

NATIONAL RADIO ASTRONOMY OBSERVATORY  
Charlottesville, Virginia

Quarterly Report  
April 1, 1980 - June 30, 1980

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RADIO ASTRONOMY OBSERVATORY  
CHARLOTTESVILLE, VA.

JUL 21 1980

RESEARCH PROGRAMS

<u>140-Foot Telescope</u>	<u>Hours</u>
Scheduled observing	1310.0
Scheduled maintenance and equipment changes	638.50
Scheduled tests and calibration	227.50
Time lost due to: equipment failure	16.75
power	0.00
weather	4.50
interference	0.00

The following line programs were conducted during this quarter.

<u>Observer</u>	<u>Program</u>
F. J. Lockman	Observations of the H127 $\alpha$ recombination line at 3173 MHz in the galactic plane and the Rosette Nebula.
K. Mattila (Helsinki, Finland)	Observations at 3335 MHz of CH in the direction of globular clusters and in dark nebulae.
L. Malkamaki (Helsinki, Finland)	
G. Sandell (Stockholm Obs.)	
34 R. Brown	Observations at 2.8 and 9 cm to study recombination lines and line to continuum ratios in HII regions.
F. J. Lockman	
P. Jackson (Maryland)	Mapping of 21-cm hydrogen in the "Puppis Window".
I. Mirabel (Puerto Rico)	
G. Stacy (Maryland)	
P. Jackson (Maryland)	Observations of galactic hydrogen in front of normal galaxies having well determined colors (B-V).
I. Mirabel (Puerto Rico)	
E. Dahlstrom (Maryland)	
M. Siegel (Maryland)	
P. Jackson (Maryland)	Observations of 21-cm hydrogen high velocity clouds.
I. Mirabel (Puerto Rico)	
P. Bowers	Studies of 18-cm OH emission from unidentified Type II OH/IR stars.

The following continuum programs were conducted during this quarter.

<u>Observer</u>	<u>Program</u>
F. J. Lockman	Observations at 2.8 cm to map the Rosette Nebula.
Q. Yin (Beijing U., People's Republic of China)	Observations at 6 cm to investigate the variability of a statistically complete sample of sources.
S. Hammond (New Mexico State)	
D. Heesch	

The following very-long baseline programs were conducted, and the stations used in the experiments are coded as follows:

A - Algonquin, Canada 150-ft	H - Hat Creek 85-ft
B - MPIR, Bonn, FRG 100-m	K - Haystack 120-ft
C - Chilbolton, England 25-m	O - OVRO 130-ft
E - Jodrell Bank, England MKII	R - Simeis, Crimea, USSR 22-m
F - Harvard, Fort Davis 85-ft	S - Onsala, Sweden 26-m
G - NRAO 140-ft	W - Westerbork Synthesis Radio Telescope, The Netherlands

<u>Observer</u>	<u>Program</u>
L. Blitz (Calif., Berkeley)	Observations at 22.235 GHz of H <sub>2</sub> O masers with telescopes at B, K, O, and G.
C. Lada (Iowa)	
R. Genzel (Center for Astrophys.)	
J. Moran (Center for Astrophys.)	
M. Reid (Center for Astrophys.)	
W. Alef (MPIR, Bonn)	Observations at 22.235 GHz to map 3C 84 and 3C 273 with telescopes at A, B, C, R, S, K, and G.
I. Pauliny-Toth (MPIR, Bonn)	
E. Preuss (MPIR, Bonn)	
J. Romney (MPIR, Bonn)	
A. Witzel (MPIR, Bonn)	
A. Yen (MPIR, Bonn)	
B. Burke (MIT)	Observations at 2.8 cm of the double quasar 0957+561 with telescopes at K, O, and G.
P. Greenfield (MIT)	
D. Roberts (MIT)	
W. Cotton (MIT)	Observations at 2.8 cm of the Seyfert galaxy III Zw 2 with telescopes at B, K, O, and G.
B. Geldzahler (MIT)	
J. Romney (MPIR, Bonn)	
W. Altenhoff (MPIR, Bonn)	Observations at 2.8 cm of weak compact radio stars including galactic nuclei, central components of quasars, and radio stars with telescopes at B, K, and G.
I. Pauliny-Toth (MPIR, Bonn)	
R. Porcas (MPIR, Bonn)	
J. Romney (MPIR, Bonn)	
T. Clark (NASA, Greenbelt)	
A. Rogers (Haystack)	
A. Whitney (Haystack)	

