NATIONAL RADIO ASTRONOMY OBSERVATORY

SOCORRO, NEW MEXICO

VERY LARGE ARRAY PROGRAM

VLA OBSERVATIONAL STATUS REPORT

January 31, 1983

This report communicates the current observational limitations of the VLA to both users and potential users. It contains essential information needed to prepare an observing program with the VLA.

The hardware configuration as well as the best estimates of the sensitivity of the VLA at the end of 1982 are briefly outlined. More current estimates of the array status or information not covered in this report may be obtained directly from the VLA staff.

More technical information is also available from the following books:

a) Synthesis Mapping - Proceedings of the NRAO-VLA Workshop held at Socorro, NM (June 21-25, 1982) (available from B. O'Brien, Green Bank).

b) An Introduction to the NRAO, Very Large Array (available from A. Patrick, VLA).

c) Various manuals available at the VLA (see Section 7.0).

1.0 HARDWARE CONFIGURATIONS

Continuum, polarization and spectral line observations at the four separate wavelengths 1.3 cm, 2 cm, 6 cm, and 18-20 cm are supported. Observations at seven different bandwidths (50 MHz/2^n where n = 0,1,2...6) are possible. Circularly polarized feeds are used at all bands.

The array is cycled through its four main configurations during the year. The reconfiguration schedule for the next year is outlined in Table IV.

2.0 OBSERVATIONAL LIMITATIONS

Tables I and V summarize the sensitivity and resolution of the VLA.

2.1 Sensitivities

The sensitivity parameters listed in Table I are based on theoretical estimates using the quoted system temperature and comfirmed from observations. The numbers refer to 50 MHz continuum observations using two IF correlations for naturally weighted u,v data. The sensitivities have been calculated using the formulae (for natural weighting):

in brightness temperature:

$$\frac{1.1a}{\sqrt{n(n-1)h\ df}}\ t^2 \quad K$$

or:

$$\frac{1.5a}{b_1 b_2 \sqrt{n(n-1)h\ df}}\ \lambda^2 \quad K$$

or noise level:

$$\frac{a}{\sqrt{n(n-1)h\ df}} \quad mJy$$

where:

n = number of antennas involved

h = integration time on source, in hours

df = channel bandwidth, in KHz

t = taper, in km

λ = observing wavelength, in cm

b_1, b_2 = FWHP's of the synthesized beam, in arcsec

and the constant a depends on T_{sys} and antenna efficiency:

L-band	C-band	U-band*	K-band
620	420	3200?	4500?

* Constant refers to old receivers (b=1100 for new U band FETs).

A more detailed description of noise formulae is given in the "Synthesis Mapping - Proceedings of the NRAO-VLA Workshop held at Socorro, NM".

The sensitivity degrades near the band edges. Dynamic range, interference and/or confusion (particularly at 20 cm) may prevent one from reaching the sensitivity limits quoted in Table I.

Eight antennas have now been outfitted with new 2 cm FETs. The sensitivity of these antennas at 2 cm is about 3 times better than the others ($T_{sys} \approx 105°-120°$). The current plan is to have all antennas outfitted by the summer of 1983.

One antenna has a 1.3 cm maser receiver. The sensitivity of this antenna is about four times better than the average.

When the additional IF bands (B and D) come on-line the overall bandwidth will increase to 100 MHz for both orthogonal polarizations increasing sensitivity by $\sqrt{2}$. They are currently planned to be available in the summer or fall of 1983.

2.2 Large Scale Structures

Mapping of large sources is restricted by the smallest spacings of the array. Table V indicates approximately the largest-scale structure "visible" to the VLA at the four standard bands and configurations. Sources with extended regions larger than these limits will be missing major fractions of flux density and maps may seriously misrepresent the large-scale structures. See the "Synthesis Mapping - Proceedings of the NRAO-VLA Workshop held at Socorro, NM" for more details.

2.3 Dynamic Range

The dynamic range, loosely defined to be the ratio of the maximum source brightness to the minimum believable source brightness, is mainly limited by phase stability. Many of the synthesized maps generated from VLA observations are limited by dynamic range and not by noise (Table I). Self-calibration can improve on dynamic ranges up to 5000:1 depending strongly upon source structure, u,v coverage, signal-to-noise levels and data quality (general guidelines are available from the VLA COOKBOOK). See the "Synthesis Mapping - Proceedings of the NRAO-VLA Workshop held at Socorro, NM" for more details.

2.4 Pointing

Occasional large daytime antenna pointing errors of 1 arcminute or more will influence observational results to the extent that sensitivity and dynamic range may be seriously degraded at high frequencies.

Installation of antenna thermal insulation is in progress and will not be complete until the end of 1985 or early 1986. This will significantly reduce the large pointing errors on calm days. Consult the on-duty operator for a list of insulated antennas. Pointing errors due to wind continue to be a problem. Noticeable degradation at high frequencies occurs at wind velocities above three meters per second (~6.7 mph).

