# NRAO Call for Proposals
# Semester 2015A

**7 July 2014**


The National Radio Astronomy Observatory (NRAO) invites scientists to participate in the NRAO Semester 2015A Call for Proposals for the Green Bank Telescope (GBT), Very Large Array (VLA), and Very Long Baseline Array (VLBA), High Sensitivity Array (HSA), and Very Long Baseline Interferometry (VLBI).

**The submission deadline for Semester 2015A proposals is Friday, 1 August 2014, at 17:00 EDT (21:00 UTC).**

The NRAO especially wishes to highlight new opportunities for joint observations with the Hubble Space Telescope and with the Swift Gamma-Ray Burst Mission.

## Proposal Preparation and Assistance

Proposal preparation and submission are via the NRAO Proposal Submission Tool (PST) available at NRAO Interactive Services. Note that PST use requires registration.

## Proposal Assistance

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.

# Semester 2015A Proposal News & Opportunities

## New Opportunity: 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 time on NRAO facilities to highly ranked proposals that request time on both HST and NRAO telescopes. NRAO has offered up to 3% of the available time on its North American facilities, namely the Green Bank Telescope (GBT), the Very Large Array (VLA), and the Very Long Baseline Array (VLBA), for allocation by the HST Time Allocation Committee (TAC), subject to a maximum of 5% of the available time in any given VLA configuration.

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 2014B and Semester 2015A. Joint

HST/NRAO proposals should be submitted to the observatory that represents the primary science facility, not to both observatories.

**HST as Primary Observatory**: NRAO observing time awarded through the HST Cycle 22 review will be implemented during the 2014B and 2015A observing semesters. The award of time on NRAO facilities will be subject to approval by the NRAO Director, after nominal review by the NRAO TAC to avoid duplication of programs. The important additional criterion for the award of NRAO time is that both the HST and the radio data are required to meet the science goals of the project. It is not essential that the project requires simultaneous NRAO and HST observations. Under this agreement, NRAO time will only be awarded in conjunction with new HST observations (and should not be proposed for in conjunction with an Archival Research or Theory Proposal).

**NRAO as Primary Observatory**: HST time awarded through the NRAO TAC will be implemented during the course of HST Cycle 22. No orbits were awarded by the 2014B NRAO TAC and up to 30 orbits can therefore be awarded by the 2015A NRAO TAC. Proposals submitted to the NRAO requesting HST orbits must indicate that the proposal is joint with HST and must specify the number of orbits requested. The important additional criterion for the award of HST orbits is that both the HST and radio data are required to meet the science goals of the project. It is not essential that the project requires simultaneous NRAO and HST observations.

Successful proposers will submit Phase II HST proposals at the standard Phase II deadline. Funding will be available to US investigators to support HST data reduction; budgets should be submitted at the standard deadline

Proposers must always check whether appropriate archival data exist, and provide clear scientific and technical justification for any new observations of previously observed targets. Observations awarded time that duplicate observations already approved by HST or NRAO for the same time period may be canceled, or data sharing and cooperation among different groups may be necessary, as determined by the two observatories. This includes triggered proposals with similar trigger criteria, with or without previously known coordinates.

Be aware that some HST targets might not require new NRAO observations because the joint science goals can be met using:

- non-proprietary archival data from the VLA or VLBA that are online
- VLA continuum images from sky surveys at a wavelength of 20cm and at a FWHM resolution of 45 arcseconds or 5 arcseconds.

All scientific data from NRAO telescopes have a proprietary period during which the data are reserved for the exclusive use of the observing team. The NRAO data archive policy and proprietary periods are online, and apply to data taken through the joint HST-NRAO program.

## New Opportunity: Joint Observations with Swift Gamma-Ray Burst Mission

Swift is a robotic, multi-wavelength observatory with instruments covering the following energy bandpasses: 15-150 keV (Burst Alert Telescope; BAT), 0.3-10 keV (X-ray Telescope; XRT), and 160-800 nm (UltraViolet/Optical Telescope; UVOT). The primary goal of this mission is to

determine the origin of gamma-ray bursts (GRBs) and use these bursts to probe the early universe. Swift is also a valuable asset for obtaining multi-wavelength images, spectra, and light curves on interesting Targets of Opportunity (ToOs) and other non-transient sources. With nearly instantaneous data dissemination, Swift is the premier observatory for discovery and follow-up of gamma-ray bursts (GRBs) and other transient sources.