<u>Observer</u>	<u>Program</u>
(continued)	
D. Shaffer (Phoenix Corp.)	
I. Shapiro (MIT)	
K. Kellermann	
B. Geldzahler (MIT)	
D. Shaffer (Phoenix Corp.)	Observations at 2.8 cm of the compact radio sources G127.11+0.54 and G74.87+122 with telescopes at B, K, O, and G.
M. Cohen (Caltech)	
R. Linfield (Caltech)	Observations at 2.8 cm to monitor superluminal sources at B, F, K, O, and G.
A. Moffet (Caltech)	
T. Pearson (Caltech)	
A. Readhead (Caltech)	
G. Seielstad (Caltech)	
R. Simon (Caltech)	
R. C. Walker	
J. Broderick (VPI & SU)	
A. Marscher (Calif., San Diego)	Observations at 2.8 cm to determine the angular sizes of NRAO 140 and NRAO 350 with telescopes at B, K, O, and G.
D. Backer (Calif., Berkeley)	
K. Lo (Caltech)	Observations at 2.8 cm of the compact source in the galactic center with telescopes at K, O, and G.
J. Moran (SAO)	
M. Reid (SAO)	Observations at 2.8 cm to examine continuum sources in the direction of the galactic center with telescopes at K, O, and G.
I. Pauliny-Toth (MPIR, Bonn)	
T. Clark (NASA, Greenbelt)	
R. Coates (NASA, Greenbelt)	
C. Ma (NASA, Greenbelt)	
J. Ryan (NASA, Greenbelt)	
N. Vandenberg (NASA, Greenbelt)	
H. Hinteregger (Haystack)	
C. Knight (Haystack)	
E. Nesman (Haystack)	
A. Rogers (Haystack)	
A. Whitney (Haystack)	
W. Cotton (MIT)	
B. Corey (MIT)	
C. Counselman (MIT)	
T. Herring (MIT)	
I. Shapiro (MIT)	
J. Wittels (MIT)	
D. Robertson (NGS, Rockville)	
D. Shaffer (Phoenix Corp.)	Observations at 3.6 and 13 cm to test the capabilities of the Mark III VLBI system and to observe the structure of galactic nuclei, low surface brightness objects, radio stars, and to improve astrometric and geodetic measurements with telescopes at F, O, K, and G.

<u>Observer</u>	<u>Program</u>
(continued)	
K. Kellermann R. Lacasse B. Rayhrer	
C. Bennett (MIT) B. Burke (MIT) A. Garcia (MIT) P. Greenfield (MIT) C. Lawrence (MIT)	Observations at 600 MHz of the double quasar 0957+561 with telescopes at K, O, and G.
R. Porcas (MPIR, Bonn) W. Reich (MPIR, Bonn)	Observations at 2.8 cm of the compact source 0528+13 with telescopes at B, K, O, and G.
A. Downes (MPIR, Bonn) I. Pauliny-Toth (MPIR, Bonn) K. Kellermann	Observations at 2.8 cm of Cyg A with telescopes at B, F, K, O, and G.
B. Geldzahler (MIT) J. Marcaide (MIT) I. Shapiro (MIT)	Observations at 2.8 cm of the double quasar 1038+528 with telescopes at B, S, F, K, O, and G.
R. Porcas (MPIR, Bonn)	Studies at 2.8 cm of the source 0300+47 and 1636+47 with telescopes at B, K, O, and G.
N. Cohen (Cornell) B. Geldzahler (MIT) D. Shaffer (Phoenix Corp.)	Observations at 2.8 cm of 0236+610, 0241+622, and Maffei 2 with telescopes at B, K, O, and G.
R. Booth (Jodrell Bank) P. Wilkinson (Jodrell Bank)	Observations of 3C 309.1 with telescopes at B, E, S, and G.
E. Preuss (MPIR, Bonn) I. Pauliny-Toth (MPIR, Bonn) K. Kellermann	Observations at 6 cm of the radio cores of 3C 390.3 and 3C 111 with telescopes at B, K, F, O, and G.
R. Mutel (Iowa) R. Phillips (Brandeis) H. Aller (Michigan)	Observations at 6 cm to monitor the flux and structure of the rapidly varying objects 1418+546, 0420-014, and BL Lac with telescopes at B, H, O, and G.
L. Baarth (Chalmers) B. Ronnang (Chalmers) D. Graham (MPIR, Bonn) R. Schilizzi (Leiden) G. Seielstad (Caltech)	Studies at 6 cm of the structural variations of the BL Lac type objects MK421, 1749+70.1, and BL Lac with telescopes at B, S, W, H, K, O, and G.