2.5 Interference

The bands within the frequency range of the VLA that are allocated exclusively to radio astronomy are the following: 1400-1427 MHz, 4990-5000 MHz, 15.35-15.4 GHz, and 23.6-24.0 GHz. There should be no interference within these bands. Some interference (White Sands radar, meterological balloons, airborne drones, etc) can be expected outside of these bands, particularly at 20 cm (1340-1730 MHz). The results of an interference study in the 20 cm band (from 1350 to 1730 MHz) are available in VLA Test Memorandum No. 139. In summary:

(1) There are birdies every 50 MHz at frequencies of 1300 +n50 (n=1,...) MHz over the whole tunable range. These are of moderate strength, and could even interfere with broad-band observations. They should be avoided. It is most important to avoid the 1600 MHz birdie as this one is exceptionally strong.

(2) Strong signals which are always present are listed in VLA Test Memorandum No. 139.

(3) We have a statistical picture of sporadic interfering

signals, and one can avoid most with proper selection of observing frequency/bandwidth. Most of these are weak and present no problem to continuum observing.

(4) Located within the range 1670 to 1700 MHz are the frequencies used by meteorologists to receive weather data from balloons. These are released from nearby Mt. Baldy during thunderstorm season. Thus, one is 'probably' safe during the winter and spring in this frequency range - but summer observations, especially in the daytime, are likely to be affected.

2.6 Bandwidth and Time Averaging Smearing

A. Effects Due to Bandwidth

Observing with a finite bandwidth causes degradation of the synthesized beam which worsens with separation from the phase center. The degradation causes the peak response (and hence sensitivity) to decrease with the radial separation from the phase center, and the synthesized beamwidth to increase along the radial direction.

These losses are dependent upon bandwidth, distance from the phase center, spacings used and the taper. The loss in gain is tabulated in Table II(a) for an untapered observation at 50 MHz. $\frac{\Delta\nu}{\nu}$ is the ratio of the bandwidth to the observing frequency and $\frac{x}{x_{\frac{1}{2}}}$ is the ratio of the radial distance from the phase center to the FWHP of the synthesized beam.

The increase in the beamwidth in the radial direction is proportional to the loss in peak intensity (i.e. radial beamwidth is approximately equal to FWHP [Table V] divided by the loss in sensitivity [Table II(a)]). The integrated flux density remains constant.

A more detailed discussion of this effect is found in the Green Book (An Introduction to the NRAO Very Large Array) and the "Synthesis Mapping - Proceedings of the NRAO-VLA Workshop held at Socorro, NM".

B. Effects Due to Time Averaging

Averaging over a time in which the visibility changes significantly causes loss of amplitude similar to that due to the bandwidth effect. However, the analysis of the time effects is more complicated. A simple case exists only for the north pole, where the losses are equivalent to bandwidth losses except that the smearing is in the azimuthal, rather than the radial direction. A good and simple guideline for keeping time averaging losses small is to keep them less than the corresponding bandwidth losses. Table II(b) gives the averaging times for which, at $\delta = 90^\circ$, time losses equal bandwidth losses.

2.7 Confusion

As indicated in Table I, confusion or the presence of other sources in the primary beam can limit map quality. These sources can lead to aliasing problems and produce unwanted sidelobes in the maps. Although bandwidth smearing in the larger configurations will suppress some of the effects from confusing sources in the primary beam, it may still be a major concern at 20 cm. The brightest source expected in the primary antenna beam is listed in Table I for each of the observing bands.

2.8 Strong Source Interference

The presence of very strong sources in the sky may lead to interference problems. For example, the Sun is such a strong source that the far sidelobes of the antenna are not able to suppress its signal entirely. For broad continuum bandwidths the correlated signal from the sun is bandwidth smeared down to very low levels. However, this is not true for the narrow bandwidth spectral line observations of weak sources in the more compact configuration during the daytime which may be degraded even when the sun is far away from the source.

2.9 Positions

The absolute positional accuracy obtained is generally about

0.1 arcsec in the A array (in C array accuracy is about 0.3 arcseconds). The main limitations are the phase errors caused by the ionosphere and the troposphere and the positional accuracy of the calibrator. Positional accuracy of 0.03 arcsec can be obtained by using only the B calibrators, checking antenna baseline parameters and praying for stable weather. Position errors in declination are about a factor of 2 worse for sources at -20 degrees declination and will deteriorate at more southern declinations.

2.10 Polarization

Circular polarization measurements are limited by large circularly polarized sidelobes and are restricted to sources with very large degrees (>10%) of circular polarization or to point sources located at the center of the primary beam. This limitation is due to the large circularly polarized sidelobes.