To foster correlative observations, a joint Swift/NRAO observing program has been established, detailed in aMemorandum of Understanding. By this agreement, the Swift Program permits NRAO to award up to 300 kiloseconds of Swift observing time per year. This award of time shall occur without further scientific review by the Swift mission, provided compelling justification is provided to NRAO that such observations substantially enhance the scientific reach of the proposed observations.

- Proposed observing time on Swift may be time-constrained, including coordinated and monitoring observations, and Targets of Opportunity, if full justification is included in the proposal. Note that proposed Swift observing time can include monitoring that precedes, follows and/or (for TOOs) triggers NRAO observing time.

- Swift data sets obtained under this agreement will not be proprietary to the PI and will be immediately released publicly via the HEASARC data archive. No funds will be awarded from the Swift Project for such joint NRAO/Swift investigations. However, successful U.S.-based investigators are eligible for funding via the "Correlative Observations" Opportunity (see below).

- The peer-reviewed NRAO proposal-evaluation process will identify programs with sufficient merit to be allocated observing time by NRAO, and those that fall within the agreed-on range of joint programs will be allocated Swift observing time without additional scientific review if they to be judged technically feasible. The Swift Project will perform feasibility checks on the proposed observations and reserves the right to reject any observation determined to be technically unfeasible for any reason. Such a rejection could jeopardize the entire proposed science program and impact the award of NRAO observing time as well.

Similarly, NRAO permits the Swift GI Program to award NRAO observing time. The Swift GI program was announced in the 2014 NASA ROSES program solicitation (D.5). Cycle 11 proposals are due on 25 September 2014. Cycle 11 observations will commence on or around 1 April 2015, and last approximately 12 months. Further details on the Cycle 11 program will be posted on the Swift web pages in August 2014.

- No more than 5% of the NRAO scientific observing time will be made available on NRAO's VLA, GBT and VLBA, or up to 200-300 hours per year on each telescope. The allocation of time on the Atacama Large Millimeter/Submillimeter Array (ALMA) is not covered by this agreement.

- The Swift Mission Project will make funding available to successful U.S.-based investigators who request NRAO observing time through the Swift GI process.

- Only proposals falling in the NRAO Regular proposals and Triggered proposals categories are eligible for observing time through this joint opportunity. NRAO Large Proposals (those requesting 200 hours or more) will not be eligible for time, but will be eligible for funding via the "Correlative Observations" Opportunity (see below).

- Radio data acquired through the Swift GI Program will be the property of the proposers for the standard NRAO 12-month proprietary period. Unless the users petition for an extension of the proprietary period, the data will then become publicly available in the NRAO Archive.

- The peer-reviewed Swift GI proposal-evaluation process will identify programs with sufficient merit to be allocated observing time and funding by Swift, and those that fall within the agreed-on range of NRAO observing time will be allocated NRAO observing time without additional scientific review, if judged technically feasible. NRAO will perform feasibility checks on the proposed observations and reserves the right to reject any observation determined for any reason to be technically unfeasible or to jeopardize NRAO instrumentation. Such a rejection could jeopardize the entire proposed science program and impact the award of Swift observing time as well.

All successful NRAO investigators may be eligible for Swift GI funding, provided their observing programs complement the Swift science program. These programs do not necessarily need to involve joint observing programs as detailed above. In making their case for such funding, proposers should address how the use of NRAO time will enhance the Swift science return. The extent to which such proposed "correlative investigations" will augment the science return from Swift will be considered in the proposal evaluation process, and the peer-reviewed Swift GI proposal-evaluation process will identify programs with sufficient merit to be allocated funding by Swift. Hence, proposals falling in the NRAO Regular proposals, Triggered proposals, and Large proposals categories, are eligible for funding through this opportunity.

For all correlative investigations funded by Swift, rapid public availability of the data or results is strongly encouraged. Public data availability for correlative studies should be discussed in these proposals and will be considered in the evaluation of the proposals. Funded correlative proposals involve requests for Swift GI funding that are made subsequent to NRAO approval of observing time. The award of NRAO observing time will not be a guarantee of Swift funding; likewise, the granting of observing time is not contingent on Swift funding.

