

NATIONAL RADIO ASTRONOMY OBSERVATORY  
Charlottesville, Virginia

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RADIO ASTRONOMY OBSERVATORY  
CHARLOTTESVILLE, VA.

Quarterly Report

January 1, 1977 - March 31, 1977

APR 15 1977

RESEARCH PROGRAMS

	<u>Hours</u>
<u>140-Foot Telescope</u>	
Scheduled observing	1998.00
Scheduled maintenance and equipment changes	140.00
Scheduled tests and calibration	0.00
Time lost due to: equipment failure	42.75
power	13.50
weather	16.75
interference	4.50

The following line programs were conducted during this quarter.

<u>Observer</u>	<u>Program</u>
G. Knapp (Caltech) R. Brown	Observations at 21 cm in a search for the 166 $\alpha$ and 167 $\alpha$ series of recombination lines in a number of dark clouds.
R. Giovanelli (Bologna, Italy)	Observations of high-velocity 21-cm hydrogen complexes and of faint emission from high-velocity hydrogen between high-velocity complexes.
M. Haynes (Indiana) M. Roberts	Search for 21-cm intergalactic hydrogen clouds near the galaxies NGC 55 and NGC 300, and a study of the 21-cm hydrogen structure in the northernmost extension of the Magellanic Stream.
R. Tully (Hawaii) J. R. Fisher	Observations of 21-cm hydrogen in external galaxies.
V. Rubin (DTM) N. Thonnard (DTM) W. K. Ford (DTM) M. Roberts	Search for 21-cm hydrogen emission from 12-14 magnitude spiral galaxies.

<u>Observer</u>	<u>Program</u>
R. Crutcher (Illinois)	Observations to detect 21-cm hydrogen in self-absorption in the detection of stars for which H <sub>2</sub> data are available and an attempt to detect 21-cm carbon recombination lines toward $\zeta$ Oph and oPer.
F. J. Lockman (DTM) R. Brown	Observations of 21-cm hydrogen and the H166 $\alpha$ -recombination line in the Cygnus X region.
W. B. Burton H. Liszt	Observations of 21-cm hydrogen to study the kinematic symmetries in the nuclear region of the galaxy.
F. J. Lockman (DTM)	Observations to map the 21-cm H166 $\alpha$ -recombination line in the Rosette nebula.
B. Balick (Washington) T. Heckman (Washington) W. Sullivan (Washington)	Search for 21-cm hydrogen--both in emission and absorption--in Seyfert and radio galaxies.
G. Knapp (Caltech) K. Lo (Caltech) N. Evans (Texas) R. Loren (Battelle Northwest Inst.)	Observations at 14.49 GHz to study the H <sub>2</sub> CO absorption line in dark nebulae associated with Herbig-Haro objects.
R. Loren (Battelle Northwest Inst.) P. Nachman (Chicago)	Observations of the 14.49 GHz H <sub>2</sub> CO absorption line in colliding molecular clouds and other regions of star formation.
F. Clark (Kentucky) D. Johnson (NBS)	A study of 14.49 GHz CH transitions in Cas A and other CH sources, and the mapping of 14.49 GHz H <sub>2</sub> CO in Tau A.
P. Wannier (Caltech) N. Scoville (Massachusetts)	Observations of 14.49 GHz H <sub>2</sub> CO in dense molecular clouds.
B. Zuckerman (Maryland) B. Turner	Search at 9 cm for <sup>13</sup> CH, and continued mapping of CH in the galactic plane.
F. Clark (Kentucky) D. Johnson (NBS)	Zeeman observations of interstellar SO at 13 GHz to confirm the possible detection of large magnetic fields in Orion and Sgr B2.

The following very long baseline observations were conducted during this quarter.