Linear polarization observations are possible at all bands. The on-axis instrumental polarization can usually be determined to an accuracy of much better than 0.5 percent at 6 and 20 cm. At 2 and 1.3 cm the accuracies are usually about a factor of 2 worse. The limit of this accuracy is partly a result of pointing errors. Mapping the polarization of sources more than 10 percent of the half power beam width away from the beam center at 6 cm may be subject to uncertainties greater than one percent because of the large linearly polarized sidelobes. This limitation is also present at the other bands; the location of the polarized side lobes scales with wavelength. Polarization observations in the 20-cm band are sometimes hampered by ionospheric Faraday rotation. The amount of Faraday rotation has been occasionally larger than 35 degrees and will probably continue to be a factor in observations at 20 cm. Observations at the short wavelengths, particularly 1.3 cm, are hampered by pointing problems. More information can be obtained from the Linear Polarization Measurements document in the COOKBOOK and a general discussion is available in the "Synthesis Mapping - Proceedings of the NRAO-VLA Workshop held at Socorro, NM".

In general the instrumental polarization can be calculated from observations of the calibrator normally used to obtain the amplitude and phase of the instrument, provided that there are enough observations to ensure both a high signal-to-noise ratio in the cross hands and reasonable change in parallactic angle ($\geq 90°$). Absolute position angles are determined by observing a strongly linearily polarized source whose polarization is known (i.e. 3C286, 3C138).

2.11 Spectral Line Capabilities

Spectral line observations are currently supported in only a single polarization mode (right or left circular polarization). Software for the spectral line calibration is still crude and calibration can be quite involved.

In general, a channel-to-channel dynamic range of about 30:1 can be achieved easily but achieving 100:1 at wide bandwidths is very hard. Dynamic ranges better than 100:1 require special treatment and cannot be guaranteed.

The basic combination of bandwidth channels and antennas are listed in Table III. Further trade offs between the number of channels and antennas by bandwidth are possible. See "A Short Guide for VLA Spectral Line Observers" or the "Synthesis Mapping - Proceedings of the NRAO-VLA Workshop held at Socorro, NM" or the Green Book for more information.

The number of baseline-channels will be doubled by late spring/early summer.

2.12 VLBI Observations

VLBI observations using the VLA and the Mark II or Mark III backend are possible either using phased array mode or a single antenna. There is one antenna (9) which has a maser at 22 GHz (T_{sys} = 95 K, $\Delta\nu$ = 200 MHz, Frequency = 22-24 GHz). One other antenna is equipped with a 90 cm receiver (T_{sys} = 120° K, efficiency = 30%) and it may be used for 90 cm VLB experiments. See comments under 3.0 (VLA REMOTE OBSERVING PROGRAM) for the support available for in-absentia VLBI observing.

2.13 Snap Shot Mode

When signal to noise is not critical adequate observations of small strong sources can be made in as short a period of time as 10 minutes.

Single snap shots with good phase stability should give dynamic ranges of about 50 to 1 for sources whose angular size does not exceed the numbers listed in Table V for "Largest Scale Structure Visible". Snapshots do not give as good protection against the sidelobes of distant confusing sources, as full mapping. At 20 cm, problems may arise from the expected 100 mJy source in the antenna beam especially in the D and C arrays. A snap shot gives an rms ~1 mJy at best due to confusing sidelobes.

2.14 Shadowing

Observations at low elevations taken in the D array may be affected by antenna shadowing (see VLA Scientific Memoranda No. 134). The OBSERV program has an option which will indicate when shadowing will occur and on what antennas. After the observations the program GTBCOR can be used to find out what antennas have been shadowed. Observations using a hybrid array with a longer north arm (see Section 8.0) may be preferable for sources with declinations $<-15°$.

3.0 VLA REMOTE OBSERVING

3.1 "Absentee" Observing

(a) The observing file can be prepared for standard VLA observing programs. The observer is required to specify the detailed source list, sequences and observing options at least two weeks in advance. The observing files for any very complicated or spectral line programs generally must be completed by the observer himself. The preparation of VLBI observing files is the responsibility of the observer. In those circumstances where it is not possible for the VLBI observer to prepare his source file, NRAO will do it for him if P. Crane receives the schedule at least two weeks before the start of the Network run.

(b) Observers may be absent during the observations. For standard VLA continuum or spectral line programs and all standard Mark II VLBI programs which need very little operator interaction, the observer is generally not required to be present at the VLA site. However, for all Mark III VLBI programs or for observing programs which require the attention of the operator beyond his normal duties, an on-site observer is required and the observer will have to carry out most of the extra tasks related to his programs. The VLA will supply help to relieve the observer in long (>18 hours continuous) programs of this type; however the observer MUST request this service WELL (>2 weeks) in advance of the observing run.

3.2 Editing and Calibration of VLA Data and Related Tasks

(a) Any standard VLA continuum observing program can be edited and calibrated. Complicated calibration of continuum data or calibration of sepctral line data may be possible but must be checked out well in advance.