## New Opportunity: Large Millimeter Telescope to join High Sensitivity Array for 3mm VLBI

Following a successful 3mm VLBI run between the Large Millimeter Telescope Alfonso Serrano (LMT) in Mexico and the VLBA in May 2014 (see the associated NRAO eNews article), the LMT is now being offered for inclusion in the High Sensitivity Array (HSA) operating at 3mm, enabling combinations of the LMT with the VLBA, and optionally the GBT, for semester 2015A. Access to this capability is provided through the VLBA Resident Shared Risk Observing (RSRO) program. Proposals should be submitted through the NRAO Proposal Submission Tool for the NRAO 2015A proposal deadline.

## Continuing Opportunity: 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. For Fermi, which is primarily in sky-survey mode, potential observers may propose for NRAO observations that make use of the Fermi survey data even without re-pointing of the Fermi satellite. The actual amount of NRAO observing time allocated via the Joint Fermi Process depends on the amount of proposal pressure and the scientific quality of the

proposals. A maximum of 10% of the NRAO scientific observing time is made available on the VLA, the VLBA and the GBT, or up to 400-650 hours per year on each telescope. Details about joint observations with Fermi and the VLA, the VLBA or the GBT may be found here. The next Fermi proposal deadline is in January 2015.

## Continuing Opportunity: Joint Observations with Chandra X-ray Observatory

Similarly, the community may propose for observing time on NRAO facilities through a joint program with the Chandra X-ray Observatory. For Chandra, proposals must be for observations that require both Chandra pointing and NRAO observations to carry out a scientific investigation. The NRAO has allocated up to 3% of the observing time on the VLA, the VLBA and the GBT for Chandra joint proposals. Section 4.5.5 of the Chandra call for proposals gives specifics of the joint NRAO/Chandra program. The next Chandra proposal deadline is in March 2015.

## High Risk Proposals

As a means of maximizing its scientific impact through cutting edge observations, the Observatory also encourages the submission of high-risk/high-reward proposals. Such proposals may involve unusual targets, nonstandard observing techniques, new post-observing data reduction and analysis, or supplementary hardware or new back ends. Please contact Science Support and Research prior to submitting such proposals to discuss anticipated resource requirements. Observers contemplating such proposals may also wish to consider submitting an Exploratory Proposal to request Director's Discretionary Time as a means of demonstrating a proof of concept.

## Commensal Proposals

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. Groups wishing to carry out commensal observations should submit independent science cases as separate *primary* and *secondary* proposals.

A primary proposal controls the telescope pointings and requests the full amount of telescope hours required to fulfill the science objectives detailed in the proposal. Secondary proposals(s) are to run commensally with the primary pointings but make no formal request for an allocation of telescope time. However, when preparing a secondary commensal proposal, please ensure that a nominal amount of time is requested for a session (e.g., 0.1 hrs), even if it is a dummy session. Each proposal must contain estimates of the full resources needed (correlator setup, data rates, etc.) to carry out their specific part of the project.

During the proposal review and time allocation process it will be determined if the combination of the observing set-up and the positions by the primary or secondary proposals conflict with any approved projects. In the case of a conflict, some data restrictions may be applied to the primary and/or the secondary commensal proposal. If the primary and secondary proposals use the same back-end resources (VLA-WIDAR, GBT-VEGAS, etc) it may be necessary for technical reasons to require that the investigators on both primary and commensal projects be given full access to all data.

## Filler Time

The Observatory would like to point out that there are opportunities for so-called "filler" programs on all of its telescopes. Observing programs that exploit frequencies below 10 GHz, do not have strong scheduling constraints, and could benefit from short scheduling blocks are encouraged to propose for such opportunities. The proposal should make clear in the abstract and early in the science justification that "filler" time (scheduling priority C) is being requested, not time at scheduling priority A or B.

## Triggered Proposals

Those who are planning to submit a proposal of type Triggered are reminded that they must include well-defined trigger criteria and state applicable semesters in their request for telescope time. Furthermore, a Triggered proposal must ask for the full amount of time needed to achieve the science goals, including both initial **and** follow-up observations. Proposers should not be using Director's Discretionary Time to request follow-up of an event initially observed under a Triggered proposal**.** A list of all active VLA proposals of type Triggered is available**.**

## 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. 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. 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. 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.

