PREPARING A COMPETITIVE RADIO PROPOSAL

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Abstract

This paper covers many facets of preparing a radio proposal. It will concentrate on VLA proposals, although many comments will apply to most radio array proposals. The four topics covered are: properties of radio observations; proposal types and time frames; cover-sheet information; and writing a good proposal. Many web-site locations where additional information can be obtained are given.

1 Introduction

The main criteria for any scientific proposal are the quality of the science that is proposed, and the appropriateness of the radio telescopes for obtaining the relevant data. No amount of camouflage can guarantee observing time for a mediocre or poor proposal. But the success of obtaining telescope facilities can be greatly enhanced by understanding the capabilities of the instrument and succinctly describing the scientific goals of the proposed observations. First, we will concentrate on the capabilities of the VLA. The mechanics of the proposal processes and the cover-sheet used by NRAO will be outlined. Finally, we will give many suggestions for the preparation and writing of the proposal. Many are obvious guidelines which apply to any proposal, but there are specific suggestions which, from long years of personal experience, may help in the procurement of VLA telescope time.

The paper contains many references to web-sites for more detailed information. In order to unclutter the paper, each web-site address is listed by a title in this font in the text, with the complete listing given in the appendix.

2 Properties of radio observations

The overview web-sites for the NRAO telescopes will lead you to most of the information which will be given in this paper. Please look in the appendix for the web address. For the three major NRAO radio instruments, please go to VLAgen, VLBAgen, GBTgen. The NRAO newsletter can be obtained on-line from NRAOnl.

The basic properties of a radio observation that should be considered before submitting a proposal are:

1. Resolution: The resolutions needed to obtain the desired scientific results generally point to the telescope. For arcminute resolutions, a single dish like the GBT is recommended. For arcsecond resolutions, the VLA, ATCA or WSRT is the array of choice. For milliarcsecond resolution the VLBA should be used. For many objects, however, a wide-range of resolutions may be needed to cover both the large-scale and small-scale emission structure, or to obtain approximately the same resolution at widely different frequencies. For *Chandra* X-ray Observations (CXO), the most compatible radio resolution is obtained with the VLA.

2. Sensitivity: Many observations are limited by the effect of the receiver noise which depends on the receiver capabilities at the chosen frequency and the amount of observing time. Use the VLA Exposure Calculator, VLAexp, to determine the observation sensitivity as a function of input parameters.

3. Image quality: Limitations, other than receiver noise, are caused by instrumental and environmental effects which limit the image quality to a small fraction of the brightest radio component. This is called the *dynamic range* of the observation, and it is equal to the peak brightness on the image divided by the rms noise on the image. A more stringent quality is called the *fidelity*

which deals with the faintest believable feature on the image. The dynamic range before self-calibration techniques are used is typically 100:1 for VLA observations. Dynamic ranges greater than 5000:1, especially for large sources which cover the primary beam, or weak lines on strong continuum sources, need special reduction considerations.

4. Polarization: RCP and LCP are the polarization modes which are measured by the VLA and VLBA. All four cross-correlations are generally obtained with VLA observations so that linear polarization emission can be routinely obtained. See VLApol. With very little extra calibration, the polarization accuracy is $< 1\%$ of the total intensity if not limited by the receiver noise. The measurement of circular polarization requires very accurate amplitude stability.

5. Variability: The amplitude stability for the VLA is approximately 3%, for the VLBA about 5%, using apriori calibrations provided during the observations. Observations of a standard flux density calibrator will place the observations on the absolute scale to about 2% accuracy. At frequencies above 22 GHz, atmospheric opacity changes are large and extra calibrations are needed (see VLAhifr). Relative stability $< 1\%$ among several sources is possible.

6. Positional accuracy: The relative positional accuracy for the VLA between objects which are close in the sky is about $0.03\times$ the resolution. Absolute positional measurements are made by alternating observations of the target source to a nearby calibrator. Assuming that the calibrator position is correct, the VLA A-configuration accuracy at 8 GHz is $0.05''$. For the VLBA, an accuracy of $0.001''$ is generally obtained. Special astrometric observations are needed to obtain higher accuracy. Lists of calibrators can be found at VLAcal and VLBAcal

7. Spectral Line Observations: Use the VLA exposure calculation VLAexp to determine the necessary observing time to obtain the desired sensitivity and brightness. There is a large choice of available bandwidths and channel widths. For line to continuum ratios less than one percent, bandpass calibration is important.