(b) Calibrated visibility tapes (Export tapes), backup tapes and copies of archive tapes can be prepared.

(c) In general, maps will not be produced.

3.3 DEC-10 Dial-Up Line

The DEC-10 has a dial-up line which may be used for preparing observing files or monitoring progress of an observing run from the database on the DEC-10. The telephone number is (505) 772-4346 and a Racal-Vadic modem is used with options of 1200 baud, 8 bits and no parity.

NRAO will pay for the call. Dial (505) 772-4011 (between midnight and 4:30 pm weekdays and all hours on the weekend and holidays) or (505) 772-4254 (between 4:00 pm and midnight on weekdays) and request to be called back on FTS and transferred to the computer (DEC-10).

3.4 On-Site Help

The data analyst (DA) who normally carries out the above tasks will be available on week days to on-site observers for direct assistance in matters related to the remote observing program.

3.5 How To Make Use of These Services

(a) Check the appropriate box on the observing cover sheet for your proposal.

(b) Contact either R. Perley or P. Perley and pass on the details well in advance (>2 weeks). The advance notice is required to enable us to schedule all the requests efficiently.

(c) For VLBI observations contact P. Crane at least two weeks before the start of the VLBI Network session. Complicated observing files must be prepared by the observer.

4.0 VLA CALIBRATORS

The VLA staff has completed a list of sources which are sufficiently unresolved and unconfused to permit calibration at all bands to a few percent. This list currently contains about four hundred sources and it is readily available at the VLA site. Although the primary flux density calibrator is 3C286, there are three circumpolar sources (0212+734, 0836+710, 1803+784) whose fluxes are monitored frequently for use as flux density calibrators. 1328+307 (3C286) and 0518+165 (3C138) are currently used to establish the absolute position angle of the linear polarization. More information is available in the VLA Calibrator books located at the VLA site.

5.0 PLOTS OF U,V COVERAGE

The u,v coverage of the full 27-antenna VLA for the A, B, C, and D configurations is shown in Figure 1 for 7 different declinations.

These displays refer to continuous observations tracking the source from rising to setting for sources at declinations less than 64° and tracking the sources for 12 hours for sources at declinations greater than 64°. Figure 2 displays the u,v coverage of a snap shot observation at 50 degrees declination and for a duration of 15 minutes at zero hour angle. More detailed plots are available in the u,v coverage manual at the VLA site. A summary of the standard configurations is displayed in Table V.

6.0 SOFTWARE STATUS

The current on-site VLA software capabilities for converting raw visibility data into well-calibrated maps are best summarized by briefly listing the various tasks presently implemented at the different stages of data processing. No attempt is made to list the complete set of either the software options or its limitations.

The on-line computers, the Modcomps, automatically (a) change the LO phase to compensate for differential atmospheric refraction; and (b) correct the visibility phases for variations in the effective electrical length of the waveguide and some of the antenna LO paths (this latter correction is often termed the "round-trip phase correction"). In addition, gain variations caused by changes in the system temperature are corrected by using real time measured system temperatures. The latter correction may be turned on or off at the astronomer's option and by default is turned on at all bands.

Processing required to take the initially corrected visibility data from the Modcomps through calibration to the final maps is accomplished using the DEC-10 general purpose computer. The software is quite extensive and employs an antenna-based calibration technique. For the calibration of data there exist programs to (a) flag data good or bad, (b) correct phases for known source position errors, antenna position errors and time errors, and (c) correct amplitudes for general zenith angle dependent effects such as atmospheric absorption. System temperature corrections for all bands utilizing the measured system temperature data are possible. The antenna gain, phase and polarization characteristics are calculated from calibrator source observations, interpolated in time and stored with the visibility data.

Conversion of calibrated u,v data to maps can be done using either the DEC-10 and the PDP 11/70 mini-computer network or the VAX based post-processing system (AIPS). On both systems the tasks for conversion of calibrated data to maps include sorting, gridding, fast Fourier transform, source subtraction in the u,v plane, the clean algorithm and self-calibration (VAX only). Both u,v plane convolution (to aid in reducing the aliasing problems) and tapering are supported.

It is also possible to make maps on the Pipeline System which is currently under development. This system is designed to handle a large volume of data efficiently and in particular, to accommodate a substantial increase in spectral line processing. A very preliminary version of this system will become available early in 1983 with the more friendly and larger capacity system being ready by the end of 1983.

Map display formats include: character display on computer terminals, line printer output (DEC-10) and Versatec (VAX); contours with or without polarization on the Tektronix storage tube terminal (DEC-10), ZETA pen plotter (PDP 11's) and the Versatec dot matrix plotter (DEC-10, PDP 11/44 and VAX); gray scale and color images on the Comtal video terminal (PDP-11/44) or IIS video terminal (VAX); and Dicomed film recorder from VAX and PDP-11s.