### Proposal Finder Tool

The Proposal Finder Tool (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
- The Performance of the GBT: A Guide for Planning Observations
- GBT Sensitivity Calculator

**Very Large Array (VLA)**

- VLA Observational Status Summary
- VLA Proposal Preparation and Submission
- Guide to Observing with the VLA
- VLA Configuration Plans and Science Time Available
- VLA Exposure Calculator

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

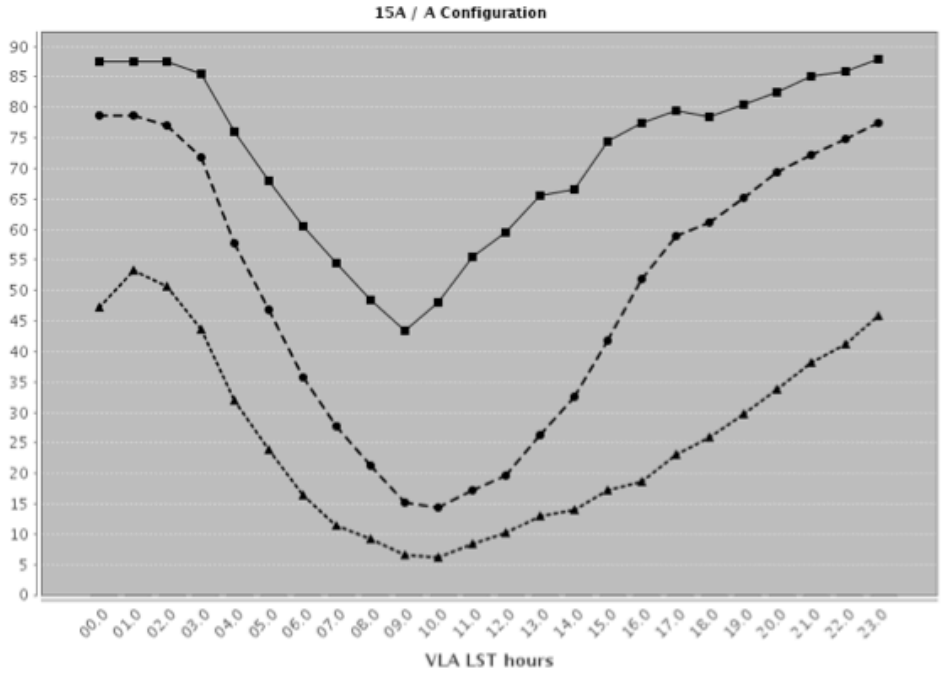
- VLBA Observational Status Summary
- VLBI at the VLA
- VLBI on the GBT
- Observing with the High Sensitivity Array
- EVN Sensitivity Calculator

# Very Large Array (VLA) Proposals

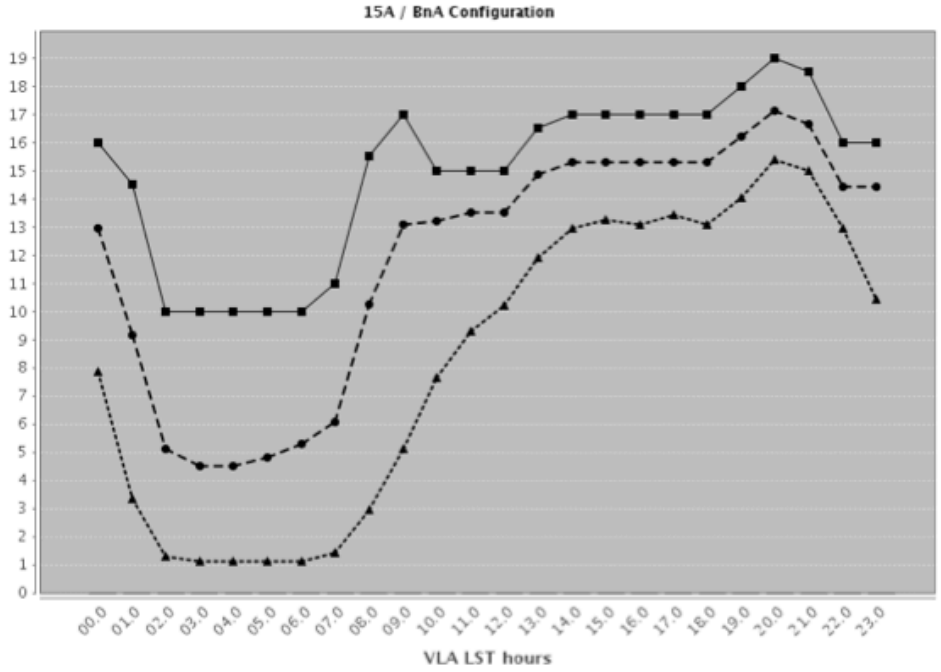
## VLA Configuration Plans and Science Time Available