<u>Observer</u>	<u>Program</u>
T. Clark (NASA, Greenbelt)	Studies of the radio nuclei of bright galaxies with telescopes at F, K, O, and G.
N. Vandenberg (NASA, Greenbelt)	
D. Shaffer (Phoenix Corp.)	
P. Crane	

In addition to the observing during this quarter, the focus-rotation assembly was re-centered to optimize telescope performance, the new 1000-channel autocorrelator was installed, and one channel of the new up-converter maser system was installed.

<u>300-foot Telescope</u>	<u>Hours</u>
Scheduled observing	2045.25
Scheduled maintenance and equipment changes	138.75
Scheduled tests and calibration	0.00
Time lost due to: equipment failure	21.00
power	0.00
weather	5.00
interference	2.25

The following line programs were conducted during this quarter.

<u>Observer</u>	<u>Program</u>
D. Burstein	Survey the thinnest galaxies found in the Uppsala General Catalog for neutral hydrogen.
T. Heckman (Leiden)	Attempt at 1358 MHz to detect low redshift HI emission from the x-ray quasar 4HU0241+61.
B. Balick (Washington)	
W. Baan (Penn State)	Observations to confirm a recently discovered 21-cm hydrogen absorption feature in the radio galaxy 3C 293.
A. Haschick (ASO)	
K. Mitchell (Penn State)	Search between 1000 and 1420 MHz for redshifted 21-cm absorption lines toward bright quasars.
R. Brown	

The following continuum programs were conducted this quarter.

<u>Observer</u>	<u>Program</u>
T. Balonek (Massachusetts)	Polarization and flux density measurements of variable radio sources at 2695 MHz.
W. Dent (Massachusetts)	
C. O'Dea (Massachusetts)	

<u>Observer</u>	<u>Program</u>
J. Broderick (VPI & SU) B. Dennison (VPI & SU) J. Ledden (VPI & SU) S. O'Dell (VPI & SU) J. Condon	Observations at 900 and 1400 MHz of low frequency variable sources.
J. Dickey	Studies at 1400 MHz of galactic confusion: small-scale structure of the galactic background.
B. Burke (MIT) C. Bennett (MIT) C. Lawrence (MIT)	Search at 6 cm for new compact sources.
J. Cordes (Cornell) J. Dickey	Interstellar scintillation measurements of compact sources at 410 MHz.
Q. Yin (Beijing U., Peoples Republic of China) S. Hammond (New Mexico State) D. Heesch	Observations at 330 MHz to investigate the variability of a statistically complete sample of sources.
G. Kojoian (Wisconsin) D. Dickinson (JPL)	Survey of approximately 600 galaxies at 6 cm, having high surface brightness.

The following pulsar program was conducted.

<u>Observer</u>	<u>Program</u>
J. Taylor (Massachusetts) P. Backus (Massachusetts) M. Damashek	Observations at 610 MHz to determine periods, period derivatives, positions and dispersion measures of known pulsars.

<u>36-foot Telescope</u>	<u>Hours</u>
Scheduled observing	1976.25
Scheduled maintenance and equipment changes	125.50
Scheduled tests and calibration	82.25
Time lost due to: equipment failure	78.75
power	0.00
weather	57.75
interference	0.00

<u>Observer</u>	<u>Program</u>
M. Beckers (MMTO) B. Ulich (MMTO)	Search for radio recombination lines in the sun.