The post-processing system includes options to edit and display u,v data, to make and clean maps, self calibrate, display maps on a terminal, contour maps on the VERSATEC printer, source fitting, polarization, optical depth, etc. Input is maps (FITS) or u,v data (EXPVIS). Modest spectral line capabilities are available. This system is currently running on the VAX 11/780 computers at the VLA and in Charlottesville as well as the Modcomp in Charlottesville. The AIPS system at the VLA now has dismountable disk packs for observers who have very large storage requirements. These packs are available from Ina Cole.

One return visit to Charlottesville or the VLA for further VLA reduction is supported by NRAO (contact Ed Fomalont at the VLA (505) 772-4247).

All computers support map data exchange using the FITS format.

7.0 DOCUMENTATION

Documentation for VLA data reduction, map making, observing preparation, etc. is found in five main manuals: An Introduction to the NRAO Very Large Array (Green Book), COOKBOOK, Observers Reference Manual, the VLA Calibrator Book and the AIPS Cookbook for the VAX Post Processing System. More technical information is found in the "Synthesis Mapping - Proceedings of the NRAO-VLA Workshop held at Socorro, N.M.". The Green Book, which covers most of all the topics at a general level, has been rewritten (June 1982). Many parts of it were out of date. The COOKBOOK describes some simple (and limited) recipes for observing strategies, calibration of data, map making and self-calibration. The Short Guide for VLA Spectral Line Observers is found in the COOKBOOK. The Reference Manual describes the computer program options in a reference style. The VLA Calibrator book contains the current list of primary and secondary calibrators. The last three of these manuals are constantly being revised. In addition, visibility plots are also available at the site. Copies of most of this documentation can be readily obtained at the VLA site.

8.0 VLA OBSERVING REQUESTS

Observing requests should be sent to the NRAO Director:

Dr. Morton S. Roberts
Director
NRAO
Edgemont Road
Charlottesville VA 22901

Requests should be concise (less than 1000 words) and emphasize the scientific justification. Sufficient thought should be given to instrumental capabilities to enable filling out the attached observing application form, which should be submitted with the proposal.

Closing dates for receipt of observing requests are listed in Table IV. Prospective users are advised to submit their proposals well in advance of the change to the required configuration and certainly no later than the appropriate deadlines listed in the Table. Proposals submitted requiring a specific configuration other than the one for the next quarter will be referreed but final evaluation and scheduling will not occur until the appropriate quarter.

The normal sequence of VLA configurations will be changed beginning in 1983 to a basic A B C D A ... cycle in order to provide all adjacent hybrids. As before the basic cycle to be spread over one and a quarter years in order to slide the sidereal times available through each configuration. This cycle will be perturbed whenever A array occurs in summer by inserting one of the more compact arrays.

The actual length of each configuration will be varied in response to proposal pressure. We will support observations during the reconfiguration. Suitable observations are point source monitoring and detection programs for which the configuration is not critical, and observations of low elevation sources with the North arm in the next larger configuration. For declinations $<-15^\circ$ the longer North arm hybrid gives a more circular beam and reduces shadowing.

Configurations for 1983 are listed in Table IV.

VLA observers are also urged to arrange their travel as soon as possible after scheduling and no later than two weeks before you are scheduled to arrive at the site. Both room and vehicle reservations (Albuquerque to VLA site) can be made by dialing (505) 772-4357, or FTS 476-8357.

9.0 PUBLICATION GUIDELINES

Any papers using observational material taken with NRAO instruments (VLA or otherwise) or papers where a significant portion of the work was done at NRAO, should include the following acknowledgement to NRAO and NSF:

> "The National Radio Astronomy Observatory is operated by Associated Universities, Inc., under contract with the National Science Foundation."

If you wish to have any paper put into the NRAO preprint system send three copies to Sarah Stevens-Rayburn in Charlottesville. This action will also cause the paper to be included in NRAO's publication lists.

TABLE I

VLA SENSITIVITY AND RESOLUTION*

Frequency (GHz)	1.34 - 1.73	4.5 - 5.0	14.4 - 15.4	22.0 - 24.0
Wavelength (cm)	22 - 18	6	2	1.3
Band Name	20cm (L)	6cm (C)	2cm (U)	1.3cm (K)
System Temperature (°K)	60	50	300 ††	400 †
Antenna Effeciency (%)	51	65	52	43
RMS Sensitivity (mJy) in 10 minutes (50-MHz bandwidth - 27 antennas)	.18	.12	.94	1.3 †
RMS Sensitivity in 12 hours (50-MHz bandwidth - 27 antennas) mJy	.021	.014	0.11	.16†
**Untapered brightness temperature (D configuration) mK	7.4	4.9	41	55†
***Dynamic Range without Self-Calibration	50	70	10 - 20?	10?
Antenna Primary Beam Size (FWHP - arcsecs)	1800	540	220	120
Brightest Source (mJy) Expected in Antenna Primary Beam	100	2.3	<.1	<.01

* Table entries are theoretical estimates (sensitivities are for a point source and refer to both IF pairs).

