share of the international Atacama Large Millimeter/ submillimeter Array (ALMA), and the Central Development Laboratory (see the AUI news article (http://www.aui.edu/news/just-announced-associated-universities-inc-has-been-selected-as-the-management-organization-for-the-national-radio-astronomy-observatory-largest-nsf-cooperative-agreement-ever-for-astronomical-res/)). The Robert C. Byrd Green Bank Telescope (GBT) and the Very Long Baseline Array (VLBA) will continue to be managed by AUI under a separate cooperative agreement for the foreseeable future. AUI is working with the NSF on a path forward that continues operations of these world-leading facilities and integrates them into an overarching vision for astronomy research. The current call for proposals for semester 2016B straddles the transition of the NRAO to the new cooperative agreement. From the user perspective, for the moment there is no change in the way in which NRAO conducts its telescope time allocation process for the VLA, GBT, and VLBA. Users should propose for observing time in semester 2016B on the GBT and VLBA through the NRAO using the same procedures and software tools used in previous semesters. We will inform the community of any developments that may impact their use of the GBT or the VLBA as soon as they are known.

New Opportunity

ALMA Available for the Global 3mm VLBI Array (GMVA)

New for semester 2016B, phased ALMA may be requested as part of the GMVA. Both the phased ALMA and the Large Millimeter Telescope (see the 2015A call for proposals (https://science.nrao.edu/observing/call-for-proposals/2015A)) can be selected using the *Other Stations* text field in the PST. Successful proposals will be considered for scheduling in ALMA Cycle 4, corresponding to the Spring 2017 GMVA session. Please see the section on VLBA, HSA, and GMVA proposals in this Call.

Continuing Opportunities:

Joint Observations with Chandra X-ray Observatory

In previous semesters, the community has had the opportunity to propose for observing time on NRAO facilities through a joint program with the Chandra X-ray Observatory. The NRAO would like to alert the community to the fact that, beginning in semester 2016A proposers to the NRAO will 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/2016B/chandra) page for details.

Joint Observations with the Hubble Space Telescope (HST)

By agreement between the NRAO and the Space Telescope Science Institute, STScI will be able to 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 to proposals submitted for the NRAO deadlines for Semester 2016B and Semester 2017A. See the Joint Observations with HST (https://science.nrao.edu/observing/call-for-proposals/2016B/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) . 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/2016B/swift) page for details.

Joint Observations with Fermi Gamma-ray Space Telescope

We remind the community that 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/2016B/fermi) page for details.

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. There are opportunities for so-called "filler" programs on the GBT, VLA, and VLBA.

Further information about each of these programs can be found here (https://science.nrao.edu/observing/proposal-types/proposal-opportunities) .

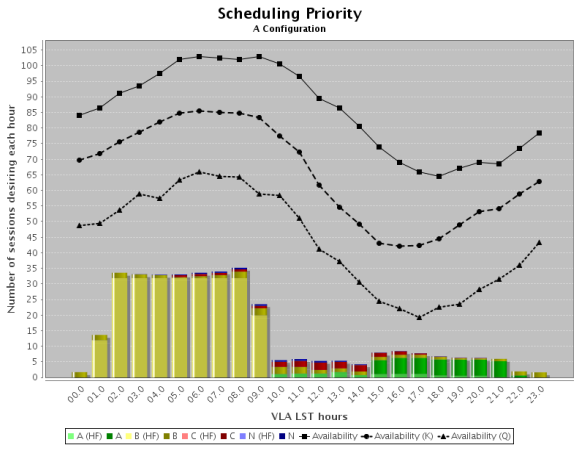
Very Large Array (VLA) Proposals

VLA Configuration Plans and Science Time Available

The 1 February 2016 deadline covers the observing period 23 September 2016 through 23 January 2017 (Semester 2016B), corresponding to the A configuration. Multi-configuration proposals that include the A configuration may also be submitted. Additionally, proposals requesting only configurations that will fall in semester 2017A (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) for details and availability of upcoming configurations.

Note that semester 2016A was the last semester NRAO offered any hybrid configuration. Proposers with very southern or northern targets should consult the Array Configurations (http://go.nrao.edu/array) section of the Guide to Proposing for the VLA (http://go.nrao.edu/vla-prop) on how to combine principal configurations to obtain similar surface brightness sensitivity to the hybrids.