<u>Observer</u>	<u>Program</u>
H. Dickel (Illinois)	Study of sulfur chemistry in the inter-stellar medium.
J. Dickel (Illinois)	
M. Elitzur (Illinois)	
W. Wilson (Aerospace)	
H. Dickel (Illinois)	Observations of formaldehyde at 2 mm to compare with 2 cm and 6 cm observations.
J. Dickel (Illinois)	
M. Goss (Groningen)	
W. Wilson (Aerospace)	
B. Elmegreen (Columbia)	Observations of CO in barred spiral galaxies.
D. Elmegreen (Hale Observatory)	
L. Higgs (Herzberg Inst.)	Study of high velocity cloudlets near the supernova remnant G78.2+2.1.
R. Roger (DRAO, Canada)	
T. Landecker (DRAO, Canada)	
P. Ho (Calif., Berkeley)	Test of CO as a reliable measure of molecular hydrogen.
L. Blitz (Calif., Berkeley)	
J. Hollis (NASA Greenbelt)	Search for HCP.
L. Snyder (Illinois)	
F. Lovas (NBS)	
R. Svenram (NBS)	
B. Ulich (MMTO)	
D. Johnson (NBS)	Study of flux and polarization of silicon monoxide maser sources.
C. Heiles (Calif., Berkeley)	
T. Troland (Calif., Berkeley)	
F. Clark (Kentucky)	
D. Hummer (JILA)	
M. Kutner (Rensselaer)	Study of CO line profiles in T-Tauri stars.
C. Leung (Rensselaer)	
D. Machnik (Rensselaer)	
K. Tucker (Fordham)	
M. Kutner (Rensselaer)	Proposal to observe $\text{DCO}^+$ in NGC 1977 as a test of fractionation.
K. Tucker (Fordham)	
N. Evans (Texas)	
M. Kutner (Rensselaer)	Study of formaldehyde isotopic abundances at 2 mm.
K. Tucker (Fordham)	
N. Evans (Texas)	
M. Kutner (Rensselaer)	Study of $\text{CH}_3\text{OH}$ and $^{13}\text{CH}_3\text{OH}$ at 2 mm.
K. Tucker (Fordham)	
N. Evans (Texas)	
M. Kutner (Rensselaer)	Investigation of CO in Canis Major, an alleged star formation site.
D. Machnik (Rensselaer)	

<u>Observer</u>	<u>Program</u>
H. Liszt B. Turner	Study of nitrogen dioxide ( $\text{NO}_2$ ) to explain apparent underabundance.
R. Loren (Texas) A. Wootten (Caltech) A. Sandquist (Stockholm, Sweden)	Study of molecular clouds with $\text{HCO}^+$ line reversals.
F. Owen J. Puschell	Observations of x-ray quasars at 90 GHz.
L. Rickard P. Palmer (Chicago)	Study of molecular components to galaxies.
G. Righini-Cohen (SUNY, Stony Brook) M. Simon (SUNY, Stony Brook) P. Solomon (SUNY, Stony Brook) J. Barrett (SUNY, Stony Brook) J. Fischer (SUNY, Stony Brook)	Observations of CO molecular clouds showing vibrationally excited molecular hydrogen.
D. Sanders (SUNY, Stony Brook) J. Barrett (SUNY, Stony Brook) P. Solomon (SUNY, Stony Brook)	Search for structure in spiral galaxies by CO emission.
A. Sandquist (Stockholm, Sweden)	Study of the 2 mm line of $\text{H}_2\text{CO}$ in the galactic center.
P. Schwartz (NRL)	Measurement of dust emission in molecular clouds.
P. Schwartz (NRL) B. Zuckerman (Maryland)	Monitoring emission from SiO maser sources.
B. Ulich (MMTO) J. Hollis (NASA, Greenbelt) R. Suenram (NBS) F. Lovas (NBS) B. Kuczkowski (NBS)	Search for molecular compounds in the Venusian atmosphere.
B. Wilking (Arizona) C. Lada (Arizona)	Study of $\text{C}^{18}\text{O}$ in Rho Ophiuchus dark cloud.
B. Zuckerman (Maryland)	Search for $\text{O}_2\text{H}$ at 2 mm wavelength.



## THE VERY LARGE ARRAY

The array was scheduled for observations 62% (1361 hours) of the time in the second quarter of 1980. Forty-six percent (1003 hours) of the time was devoted to astronomical observing and the remaining 16% (358 hours) to instrumental development and tests. Approximately 15% of the observing time was lost due to instrumental problems. The following research programs were conducted with the VLA during this quarter.