<u>Observer</u>	<u>Program</u>
J. Broderick (VPI & SU) J. Condon (VPI & SU) L. Dressel (Virginia) B. Dennison (VPI & SU)	Observations of a complete sample of sources at 1400 MHz, using the NAIC, Puerto Rico 1000-ft telescope and the NRAO 140-ft telescope.
D. Backer (California, Berkeley) R. Sramek (NAIC, Puerto Rico)	Observations at 1400 MHz in an attempt to measure relative positions of sources (pulsars, radio stars, and compact nuclei of extragalactic objects) to an accuracy of 0.001 arc seconds, using the NAIC, Puerto Rico 1000-ft telescope and the NRAO 140-ft telescope.
E. Preuss (MPIR, Bonn, W. Germany) I. Pauliny-Toth (MPIR, Bonn, W. Germany) B. Geldzahler (Pennsylvania) K. Kellermann D. Shaffer	Observations at 2.8 cm to study M87, Cyg A, and 3C 111, using the Harvard Fort Davis 85-ft telescope, the OVRO 130-ft telescope, and the NRAO 140-ft telescope.
M. Cohen (Caltech) A. Moffet (Caltech) J. Romney (Caltech) G. Seielstad (Caltech) P. Wilkinson (Caltech) R. Schilizzi (Kapteyn Labs, Groningen Netherlands)	Observations at 2.8 cm of variable complex extragalactic objects, using the Harvard Fort Davis 85-ft telescope, the OVRO 130-ft telescope, and the NRAO 140-ft telescope.
N. Broten (NRC, Canada) D. Fort (NRC, Canada) J. Yen (Toronto, Canada) G. Swenson (Illinois) S. Knowles (NRL) W. Waltman (NRL) K. Kellermann B. Rayhrer	Observations at 2.8 cm using the Algonquin, Canada 150-ft telescope and the NRAO 140-ft telescope, with the 140 ft data transmitted from the NRAO 85-ft telescope to the Canadian CTS geostationary satellite, and thence to Algonquin, Canada to permit real-time data analysis.
B. Geldzahler (Pennsylvania) K. Kellermann D. Shaffer	Studies at 2 cm of the structure and time variations of weak central components found in extended sources, using the NASA Goldstone 210-ft telescope and the NRAO 140-ft telescope.

<u>Observer</u>	<u>Program</u>
T. Clark (Goddard)	Observations at 8.4 GHz to measure positions and to study small-scale kinematics of the nuclei of various types of radio sources, to improve and validate the geodetic capabilities of VLB techniques, and to validate new VLB instrumentation and techniques, using the OVRO 130-ft telescope, the Haystack 120-ft telescope, and the NRAO 140-ft telescope.
R. Coates (Goddard)	
D. Robertson (Goddard)	
W. Webster (Goddard)	
L. Hutton (Goddard)	
J. Ryan (Goddard)	
C. Counselman (MIT)	
J. Wittels (MIT)	
I. Shapiro (MIT)	
C. Ma (Maryland)	
H. Hinteregger (Haystack)	
C. Knight (Haystack)	
A. Rogers (Haystack)	
A. Whitney (Haystack)	
J. Moran (Center for Astrophys.)	
H. Penfield (Center for Astrophys.)	
G. Resch (JPL)	
D. Trask (JPL)	
A. Niell (JPL)	
B. Geldzahler (Pennsylvania)	Observations of the galactic center at 8.4 GHz using the Haystack 120-ft telescope and the NRAO 140-ft telescope.
K. Kellermann	
D. Shaffer	
B. Geldzahler (Pennsylvania)	Observations at 18 cm to complete synthesis maps of several complex sources, to test for variations, and to search for other interesting sources, using the Harvard Fort Davis 85-ft telescope, the OVRO 130-ft telescope, and the NRAO 140-ft telescope.
K. Kellermann	
D. Shaffer	

<u>Interferometer</u>	<u>Hours</u>
Scheduled observing	1843.00
Scheduled maintenance and equipment changes	116.75
Scheduled tests and calibration	145.50
Time lost due to: equipment failure	73.50
power	15.00
weather	100.75
interference	0.25

While several programs used the 45-ft telescope over a 35-km baseline, only those specifically requiring its use are indicated in the program description.

The following continuum programs were conducted at 2695 and 8085 GHz, unless otherwise indicated.

<u>Observer</u>	<u>Program</u>
R. M. Price (NSF) P. Crane	Monitor the flux density variations of compact sources in spiral galaxies, using the 45-ft telescope.
L. Rudnick	Observations of extended structure in 4C sources, using the 45 ft.
F. Owen L. Rudnick	Observations of low brightness radio structure in rich clusters of galaxies, using the 45 ft.
M. Valtonen (Alabama) F. Owen	Search for compact, unresolved structure in the outer components of Cen A and 3C 270, using the 45 ft.
J. Dickel (Illinois) E. Greisen	Aperture synthesis of Cas A.
K. Johnston (NRL) C. Wade F. Owen	An attempt to measure the absolute position, parallax, and proper motion of four radio binaries, using the 45 ft.
E. Seaquist (Toronto, Canada) P. Crane	Maps of the radio emission from normal spiral galaxies, using the 45 ft.
D. Altschuler (Maryland) J. Wardle (Brandeis)	An attempt to detect faint radio tails near BL Lac objects, using the 45 ft; and monitoring the variability of flux and polarization in approximately 80 sources.
J. Katzin (Florida Tech) R. Hobbs (Goddard) S. Maran (Goddard)	An attempt to detect continuum emission from IR cometary nebulae.
J. Karpen (Maryland) P. Angerhofer (Maryland)	Observations of the X-ray binary AM Her, using the 45 ft.
W. Rose (Maryland)	Observations in an attempt to correlate X-ray and radio emission from the compact component in Cen A.

