NATIONAL RADIO ASTRONOMY OBSERVATORY

QUARTERLY REPORT

01 April 1991 - 30 June 1991

TABLE OF CONTENTS

A. TELESCOPE USAGE

The following telescopes have been scheduled for research and maintenance in the following manner during the second quarter of 1991.

	140-Foot	12-Meter	VLA
Scheduled Observing (hrs)	1879.25	1884.00	1643.3
Scheduled Maintenance and Equipment Changes	197.25	59.00	276.9
Scheduled Tests and Calibrations	103.50	220.75	268.9
Time Lost	64.25	145.50	80.5
Actual Observing	1815.00	1739.50	1562.8

B. 140-FOOT OBSERVING PROGRAMS

The following line programs were conducted during this quarter.

No.	Observers	Programs
A-86	Albert, C. (USNA) Blades, J. (STScI) Lockman, F. J. Morton, D. (Herzberg)	Study of HI in the Galactic Halo.
A-101	Arzamasova, N. (Inst. Applied Math, USSR)	Fine structure studies of high velocity HI in the vicinity of the North Galactic Pole.
B-542	Borkowski, K. (Maryland) Lockman, F. J.	Observations at 1420 MHz to measure the distance to and map the HI cloud near NGC 246.
G-310	Giovanelli, R. (NAIC) Haynes, M. (Cornell)	Search for intergalactic HI clouds.
H-278	Heiles, C. (Berkeley) Goodman, A. (Berkeley) Troland, T. (Kentucky) Crutcher, R. (Illinois)	Observations of 18 cm OH lines in absorption against W22, Cas A, and other sources, to determine the existence of linear polarization.
J-122	Jenkins, E. (Princeton) Joseph, C. (Princeton)	HI observations toward πSco and υPer.
L-246	Lockman, F. J. Savage, B. (Wisconsin)	Observations of 21 cm hydrogen toward QSOs.
M-302	Menten, K. M. (CFA) Batrla, W. (Fachhochschule, Coberg)	Observations at 6.668 GHz of Class A methanol maser sources.
M-309	Mutel, R. (Iowa) Allen, J. (Iowa)	Survey of the galactic plane for 18 cm OH masers, and confirmation of three newly discovered OH masers that are coincident with IRAS sources.

No.	Observers	Programs
M-323	Matsakis, D. (USNO)	Line search of W3OH at 1.665 GHz and W49 at 22.229 GHz to detect very narrow spectral features.
S-341	Sato, F. (Tokyo Gakugei) Fukui, Y. (Nagoya)	Observations of the structure and motions of HI in the Taurus-Auriga region.
T-282	Turner, B. Yamamoto, S. (Nagoya) Saito, S. (Nagoya) Mangum, J. (Texas) Wootten, H. A.	Search at 10.3 GHz for C_3D as a test for hydrocarbon-ion-molecule chemistry.
T-284	Tifft, W. (Arizona) Cocke, W. (Arizona)	Observations at 21 cm of precision redshifts with applications to basic studies of the redshift.
W-280	Wootten, H. A.	H_2O monitoring in star-forming cores in ρOph.
W-282	Wilson, T. (MPIR, Bonn) Bania, T. (Boston) Huttmeister, S. (MPIR, Bonn) Martin-Pintado, J. (Yebes Obs.)	NH_3 observations at 1.25 cm to determine molecular temperatures of Galactic Center clouds.
X-3	Xiang, D. (Purple Mountain) Turner, B.	Search at 22.235 GHz for H_2O masers in established molecular outflow sources.

The following pulsar programs were conducted during this quarter.

No.	Observers	Programs
B-484	Backer, D. (Berkeley) Foster, R. (NRL)	Timing observations over the range 800-840 MHz and at 1330 MHz of PSR 1821-24 and other millisecond pulsars.
C-270	Cordes, J. (Cornell) Foster, R. (NRL) Lundgren, S. (Cornell) Weisberg, J. (Carleton College) Hankins, T. (NMIMT) Ulmer, M. (Northwestern)	Observations at 800 and 1330 MHz coincident with gamma ray observations of the Crab Pulsar.
F-104	Fruchter, A. (DTM) Nice, D. (Princeton) Stinebring, D. (Oberlin) Taylor, J. (Princeton) Thorsett, S. (Princeton)	Observations at 800, 1330, and 1665 MHz of the Terzan5 Pulsar.
F-105	Foster, R. (NRL) Fiedler, R. (NRL) Cordes, J. (Cornell)	Observations at 800-840 and 1330 MHz to obtain the dynamic spectra of strong radio pulsars.