3 Proposal types and time frames

There are three types of VLA and VLBA proposals: Normal, Rapid Response and Large. You will mostly deal with normal proposals which are for < 300 hours of observations, to begin within 12 months of the proposal deadline. Larger requests for time will go through a more detailed refereeing response. Both the normal and large proposals can be submitted every four months. Rapid response observations are observations for known transients, of an exploratory nature, or for targets of opportunity. For more details, see Rapidprop. By their nature, these proposals can obtain telescope time (or not) within 24 hours if necessary.

The deadline for normal and large proposals are February 1, June 1 and October 1 at 17:00 Eastern US time. These deadlines are associated with specific VLA configurations which are given in VLAconf or the newsletter NRAOnl. The proposals are sent to referees (mostly outside of NRAO), and grades and comments are returned six weeks after the proposal deadline. The NRAO Scheduling committee (TAC) meets about nine weeks after the deadline and the proposal status is communicated to the observer about three weeks later. Large proposals may require more time for consideration.

Proposals for all configurations are accepted for any deadline even if that configuration is not available for a year. It is recommended to send in a proposal as soon as possible, even before the deadline which is needed for the desired configuration. All proposals are evaluated and if your proposal is rejected or lowly rated, than you have the opportunity to re-propose the experiment in light of the comments from the referees and the TAC. This feedback is extremely useful, especially for first-time VLA or VLBA users. When re-submitting, please state the code number of the proposal that is being replaced.

Multi-telescope proposals are becoming more common, and it is important to clearly state how the NRAO proposal is coupled to other proposals, especially if simultaneity or near simultaneity is required. However, do not overuse this coupling with the sole hope of increasing the chances of getting observing time on the several telescopes. At the present time there is an agreement between CXO and NRAO for joint proposals and these need be sent only to CXO for evaluation. However, the VLA or VLBA part of the proposal should be well-thought out. More information can be found in CXONRAO

Travel support for NRAO observations and data reduction is available to anyone from an American institution. Up to $1000 in airfare and some lodging support can be obtained. More details are given in NRAOsup. Partial page charges are support by NRAO with the rules given in NRAOpage. Additional technical and logistical support can be obtained from NRAOhelp, by email to schedsoc@nrao.edu, or by contacting Joan Wrobel (505-835-7392)

4 Cover-sheet information

The VLA and VLBI cover-sheets can be obtained from VLAcover and VLBAcover. The VLA cover-sheet is shown in Fig. 1. Some important cover-sheet items are:

- Line 4: Fill in any related VLA proposals
- Line 12: Dynamic scheduling not yet implemented
- Line 13: Abstract should be short and sweet with main objective
- Line 16: Please specify parameters correctly.
- Line 18: Fill in the source list as completely as possible.
- Line 19-21: Include any time constraints and coordination with other telescopes. Elaborate in the proposal

5 Advice on writing a good proposal

First, some obvious and general comments on writing proposals. Of course, fantastic scientific proposals (how many of these have you had?) will get observing time even if the proposal is somewhat poorly justified and written. Sometimes, the referees and the TAC are so excited they may give advice and even increase the time, but do not count on this. A poor scientific proposal will fail to get time. If you are not overly confident on the quality of the proposal, do not add *famous* astronomers as co-PI's for two reasons: the addition is usually transparent, and you may lose referees who may be sympathetic if they are also co-PI's. Out-of-the-box proposals are encouraged, but be realistic. Of course, about 95% of the proposals lie between the fantastic and rubbish extremes, and the remainder of the paper gives suggestions to improve the chances of getting the desired observing time.

5.1 General proposal organization

The abstract is very important and approximately 100 words should emphasize the goals of the observation and how it fits with current ideas. Do not repeat the abstract in the main body of the proposal justification since this is a waste of 100 words. The justification should be less than 1000 words, and proposals which are longer generate a sarcastic note from Barry Clark. Figures and figure captions and appendices are not included in the overall word count. But, *do not use diagrams to circumvent the 1000-word limit*. Page-long figure captions are not appreciated.

Avoid cliches which drive the referees and the TAC crazy. Some notorious examples are: Rosetta-stone, Missing-link, Definitive experiment, Unprecedented, Almost unique, Holy grail.

Although there is no recommended style, most proposals have three sections. First, there is a general statement of the scientific goals and the relevance of the observations in meeting the goals. The referees are knowledgeable and up-to-date, so the discussion should not be a tutorial. Important supporting evidence which may not be widely known (e.g., recent astro-ph papers) should be noted.