<u>Name</u>	<u>Program</u>
D. Abbott (Washburn Obs.) J. Bieging (Calif., Berkeley) E. Churchwell (Washburn Obs.)	Mass loss in early type stars. 2 and 6 cm.
J. Angel (Arizona) R. Moore (Arizona) H. Stockman (Arizona) J. Wardle (Brandeis)	Double lobe structure in BL Lac objects and new OVV QSS. 21 cm.
J. Archer R. Hjellming R. Robinson (Sac Peak)	Fine structure of solar active regions in brightness and circular polarisation. 1.3, 2 and 6 cm.
D. Backer (Calif., Berkeley) R. Sramek	Astrometry of Sgr A compact object. 6 cm.
B. Balick (Washington) T. Heckman (NFRA, Leiden) P. Crane	Seyfert galaxies NGC 1068, 3C 120, Mrk 335, and NGC 3516. 6 and 20 cm.
B. Baud (Calif., Berkeley) A. Winnberg (MPIR, Bonn) H. Matthews (Herzberg Inst.)	OH halo structure of Mira variables. 18 cm.
A. Bridle (Queen's, Canada) E. Fomalont	Extended radio core and large-scale structure of 3C 293. 2, 6, and 20 cm.
A. Bridle (Queen's, Canada) E. Fomalont R. Perley A. Willis (NFRA, Zwiggelte)	Jet source NGC 315. 20 cm.
A. Bridle (Queen's, Canada) E. Fomalont R. Perley A. Willis (NFRA, Zwiggelte)	Jet source 0326+396. 6 cm.
A. Bridle (Queen's, Canada) E. Fomalont R. Perley A. Willis (NFRA, Zwiggelte)	Linear polarization of radio jets in 3C 31. 20 cm.

<u>Name</u>	<u>Program</u>
B. Burke (MIT) D. H. Roberts (MIT) P. E. Greenfield (MIT)	Double quasar 0957+561. 2, 6 and 20 cm.
J. Burns D. De Young	Search for jet-like structure in "classical" double sources. 6 and 20 cm.
J. Dreher	Limb-brightened "hot spots" in 3C 390.3. 6 and 20 cm.
A. Dupree (SAO) B. Burke (MIT)	W Ursae Majoris stars. 6 and 21 cm.
M. Felli (Arcetri, Italy) S. D'Odorico (ESO, Switzerland) J. Dickel (Illinois)	Optically identified SNR's in M31. 20 cm.
M. Felli (Arcetri, Italy) K. Johnston (NRL) E. Churchwell (Washburn Obs.)	Continuum mapping of M17. 1.3, 6, and 20 cm.
F. Ghigo (Minnesota)	Mapping ring-type galaxies. 6 and 20 cm.
D. Gibson (NMIM) P. Fisher (NMIMT)	M-dwarf flare stars. 6 and 20 cm.
D. Harris (DRAO, Canada) C. Costain (DRAO, Canada) P. Dewdney (DRAO, Canada) R. Perley	Steep-spectrum sources with x-ray emis- sion. 6 and 21 cm
D. Helfand (Columbia) M. Morris (Columbia) L. Lucy (Columbia) W. Romanishin (Calif., Los Angeles)	A rich x-ray emitting cluster at $z = 0.39$ . 2, 6, and 21 cm.
L. Higgs (Herzberg Inst.) T. Landecker (DRAO, Canada) R. Roger (DRAO, Canada)	Point source in SNR 678.2+2.1. 2, 6 and 21 cm.
R. Hjellming	Rapid x-ray burster MXB 1730-335. 2, 6, and 20 cm.
R. Hjellming K. Johnston (NRL) G. Miley (NFRA, Leiden)	Moving jets in SS433. 2, 6, and 21 cm.

<u>Name</u>	<u>Program</u>
R. Hjellming N. Vandenberg (NASA, Greenbelt)	Nova Vulpeculae 1976. 2, 3 and 21 cm.
W. Jaffe R. Courtin (SUNY, Stony Brook) T. C. Owen (SUNY, Stony Brook) G. Berge (Caltech)	Mapping of Uranus; 6 cm flux of Io. 2, 6, and 21 cm.
D. Jones (NAIC) R. Sramek Y. Terzian (NAIC)	Search for extended structure in normal galaxies with compact nuclear radio sources. 6 cm.
M. Kundu (Maryland) T. Velusamy (Maryland) F. Erskine (Maryland)	Solar observations during SMM. 1.3, 2, 6, and 20 cm.
K. Lang (Tufts) R. Willson (Tufts) M. Felli (Arcetri, Italy)	Solar active regions. 2, 6, and 21 cm.
J. Machaliski (Jagiellonian, Poland) J. Maslowski (Jagiellonian, Poland) J. Condon M. Gordon	Mapping and identification of sources from GB and GB2 surveys. 20 cm.
D. Muhleman (Caltech) G. Berge (Caltech) S. Deguchi (Caltech)	Polar heating on Venus. 6 and 18 cm.
S. Neff (Virginia) R. Brown	Radio structure in QSS. 18 cm
F. Owen R. White	Abell cluster strong source survey-- morphology of extended sources. 20 cm.
R. Perley E. Fomalont K. Johnston	Compact objects with faint nearby com- panions. 6 and 20 cm.
J. Pipher (Rochester) T. Herter (Rochester) J. Krassner (Grumman Aerospace and Rochester)	Compact HII regions. 2 cm.
L. Rodriguez (Ins. de Ast., Mexico) J. Moran (SAO)	HII regions NGC 6334. 6 and 20 cm.