A plot of estimated available observing hours as a function of LST and weather conditions for the A configuration in semester 2016B is below. In this plot, engineering, maintenance, and 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 time already committed in previous proposal rounds, where green represents priority A, yellow priority B, and red priority C. For the net available time in 2016B per LST hour subtract the bars of the pre-committed time from the black curve.

Observing Capabilities for Semester 2016B

The capabilities offered for 2016B through our General Observing (GO) program are similar to those offered for 2016A, with the exception that recirculation by up to a factor of 64 can now provide as many as 1,048,576 channels (subject to the data rate limits noted below and the chosen subband bandwidth); details are given in the Proposing for the VLA (http://go.nrao.edu/vla-capabilities) section of the Observational Status Summary (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	Standard default setups for: ◦ 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) 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 Single, dual, and full polarization products
3-bit samplers	Standard default setups for: ◦ 8 GHz bandwidth continuum observations at K/Ka/Q-bands ◦ 6 GHz bandwidth at Ku-band ◦ 4 GHz bandwidth at C/X-bands Flexible setups for spectroscopy, using four, independently tunable, 2 GHz baseband pairs, each of which can be split into up to 16 flexibly tunable sub-bands Single, dual, and full polarization products
Mixed 3-bit and 8-bit samplers	Allows more flexibility for simultaneous continuum and high-resolution spectral line observing
Sub-arrays	Up to 3 independent subarrays using standard 8-bit continuum setups
Phased array for VLBI	See VLBA-HSA-VLBI section of this Call for Proposals

Both single pointing and mosaics with discrete, multiple field centers will be supported. Data rates up to 25 MB/s (90 GB/hour) will be available to all users and, with additional justification, data rates up to 60 MB/s (216 GB/hour) will be available. Correlator integration time limits per band and per array configuration (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) , especially at Ka-band; please consult the OSS for further details. Additionally, the Exposure Calculator (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)). 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).

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 well tested. The following capabilities are offered under the SRO program in Semester 2016B:

- On-the-Fly (OTF) mosaicing (used when each pointing on the sky is no more than a few seconds)
- 32 subbands per baseband with the 8-bit samplers

See the VLA Proposal Submission Guidelines (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 Semester 2016B include:

- correlator dump times shorter than 50 msec, including integration times as short as 5 msec for transient detection;
- pulsar observations;
- data rates above 60 MB/s;
- recirculation beyond a factor of 64 in the correlator;
- P-band system (230–470 MHz) polarimetry and spectroscopy;
- 4-band system (54–86 MHz; see Low Frequency Observing section below);
- more than 3 subarrays, or sub-arrays with the 3-bit system;
- complex phased array observations (e.g., pulsar and complex VLBI observing modes); and
- frequency averaging in the correlator: a new capability for averaging to wider frequency channels in the correlator has been developed that will reduce the data volume for all continuum subbands

A detailed description of the VLA RSRO program for semester 2016B and beyond is available at the VLA Proposal Submission Guidelines (http://go.nrao.edu/vla-steps) web page.

Low Frequency Observing

The new low frequency receiver system developed in collaboration with the Naval Research Laboratory is available for Stokes I continuum observations at P-band (230–470 MHz) through the GO program. Use of the P-band system for polarimetry and/or spectroscopy is through the RSRO Program. The new receivers also work at 4-band (54–86 MHz), and new feeds will be deployed on at least ten (and up to fourteen) VLA antennas. Both 4-band and P-band can be observed simultaneously, but access to the 4-band system is only available through the RSRO program.

Finally, the commensal VLITE (http://vlite.nrao.edu/) system will take data at P-band during regular observations that use bands other than P-band. The VLITE system is deployed on ten 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/) web page for doing so.

Proposal and Observation Preparation

Proposal preparation and submission are via the Proposal Submission Tool (PST) at NRAO Interactive Services (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) 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, the TAC will assign a scheduling priority to each session in each proposal. 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), the total time requested in the session, and the competition from better-ranked proposals requesting time at similar LSTs. Please see the description of the VLA prioritizer (http://www.aoc.nrao.edu/~schedsoc/VLAprioritizerMemo.pdf) for further details.