The next section should discuss previous observations at radio and other wavebands which are related to the current goals. If some radio observations have already been made, you should succinctly discuss and clearly state why more observations are needed, whether for the same source, perhaps at a different frequency, or other sources which are in the same category. The referees and the TAC have a list of all previous observations and will often deny time to a good proposal if most of the goals can be obtained from already existing observations. Use the previous results to suggest your present goals, but make a good case that much more and varied data are needed.

Finally, the last section should give the observational procedures. These will be obvious for many experiments, and the desired frequency and integration time, with relevant sensitivities, may be most that is needed. For observations for which good calibrations are crucial to obtain the desired image or other parameters, some indication of the problems and possible techniques are needed. You do not have to sound like a black-belt user, but at least recognize where the extra effort will be. Please obtain advice from experts at

VLA OBSERVING APPLICATION

A

rcvd:

DEADLINES: 1st of Feb., June., Oct. for next configuration following review
INSTRUCTIONS: Each numbered item must have an entry or N/A
E-MAIL TO: propsoc@nrao.edu
OR MAIL TO: Director NRAO, 520 Edgemont Rd., Charlottesville, VA 22903-2475

(1) Date Prepared: 20 January 2003

(2) Title of Proposal: Probing the Star-Formation History of the Universe with Local Templates: Radio Continuum of Extremely Low-Metallicity Blue Compact Dwarfs

(3) AUTHORS (Add * for new location)	INSTITUTION	E-mail	Grad Students Only: For Ph.D. Thesis?	Grad Students Only: Anticipated Ph.D. Year
*				
*				

(4) Related VLA previous proposal number(s):

(5) Contact author for scheduling: address:

(6) Telephone: E-mail: Fax:

(7) Scientific Category: ○ solar system ○ galactic ⊗ extragalactic ○ other:

(8) Configurations (one per column) (A+Pt, A, B, C, D, BnA, CnB, DnC, Any)	A				
(9) Wavelength(s) (400, 90, 20, 6, 3.5, 2, 1.3, 0.7 cm)	1.3, 3.6, 6, 20				
(10) Time requested (hours)	12				

(11) Type of observation: (check all that apply) ⊗ continuum ○ spectroscopy ○ multichannel continuum ○ polarimetry ○ solar ○ pulsar ○ high-time resolution ○ Pie Town link ○ other:

(12) Suitable for dynamic scheduling? ⊗ Suitable ○ Unsuitable

(13) ABSTRACT (do not write outside this space)

Because they are little affected by dust, radio wavelengths are ideal for measuring the cosmic star-formation rate (SFR) at high redshift. However, the radio may not reliably trace SFR of the low-mass chemically unevolved "primordial building blocks" predicted by hierarchical galaxy formation models: low-metallicity blue compact dwarfs (BCDs) – local analogs of the postulated high-redshift progenitors – have abnormally low radio emission relative to the far-infrared. This proposal is aimed at a better understanding of this puzzle, through a multifrequency study of extremely metal-poor BCDs. We will be able to broadly separate thermal/non-thermal emission, study the role of compactness in the radio properties of BCD star-forming regions, and search for optically thick emission. The proposed data will allow us to study trends in radio properties down to the metallicities and masses typical of hierarchical building blocks, and investigate star-formation properties in chemically unevolved environments with a precision impossible at high redshift.

NRAO use only
(03/02)

Figure 1: VLA cover sheet, first page.

(14) Observer present for observations? ⊗ Yes ○ No Data analysis at? ○ Home ○ AOC or CV (2 weeks notice)

(15) Help required: ⊗ None ○ Consultation ○ Friend (extensive help)

(16) Spectroscopy only	line 1	line 2	line 3	line 4
Transition (HI, OH, etc.)				
Rest Frequency (MHz)				
Velocity (km/s)				
Observing frequency (MHz)				
Correlator mode				
IF bandwidth(s) (MHz)				
Hanning smoothing (y/n)				
Number of channels per IF				
Frequency Resolution (kHz/channel)				
Rms noise (mJy/bm, nat. weight., 1 hr)				
Rms noise (K, nat. weight., 1 hr)				

(17) Number of sources:	**4**

(If more than 10 please attach list. If more than 30 give only selection criteria and LST range(s).)