No.	Observers	Programs
K-331	Kulkarni, S. (Caltech) Frail, D. Thorsett, S. (Princeton)	Observations at 1.33 GHz of the newly discovered pulsar PSR 1758-24.
T-265	Taylor, J. (Princeton) Stinebring, D. (Oberlin) Nice, D. (Princeton) Thorsett, S. (Princeton) Arzoumanian, Z. (Princeton)	Pulsar timing observations over the range 800-840, 1330, and 1665 MHz.

The following very long baseline programs were conducted and the stations used are coded as follows.

B	Effelsburg, MPIR 100 m	No	Noto, Sicily 32 m
Dm	Goldstone DSN 210 ft	O	Owens Valley 130 ft
G	Green Bank 140 ft	Pt	Pietown 25 m
Jb	Jodrell Bank 250 ft	R	Crimea, USSR 30 m
Km	Haystack 120 ft	Sn	Onsala 20 m
Kp	Kitt Peak 25 m	T	Torun 15 m
Lb	Bologna 25 m	VLBA	All available VLBA 25 m
Lm	Medicina 32 m	Wn	Westerbork n=1-14x26 m
Ma	Nobeyama 45 m	Yn	Socorro n=1-27x25 m

No.	Observers	Programs
GB-4	Bloom, S. (Boston) Marscher, A. (Boston) Gear, W. (Royal Obs.)	Millimeter strong sources. 1.3 cm.
GC-5	Carilli, C. Bartel, N. (CFA)	High dynamic range imaging observations at 6 cm of the nuclear jet (and counter-jet) in Cygnus A, with telescopes B, Jb, Lm, No, Sn, Wn, G, Km, Y_{27}, O, and VLBA.
GF-1	van Breugel, W. (IGPP, Livermore) Fanti, C. (Bologna) Fanti, R. (Bologna) Schilizzi, R. (NFRA) Spencer, R. (NRAL) Nan Rendong (Beijing) Dallacasa, D. (Bologna)	Observations at 18 cm of the steep spectrum core of 3C 293, with telescopes Sn, Wn, B, Jb, Lb, T, G, Km, Y_{27}, O, and VLBA.
GG-5	Giovannini, G. (Bologna) Comoretto, G. (Arcetri) Feretti, L. (Bologna) Venturi, T. (Bologna) Wehrle, A. (JPL)	Observations at 3.6 and 18 cm of the low luminosity radio galaxy 3C 338, with telescopes B, Sn, Lm, Wn, Jb, Km, G, Y_{27}, and VLBA.
GG-6	Gabuzda, D. (JPL) Cawthorne, T. (CFA)	Monitoring at 6 cm the intraday flux and variability in 0716+714, 0917+624, and 0954+658, with telescopes Sn, Lm, No, B, Wn, Jb, Km, G, Y_{27}, O, and VLBA.

No.	Observers	Programs
GK-2	Kollgaard, R. (Penn State) Feigelson, E. (Penn State) Gabuzda, D. (JPL) Lonsdale, C. (Haystack)	Observations at 6 cm of X-ray selected BL Lacertae objects, with telescopes B, Lm, Wn, Km, G, Y_{27}, O, A, and VLBA.
GL-4	Lestrade, J-F. (JPL) Phillips, R. (Haystack) Gabuzda, D. (JPL) Preston, R. (JPL)	Phased-referenced observations at 6 cm of RS CVn stars for HIPPARCOS, with telescopes Lm, B, Km, G, Y_{27}, and O.
GM-1	Marcaide, J. (IAA, Andalucia) Rioja, M.J. (MPIR, Bonn) Alberdi, A. (IAA, Andalucia) Cotton, W. Romney, J. Preston, R. (JPL) Kardashev, N. (SRI, Moscow) Shapiro, I. (CFA)	1.3 cm observations of Sgr A*, with telescopes B, Lm, No, Y_{27}, O, Km, G, Dm, and VLBA.
GM-4	Marcaide, J. (IAA, Andalucia) Alberdi, A. (IAA, Andalucia) Elosegui, P. (IAA, Andalucia) Marscher, A. (Boston) Zhang, Y. F. (Boston) Shapiro, I. (CFA) Ratner, M.I. (CFA) Preston, R. (JPL) Shaffer, D. (Interferometrics)	1.3 cm observations of 4C 39.25 phased-referenced to 0920+390, with telescopes B, Lm, Sn, No, Y_1, Km, G, O, and VLBA.
GP-4	Pauliny-Toth, I. (MPIR, Bonn) Unwin, S. (Caltech) Zensus, A.	Monitoring at 1.3 cm of the quasar 3C 454.3 in connection with ROSAT measurements, with telescopes B, Sn, Lm, No, Km, G, O, Y_{27}, and VLBA.
GS-3	Sakurai, T. (Iowa) Spangler, S. (Iowa)	Studies at 18 and 90 cm of density turbulence in the outer corona and solar wind, using telescopes Km, G, O, Y_{27}, B, Lm, Sn, Wn, Jb, R, and VLBA.
GU-2	Unwin, S. (Caltech) Abraham, Z. (Itapetinga) Carrara, E. (Itapetinga) Zensus, A. Urry, C. (STScI) Wehrle, A. (JPL)	Studies at 1.3 and 6 cm of the dynamics of the jet in 3C 279, with telescopes B, Sn, Lb, No, Km, G, O, E, Jb, Wn, Y_1, and VLBA.
GV-6	Vermeulen, R. (Caltech) Conway, J. (Caltech) Venturi, T. (Bologna) Readhead, A. (Caltech) Marr, J. (Haverford) Backer, D. (Berkeley)	Monitoring the core and inner jet of 3C 84 at 1.3 cm, with telescopes B, Lm, No, Sn, G, Km, O, Y_1, R, and VLBA.