**The 1 August 2014 deadline covers the observing period 6 February 2015 through 21 September 2015 (Semester 2015A), corresponding to the B, BnA and A configurations.** Multi-configuration proposals that include B, BnA and/or A configurations may also be submitted. In addition, proposals requesting only configurations that will fall in semester 2015B 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 and the plots of estimated available observing hours as a function of LST and weather conditions for all configurations in the upcoming semester, below. In these plots, engineering, maintenance, and testing cause the thick black line to be less than the total number of LST days in the configuration. Such activities occur predominantly during daytime.

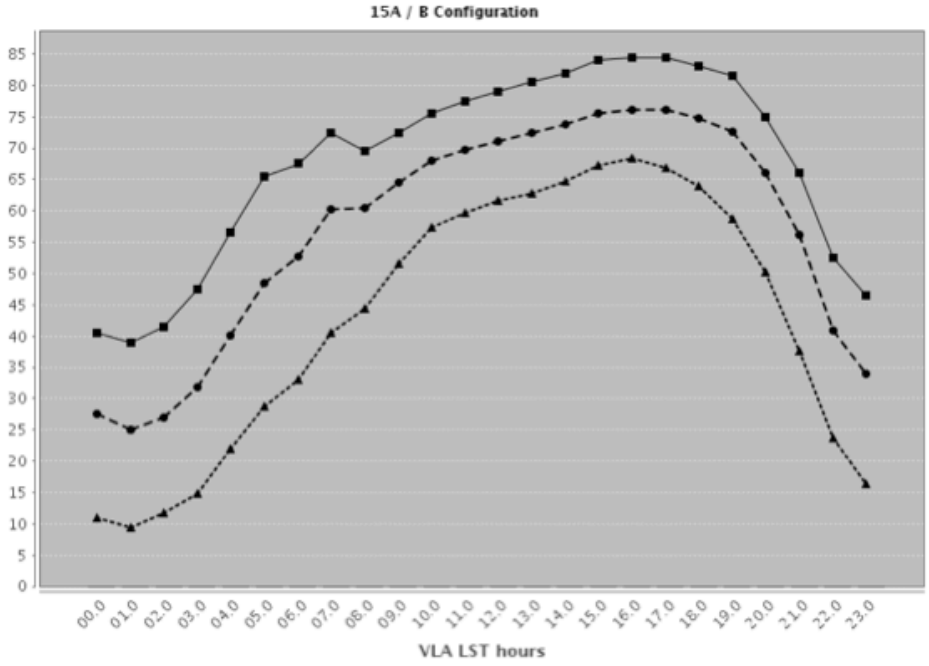
**A configuration:** Estimated science time available per LST hour is shown by the solid black line for all frequencies, the dashed line for K-band conditions, and dotted line for Q-band conditions.



**BnA configuration:** Estimated science time available per LST hour is shown by the solid black line for all frequencies, the dashed line for K-band conditions, and dotted line for Q-band conditions.




**B configuration:** Estimated science time available per LST hour is shown by the solid black line for all frequencies, the dashed line for K-band conditions, and dotted line for Q-band conditions.