(18) NAME	Coordinates 1950 ○ 2000 ⊗ RA hh mm Dec. $\pm$ xx.x°	Conf.	λ (cm)	Corr. mode	Band-width per IF (MHz)	Total Flux (mJy)*	LAS	Required rms (mJy/bm)	Required dynamic range	Time request (hr)
SBS0335-052	03 38 -05 03	A	1.3		50	0.4	$2''$	0.05	10:1	2
SBS0335-052	03 38 -05 03	A	3.6		50	0.8	$2''$	0.025	30:1	2
SBS0335-052	03 38 -05 03	A	6		50	1.1	$2''$	0.025	40:1	2
SBS0335-052	03 38 -05 03	A	20		50	0.4	$2''$	0.025	15:1	1.25
NGC 2363	07 29 +69 11	A	1.3		50	4.2	$2''$	0.1	40:1	0.45
NGC 2363	07 29 +69 11	A	3.6		50	7.4	$2''$	0.1	70:1	0.5
Mrk 996	01 28 -06 20	A	1.3		50	0.7	$2''$	0.1	200:1	0.5
Mrk 996	01 28 -06 20	A	3.6		50	1.2	$2''$	0.1	200:1	0.5
Mrk 996	01 28 -06 20	A	6		50	1.9	$2''$	0.1	200:1	0.25
Mrk 996	01 28 -06 20	A	20		50	4.3	$2''$	0.1	200:1	0.25
Mrk 1089	05 02 -04 15	A	1.3		50	18	$2''$	0.05	30:1	2

*For spectral line, this should be the total flux density at the peak of the line

Notes to the table (if any): The dynamic range for Mrk 996 takes into account background sources.

(19) Restrictions to elevation (other than hardware limits) or HA range (give reason):

(20) Preferred range of dates for scheduling (give reason):

(21) Dates which are not acceptable:

(22) Special hardware, software, or operating requirements:

(23) Please attach a self-contained Scientific Justification **not in excess of 1000 words.** (Preprints or reprints will be ignored.)
Please include the full addresses (postal and e-mail) for first-time users or for those that have moved (if not contact author).
When your proposal is scheduled, the contents of the cover sheets become public information (Any supporting pages are for refereeing only).

v4.1 3/02

Figure 1: VLA cover sheet, second page (last).

NRAO. See VLAadvice and VLBAadvice for advice on VLA and VLBA technical matters.

For the VLA, the needed configuration(s) must be indicated, and these are obvious for many proposals. Use the hybrid arrays (long VLA north-arm) for sources with $\delta < -25°$. Justify the time for each configuration, remembering that more time is generally needed in the higher resolution arrays. For determination of spectral indices of extended sources, please use scaled arrays. For point sources, the configuration is not be crucial, and if flexible, this help in the scheduling of the observation.

5.2 Supporting figures, tables and references

Diagrams and figures should be used sparingly, but are important is showing faint detections or bizarre morphologies. Massive postscript files which are longer than 5 Mbytes are automatically returned to the useful with an obvious complaint. Most large files can be significantly compressed before submission.

Tables generally have less impact than figures, and should be short. But, tables are necessary to list many sources and give the pertinent observing parameters if this information is too long to be placed on the proposal cover-sheet. The list also help in determining which sources are already in the archive data base. References are useful, especially those of more recent work in astro-ph. Do not go wild with basic references in the first part of the justification which outlines the general goals. The referees are familiar with these. Do not include reprints or significant parts of published or unpublished papers.

5.3 Surveys

The VLA and VLBA are powerful survey instruments, and hundreds of radio sources can be observed in less than 24 hours of observing. In some cases the VLA can be split into two or more subarrays when surveying point sources. The choice of VLA configuration depends on several factors. For accurate positions, then the A-configuration should be used. For detections, a smaller configuration is more useful, except at the frequencies less than 1.4 GHz where background source confusion is a problem, and frequencies greater than 23 GHz where atmospheric refraction is large.

In the proposal, justify survey observations and the sample with good arguments. Referees do not like 'fishing expeditions'. A check of the archive may indicated that some of the sample has already been observed. These previous observations can be used to cut down on the observing time and, more importantly, to justify the goals of the survey. Make extensive use of existing catalogs (NVSS, FIRST, WENSS, etc) in generating and justifying the survey source list Radiosurvey

5.4 Detections

The VLA is a sensitive instrument and detection experiments are common. Do not use the VLBA to detect sources. Use the VLA first or another instrument (e.g., the GBT for a line detection). A non-detection should provide a significant result, and there is a correlation for how much time will be granted versus the significance of a detection or non-detection. The RMS noise level does decrease as $t^{-0.5}$ up to several hundred hours of integration time at frequencies between 1.4 and 15 GHz. Source confusion limits detection levels at lower frequencies, and weather related problems at higher frequencies. Unless there is a physical reason for choosing a particular frequency for the target, 8 GHz is the most sensitive VLA and VLBA detection frequency.