No.	Observers	Programs
GX-2	Readhead, A. (Caltech) Wilkinson, P. (Manchester) Xu, W. (Caltech) Polatidis, A. (Manchester) Pearson, T. (Caltech) Lawrence, C. (Caltech) Herbig, T. (Berkeley)	A large scale VLBI snapshot survey at 6 and 18 cm, with telescopes Lb, Sn, B, Jb, Wn, No, G, Km, O, Y_1, and VLBA.
GZ-2	Zensus, A. Unwin, S. (Caltech)	Monitoring the structural evolution of the compact jet in 3C 273 at 1.3 cm, with telescopes Sn, B, Lm, No, Km, G, O, Y_1, and VLBA.
GZ-4	Zhang, F. (Chalmers) Spencer, R. (Manchester) Schlizzi, R. (NFRA) Fanti, C. (Bologna) Fanti, R. (Bologna) van Breugel, W. (Berkeley) Chu, H. (Nanjing)	Observations at 18 cm of the compact steep-spectrum radio quasar 3C 286, with telescopes B, Wn, Jb, Sn, Lm, R, Km, G, O, Y_{27}, and Pt.
GZ-7	Zensus, A. Unwin, S. (Caltech) Wehrle, A. (JPL)	Monitoring the jet in quasar 3C 345 at 1.3 cm, with telescopes B, Sn, Lm, No, Km, G, O, Y_1, R, and VLBA.
UA-2	André, P. Lestrade, J-F. (JPL) Phillips, R. (Haystack) Klein, K. (Meudon)	Observations at 3.6 and 6 cm to compare the magnetospheres of magnetic B stars Sigma Ori E and S1, with telescopes G, Y_{27}, and Kp.
UG-1	Greenhill, L. (Berkeley) Moran, J. (CFA) Reid, M. (CFA) Argon, A. (CFA) Menten, K. (CFA) Hirabayashi, H. (ISAS, Japan) Gwinn, C. (UCSB)	Observations at 1.35 cm to measure the distance to M33, with telescopes Km, G, Y_{27}, O, and B, and Ma.
UG-2	Gwinn, C. (UCSB) Barthel, P. (Groningen) Antonucci, R. (UCSB) Ulvestad, J. (Haystack) Barvainis, R. (Haystack) Neff, S. (NASA-GSFC)	Observations of H_2O megamaser and continuum radiation from the nucleus of the archetype Seyfert 2 galaxy NGC 1068, with telescopes B, Km, G, Y_{27}, and Dm.
UL-1	Lo, K. Y. (Illinois) Kellermann, K. Backer, D. (Berkeley) Reid, M. (SAO) Moran, J. (SAO)	1.35 cm mapping of Sgr A^*, with telescopes Km, G, O, Dm, Y_{27}, and VLBA.

C. 12-METER TELESCOPE

The following line programs were conducted during this quarter.

No.	Observers	Programs
A-102	Adler, D. (Illinois) Allen, R. (STScI) Lo, K. (Illinois) Sukumar, S. (Illinois)	Continuing studies of the interstellar medium in the spiral galaxy M83.
A-103	André, P. Leous, J. (Penn State) Greene, T. (Arizona) Young, E. (Arizona)	Comprehensive study of the star-forming core L1495 in Taurus.
A-105	André, P. Loren, R. (unaffiliated) Wootten, H. A. Despois, D. (Bordeaux Obs.)	Study of the mass and morphology of the dense gas of the rho Ophiuchi cloud cores.
A-106	André, P. Gordon, M.	A search for RRLs in the rho Ophiuchi region.
B-535	Balonek, T. (Colgate) Dent, W. (Massachusetts)	Study of the evolution of extragalactic radio sources at millimeter wavelengths.
B-537	Blitz, L. (Maryland) Williams, J. (Berkeley)	Study of the structure of a young GMC.
B-544	Buhl, D. (NASA/GSFC) Chin, G. (NASA/GSFC) Goldstein, J. (NASM)	Observations of CO in the upper mesosphere of Venus.
B-545	Bieging, J. (Arizona)	Study of the chemical structure of the IRC+10216 envelopes.
B-548	Barnes, P. (CFA) Myers, P. (CFA)	Mapping of dense cores in L1030-1055 molecular clouds.
C-268	Clancy, R. (Colorado) Muhleman, D. (Caltech)	CO/NOx/temperature studies of Mars, Venus, and the Earth atmospheres.
D-167	Dickel, J. (Illinois) Milne, D. (Australia Telescope)	Search for CO emission near SNRs in M31.
G-319	Gordon, M.	The detection and mapping of CO in elliptical galaxies.
G-321	Gordon, M. Martin-Pintado, J. (Yebes Obs.)	Monitoring program for the RRL maser in MWC 349.