All approved VLA observations are set up using the Observation Preparation Tool (OPT) (http://go.nrao.edu/opt-doc) . Most, if not all, projects will be observed dynamically; users should submit scheduling blocks early in 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) 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) , at the Guide to Proposing for the VLA (http://go.nrao.edu/vla-prop) , at the Guide to Observing with the VLA (http://go.nrao.edu/vla-obs) , and at the Observing FAQ (http://go.nrao.edu/vla-obsfaq) web page. Questions may also be directed to the NRAO Helpdesk (http://go.nrao.edu/obshelp) .

Green Bank Telescope (GBT) Proposals

The 1 February 2016 deadline is for the Semester 2016B GBT observing period: 1 August 2016 – 31 January 2017.

Details of all GBT observing modes are in the The Proposer's Guide for the Green Bank Telescope (https://science.nrao.edu/facilities/gbt/proposing/GBTpg.pdf) . Proposers should also consult the more general document The Performance of the GBT: A Guide for Planning Observations (http://www.gb.nrao.edu/~rmaddale/GBT/ReceiverPerformance/PlaningObservations.htm) . Proposers should make sure that they are familiar with the latest versions of these documents before writing their proposal.

The GBT receivers, backends, and observing modes that are available in Semester 2016B are listed in Tables 1 and 2 below.

Table 1: GBT Receivers

Receiver	Frequency Range
Prime Focus 1	290-920 MHz
Prime Focus 2	910-1230 MHz
L-band	1.15-1.73 GHz
S-band	1.73-2.60 GHz
C-band (linear only - see below)	3.8-8.0 GHz
X-band	8.0-11.6 GHz
Ku-band	12.0-15.4 GHz
K-band Focal Plane Array (7 pixels)	18.0-26.0 GHz
Ka-band	26.0-39.5 GHz
Q-band	38.2-49.8 GHz
W-band	67-93.3 GHz
ARGUS (shared risk - see below)	80-115.3 GHz, Private PI instrument

Table 2: GBT Backends and Observing Modes

Backend	Observing Modes
Versatile Green Bank Astronomical Spectrometer (VEGAS)	Continuum (see below), spectral line
Digital Continuum Receiver (DCR)	Continuum
Green Bank Ultimate Pulsar Processing Instrument (GUPPI)	Pulsar
Mark V Very Long Baseline Array Disk Recorder	Very Long Baseline Interferometry
Caltech Continuum Backend (CCB)	Continuum
JPL Radar backend	Private PI instrument - Open for Public Use
Radar	Private PI instrument

C-band: Proposals wishing to use the GBT C-band receiver should only use linear polarization outputs. The circular polarization of the receiver is currently not preforming correctly and we will not accept any proposals to use the circular polarization output of this receiver.

C-band VLBI on the GBT: NRAO will only accept proposals for VLBI Stokes I continuum observations using the GBT C-band receiver. All other VLBI observations requesting the C-band receiver on the GBT will be disregarded. Please see the HSA section (https://science.nrao.edu/observing/call-for-proposals/2016B/vlba-hsa-vlbi-proposals) of the call for proposals for more details.

VEGAS:

Continuum: All modes of VEGAS may now be used for continuum observations. We were not able to update the Proposal Submission Tool to reflect this situation before the proposal call was released. Proposers should use the spectral line modes of VEGAS to choose the desired bandwidth and then note in the technical justification that the observations will be for continuum measurements.

Pulsar: VEGAS pulsar modes are not yet released for use. **Proposals for VEGAS pulsar observations will not be accepted.**

ARGUS: Observers interested in shared-risk observations using the ARGUS instrument should see http://www.gb.nrao.edu/argus/ (http://www.gb.nrao.edu/argus/) for further information. All ARGUS proposals must have permission from the instrument development team.

VLBI: All Very Long Baseline Interferometry (VLBI) proposals requesting the GBT should include any needed setup and overhead time in the time request of their proposals. HSA proposals requesting the GBT should provide a justification for needing large aperture antennas. C-band VLBI observers should see C-band note above.

470-700 MHz RFI Digital TV transmissions above 470 MHz will make observing very difficult with the 450 and 600 MHz feeds of the PF1 receiver. Available RFI plots do not show the strength of these signals as they overpower the system: they are too low by a factor of 10 to 50. Observers should consult the GBT support scientists before submitting a proposal for these feeds.