Proposals which ask for significant time ($>$ 6 hours) for the confirmation of previous 2-σ or 3-σ results need good justification. A figure of the previous almost detection is worthwhile in order to show that a near detection was obtained.

5.5 NRAO refereeing system

The guidelines that NRAO give to the referees are given in NRAOref, so you can see what they are looking for in a good proposal, and how they judge the proposals. Approximately 150 VLA proposals are received for each four-month cycle, with a typical oversubscription rate of 2:1 (time asked for versus time available). There are over 60 referees, split into more than ten subgroups. Each proposal is categorized into one (sometimes several) subgroup and sent to about five referees assigned to the subgroup. All communication is done by e-mail; there is no face-to-face meeting of the referees who are unknown to each other. Each referee gives an overall rating to the proposal and a suggested percentage of time to be allocated. Referee comments on the proposal are extremely important to the overall evaluation, and touch on the technical problems and overlapping proposals.

The referee reports are collated and an average grade is obtained for each proposal. The TAC of approximately 6 people (mostly NRAO staff plus one or two outsiders) then meets for two days and goes through the proposals one by one, discussing all aspects of the referee reports and their own impression of the proposal. Technical problems are covered and the overlap of the proposal with existing or previous proposals are considered. The VLBA and VLA proposals are done independently, except when the VLBA proposal asks for VLA resources. The proposals are separated into four categories: definitely schedule (with possible time adjustments), schedule if possible, possibly schedule, reject. There is, of course, good correlation between the the average referee proposal grades and the above categories, but the TAC makes adjustments on technical grounds, referee disagreements, etc.

A first-pass VLA schedule for the four-month period is then generated from all the proposals except those rejected. Because of the non-uniformity of the proposal targets in the sky, some sidereal time ranges are oversubscribed by nearly 1.5:1, and other ranges may be slightly undersubscribed. In order to schedule the top two categories of definitely schedule and schedule if possible, readjustment of the schedule, including the moving of calibration time and test time, is made. The tentative move date of the VLA from one configuration to another may be adjusted by as much as a week in order to include the highest ranked proposals, especially if the VLA is observing one of the large proposals during the coming four-month segment. This VLA scheduling is a painful procedure because some high ranked proposals cannot be scheduled, whereas lower ranked proposals do get observing time—all because of the sidereal time range requested. Thus, comparison of the average proposal grade and whether time has been granted is not a precise one-to-one correlation.

The VLBA proposals are judged in a similar manner, although the observing pressure is not as high as that for the VLA, there is no four-month configuration constraint, and many VLBA proposals are now done dynamically, that is, observed when the whether conditions are optimum.

5.6 The proposer response

An example of the referee's report is given below. After the proposal code and title, the proposal status is listed. For multi-configuration or monitoring programs, the status of future configurations will also be given. For the longer programs, the TAC may ask for a status report at some time in the future.

PROPOSAL CODE: AH818

PROPOSAL TITLE: Extremely low-metallicity blue compact dwarfs

PROPOSAL STATUS (05/07/03): No time currently scheduled, no further consideration. Time requested: 1 times 12.0 hrs in A config centered at 4.5

Referee A Rating= 5.0 Time rec= 30% Ref mean 4.0 The connection of these objects to anything that will be observable in the distant universe anytime soon seems tenuous at best. Including a large metallicity baseline is interesting, but what predictions are being made or tested? Considerable data exists in the archives on most of these galaxies which would enable a good start on this program. A configuration at 1 frequency would serve to establish the presence of compact radio sources. The source list in Table 1 does not seem to match the source list on the cover page.

Referee B Rating= 6.0 Time rec= 0% Ref mean 4.7 Is a 1.3 cm A-array observation practical during the summer? The goal of this project is to measure the radio luminosities and spectra of 4 local “primordial” low-metallicity galaxies in order to infer the radio properties of the CDM galaxy building blocks at high redshifts. These proposed high-resolution (LAS $\sim 2''$) observations of much larger (optical size $\sim 1'$) nearby low-metallicity galaxies will probe individual star-forming regions but will miss extended emission, which may be a significant fraction of the total non-thermal flux. Still, these are worthwhile galaxies to observe in their own right, just to understand their compact regions of star formation.