## Observing Capabilities for Semester 2015A

Enhanced capabilities offered for 2015A include the transition of P-band Stokes I observing, dump times as short as 50 msec, and recirculation up to a factor of 4 to our General Observing (GO) program. In addition, observing with the On The Fly (OTF) mosaicing mode, 32 sub-bands per baseband with either the 3-bit or 8-bit samplers, recirculation up to a factor of 64, and 8-stream recording for VLBA observations with the phased VLA have been moved from our Resident Shared Risk Observing (RSRO) program to our Shared Risk Observing (SRO) program. Details of the general capabilities are given in the VLA Observational Status Summary (OSS), and are summarized below.

| Capability | Description |
|---|---|
| 8-bit samplers | Standard default set-ups for:<br>▪ 2 GHz bandwidth continuum observations at S/C/X/Ku/K/Ka/Q bands (16 x 128 MHz sub-bands)<br>▪ 1 GHz bandwidth continuum observations at L-band (16 x 64 MHz sub-bands)<br>▪ 256 MHz bandwidth continuum observations at P-band (16 x 16 MHz sub-bands)<br>Flexible set-ups for spectroscopy, using two independently tunable 1 GHz basebands, each of which can be split into up to 16 flexibly tunable sub-bands<br>Single, dual, and full polarization products<br>Number of channels summed over all polarization products up to 16,384 (no recirculation) or up to 65,536 (with recirculation) |
| 3-bit samplers | Standard default set-ups for:<br>▪ 8 GHz bandwidth continuum observations at K/Ka/Q bands<br>▪ 6 GHz bandwidth at Ku band<br>▪ 4 GHz bandwidth at C/X bands<br>Flexible set-ups for spectroscopy, using four independently tunable 2 GHz basebands, each of which can be split into up to 16 flexibly tunable sub-bands<br>Single, dual, and full polarization products<br>Number of channels summed over all polarization products up to 16,384 (no recirculation) or up to 65,536 (with recirculation) |
| 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 sub-arrays using standard 8-bit continuum set-ups |
| 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 configuration 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, please consult the OSS for further details. In addition, special tools are available to assist users with the development of correlator set-ups for the proposal deadline (see VLA Proposal Preparation and Submission), and the Exposure Calculator has been updated. 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); 8-12 GHz (X); 12-18 GHz (Ku); 18-26.5 GHz (K); 26.5-40 GHz (Ka); and 40-50 GHz (Q).

We will 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 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 2015A:

- On-the-Fly (OTF) mosaicing
- 32 sub-bands per baseband with either the 3-bit or 8-bit samplers (no mixed 3/8-bit set-ups)
- recirculation of up to a factor of 64
- 8-stream recording with phased VLA for VLBA observing.

See the VLA Proposal Preparation and Submission 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, in exchange for a period of residence to help commission those capabilities. Capabilities that would fall under the RSRO program in Semester 2015A include, e.g.,

- 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 polarimetry and spectroscopy

- more than 3 sub-arrays or sub-arrays with the 3-bit system, and
- complex phased array observations (e.g., pulsar and complex VLBI observing modes).

A detailed description of the VLA RSRO program for semester 2015A and beyond is available at the VLA Proposal Preparation and Submission web page.

## Low Frequency Observing

The new low frequency receiver system developed in collaboration with the Naval Research Laboratory will be available for Stokes I continuum observations at P-band (230 to 470 MHz), through the General Observing program. Use of the P-band system for polarimetry and/or spectroscopy will be through the Resident Shared Risk Observing Program. The new receivers also work at 4-band (54 to 86 MHz), and a new feed compatible with the EVLA electronics is being developed, but is not yet commissioned. Members of the community interested in helping to commission the 4-band system in return for early access to this system via peer-reviewed telescope time should apply through the RSRO program described above. We expect at least 6 antennas to be outfitted with 4-band receivers for Semester 2015A.

## Proposal and Observation Preparation

Proposal preparation and submission are via the Proposal Submission Tool (PST) at NRAO Interactive Services. 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 VLA Proposal Preparation and Submission 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, 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 for further details.

All approved VLA observations are set up using the Observation Preparation Tool (OPT). Most, if not all, projects will be observed dynamically so 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 web page.

Information about VLA capabilities, observing strategies, and calibration overhead can be found in the VLA Observational Status Summary, at the Guide to Observing with the VLA, and at the Observing FAQ web page. Questions may also be directed to the NRAO Helpdesk.