<u>Observer</u>	<u>Program</u>
P. Angerhofer (Maryland) M. Kundu (Maryland)	Observations to synthesize the possible supernova remnant CTB 80.
R. Hobbs (Goddard) S. Maran (Goddard) M. Jura (California, Los Angeles) M. Wright (California, Los Angeles) R. Dickman (Aerospace)	Observations to measure the radiation from the emission nebulae around T Tauri stars.
R. Brown T. Jones	Study of the BL Lac object 0735+178.
J. Burns (Indiana) F. Owen	Observations of Zwicky clusters of galaxies.
K. Lo (Caltech) R. Brown	Study of the possible time variations in the compact source in Sgr A, using the 45 ft.
W. Cotton (MIT) S. Spangler	Observations to monitor the flux densities of extragalactic radio sources which are known or probable variables at 365 MHz, using the 45 ft.
L. Kavanagh (Virginia)	Further studies to: (1) search for synchrotron radio emission from Uranus and Neptune, (2) compile additional data on Saturn's satellite Titan, and (3) compile additional data on the Galilean satellites of Jupiter in order to establish their brightness temperature.
B. Geldzahler (Pennsylvania)	Study of the evolution of three recently reported novae.
J. Scott (Maryland) J. T. Stocke (Arizona) A. Pacholczyk (Arizona)	Detailed observations of known and probable radio-tailed galaxies.
R. Green (Caltech) D. Shaffer	Search for radio emission from four new, optically bright quasistellar objects.
D. Heeschen	Study of approximately ten normal elliptical galaxies, coordinated with observations done with the NRAO VLA and the NRAO 36-ft telescope, to obtain the spectra of these sources.

<u>Observer</u>	<u>Program</u>
R. Brown B. Clark R. Hjellming	Observations coordinated with the VLA to determine the spectra of selected variable radio stars, using the 45 ft.
R. Hjellming	Detailed measurements of the radio properties of Nova Cygni 1975, using the 45 ft.
D. Florkowski (Florida) S. Gottesman (Florida)	Study of radio binaries, including a number of Wolf-Rayet stars, using the 45 ft.
W. Jaffe (Inst. for Advanced Study)	Study of the size of the bright radio galaxies in the Coma cluster.
K. Lang (Tufts)	Study the small-scale magnetic field structures in active solar regions, using the 45 ft.
R. M. Price (NSF) P. Crane	Observations to complete a survey of emission from normal galaxies, using the 45 ft.
D. Backer (California, Berkeley) R. Sramek (NAIC, Puerto Rico)	Proper motion and parallax studies of pulsars and radio stars, using the 45 ft.

Also during this quarter, the 85-1 telescope was used as a radio relay link for VLB data from the NRAO 140-ft telescope to the Canadian CTS geostationary satellite and thence to Algonquin, Canada to permit real-time data analysis.

<u>300-Foot Telescope</u>	<u>Hours</u>
Scheduled observing	1975.00
Scheduled maintenance and equipment changes	158.00
Scheduled tests and calibration	7.00
Time lost due to: equipment failure	16.50
power	9.00
weather	3.75
interference	1.00

The following line programs were conducted during this quarter.