MUSTANG: NRAO will not accept any proposals to use MUSTANG, MUSTANG1.5 or MUSTANG2.0 at the 1 February 2016, deadline.

Mapping If you are considering mapping with the GBT such that there are major turns or moves (end of rows in raster map, change in position for pointed maps, etc.) that occur with a cadence faster than every 30 seconds, you will need to consult with a GBT support scientist to ensure that the GBT can safely withstand the stresses induced by the mapping motions.

Scheduling

The GBT is scheduled by the Dynamic Scheduling System (DSS) (http://www.gb.nrao.edu/DSS) . The DSS system is fully described in theGBT Proposer's Guide (https://science.nrao.edu/facilities/gbt/proposing/GBTpg.pdf) and the GBT Observer's Guide (https://science.nrao.edu/facilities/gbt/observing/GBTog.pdf) .

GBT Proposal Preparation

Proposers should consult the The Performance of the GBT: A Guide for Planning Observations (http://www.gb.nrao.edu/~rmaddale/GBT/ReceiverPerformance/PlaningObservations.htm) and the GBT Observer's Guide (http://www.gb.nrao.edu/gbtprops/obsman/GBTog.pdf) . All proposers, including pulsar proposers, should

use the GBT Sensitivity Calculator (https://dss.gb.nrao.edu/calculator-ui/war/Calculator_ui.html) . Please see the Calculator's User's Guide (https://dss.gb.nrao.edu/docs/Calculator_ug.pdf) for instructions. The Sensitivity Calculator results can be cut and pasted into the Technical Justification section of the proposal. This will streamline the creation of your Technical Justification and will increase your chances of getting a positive technical review. If you are planning on making maps with the GBT, you should use the GBT Mapping Calculator (http://www.gb.nrao.edu/~rmaddale/GBT/GBTMappingCalculator.html) tool.

The GBT observing policies (https://science.nrao.edu/facilities/gbt/observing/policies) describe the telescope's remote observing restrictions.

Proposers requesting GBT participation in High Sensitivity Array (HSA), Very Long Baseline Array (VLBA), or Global Millimeter Very Long Baseline Interferometry (GMVA) observations should consult the VLBA, HSA, and GMVA section of this Call.

GBT Shared Risk Observing

Observers requesting instruments that are shared-risk will be expected to travel to Green Bank for observations. The observers will be expected to help commission the instruments, to help debug observing and data reduction software, as well as helping to develop data reduction and calibration schemes.

Proposals to use ARGUS (80-115.3 GHz) will be accepted with the instrument development team's permission. NRAO will consider shared-risk proposals for Semester 2016B observations with this instrument.

Limited Time for "Fixed" and "Windowed" Observations

Due to varied pressures on the GBT's schedule, the amount of time that can be accepted for fixed time observations (e.g. VLBI, pulsar transit observations, etc.) and windowed observations (e.g. monitoring observations) will be limited for the proposal call. Proposals needing fixed and windowed observations will likely have to be ranked at least in or near the top decile in order to be accepted.

Limited Receiver Availability

Due to contractual obligations, the Prime Focus 800 MHz feed will only be available for approximately two weeks each month. The Prime Focus 342 MHz feed will only be available for approximately one week per month. The other Prime Focus feeds (450, 600 and Prime Focus 2) will likely only be considered for installation if a proposal requesting one of those feeds is ranked in the top decile of proposals and there is a significant time request for that receiver from all accepted proposals.

Other GBT Gregorian receivers may only be available during a few short, two or three week periods during the semester.

Very Long Baseline Array (VLBA), High Sensitivity Array (HSA), & Global 3mm VLBI Array (GMVA) Proposals

The 1 February 2016 deadline applies to all types of Very Long Baseline Array (VLBA (https://science.nrao.edu/facilities/vlba)) and High Sensitivity Array (HSA (https://science.nrao.edu/facilities/vlba/proposing/HSA)) proposals requesting time in semester 2016B (1 August 2016 – 31 January 2017) or multi-semester proposals. It also applies to global mm VLBI proposals for the Fall 2016 (September 29 – October 3), or later, sessions. Please see the summary instructions (https://science.nrao.edu/facilities/vlba/proposing/gvlbi) for submitting VLBA, HSA, and global mm and cm VLBI proposals. Requests for resources beyond just the VLBA—i.e., the inclusion of HSA or Global 3mm VLBI (GMVA) stations—need to be quantitatively justified in the proposal.