# Green Bank Telescope (GBT) Proposals

**The 1 August 2014 deadline is for the Semester 2015A GBT observing period: 1 February – 31 July 2015.**

Details of all GBT observing modes are in the The Proposer's Guide for the Green Bank Telescope. Proposers should also consult the more general document The Performance of the GBT: A Guide for Planning Observations. 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 2015A 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 (shared risk) | 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 |
| MUSTANG 1.5 bolometer array (shared risk) | 80-100 GHz |
| ARGUS (shared risk) | 75-115.3 GHz, Private PI instrument |

**Table 2: GBT Backends and Observing Modes**

| Backend | Observing Modes |
|---|---|
| Versatile Green Bank Astronomical Spectrometer (VEGAS) | Continuum, pulsar, 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 |
| Zpectrometer | Private PI instrument |
| Radar | Private PI instrument |

The MUSTANG bolometer array will undergo an upgrade. The receiver cryogenics will be redesigned such that the receiver can be kept cool at all elevations and will allow observations below 30 degrees elevation. We will accept shared-risk proposals to help commission the upgraded Mustang bolometer array in the 15A semester.

Observers interested in shared-risk observations using the ARGUS instrument should contact the NRAO helpdesk for further information. All ARGUS proposals must have permission from the instrument development team.

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.

Digital TV transmissions above 470 MHz will make observing very difficult with these two 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 at minimum. Observers should consult the GBT support scientists before submitting a proposal for these feeds.

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.

The GBT is scheduled by the Dynamic Scheduling System (DSS). The DSS system is fully described in theGBT Proposer's Guide and the GBT Observer's Guide.

## GBT Proposal Preparation

Proposers should consult the The Performance of the GBT: A Guide for Planning Observations and the GBT Observer's Guide. All proposers, including pulsar proposers, should use the GBT Sensitivity Calculator. Please see the Calculator's User's Guide 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.

The 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 Very Long Baseline Interferometry (VLBI) observations should consult the VLBA, HSA, and VLBIsection 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.

NRAO will accept shared-risk proposals in Semester 2015A from observers willing to help commission the upgraded Multiplexed SQUID TES Array at Ninety GHz (MUSTANG 1.5, 80-100 GHz) bolometer array. The GBT C-band receiver is being upgraded to cover the 3.8-8.0 GHz frequency range. Proposals to use ARGUS (75-115.3 GHz) will also be accepted with the instrument development team's permission.  NRAO will consider shared-risk proposals for Semester 2015A observations with these receivers.

# Very Long Baseline Array (VLBA), High Sensitivity Array (HSA), & Very Long Baseline Interferometry (VLBI) Proposals

The 1 August 2014 deadline applies to all types of Very Long Baseline Array (VLBA) and High Sensitivity Array (HSA) proposals requesting time in semester 2015A (1 February – 31 July 2015), or multi-semester proposals. It also applies to global mm VLBI proposals for the May 2015, or later, sessions. Please see theinstructions for submitting VLBA, HSA, and global 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, and 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 selected arbitrarily 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 2. 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. All bandwidths must be identical, and channels cannot span either of two zone boundaries within the IF band, at 640 and 896 MHz. Use of 128 MHz bandwidth is limited to 4 (or fewer) channels by the 2048-Mbps recording rate limitation.

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. 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 used, in opposite polarizations, but less common modes are also possible, generally dual-polarization dual-frequency cases. The four-IF capability of the DDC allows these modes to be exploited.

## 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:

- under non-ideal weather conditions
- with less than the full complement of antennas
- with a target list of source positions around the sky
- 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 more when such time becomes available during dynamic scheduling. Large proposals for VLBA filler time will be subject to the usual NRAO Large Proposal Policy. Multi-semester proposals will be considered.

Types of projects that might use VLBA filler time include surveys of many sources, astrometry, geodesy, deep integrations spread over many sessions, and long term monitoring. It is rare for fewer than 6 or 7 antennas to be functional and have good observing conditions, so high frequency projects that can use a reduced array are viable. Proposers should be aware that the available time will not be uniformly spread across the sky because of the high demand for Galactic time from high priority programs. Proposals that require much greater correlator resources than typical projects (such as multiple phase centers per field) should address mechanisms to support the correlation without adversely affecting the throughput of other projects.