<u>Observer</u>	<u>Program</u>
G. Knapp (Caltech) S. Faber (California, Santa Cruz) J. Gallagher (Minnesota)	Deep survey for 21-cm hydrogen in E and S0 galaxies.
A. Haschick (MIT) P. Crane	Study the variability of 21-cm hydrogen absorption in 3C 84.
B. Balick (Washington) W. Sullivan (Washington) T. Heckman (Washington)	Search for 21-cm hydrogen in emission and absorption in Seyfert and radio galaxies.
J. Erkes (SUNY, Albany) A. Philip (SUNY, Albany) K. Turner (DTM)	Observations to search for 21-cm hydrogen in clouds surrounding stars found in the northern extension of the Magellanic Stream.
B. Burke (MIT) W. Baan (MIT) A. Haschick (MIT) P. Crane	A search in two radio galaxies for narrow absorption features.
A. Rots (Netherlands Foundation for Radio Astronomy, Netherlands) A. Wolfe (Pittsburgh) D. Shaffer	Observations at 932 MHz to monitor HI absorption features of A0 0235+16.
M. Haynes (Indiana) M. Roberts	Search for 21-cm intergalactic hydrogen in spiral galaxies found in Abell clusters and in nearby loose groups of galaxies.
S. Gottesman (Florida) D. Gordon (Florida)	Study 21-cm hydrogen in "active galaxies".
A. Marscher (Virginia) R. Brown	Search for highly redshifted 21-cm HI absorption in quasars between the frequencies 740 and 1000 GHz.

The following continuum programs were conducted.

<u>Observer</u>	<u>Program</u>
J. Armstrong S. Spangler	Observations at 385 MHz in a search for interstellar scintillation of selected low-frequency variable sources.



<u>Observer</u>	<u>Program</u>
L. Rudnick	Observations at 9 cm to resolve ambiguities in large rotation measures.
J. Kraus (Ohio State) M. Gearhart (Ohio State)	Flux density measurements of selected Ohio State University sources at 775 and 968 MHz.
A. Rots (Netherlands Foundation for Radio Astronomy, Netherlands) W. Cotton (MIT) S. Spangler	Observations at four discrete frequencies between 270 and 435 MHz and at 1400 MHz to monitor variable sources selected from the University of Texas Interferometer Survey.
W. Jaffe (Inst. for Advanced Studies) L. Rudnick	A study of extended emission in clusters of galaxies at 610 MHz.

The following pulsar programs were conducted.

<u>Observer</u>	<u>Program</u>
R. Hulse	Search at 410 MHz for new high latitude pulsars.
J. Taylor (Massachusetts) D. Helfand (Massachusetts) P. Backus (Massachusetts) L. Flower (Massachusetts)	Observations of the positions, proper motions and timing of known pulsars; a search for new pulsars at 610 MHz.

In addition to the above programs, T. Clark (Goddard), D. Black (Ames), J. Cuzzi (Ames), and J. Tarter (Ames) conducted high-resolution spectral observations near the 18-cm OH lines in an attempt to detect extraterrestrial intelligence.

### 36-Foot Telescope

	<u>Hours</u>
Scheduled observing	1901.00
Scheduled maintenance and equipment changes	125.25
Scheduled tests and calibration	120.75
Time lost due to:	
equipment failure	92.50
weather	155.75
power	0.00
interference	0.00

<u>Observer</u>	<u>Program</u>
C. Alcock (Caltech) M. Morris (Caltech)	Search for TiO in circumstellar envelopes around late stars.
A. Barrett (MIT) P. Ho (MIT) M. Schneps (MIT)	Study of CO line profiles from the source CRL 437.
D. Buhl (Goddard) L. Brown (Goddard) T. Clark (Goddard) R. Hobbs (Goddard) S. Mosier (Goddard) J. Novaco (Goddard) L. Snyder (Illinois) F. Lovas (NBS) J. Hollis	Search for molecular lines of ions and radicals.
F. Clark (Kentucky) C. Heiles (California, Berkeley) T. Troland (California, Berkeley) D. Johnson (NBS)	Search for polarization in SO emission.
P. Clegg (Queen Mary College, England) P. Ade (Queen Mary College, England) M. Rowan-Robinson (Queen Mary College, England)	One millimeter observations of galactic and extragalactic sources.
M. Cohen (California, Berkeley)	Search for young stars having circumstellar nebulosities detectable at 9 mm.
W. Dent (Massachusetts) R. Hobbs (Goddard)	Evolution of extragalactic radio sources at millimeter wavelengths.
M. Guelin (Inst. for Space Studies) P. Thaddeus (Inst. for Space Studies)	Search for spectral lines of H <sub>2</sub> S, SiO, HCN, HCO <sup>+</sup> , N <sub>2</sub> H <sup>+</sup> and C <sub>2</sub> H in the 173-180 GHz frequency range.
C. Heiles (California, Berkeley) T. Troland (California, Berkeley) J. Hesser (CTIO)	Search for molecular materials in dusty and X-ray globular clusters.
L. Higgs (Herzberg Inst. of Astrophysics) P. Feldman (Herzberg Inst. of Astrophysics) J. Smolinski (Nicolaus Copernicus University, Torun, Poland)	Measurement of the 3-mm flux of HD217476, a radio emitting supergiant.