No.	Observers	Programs
H-272	Hollis, J. M. (NASA/GSFC) Snyder, L. (Illinois) Ziurys, L. (Arizona State)	The search for the confirming transition of HNO.
H-275	Hunter, D. (Lowell Obs.) Gallagher, J. (AURA, Inc.)	Study of the molecular gas content of NGC 2366.
H-276	Hunter, D. (Lowell Obs.) Gallagher, J. (AURA)	Study of the molecular gas content in amorphous irregulars.
L-258	Lubowich, D. (AIP) Turner, B.	Study of mass-loss from Li-rich stars, and shock chemistry in IC 443G.
M-316	Martin, R. (Arizona) Turner, J. (UCLA) Ho, P. (CFA-Harvard)	Study of CO and ^{13}CO J=2-1 emission from HII regions in the spiral arms of IC 342 and the nucleus of M83.
M-317	Magnani, L. (NAIC) La Rosa, T. (Alabama) Lada, E. (CFA-Harvard)	A survey of CS emission in translucent cloud cores.
M-318	McCullough, P. (Berkeley) Reach, W. (Berkeley) Heiles, C. (Berkeley)	Study of bright-rimmed globules in IC 1396, IC 1805, and IC 1848.
M-319	McCullough, P. (Berkeley) Reach, W. (Berkeley) Heiles, C. (Berkeley)	1.3 mm CO mapping of globules in HII regions.
M-320	Mead, K. (Union College) Carey, S. (Rensselaer) Kutner, M. (Rensselaer)	Unbiased study of molecular clouds in the outer galaxy.
P-156	Pound, M. (Maryland) Blitz, L. (Maryland)	A search for proto-brown dwarfs.
S-342	Sage, L. (MPIR, Bonn) Ziurys, L. (Arizona State)	A study of extragalactic N_2H^+.
S-343	Shupe, D. (Cornell) Herter, T. (Cornell)	A search for CO (J=1-0) emission in a nearby diffuse cloud.
T-281	Turner, B.	A search for vinyl (CH_2CH).
T-285	Turner, B.	Search for refractory-element molecules.
T-290	Turner, B. Rickard, L. (NRL) Lanping, X. (Beijing)	Are cirrus clouds different from galactic-plane clouds?

No.	Observers	Programs
T-292	Thronson, H. (Wyoming) Latter, W. (CITA)	Study of the state of the ISM and star formation in early-type galaxies.
T-298	Terebey, S. (Caltech)	A search for protostellar collapse motions.
T-299	Turner, B.	A confirmation of a detection of SiN in IRC+10216.
V-77	Verter, F. (NASA/GSFC) Hodge, P. (Washington)	Study of molecular gas emissivity in GR8.
W-283	Wilner, D. (Berkeley) Welch, W. (Berkeley) Bieging, J. (Arizona)	A multi-transition study of OMC-N.
W-298	Wilking, B. (Missouri) Mundy, L. (Caltech) McMullin, J. (Maryland)	Study of the relationship of nearby cloud cores to star formation.
W-294	Wolf, G. (Arizona)	A search for dense gas in the Mon OB1 molecular cloud.
W-297	Wilk, K. (Waterloo) Fich, M. (Waterloo)	Study of star-formation conditions around small nearby HII regions.
W-298	Womack, M. (Arizona State) Ziurys, L. (Arizona State) Wyckoff, S. (Arizona State)	Study of CH_4 abundances in the ISM and constraints on conditions in the primitive solar nebula.
W-299	Wilson, C. (Caltech) de Geus, E. (Maryland)	Observations of CS in outer galaxy star-forming regions.
Z-90	Ziurys, L. (Arizona State)	Confirmation of vibrationally-excited HCO^+.

D. THE VERY LARGE ARRAY

Second quarter configurations were: D configuration, April 1-May 28; A/D configuration, May 28-June 10; and A configuration, June 10-30.