Referee C Rating= 5.0 Time rec= 0% Ref mean 4.1 This sounds like an interesting project, but I have the impression that the authors have not spent much time thinking about the correct observational technique to achieve their science goals. To correctly separate thermal and non-thermal emission and study the compactness of radio sources in these galaxies they will need matched beams at the different frequencies.

The specific comments from the referees are then listed. If you have not been granted time, then you should look at these comments in the same way as you would a referee's report for a submitted journal paper: How can the proposal be improved in order to increase the chances of getting observing time? Hence *submitting a proposal at least one submission period before the needed configuration will be scheduled allows time to resubmit with an improved proposal while not waiting 15 months for the needed configuration to come-up again.* It is possible to complain to the NRAO TAC if you think a grave injustice or mis-understanding has occurred, but it is much simpler to resubmit with the referee's and NRAO's comments as a guideline. Obviously, for time-critical observations, this is not possible.

5.7 Other topics

1. Spectral Properties: For the determination of accurate spectral properties of extended sources, use scaled arrays. The scaling does not have to be perfect, but more than a factor of two in resolution between observations at different frequencies may cause uncertainties. *Do not submit a one-configuration VLA proposal for spectral in-*

dex determinations from 1.4 to 22 GHz unless the sources are point sources.

2. Do Not Over-resolve the Source: For diffuse sources, start with a relatively short VLA configuration. Include longer configurations in the proposal is there is known fine-scale structure, or wait until the results of the present observations. This is particularly true for 21 cm H I emission which have a relatively low brightness temperature.

3. One Big Proposal is Better than many Small Proposals: The conventional wisdom that two 50-hour proposals stand a better chance of getting some observing time compared with one 100-hour proposal is wrong. Projects with similar goals should be placed in one proposal, or clearly linked to present and previous proposals in the write-up. If you don't do it, then the referees and the TAC will—with some consternation at the extra work.

4. Symbiotic Relationship between Referees and Proposers: The NRAO wants to observe the best science and will give comments to the observer (regardless if the proposal is accepted or rejected) on possible observational improvements.

5. Ph.D. Candidates: Every effort is made to support and schedule observations associated with dissertations.

6. Overlapping and Conflicting Proposals: Overlapping proposals from competing groups are handled primarily to produce the best scientific results. Proposal arrival dates are only one of several factors used. Combining forces is generally attempted, with some negotiations.

Now, get those proposals in!

Appendix: Web-site addresses

In order of first appearance in the text

VLAgen: http://www.vla.nrao.edu/astro/guides/vlas/current

VLBAgen: http://www.vlba.nrao.edu/astro/obstatus/current/obssum.html

GBTgen: http://www.gb.nrao.edu/GBT/GBT.shtml

NRAOns: http://www.nrao.edu/news/newsletters

VLAexp: http://www.vla.nrao.edu/astro/guides/exposure

VLApol: http://www.aoc.nrao.edu/~gtaylor/calman/polcal.html

VLAhifr: http://www.aoc.nrao.edu/~gtaylor/calib.html

VLAcal: http://www.aoc.nrao.edu/~gtaylor/csource.html

VLBAcal: http://www.vlba.nrao.edu/astro/calib/index.shtml

Rapidprop: http://www.vla.nrao.edu/astro/prop/rapid

VLAconf: http://www.vla.nrao.edu/genpub/configs

CXONRAO: http://cxc.harvard.edu/proposer/CfP/html

NRAOsup: http://www.nrao.edu/administration/directors_office/nonemployee_observing_travel.shtml

NRAOpage: http://www.nrao.edu/library/page_charges.shtml

NRAOhelp: http://www.aoc.nrao.edu/~schedsoc

VLAcover: http://www.nrao.edu/administration/directors_office/tel-vla.shtml

VLBIcover: http://www.nrao.edu/administration/directors_office/vlba-gvlbi.shtml

VLAadvice: http://www.vla.nrao.edu/astro/#D5

VLBAadvice: http://www.vlba.nrao.edu/astro/

Radiosurvey: http://www.nrao.edu/astrores

NRAOref: http://www.nrao.edu/administration/directors_office/refguide