<u>Observer</u>	<u>Program</u>
R. Hobbs (Goddard) D. Buhl (Goddard) L. Brown (Goddard) S. Maran (Goddard)	Measurement of 3-mm continuum polarization.
H. Johnson (Lockheed Res. Lab)	Search for continuum emission from globular clusters.
K. Kellermann A. Witzel (MPIR, Bonn, W. Germany) B. Geldzahler (Pennsylvania) I. Pauliny-Toth (MPIR, Bonn, W. Germany)	Observations of the Bonn-NRAO sources at 9 mm.
G. Knapp (Caltech) S. Knapp (Caltech) T. Kuiper (JPL) R. Brown	Study of the collapse process in interstellar clouds using CO emission.
C. Leung B. Turner	Study of chemical fractionation in selected molecular clouds.
H. Liszt	Search for S <sub>2</sub> in molecular clouds.
K. Lo (California, Berkeley) K. Bechis (Massachusetts)	Study of molecular line emission from Red Giants.
F. Owen S. Mufson (Marshall Space Flight Ctr.) R. Porcas T. Moffett (Purdue)	Continuum observations of extragalactic radio sources with flat spectra.
T. Phillips (Bell Labs) N. Scoville (Massachusetts) P. Wannier (Caltech)	Observations of 230 GHz CO line.
P. Schwartz (NRL) J. Spencer (NRL)	Attempt to detect 3-mm emission from early stars and IR sources.
M. Simon (SUNY, Stony Brook) G. Righini-Cohen (SUNY, Stony Brook)	Molecular observations of 100 micron IR sources, the gas and dust ratio in known molecular sources and CO in supernova remnants.
L. Snyder (Illinois) J. Hollis B. Ulich	Search for HNO.

<u>Observer</u>	<u>Program</u>
P. Thaddeus (Inst. for Space Studies) M. Guelin (Inst. for Space Studies)	Investigation of unidentified doublet near 85.3 GHz.
B. Wills (Texas) D. Wills (Texas)	Millimeter spectra of strong extragalactic sources.
W. Wilson (Texas) R. Kakar (JPL) M. Klein (JPL) S. Gulkis (JPL)	CO absorption in the atmospheres of Mars and Venus and the search for CS, SO, SO <sub>2</sub> , and OCS in planetary atmospheres.

## ELECTRONICS DIVISION

### Charlottesville

The VLB Mark III system development is continuing and the current construction schedule is aimed at a July-August 1977 date for the first observations.

Development of Model IV autocorrelator is progressing satisfactorily. Programming will start as soon as the National Semiconductor SuperPace computer is delivered in the next few weeks. The delivery of the custom integrated circuits will be three months later than expected, but this will not affect the schedule significantly.

We have observed one of the University of Virginia Josephson junctions superconducting in a modified NRAO 100-GHz mount. Current work is being directed at improving the junction thermal properties and also building devices with up to five junctions in series.

The hardware for a subharmonically pumped 230 GHz mixer has been built and work is now directed to the difficult problem of whiskering the pair of diodes.

### Tucson

Efforts have been made to solve various problems with the 80-120 GHz receiver. The main problems attacked were refrigerator pump modulation and variations in gain with elevation angle. As an aid in laboratory testing of gain variation with elevation angle, an outside test facility has been constructed adjacent to our mountain laboratory. Both problems have now been solved and the receiver gives close to theoretical performance for

continuum observations. The receiver's poor performance at frequencies below 80 GHz has been investigated and changes have been made that give good performance down to 70 GHz.

Observing programs in both line and continuum using the new quasi-optical polarizer have been conducted during this quarter with good results.

The 30 kHz filter bank is in regular use and gives good performance.

The 33-50, 80-120 GHz receiver is complete, and after laboratory testing will be tested on the telescope during the summer shutdown.

Tests have been made on a prototype 130-170 GHz room temperature receiver using quasi-optical techniques. This receiver will use the 4.75 GHz cooled parametric amplifiers in the 33-50, 80-120 GHz receiver as the I.F. amplifier, and a noise temperature of less than 2000 K SSB is expected with the mixer uncooled. The receiver is designed to permit cooling of the mixer with minimum modifications, and this should result in a substantial reduction in noise temperature.