No.	Observers	Programs
AA-108	Anderson, M. (Minnesota) Rudnick, L. (Minnesota) Perley, R.	The time evolution of SNR Cassiopeia A. 6, 20 cm.
AA-120	Andre, P. Feigelson, E. (Penn State) Leous, J. (Penn State) Montmerle, T. (CNRS, France)	Possible dust emission of young stellar objects. 6 cm.

No.	Observers	Programs
AA-123	André, P. Feigelson, E. (Penn State) Leous, J. (Penn State) Montmerle, T. (CNRS, France)	Circular polarization from magnetic star S1 in ρOPH cloud. 3.8 cm.
AA-125	Appleton, P. (Iowa State) Marcum, P. (Iowa State)	HI observations of the edge-on galaxy NGC 4631. 20 cm line.
AB414	Becker, R. (Calif., Davis) White, R. (STScI)	Monitoring radio stars HD193793 and P Cygni. 2, 6 cm.
AB-582	Bastian, T. Bookbinder, J. (CFA) Dulk, G. (Colorado) Lecacheux, A. (Meudon) Belkora, L. (Colorado)	Stellar flares on AD Leo: multiband observations. 2, 3.8 cm.
AB-586	Brinks, E. Skillman, E. (Minnesota) Taylor, C. (Minnesota)	Search for intergalactic HI clouds. 20 cm line.
AB-591	Beck, R. (MPIR, Bonn) Horellou, C. (Meudon) Neininger, N. (MPIR, Bonn) Brouillet, N. (MPIR, Bonn)	The detailed magnetic field structure of M51. 6 cm.
AB-593	Batuski, D. (Maine) Venkatesan, T. (Maine) Hanisch, R. (STScI) Burns, J. (New Mexico State)	Head-tail radio sources in poor clusters of galaxies. 6 cm.
AB-595	Beck, R. (MPIR, Bonn) Ehle, M. (MPIR, Bonn) Neininger, N. (MPIR, Bonn)	Magnetic fields and star formation in NGC 6946. 6 cm.
AB-596	Birkinshaw, M. (Harvard)	Radio sources in clusters observed in the Sunyaev-Zel'dovich effect. 2, 6, 20 cm.
AB-597	Bookbinder, J. (CFA) Pye, J. (Leicester) Bromage, G. (RAL) Saar, S. (CFA)	Stellar flares on UV Ceti and AT Mic: multiband observations. 2, 3.8, 6, 20 cm line.
AB-598	Bregman, J. (Michigan) Brinks, E. Roberts, M.	High velocity clouds in NGC 5668. 20 cm line.
AB-599	Brett, B. (Manchester) Beck, R. (MPIR, Bonn)	The magnetic field of NGC 2903. 6 cm.

No.	Observers	Programs
AB-602	Byrne, R. (Florida) Gottesman, S. (Florida)	HI observations of dwarf galaxies: UGC 10805. 20 cm.
AB-603	Bastian, T. Dulk, G. (Colorado) Bookbinder, J. (CFA)	Multiband observations of AE Aquarii. 1.3, 2, 3.8, 6 cm.
AB-607	Benz, A. (ETH Zurich) Gudel, M. (ETH Zurich) Schmitt, M. (MPIfEP, Garching)	Monitoring the quiescent radio emission of UV Cet. 2, 3.8, 6 cm.
AB-612	Biretta, J. Owen, F.	Monitoring proper motions in the M87 jet. 2 cm.
AC-278	Carilli, C. Ho, P. (CFA)	Two nuclear starburst galaxies. 3.8, 6, 20 cm.
AC-284	Carignan, C. (Montreal)	HI studies of gas-rich dwarf irregulars. 20 cm line.
AC-289	Curiel, S. (CFA) Gomez, J. (CFA) Torrelles, J. (IAA, Andalucia) Rodriguez, L. (Mexico/UNAM) Anglada, G. (Barcelona)	Temperature gradients in bipolar outflows L1448S and NGC 2264G. 1.3 cm line.
AC-293	Churchwell, E. (Wisconsin) Walmsley, M. (MPIR, Bonn) Cesaroni, R. (MPIR, Bonn) Wood, D. Hofner, P. (Wisconsin)	Hot (shocked?) ammonia associated with UC HII regions. 1.3 cm line.
AD-262	Dahlem, M. (MPIR, Bonn) Lesch, H. (Heidelburg Obs.) Hummel, E. (Manchester)	Magnetic fields in interacting galaxies: NGC 5426/27. 20 cm.
AD-263	Dewdney, P. (DRAO) Purton, C. (DRAO) McCutcheon, W. (British Columbia) Roger, R. (DRAO)	Sources associated with IRAS 23545+6508. 2 cm.
AD-264	Drake, S. (NASA/GSFC) Brown, A. (Colorado) Simon, T. (Hawaii) Judge, P. (High Altitude Obs.)	Procyon--is it losing mass? 3.8 cm.
AD-265	Drake, S. (NASA/GSFC) Walter, F. (SUNY) Jetsy, L. (Helsinki) Florkowski, D. (USNO)	Radio emission from rapidly-rotating cool giant stars. 3.8 cm.