VLBA Observing Capabilities

The VLBA provides ultra-high angular resolution for observations of non-thermal continuum emission, maser lines of OH (1.7 and 6.0 GHz), CH_3OH (6.7 and 12.2 GHz), H_2O (22 GHz), SiO (43 and 86 GHz) and other molecules, and absorption-line studies of numerous thermal spectral lines. The VLBA operates two data systems. In the following summary, an IF is one of the four 512 MHz signals carried on cables from the antenna's vertex to the control building; a channel refers to a single contiguous frequency range of any bandwidth, observed in a single polarization, that is sampled, filtered, and recorded as a separate entity. The two data systems comprise the following:

- The Polyphase Filterbank (PFB) observing system provides sixteen 32 MHz channels with a fixed 2048 Mbps recording rate. The channels can be selected flexibly between two VLBA IF inputs. Channel placement is restricted to 32 MHz steps along the frequency axis.
- The Digital Downconverter (DDC) observing system is considerably more flexible than the PFB. As many as eight channels can be arbitrarily selected from up to four VLBA IFs and placed at 15.625 kHz steps on the frequency axis with bandwidths ranging from 1 MHz to 128 MHz by factors of two. Extremely narrow bands can be accommodated by observing at 1 MHz bandwidth and selecting a narrower range using the DiFX correlator's spectral zoom mode. Channels may not span either of two zone boundaries, at 640 and 896 MHz within the IF band. The 128 MHz bandwidth is limited to a maximum of 4 channels by the maximum 2048 Mbps recording rate.

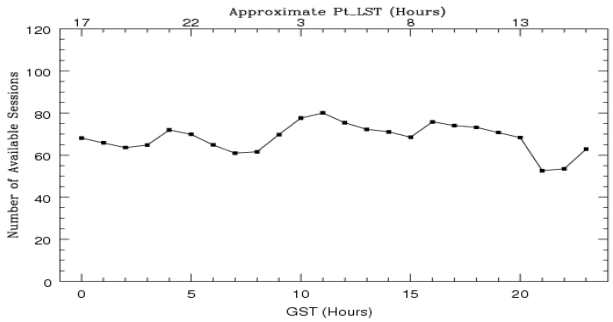
Wideband science is possible using either the PFB observing system at its fixed 2048 Mbps data rate, or the DDC system at 2048 Mbps or lower rates. Further details are available in the VLBA Observational Status Summary (https://science.nrao.edu/facilities/vlba/docs/manuals/oss) . It is anticipated that the pool of recording media will support the highest data rates for approximately half of all observing hours. Spectroscopic and other narrow-band observations will generally be best supported by the DDC system. Inputs to either data system can come from any of the four VLBA IFs. Typically only two are available, in opposite polarizations; some receivers support less common modes, such as dual-polarization dual-frequency. The four IF capability of the DDC allows these modes to be exploited.

Proposals requiring significant additional correlator resources, such as multiple phase centers per field, should address mechanisms to support the correlation without adversely affecting the throughput of other projects.

Available VLBA Observing Time

Because of the high demand for Galactic time from ongoing Large programs, proposers should be aware that

the available time on the VLBA can be distributed non-uniformly across the sky and across the semester. The plot below shows the estimated time available for new scientific observations, as a function of Pie Town LST and GST; that is, the number of available days in the semester per GST hour.



VLBA Filler Project Challenge

NRAO continues to solicit proposals for one or more Large projects for up to 750 hours per semester of filler time on the VLBA. To be eligible for this large time allocation with FILLER status the project should be flexible enough to be scheduled:

- with non-ideal weather conditions;
- with less than the full complement of antennas;
- with a target list of source positions around the sky; and
- with short duration or variable length scheduling blocks.

Teams must provide tools that allow VLBA operations, with minimal effort, to create schedules for arbitrary blocks of time of one hour or longer when such time becomes available during dynamic scheduling. Large proposals for VLBA filler time will be subject to the usual NRAO Large Proposal Policy (https://science.nrao.edu/observing/proposal-types/largeproppolicy) . Multi-semester proposals will be considered. Types of projects that might use VLBA filler time include: surveys of many sources, deep integrations spread over many sessions, and long term monitoring. It is rare for fewer than 6 antennas to be functional and have good observing conditions; high frequency projects that can use a reduced array are therefore viable. Regular proposals that can utilize the same sort of VLBA filler time are also encouraged.