### Green Bank

Besides normal support of three telescopes, the Green Bank electronics group continues to be in the development stages of the next generation of NRAO receivers and telescope improvements.

Design of the servo electronics for the 140 ft deformable subreflector is well underway and procurement of actuators has begun. Digital conversion electronics for the 300 ft declination encoder are in the test stage. The microprocessor based prototype continuum standard receiver was completed this quarter, and lab and telescope evaluations are in progress to determine its future configuration.

The 5-cm front end for the excited OH line is essentially complete and is scheduled for use in April. Final trimming of the cooled diode switch for the 6/21-cm NAIC receiver is complete and initial assembly of this receiver is in progress. Some improvements of the spurious responses of the NRAO version of this receiver are being made, particularly in the area of IF reflections. One paramp channel of the 9-cm receiver was retuned to allow a CH line search above 3.4 GHz. A harmonic generator for conversion of 5 MHz HI maser output to frequencies up to 3 GHz has been breadboarded. This will be added to the 140-ft for use in VLB observations.

In addition to the original JPL K-band maser, two 4 K refrigerators and one ruby/circulator structure now exist in Green Bank. Target date for installation of the single channel K-band system on the 140 ft is sometime in

August. Operation of the first system, including tests of Weinreb's 100 GHz down-converter, have shown the maser/refrigerator to be remarkably reliable.

A distance discriminating reflectometer has been built and tested at 3.5 GHz and will be installed on the 140 ft for antenna reflection tests in May. Feed and waveguide loss studies continue for the new maser systems.

## COMPUTER DIVISION

140-Foot Telescope - Work is continuing on the new 140 ft control system. Installation is scheduled for May 1977.

### Manuals

#### Charlottesville - 360 System

TPOWER/SPOWER - A new edition of the TPOWER/SPOWER manual describing use with the IBM 360 system has been produced and is available.

CONDARE - A draft version of the CONDARE manual describing use with the IBM 360 system is available.

#### Green Bank - 140 ft

TPOWER/SPOWER/CONDARE - A manual describing the use of the 140 ft Mod Comp has been completed and is in print. It should be available in the near future.

VLA Post-Processing - A set of programs has been developed which process VLA data starting with the output of the VLA Modcomp system. The programs resemble very closely the interferometer package used for the Green Bank interferometer. Their use is considered temporary, and they will eventually be replaced by programs which read the output of the DEC 10.

VLBI - The VLBI processor is now run by trained operators 120 hours per week.

## ENGINEERING DIVISION

Engineering efforts this quarter were utilized in various on-going projects: In improving the design and specifications for a deformable sub-reflector for the 140-ft telescope; modifications to the 140 ft structure to prepare for the installation of a maser receiver; changes in 36 ft structure to minimize thermal deformations; updating the electrical system at the 36 ft; repairs to the brake system for the 140 ft; design of a jig for calibrating

and testing inductosyns; research and conceptual design for astrodome, telescope structure, surface panels, radome fabrics, and surface measuring procedures and equipment for a future 25 meter millimeter-wave telescope; field inspection assistance to the VLA; general engineering assistance to Green Bank, Charlottesville and Tucson.

#### VERY LARGE ARRAY PROGRAM

Array observations throughout the first quarter are averaging one 40-hour and one 88-hour run every two weeks. The array continues with a 5.2 km baseline and six element array maximum.

Antenna #9 was accepted February 25, 1977 and Antenna #10 was moved on March 28, 1977 to the Master Pad for final alignment and servo installation. Assembly of Antenna #11 began March 30, 1977.

The new L-band feeds are currently being installed, with work completed on Antennas #4 and #6. The installation of the redesigned local Oscillator System was completed on Antennas #3 and #5 with testing in progress.

In the computer area, the update of the Modcomp units were completed and the disk data base system for the DEC-10 became operational.

The visiting scientist's quarters were completed and occupied during the quarter. On March 18, 1977 the New Mexico State Highway Department agreed to resurface the portion of the old Highway 60 used as an access to the VLA site.

#### PERSONNEL

##### Appointments

John W. Brooks	Electronics Engineer I	1/03/77
Henry Richards	Electronics Engineer I	1/03/77

##### Terminations

John W. Armstrong	Research Associate	3/04/77
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##### Changes in Status

Kenneth I. Kellermann	Acting Asst. Director for Green Bank and Scientist	1/01/77
Barry G. Clark	Head of Data Processing, VLA, and Scientist	1/01/77