No.	Observers	Programs
AE-077	Evans, D. (Radiophysics Inc.) Romig, J. (Radiophysics Inc.) de Pater, I. (Berkeley) Crane, P. McKinnon, M. (NMIMT)	Search for Saturn electrostatic discharge. 90 cm.
AF-196	Feretti, L. (Bologna) Giovannini, G. (Bologna) Dallacasa, D. (Bologna)	Radio polarization mapping of head-tail source NGC 4869. 3.8, 6, 20 cm.
AF-209	Frail, D. Moffett, D. (NMIMT)	Crab-like supernova remnants. 6, 20 cm.
AG-318	Gunn, J. (Princeton) Knapp, G. (Princeton) Athanassoula, E. (Marseille Obs.) Bosma, A. (Marseille Obs.) van Gorkom, J. (Columbia)	Spiral structure and the disk/halo mass ratio. 20 cm line.
AG-319	Gaume, R. (NRL) Fey, A. (NRL) Claussen, M. (NRL) Johnston, K. (NRL) Nedoluha, G. (NRL)	Hydrogen recombination lines toward G34.25+0.14. 1.3, 3.8 cm line.
AG-322	Gopalswamy, N. (Maryland) Kundu, M. (Maryland) Schmahl, E. (Maryland) White, S. (Maryland) Thejappa, G. (Maryland)	Flares and precursors. 6, 20, 90 cm.
AH-295	Habing, H. (Leiden) Goss, W. M. Winnberg, A. (Onsala) van Langevelde, H. (Leiden)	Monitoring OH/IR stars at the galactic center. 20 cm line.
AH-382	Ho, P. (CFA) Martin, R. (Arizona) Turner, J. (UCLA) Jackson, J. (Boston)	Extragalactic ammonia emission. 1.3 cm line.
AH-390	Hjellming, R. Gehrz, R. (Minnesota) Taylor, A. (Calgary) Seaquist, E. (Toronto)	Monitoring radio novae. 2, 3.6, 6, 20 cm.
AH-407	Ho, P. (CFA) Ishiguro, M. (Nobeyama Obs.) Kawabe, R. (Nobeyama Obs.) Okumura, S. (Nobeyama Obs.) Turner, J. (UCLA)	Synchrotron emission in nearby normal spiral galaxies. 20 cm.

No.	Observers	Programs
AH-417	Hibbard, J. (Columbia) van Gorkom, J. (Columbia)	Interacting and merging galaxies. 20 cm line.
AH-420	Hoffman, G. (Lafayette College) Salpeter, E. (Cornell) Dickey, J. (Minnesota)	HI mapping of two close galaxy pairs. 20 cm line.
AH-424	Han, X. (NMIMT) Hjellming, R.	The radio remnant of the 1989 outburst of V404 Cyg. 3.8, 6 cm.
AH-428	Hjellming, R. Han, X. (NMIMT) Roussel-Dupre, D. (Los Alamos)	X-ray sources observed with URA X-ray telescope on Space Shuttle. 3.8, 6, 20 cm.
AH-429	Hughes, V. (Queens)	HH objects in GGD-37. 3.8, 6 cm.
AH-430	Hummel, E. (Manchester) Beck, R. (MPIR, Bonn) Krause, M. (MPIR, Bonn)	The B-field structure in the central 1 kpc of IC 342. 3.8 cm.
AH-431	Habbal, S. (CFA) Walker, A. (Stanford) Hoover, R. (NASA/MSFC) Dowdy, J. (NASA/MSFC) Gonzalez, R. Harvey, K. (Solar Phys. Res. Corp)	Multiwavelength ground and space observations of the sun. 1.3, 2, 3.5, 6 cm.
AH-437	Hewitt, J. (MIT) Turner, E. (Princeton) Chen, G. (MIT) Angelus, A. (MIT)	Monitoring the "Einstein Ring" gravitational lens MG1131+0456. 3.5, 6 cm.
AH-444	Hjellming, R.	Gamma transient 1217+066. 3.8 cm.
AJ-198	Joncas, G. (Laval) Roger, R. (DRAO) Kompe, C. (IRAM, Spain)	Multi-frequency study of the Sh 247 star-forming complex. 1.3, 2, 6, 20 cm line.
AJ-200	Jacobson, A. (Los Alamos) Erickson, W. (Tasmania) Mercier, C. (Meudon)	Ionospheric dynamics, including "Distant Image" explosion. 90 cm.
AK-249	Klein, U. (MPIR, Bonn) Brinks, E. Skillman, E. (Minnesota)	Low-frequency specral indices of blue compact dwarfs. 90, 20 cm.
AK-266	Keene, J. (Caltech) Masson, C. (CFA) Menten, K. (CFA)	Mapping of NH_3 emission in B335. 1.3 cm line.