<u>Name</u>	<u>Program</u>
A. Rots	NGC 891 in HI line. 21 cm.
J. Goad (KPNO)	
A. Rots	Recombination lines in W49N. 2 and 6 cm.
W. Goss (Groningen)	
J. van Gorkom (Groningen)	
K. Johnston (NRL)	
A. Rots	H <sub>2</sub> O maser in NGC 7538. 6 cm.
H. Dickel (Illinois)	
J. Forster (NFRA, Dwingeloo)	
W. Goss (Groningen)	
W. Sanders (NMSU)	Continuing observations of Hyades stars.
B. Clark	6 cm.
R. Sinha	Mapping of barred spirals NGC 2146 and
V. Rubin (DTM)	NGC 3079. 20 cm.
R. Sramek	Deep mapping of four active galaxies.
D. Weedman (Penn State)	6 cm.
R. Sramek	Supernova in M100. 6 cm.
K. Weiler (NSF)	
J. van der Hulst (Minnesota)	
R. Sramek	Deep mapping of four active galaxies.
D. Weedman (Penn State)	6 cm.
J. Stocke (Arizona)	Radio structure of SS433. 1.3 and 2 cm.
E. Seaquist (Toronto)	
W. Gilmore (Toronto)	
M. Ulmer (Northwestern)	Head-tail galaxies in x-ray cluster
J. Burns	Abell 401. 6 and 20 cm.
J. Vallee (Queen's, Canada)	Mapping of head-tail source 1200+519.
A. Bridle (Queen's, Canada)	20 cm.
J. Burns	
J. van der Hulst (Minnesota)	Central sources in M31 and M33. 6 cm.
R. Brown	
K. Weiler (NSF)	Structure and polarization of BL Lac
K. Johnston (NRL)	objects. 6 and 21 cm.
J. Weisberg (Massachusetts)	Position measurements of 3 pulsars.
J. Taylor (Massachusetts)	20 cm.
J. Cordes (NAIC)	

<u>Name</u>	<u>Program</u>
R. White	CO galaxies with co-extent x-ray and
J. Burns	radio structure. 6 and 20 cm.
A. Wilson (Maryland)	Seyfert and emission line galaxy nuclei.
J. Ulvestad (Maryland)	6 and 20 cm.
R. Sramek	
A. Winnberg (MPIR, Bonn)	Galactic center in the 1612 MHz OH line.
H. Habing (NFRA, Leiden)	18 cm.
F. Olon (NFRA, Leiden)	
H. Matthews (Herzberg Inst.)	
A. Winnberg (MPIR, Bonn)	Compact HII regions near Type I OH
B. Turner	masers. 6 cm.
C. Wynn-Williams (Hawaii)	Continuum emission from IR protostars.
D. Downes (Hawaii)	6 cm.
C. A. Beichman (Caltech)	

#### ELECTRONICS DIVISION

##### Green Bank

An IF patch panel is being constructed for use at the 140-foot telescope. Included in this panel are equalizing filters to compensate for cable attenuation, power monitors, and multiple outputs. Two IF's will be accommodated by this panel.

Samplers on the digital delay at the interferometer have been shielded and power lines filtered to give approximately 20 dB improvement in radiated noise between 1 and 2 GHz.

Lab testing of the 5 to 25 GHz upconverter/maser receiver is complete. Presently the receiver is being installed in the 140-foot telescope's Cassegrain house.

The 300 to 1000 MHz cooled-upconverter/GASFET-amplifier receiver is as complete as available parts permit and is now being tested. Some upconverters and GASFET-amplifiers are still lacking, but should be ready by late summer. Variations in required pump power in the upconverters has been decreased by changing the diode mounting.

Hardware check-out of the Jansky Lab MODCOMP computer is complete with the exception of the card punch.