VLBA Resident Shared Risk Observing Program

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. **We encourage innovative ideas for new VLBA capabilities from the user community**. Some suggestions from NRAO staff are included at the VLBA RSRO program (https://science.nrao.edu/facilities/vlba/proposing/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)

The HSA (https://science.nrao.edu/facilities/vlba/proposing/HSA) comprises the VLBA, phased VLA, GBT, Effelsberg, and Arecibo telescopes. All of these are equipped with instrumentation compatible with the VLBA Observing Capabilites described above. Additionally, we are pleased to offer access to the Large Millimeter Telescope Alfonso Serrano (http://www.lmtgtm.org/) (LMT) in Mexico for use at 3mm in combination with the VLBA, and optionally the GBT, through the VLBA Resident Shared Risk Observing (https://science.nrao.edu/facilities/vlba/proposing/rsro) program described above.

The phased VLA (Y27) will be available for HSA observing in semester 2016B, in its A configuration (see theVLA section of this Call for Proposals (https://science.nrao.edu/observing/call-for-proposals/2016B/vla-proposals) for applicable dates). HSA proposals can request the phased VLA in conjunction with the VLBA and other HSA telescopes, subject to availability of matching observing systems (see below). As a general capability, the phased VLA is available as a single array (no subarrays) with two independently-tunable VLA subband pairs, one polarization pair (RCP+LCP) in the A0/C0 baseband pair and the other (RCP+LCP) in the B0/D0 baseband pair. Any matching bandwidths available on both the VLA and the VLBA DDC data system described above can be used. Since they have not been extensively tested, other sub-band configurations that match the VLBA's PFB and DDC-8 modes are available as shared risk. VLA phasing and VLBI observing must be carried out at the same total bandwidth. Sub-band bandwidths of 16 MHz to 128 MHz (by multiples of 2) are available as a general capability. Sub-band bandwidths narrower than 16 MHz may work if the phasing source is strong enough, but are expected to be of limited use. The restrictions are fewer for the VLA than for the VLBA or other stations, so the HSA guidelines should be followed. The VLA must be set up to match the VLBA; mixed modes are not allowed. Further details are available in the document VLBI at the VLA (https://science.nrao.edu/facilities/vla/docs/manuals/obsguide/modes/vlbi), and in the VLBA Observational Status Summary (https://science.nrao.edu/facilities/vlba/docs/manuals/oss).

Observing with a single VLA antenna (Y1) in conjunction with the VLBA will only be available through theVLBA Resident Shared Risk Observing (https://science.nrao.edu/facilities/vlba/proposing/rsro) program.

The GBT is equipped with the same instrumentation described in the VLBA Observing Capabilities section, and is able to support all the observing configurations described there (but see the note on the 6 cm receiver below). Further details may be found in section 5.7 of the GBT Proposer's Guide (https://science.nrao.edu/facilities/gbt/proposing/GBTpg.pdf). All proposals to use the GBT as part of VLBI must include time to set up the telescope (pointing, focus, etc.) prior to the start of the observation. This can take 0.5-1 hour depending on the frequency (see Chapter 7 of the GBT Proposer's Guide (https://science.nrao.edu/facilities/gbt/proposing/GBTpg.pdf), and the GBT Observer's Guide (https://science.nrao.edu/facilities/gbt/observing/GBTog.pdf), for further information).

The GBT's 6 cm receiver is similar to the VLBA's new system, but does differ in the conversion to circular polarization. Recent tests have seen substantial polarization leakage between the RCP and LCP channels. Improvements and further testing are under way. However, for this Call, we will consider only proposals for total-intensity observations. Such proposals should request full dual-polarization modes for both observation and correlation, and careful calibration of the leakage terms should be included in the data analysis.

The Effelsberg and Arecibo HSA stations have also installed the same wideband equipment as at the VLBA and GBT. The following table summarizes the availability of the various observing systems for HSA stations for 2016B.