No.	Observers	Programs
AK-269	Kundu, M. (Maryland) White, S. (Maryland)	Acoustic waves in the solar chromosphere. 2 cm.
AK-280	Kulkarni, S. (Caltech) Navarro, J. (Caltech) Tanaka, Y. (ISAS, Japan)	Quiescent LMXBs and millisecond pulsations. 20 cm.
AL150	Lestrade, J-F. (JPL) Preston, R. (JPL)	Properties of RSCVn stars. 6 cm.
AL-216	Leahy, D. (Calgary)	Sharpless regions S217 and S219. 6, 20 cm.
AL-225	Li, G. (Toronto) Seaquist, E. (Toronto) Wrobel, J.	Radio morphology of star-forming SO galaxies. 3.8 cm.
AL-234	Leone, F. (Catania) Umana, G. (Bologna)	Synoptic observation of CP2 (chemically peculiar) stars. 6 cm.
AL-238	Ledlow, M. (New Mexico) Owen, F.	Properties and evolution of radio galaxies in rich clusters. 20 cm.
AM-290	Menon, T. K. (British Columbia)	Interacting galaxies. 6 cm.
AM-311	Mangum, J. (Texas) Wootten, H. A.	Hot ammonia and the star-forming core in DR21(OH). 1.3 cm line.
AM-313	McKinnon, M. (NMIMT)	A search for pulsar mode-switching. 20 cm.
AM-318	McHardy, I. (Southampton) Lehto, H. (Southampton) Branduardi-Raymont, G. (U. College, London) Mason, K. (U. College, London) Green, A. (Southampton)	Radio survey of deep ROSAT X-ray survey area-spectral indices. 6 cm.
AM-319	McMullin, J. (Maryland) Mundy, L. (Maryland) Zhou, S. (Texas) Evans, N. (Texas)	Probing molecular depletions in protostellar objects. 1.3 cm line.
AM-322	Myers, S. (CITA) Lawrence, C. (Caltech) Dave, R. (Caltech)	Survey of OVRO microwave background fields. 2, 3.8 cm.
AM-323	Muhleman, D. (Caltech) Grossman, A. (Maryland) Butler, B. (Caltech) Slade, M. (JPL)	Titan bistatic radar. 3.8 cm.
AN-055	Nash, A. (ARC) Geldzahler, B. (ARC)	Survey of radio emission from Cepheid variables. 6 cm.

No.	Observers	Programs
AO-101	Odewahn, S. (Minnesota)	Magellanic type galaxy NGC 4618. 20 cm line.
AP194	Pedelty, J. (NASA/GSFC) Pisarski, R. (NASA/GSFC) Dickel, J. (Illinois) Odegard, N. (General Sciences Corp.)	Cygnus loop. 90 cm.
AP-201	Pratap, P. (CFA) Menten, K. (CFA)	A multitransitional ammonia study of the NGC 7538 star-forming region. 1.3 cm line.
AP-204	Patnaik, A. (Manchester) Browne, I. (Manchester) King, L. (Manchester) Wilkinson, P. (Manchester) Wrobel, J.	Phase calibrators for Merlin. 3.6 cm.
AP-205	Pauls, T. (NRL) Johnston, K. (NRL) Gaume, R. (NRL) Wilson, T. (MPIR, Bonn) Huettemeister, S. (MPIR, Bonn)	NH_3 (2,2) and (4,4) observations toward Sgr A. 1.3 cm line.
AP-206	Phookun, B. (Maryland) Mundy, L. (Maryland)	NGC 4254 and NGC 4654: HI observations of one-armed spiral galaxies. 20 cm line.
AP-207	Porter, A. (KPNO) Green, R. (KPNO) Osmer, P. (KPNO)	The highest redshift quasars. 3.8 cm.
AP-211	Popov, M. (Moscow, Lebedev) Novikov, A. (Moscow, Lebedev) Hankins, T. (NMIMT)	Unpulsed emission from pulsars. 20, 90 cm.
AP-212	Pedlar, A. (Manchester) Axon, D. (Manchester) Kukula, M. (Manchester) Unger, S. (RGO) Baum, S. (STScI) O'Dea, C. (STScI)	Radio structures of CFA sample of Seyferts. 3.8 cm.
AR-231	Reid, M. (CFA) Menten, K. (CFA)	"Light curves" for Mira variables. 3.8 cm.
AR-232	Reynolds, S. (NC State)	Small-scale structure in young supernova remnants. 6, 20 cm.
AR-241	Rodriguez, L. (Mexico/UNAM) Reipurth, B. (ESO)	Search for the exciting sources of new Herbig-Haro objects. 2, 3.8 cm.
AR-249	Rupen, M. (CFA) Bartel, N. (CFA)	Radio survey of optical supernovae. 6, 20 cm.