The servo control for the focal plane measurement receiver is complete. A software package to interface the digital standard receiver to this receiver is also complete, with minor exceptions. New feeds are being installed on this receiver. Once they are installed and matched to the receiver, mechanical testing and calibration will be done to assure that it is ready to go to the 140-foot in August.

Prototype upconverters for the 1 to 5 GHz range have been constructed with encouraging results. Bandwidths of about 50% have been achieved, as well as 2 to 3 dB of gain. Future work will include improving of the devices' impedance match and increasing their gain.

Final testing of the spectrum expander for the 256-channel, 100 kHz/channel filter receiver in Tucson is nearly complete. Expansion factors of 4, 8, and 16 are switch or remotely selectable. Provisions are also included for external expansion selection.

Cooled FET L and C band receivers are being built for Caltech and Ft. Davis. At present, the dewar for the Ft. Davis receiver is being tested while the dewar for the Caltech receiver is being modified.

A thermal calibrator is being constructed for use in calibrating receivers to 18 GHz.

#### Tucson

During this quarter the performance of the 170-170 GHz receiver has been improved, and we now have a noise temperature of 600 K to 700 K across the band. A Fabry Perot filter has been constructed for this receiver and tests show that the receiver sideband ratio is close to unity across the band.

The  $^3\text{He}$  bolometer system is completed but the hold times of both the  $^3\text{He}$  and  $^4\text{He}$  stages need improvement. A calibration system for the bolometer has been developed during this quarter. Tests of the bolometer will be completed during July.

Work continues on the 190-290 GHz cooled mixer receiver. Due to the difficulty of obtaining LO power at these high frequencies, we have decided to make the initial receiver single channel.

#### Charlottesville

A millimeter wave frequency doubler giving  $> 5$  mW output power and  $> 10\%$  efficiency over the 127-170 GHz frequency range has been completed and is in use in the 2 mm receiver at the 36-foot telescope. This device replaces klystrons which have been very unreliable and expensive in this frequency range. Work is continuing on the study of noise in 70-115 GHz mixers and on the design of a 190-290 GHz mixer.

Twenty-six 4.5-5 GHz FET amplifiers have been completed and shipped to the VLA site. Three two-stage amplifiers, each having noise temperature  $< 20$  K over a 500 MHz bandwidth, have been shipped to Tucson to replace parametric I.F. amplifiers now in use. Two 5 GHz amplifiers and a 1.4 to 1.7 GHz amplifier have been completed for use in the Ft. Davis VLBI front-end.

The Mark IV 1024 channel autocorrelator has been completed and shipped to Green Bank. Construction of a second VLBI Mark III terminal and expansion of the VLBI Mark II processor are continuing.

## COMPUTER DIVISION

VLBI

A gradual transition to video cassette recorders is underway. The long-term effects are as yet unknown. Cassette recording is economical due to lower priced tape recorders, lower priced tape, and lower shipping costs of cassettes.

VLA Post Processing

On April 30 a meeting was held in Charlottesville to discuss export problems associated with the VLA post processing system. Seminars and additional meetings will be held periodically, and we expect to begin exporting software at the end of 1980.

The ground work for the post processing system is nearly finished. The POPS' communication software is being used; file management routines are settled; ModComp and VAX computer systems are compatible; display routines for the I<sup>2</sup>S image processor are being developed; and basic application programs are being coded.

Green Bank

The remote job entry (RJE) station at Green Bank has been downgraded to a card entry station and a line printer. The present 50 card per minute reader will be replaced with a 300 card per minute reader. A PANDORA terminal has been installed in the Green Bank lab building and a second dedicated telephone line has been ordered for a second PANDORA terminal.

## ENGINEERING DIVISION

Shop and field work was completed repositioning the automated feed mount in the focal point structure of the 140-foot telescope. Design, shop and field work were completed in the modification of the Cassegrain house on the 140-foot. Fabrication, modification in design, operation checks and preparation for installation continued for a new traveling feed on the 300-foot. Fabrication, testing and modifications in design on the first stage of a prototype reflector plate measuring instrument were completed. A report and three composite carbon fiber sandwich-type construction prototype reflector plates for the proposed 25 meter millimeter wave telescope were received and are being reviewed. A storage and test building was designed and the drawings turned over to maintenance for construction at the 140-foot. Limited research and studies continued for the proposed 25 meter millimeter wave telescope. Specifications and requests for proposals were prepared for painting sections of the 300-foot structure. Assistance was provided in supervision and progress checks of AUI Contract 191 for a new covering on the 36-foot telescope dome. Routine engineering assistance was provided maintenance and operations at Charlottesville, Green Bank, and Tucson.