HSA station	Observing system		
	PFB	**DDC-4**	**DDC-8**
VLBA	Y	Y	Y
GBT	Y	Y	Y
Y27	Y	Y	Y
Arecibo	Y	RSRO	N
Effelsberg	Y	Y	Y

The DDC-4 and DDC-8 systems support 2 IF observing modes with a maximum of 4 and 8 channels, respectively. DDC-8 can also observe 4 IF modes for cases where they are supported by the stations' receivers and IF transmission systems. Tested 4 IF modes available at present with the HSA include only the 6 cm systems on the VLBA and GBT (see also the temporary restriction described above for the GBT). Combinations marked RSRO are available as Resident Shared Risk observing, which means these are capabilities that require some level of commissioning.

The LMT will be offered as a station of the HSA for 3mm observations with the VLBA for observing dates beginning 1 September 2016 in semester 2016B. The GBT may also be requested with the VLBA and LMT. Access to VLBI using the LMT is provided through the VLBA RSRO program, and VLBA RSRO should be selected as the resource in the Proposal Submission Tool. For VLBI the LMT can record a single-polarization 2048 Mbps mode compatible with the VLBA, using a dual-polarization 3mm receiver (RCP/LCP) with a tuning range exceeding that of the VLBA. Proposers should use the VLBA capabilities to define their resource request when proposing to use the LMT for VLBI.

Global 3mm VLBI Array (GMVA)

VLBI proposals for observing at 3mm wavelength using the VLBA, GBT, Effelsberg, Pico Veleta, Plateau de Bure, Onsala, Metsaehovi and Yebes telescopes should be submitted by 1 February 2016 through the NRAO Proposal Submission Tool. The LMT will continue to be offered for inclusion in the GMVA on a best effort basis. In addition, new for semester 2016B, telescopes of the Korean VLBI Network (KVN) may be requested as part of the GMVA. Both the LMT and the KVN can be selected using the *Other Stations* text field in the PST. Successful proposals will be considered for scheduling in the Fall 2016 (or later) session. After 2016 Session II Plateau de Bure will not be available in phased array mode; there are plans to later make a single antenna available for VLBI. As noted above, at some GSTs, the available time on the VLBA in the Fall 2016 session may be limited due to prior commitments (primarily in the Galactic Plane). Also, although the GBT can participate in 3mm VLBI during the daytime, its sensitivity could be several times worse due to thermal deformations from solar heating. To maximize the sensitivity for continuum observations, the GMVA will record at the highest bit rate that the telescope instrumentation and resources permit. All telescopes will record at 2 Gbps; the only exception being Plateau de Bure and telescopes of the KVN, which will record in a compatible 1 Gbps mode.

For further details on proposing please consult the relevant administrative and technical information hosted at the Max-Planck-Institut für Radioastronomie (http://www3.mpifr-bonn.mpg.de/div/vlbi/globalmm/) .

New: Participation of ALMA in GMVA observations in ALMA Cycle 4

It is expected that phased ALMA will participate in some GMVA observations during ALMA Cycle 4 (Oct 1 2016 - Sept 30 2017; see the ALMA Cycle 4 Pre-announcement (https://almascience.eso.org/news/alma-cycle-4-pre-announcement)). The number of ALMA dishes in the phased array is likely to be 30 - 40. ALMA will not be in a configuration suitable for VLBI during GMVA Session II 2016. GMVA session dates during Cycle 4 are not yet fixed but Session I in 2017, which is likely to be in March or April, should provide an opportunity for GMVA + ALMA observing. (GMVA Session II in 2017 is unlikely to overlap in Cycle 4 with ALMA in a configuration suitable for VLBI.)

Any GMVA proposal requesting phased ALMA during Cycle 4 must be submitted via the NRAO PST at the February 1, 2016 deadline.

Proposers should:

- specify "ALMA" in the *Other Stations* text field in the PST
- select the default GMVA 3mm observing mode of 2 Gbps, dual polarization (although a different implementation of this will actually be used)
- specify the amount of time and GST range(s) needed for ALMA *separately*, either in Session Constraints or Comments, or in the Technical Justification.

A separate proposal to ALMA must also be submitted at the deadline for ALMA Cycle 4 proposals in April 2016. For this, all proposers (PI and Co-I's) must be registered ALMA users (see: http://www.almascience.org (http://www.almascience.org/)).