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. A number of additional areas are suggested at the RSRO program page, including the development of Y1 with the VLBA. We encourage other innovative ideas for new VLBA observing modes from the community as well. Details are available on theVLBA RSRO program webpage.

## High Sensitivity Array (HSA)

The phased VLA (Y27) will be available for VLBA proposals in semester 2015A, in configurations B/BnA/A. 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). Phased-VLA observing using two independently-tunable VLA sub-band pairs, one polarization pair (RCP+LCP) in the A0/C0 baseband pair, and the other (RCP+LCP) in the B0/D0 baseband pair, is available as a general capability. Any matching bandwidths available on the VLA as well as the VLBA DDC data system described above can be used. Bandwidths must be uniform at each station, across the entire VLBI array, and throughout the entire duration of the observation. In particular, VLA phasing and VLBI observing must be carried out at the same bandwidth. Bandwidths of 16 MHz and wider are available as a general capability. Bandwidths narrower than

16 MHz may work if the source is strong enough, but are expected to be of limited use. Y27 modes equivalent to the VLBA PFB and 8-channel DDC modes described above are also available on a shared risk basis, since they are less well tested. 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, and in the VLBA Observational Status Summary.

Observing with a single VLA antenna (Y1) in conjunction with the VLBA will only be available through theVLBA Resident Shared Risk Observing program.

Semester 2015A proposals to use the GBT as part of the HSA will be considered. The GBT is equipped with the full VLBA Sensitivity Upgrade instrumentation, and is able to support all the observing configurations described in the VLBA Observing Capabilities section above. Further details may be found in section 4.7 of theGBT Proposer's Guide. Note that 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 6 of the GBT Proposer's Guide, and the GBT Observer's Guide, for further information).

The Effelsberg and Arecibo HSA stations have also installed the same wideband equipment as at the VLBA and GBT, but their implementation is not yet complete. An observing mode to match the PFB system works well for continuum science, but there is currently no mode to match the DDC for spectroscopy that has been fully commissioned. The following table summarizes the availability of the various observing systems for HSA stations for 2015A.

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

DDC-4 refers to a 4-channel, 2-IF mode, and DDC-8 to the full 8-channel, 4-IF case. The observing system must be identical for all stations in an observation. Combinations marked "RSRO" are only available through the Resident Shared Risk Observing program (below). Combinations marked "SRO" are available as "Shared Risk" observing, which means these are capabilities that have been verified to work with certain set-ups, but have not been extensively tested. Proposers should be aware that SRO and RSRO capabilities are generally not approved at priority A, owing to the level of risk associated with these observations.

Following a successful 3mm VLBI run between the Large Millimeter Telescope (LMT) in Mexico and the VLBA in May 2014, the LMT will be offered as a station of the HSA for 3mm observations with the VLBA for observing dates between 1 February 2015 and 31 May 2015, in semester 2015A. 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. The LMT has a PFB-compatible, 2048-Mbps, recording system, and a dual polarization 3mm receiver 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, and Yebes telescopes should be submitted by 1 August 2014 through the NRAO Proposal Submission Tool. Successful proposals will be considered for scheduling in the May 2015 (or later) session. Proposers should be aware that at some GSTs the available time on the VLBA in the September 2015 session may be limited due to prior commitments (primarily in the Galactic Plane), and that the GBT may only observe at 3mm at night (i.e., 3 hours after sunset until sunrise; tests of daytime 3mm observing with the GBT are being undertaken for the GMVA, but should not be relied upon at this time). In order to maximize the sensitivity for continuum observations the GMVA will record at the highest bit rate the telescope instrumentation and resources permit. All telescopes will record at 2 Gbps; the only exception being Plateau de Bure, which will record in a compatible 1 Gbps mode.

For further details on proposing please consult the relevant administrative and technical information hosted at Bonn.

## Proposal Preparation

Proposal preparation and submission for the VLBA, HSA, and GMVA are via the Proposal Submission Tool (PST) at NRAO Interactive Services. Use of the PST requires registration in the NRAO User Database.

Information about VLBA capabilities can be found in the VLBA Observational Status Summary. Questions may also be directed to the NRAO Helpdesk.