## VERY LARGE ARRAY PROGRAM

The array was scheduled for observations and tests for approximately 60% of the time during the second quarter. The maximum number of antennas used for observing was 24. The longest usable baseline is 24 km.

The Electronics Division received the last stainless steel dewar and installed it on Antenna No. 28. This completes the procurement of cryogenics equipment for the program.

In the waveguide area, installation of waveguide on Antenna No. 28 was completed. Loss measurement of the buried 60 mm waveguide from station AN6 to AN8 (a distance of 06.02 km) was completed with a measured loss of 1.04 dB/km at 50 GHz. The performance of this waveguide system is much better than specified.

The prototype for a new and improved subreflector focus-rotation control system was completed and installed on antenna No. 27.

During this period the software development of the "pipeline" data processor was accelerated and put on a step-by-step schedule plan. According to this plan the processor should be operational the second quarter of 1981. Other developments included a number of improvements to the present observing and data reduction system.

The second transporter was received and assembled during the second quarter and check-out begun. Phase I of the wye track construction was 100% complete and Phase V construction for the balance of track construction is 94% complete. VSQ No. 3 and the VAX addition to the library office building were delivered to the site during June and placed on their foundations. Finish work was progressing at the end of the month.

## PERSONNEL

### Appointments

Magne B. Hagstrom	Elect. Engineer I	04/01/80
Robert A. Laing	Research Associate	04/02/80
Craig L. Sarazin	Visiting Assoc. Scientist	06/09/80
R. Marc Price	Visiting Scientist	06/04/80
John L. Giuliani	Visiting Res. Associate	06/23/80

### Terminations

B. Murray Lewis	Visiting Scientist	05/16/80
Raymond Escoffier	Elect. Engineer I	04/30/80



Changes in Status

Richard J. Lacasse	Elect. Eng. I / Elect. Eng. I and Assoc. Div. Head (Green Bank Electronics)	06/01/80
Campbell M. Wade	Assistant Director, VLA Operations / Scientist	06/16/80
Peter J. Napier	Div. Head, VLA Electronics / Div. Head, VLA Electronics & Assistant Director, VLA Operations	06/16/80

SUMMER STUDENT PROGRAM

Announcements of the summer student program were mailed in November, 1979 to over 100 colleges and universities. From the applications received, 20 students were chosen to participate in the program as research assistants to the scientific staff and in the electronics and computer divisions. A series of lectures will be given by the staff on various topics in radio astronomy and instrumentation. Students are encouraged to attend the regular NRAO colloquia and seminars. They will also assist as tour guides in the public education program at the Green bank site.

The names of the 1980 students, their academic year and their school are as follows:

Name	School	Yr.	Hometown
Barnet, Christopher	New Mexico Tech	G2	Las Cruces, NM
Bennett, Edward	New Mexico Tech	U3	Albuquerque, NM
Biretta, John	Caltech	G1	Pasadena, CA
Blaha, Cynthia	U. Minnesota	U4	St. Paul, MN
Crocker, Deborah	Wellesley	U4	Needham, MA
Daugherty, David	West Virginia U.	G1	Beckley, WV
Ewald, Shawn	New Mexico Tech	G1	Socorro, NM
Ganzel, Barbara	Rice	U4	Titusville, FL
Goodrich, Robert	Caltech	U3	Bettendorf, IA
Hammond, Suzanne	New Mexico State	U2	Las Cruces, NM
Hine, Butler	U. Alabama	U3	Tuscaloosa, AL
Hough, David	U. Pennsylvania	U4	S. Plainfield, NJ
Kulkarni, Shrinivas	California, Berkeley	G2	Berkeley, CA
Lind, Kevin	Rice	U3	Canon City, CO
Mateo, Mario	Rice	U3	Houston, TX
O'Dea, Christopher	U. Massachusetts	G2	Amherst, MA
Pauley, Robert	Georgia Tech	U4	Charleston, WV
Smith, Mark A.	New Mexico Tech	U3	Alamogordo, NM
Williams, Theodore	U. Michigan	U4	Troy, MI
Wing, Nancy	Mount Holyoke	U3	E. Thetford, VI