Restrictions on GMVA+ALMA proposal in Cycle 4:

- GMVA observations with ALMA will be limited to a fixed, continuum-only, mode, which will provide 2 Gbps on all baselines (except those to Plateau de Bure and the KVN).
- Due to the need to phase up on the target source, only sources with correlated flux densities >0.5 Jy in intra-ALMA baselines out to 1 km may be proposed for observation. (This limit is set by the current state of testing of the phasing system).
- In order to make a clean linear-to-circular transformation of ALMA recordings, any target source must be observed for a duration of at least 3 hours (breaks for calibrators permitted) to sample a range of parallactic angles.
- Large Programs (>50 hours of observing time) are not permitted because phased ALMA is a non-standard mode.
- No long-term programs may be proposed, and no proposals will be carried over into the next cycle.
- There is a cap for VLBI of 5% of ALMA Cycle 4 observing time. As time for GMVA observations will thus be scarce, proposals should include a quantitative justification as to why ALMA is essential for the goals of the project.

Proposal Preparation

Proposal preparation and submission for the VLBA, HSA, and GMVA are via the Proposal Submission Tool (PST) at NRAO Interactive Services

(https://my.nrao.edu/) . Use of the PST requires registration in the NRAO User Database.

Information about VLBA capabilities can be found in the VLBA Observational Status Summary (https://science.nrao.edu/facilities/vlba/docs/manuals/oss) . Questions may also be directed to the NRAO Helpdesk (http://go.nrao.edu/obshelp) .

Alerts & Tips for Proposers

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 planning to use one or more NRAO telescopes for their PhD dissertation must submit a "Plan of Dissertation Research" of no more than 1000 words with their first proposal. This plan must be referred to in later proposals for time allocations relevant to the thesis work described in the plan. It is the responsibility of the student to ensure that the information contained in the plan is up-to-date at the time a given proposal is submitted. By the same token, a proposal for work that is relevant to a student thesis should refer to the plan and clearly state the relevance of the proposal to the plan. At a minimum the plan should contain:

1. An overview of the research program
2. The thesis timeline, including the expected date of completion
3. An estimate of the NRAO telescope resources needed to complete the program of research
4. Clear statements about the importance of each proposal to the thesis as a whole.

The plan provides some assurance against a dissertation being impaired by an adverse review of a proposal when the full scope of the thesis is not seen. The plan can be submitted via NRAO Interactive Services (http://my.nrao.edu/) . Students are reminded to submit their plan comfortably in advance of the proposal deadline. Thesis plans must be in pdf format so science reviewers can easily access the plans. Students who have not yet graduated but have active plans on file should update those plans to a pdf format if they are not already in that form.

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 eight Science Review Panels (https://science.nrao.edu/observing/proposal-types/sciencereviewpanels) . 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 many of these resources. Please go to NRAO Interactive Services (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/) .

Proposal Finder Tool

The Proposal Finder Tool (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.

Green Bank Telescope (GBT)

- The Proposer's Guide for the Green Bank Telescope (https://science.nrao.edu/facilities/gbt/proposing/GBTpg.pdf)
- The Performance of the GBT: A Guide for Planning Observations (http://www.gb.nrao.edu/~rmaddale/GBT/ReceiverPerformance/PlaningObservations.htm)
- GBT Sensitivity Calculator (https://dss.gb.nrao.edu/calculator-ui/war/Calculator_ui.html)
- GBT Mapping Calculator (http://www.gb.nrao.edu/~rmaddale/GBT/GBTMappingCalculator.html)

Very Large Array (VLA)

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

Very Long Baseline Array (VLBA), High Sensitivity Array (HSA)

- VLBA Observational Status Summary (https://science.nrao.edu/facilities/vlba/docs/manuals/oss)
- VLBI at the VLA (https://science.nrao.edu/facilities/vla/docs/manuals/obsguide/modes/vlbi)
- VLBI on the GBT (http://www.gb.nrao.edu/~fghigo/gbtdoc/vlbinfo.html)
- Observing with the High Sensitivity Array (https://science.nrao.edu/facilities/vlba/proposing/HSA-Tips)
- EVN Sensitivity Calculator (http://www.evlbi.org/cgi-bin/EVNcalc)