** See text for discussion of formula used. Calculations based on natural weighting.

*** Extremely dependent on weather and frequency of calibration.

† The ammonia lines are located near the band edge where sensitivities are about a factor of 2 worse.

†† The 2 cm estimates are based on the old receiver temperatures. New 2 cm receiver temperatures are 105°-120°.

TABLE II(a)

LOSS OF PEAK INTENSITY DUE TO BANDWIDTH SMEARING

Peak Intensity	1.0	0.95	0.90	0.80	0.50
Distance from the phase center for* configuration A	0	13"	20"	25"	50"
B	0	40"	60"	80"	3'
C	0	2'	3'	4'	9'
D	0	8'	11'	15'	30'
$\frac{\Delta\nu}{\nu}\frac{\chi}{\chi_{\frac{1}{2}}}$ **	0	.52	.74	1.0	2.0

* For an average untapered observation with 50 MHz bandwidth.
** See Section 2.6 A for discussion of parameters or the GREEN BOOK or the "Synthesis Mapping - Proceedings of the NRAO-VLA Workshop held at Socorro, NM" for more details.

TABLE II(b)

AVERAGING TIMES AT WHICH TIME LOSSES EQUAL BANDWIDTH LOSSES, FOR $\delta = 90°$

Bandwidth (MHz)		50	25	12.5	6.25	3.125
Observing Frequency (MHz)	1460	415	210	105	55	25
	4885	140	70	35	18	9*
	15000	45	22	10	5*	3*
	23000	30	15	7*	3*	2*

Note that, whereas bandwidth losses are unrecoverable, time losses due to averaging periods in excess of 10^s can be repaired by re-filling data bases with a shorter averaging period.

* Default integration time is 10^s. It is possible to obtain integration times as low as 3 1/3 seconds (DEC-10 FILLER will not currently handle this rate on-line; data must be filled from tape).

TABLE III

NUMBER OF ANTENNAS AND MAXIMUM CHANNEL SEPARATION
WHICH CAN BE USED FOR SPECTRAL LINE OBSERVING*

# Channels	# Antennas	Maximum Channel Separation Achievable for This # Channels (kHz)
8	All	6250
16	All	3125
32	21	781
64	15	195
128	11	49
256	8	12

* Channel separations from 380 Hz to 6.25 MHz are now available in steps of factors of 2.

TABLE IV

VLA CONFIGURATIONS FOR 1983

Configuration	Quarters Available	Proposal Deadline
C	Q1 1983	Oct. 15, 1982
C+D	Q2 1983	Jan. 15, 1983
D+A	Q3 1983	Apr. 15, 1983
A+B	Q4 1983	Jul. 15, 1983
B+C	Q1 1984	Oct. 15, 1984

Mixed configurations will be available during each configuration change. These will normally consist of a longer North arm.

TABLE V

CONFIGURATION SUMMARY

CONFIG-URATION	MAXIMUM ANTENNA PAIR SEPARATION		MINIMUM ANTENNA PAIR SEPARATION		APPROXIMATE SYNTHESIZED* HALF-POWER BEAMWIDTH FOR HIGH DECLINATION SOURCES (arcseconds)				APPROXIMATE LARGEST SCALE STRUCTURE "VISIBLE" TO VLA** (arcseconds)			
	km	ns	km	ns	20 cm	6 cm	2 cm	1.3 cm	20 cm	6 cm	2 cm	1.3 cm
A	29.7	99,000	.68	2,267	0.80	.25	.08	.05	25	7	2	2
B	9.0	30,000	.21	700	2.6	.83	.26	.17	80	25	7	5
C	2.8	9,333	.063	210	8.3	2.6	.83	.54	240	80	25	15
D	.84	2,800	.040	133	29.0	9.1	2.9	1.9	900	240	80	50

* These numbers refer to an aperture untapered, uniformly weighted and uniformally filled out to the maximum spacing.

**These numbers represent the approximate source size for full synthesis observations. For single snap shot observations these numbers should be divided by 2.

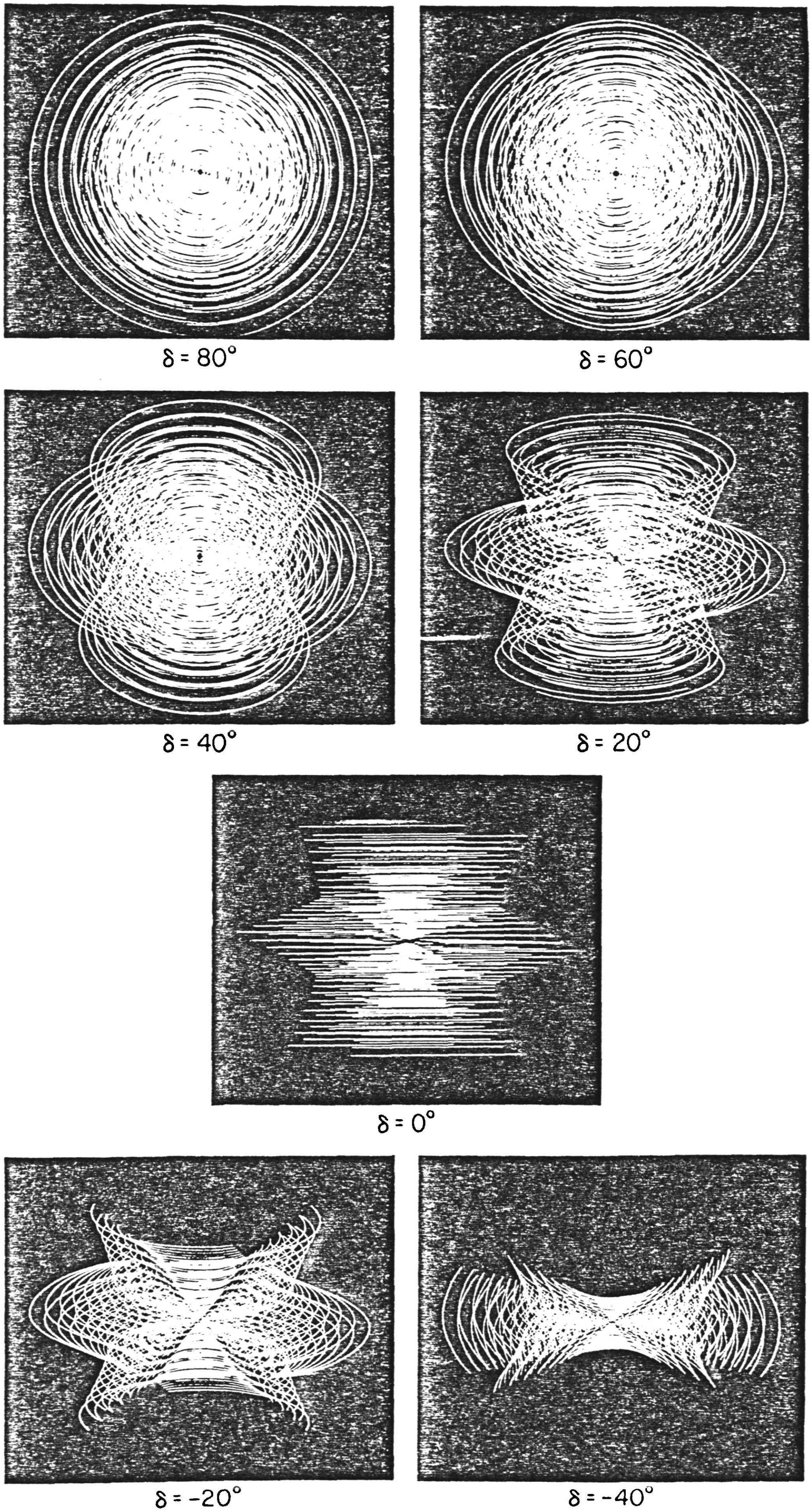

Figure 1

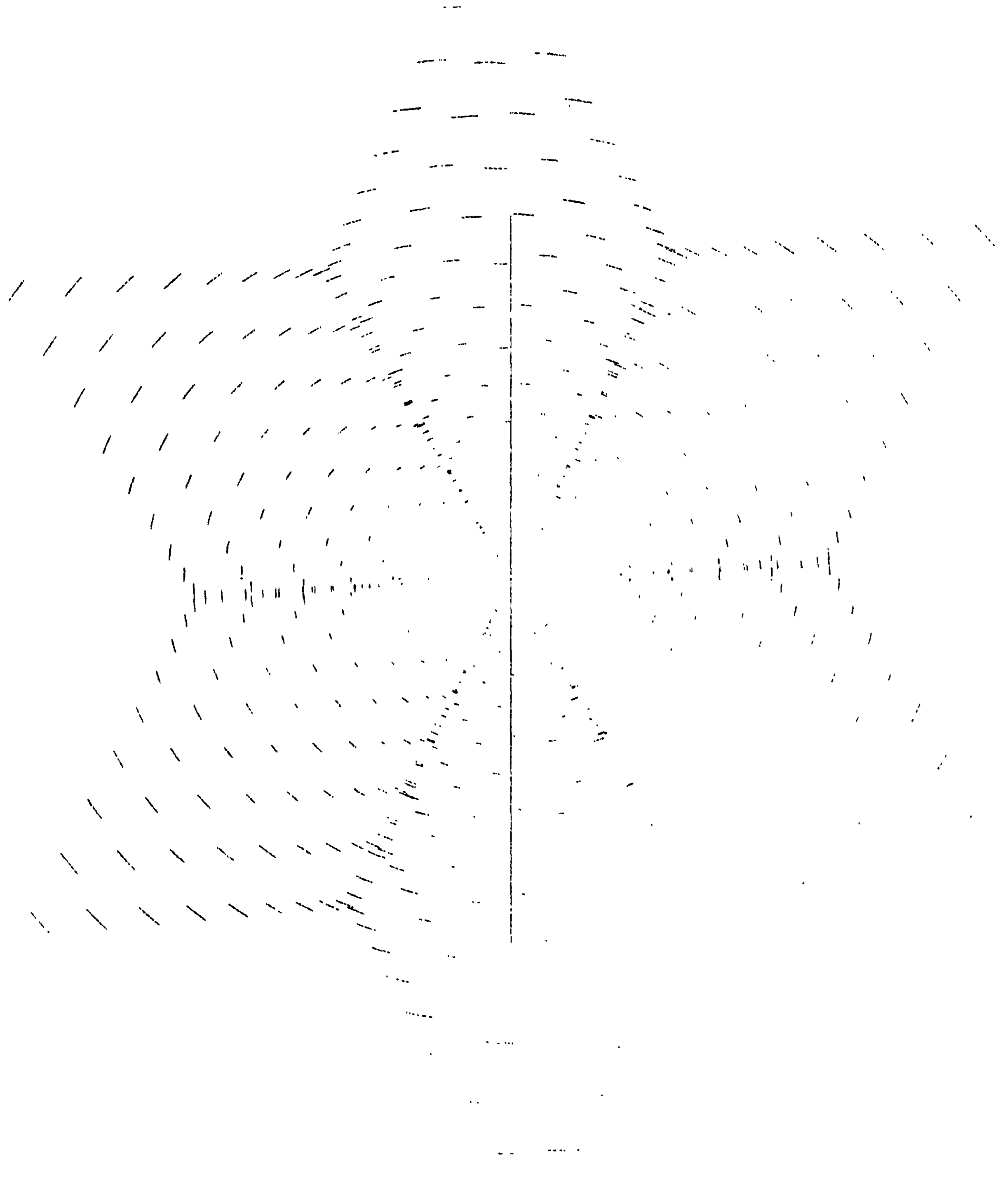

Figure 2

NRAO use only
A
received:

VLA OBSERVING APPLICATION

SEND TO: Director NRAO Edgemont Rd. Charlottesville, Va. 22901

DEADLINES: 15th of Jan., Apr., July, Oct. for Q 2, 3, 4, 1 respectively

1. Date:

2. Title of Proposal:

(3) Authors	Institution	Who will observe?	Grad Student?	Observations for PhD Thesis?	Anticipated PhD Year

4. Contact author for scheduling:

Address:

5. Telephone: or TWX:

6. Any related VLA proposal:

7. Scientific category: ☐ planetary, ☐ solar, ☐ stellar, ☐ galactic, ☐ extragalactic

(8) Preferred Configuration(s) (A, B, C, D, Any, Special)					Alternate(s) if any ______
(9) Wavelength (20 18 6 2 1.3 cm)					
(10) Time requested (hours or days)					

11. Type of observation: ☐ mapping, ☐ point source, ☐ monitoring, ☐ continuum, ☐ lin poln, ☐ circ poln, ☐ spectral line, ☐ solar, ☐ VLBI, ☐ phased array, ☐ other ______________

12. ABSTRACT (do not write outside this space):

NRAO use only

13 Reduction: Number of maps ________ Maximum size of maps ________________ Self-cal maps ________

14 Off-site reduction: ☐ none, ☐ post map, ☐ post calibration, ☐ everything.

15 Help required: ☐ none, ☐ consultation, ☐ friend, ☐ absentee observing, ☐ staff collaborator.

16 Spectral line only:

transitions to be observed				
channel bandwidth (KHz) (Δ)				
observing frequency ($\pm\Delta/2$)				
number of channels				
number of antennas				
rms noise after 1 hour (mJy)				

17 Number of sources _____ (If more than 10 sources please attach list. If more than 30 give only selection criteria and LST range(s).)

Name	coord (1950.0) RA hh mm	Dec $\pm$xx°x	Config.	Band (cm)	Band width (MHz)	Total flux (Jy)	Largest ang. size	Weakest signal (mJy/beam)	Required dynamic range	Possible LST range hh - hh	Time requested
1.											
2.											
3.											
4.											
5.											
6.											
7.											
8.											
9.											
10.											

18 Special hardware, software, or operating requirements:

19 Preferred range of dates for scheduling:

20 Dates which are not acceptable:

21 Please attach a self-contained Scientific Justification not in excess of 1000 words.

When your proposal is scheduled, the contents of this cover sheet become public information. (Any supporting documents are for refereeing only)