No.	Observers	Programs
AR-250	Rawlings, S. (Cambridge) McMahon, R. (Cambridge)	1-Jy/1-sr sample of steep-spectrum radio quasars. 20 cm.
AS-333	Sramek, R. Weiler, K. (NRL) Van Dyk, S. (NRL) Panagia, N. (STScI)	Properties of radio supernovae. 2, 6, 20 cm.
AS-391	Sofue, Y. (Tokyo) Reich, W. (MPIR, Bonn) Reich, P. (MPIR, Bonn) Pedlar, A. (Manchester)	Galactic center jet. 90 cm line.
AS-430	Seaquist, E. (Toronto) Taylor, A. (Calgary) Krogulec, M. (Toronto) Weston, D. (York)	A survey of symbiotic stars. 3.8 cm.
AS-431	Serabyn, G. (Caltech) Masson, C. (CFA)	Zeeman measurement of magnetic field near galactic center arc. 18 cm.
AS-433	Skinner, S. (Colorado) Brown, A. (Colorado) Linsky, J. (Colorado)	Spectral indices of radio-emitting Herbig Ae/Be stars. 2, 3.6, 6, 20 cm.
AS-435	Smoker, J. (Manchester) Axon, D. (Manchester) Davies, R. (Manchester) Hummel, E. (Manchester)	Dark matter in the galaxy NGC 428. 20 cm line.
AS-436	Szomoru, A. (Groningen/Kapteyn) van Gorkom, J. (Columbia) Gregg, M. (Mt. Stromlo)	HI survey of the Bootes void. 20 cm line.
AS-443	Stanghellini, C. (IdR, Bologna) O'Dea, C. (STScI) Baum, S. (STScI) Fanti, R. (IdR, Bologna) Fanti, C. (IdR, Bologna)	A complete sample of GPS radio sources. 1.3, 3.5, 6, 20, 90 cm.
AS-445	Sanders, W. (New Mexico State) Fomalont, E.	VLBI reference sources in star fields. 3.8, 6, 20 cm.
AS-450	Sahai, R. (Onsala) Claussen, M. (NRL)	Time variation of the enigmatic radio source in IRC+10216. 1.3, 2, 3.8 cm.
AT-108	Terlevich, R. (RGO) Brinks, E. Skillman, E. (Minnesota) Terlevich, E. (RGO)	Seyfert galaxy NGC 1068. 20 cm line.

No.	Observers	Programs
AT-113	Troland, T. (Kentucky) Crutcher, D. (Illinois) Roberts, D. (Oklahoma) Goss, W. M.	New VLA Zeeman observations of Orion A, Orion B, and W3. 20 cm line.
AT-114	Taylor, A. (Calgary) Dougherty, S. (Calgary)	Monitoring of radio variable Be stars. 3.8 cm.
AT-115	Taylor, G. (UCLA) Perley, R.	A search for HI gas in Hydra A. 20 cm line.
AT-116	Taylor, J. (Princeton) Thorsett, S. (Princeton) McKinnon, M. (NMIMT)	Binary pulsar timing measurements: 0655+64. 90 cm.
AT-118	Thorsett, S. (Princeton) Taylor, J. (Princeton) McKinnon, M. (NMIMT)	Binary pulsar timing measurements: pulsars not accessible to Arecibo. 20, 90 cm.
AT-119	Thorsett, S. (Princeton) Taylor, J. (Princeton) Stinebring, D. (Oberlin) Hankins, T. (NMIMT)	Timing fast pulsars. 6, 20 cm.
AT-120	Torrelles, J. (IAA, Andalucia) Gomez, J. (CFA) Curiel, S. (CFA) Ho, P. (CFA) Rodriguez, L. (Mexico/UNAM) Eiroa, C. (Madrid Obs.)	Ammonia observations of the Serpens triple. 1.3 cm line.
AT-121	Torrelles, J. (IAA, Andalucia) Gomez, J. (CFA) Ho, P. (CFA) Rodriguez, L. (Mexico/UNAM) Canto, J. (Mexico/UNAM) Anglada, G. (Barcelona)	Ammonia observations of HH1, HH2. 1.3 cm line.
AT-123	Tyson, N. (Columbia) van Gorkom, J. (Columbia)	HI near supernovae distant from the galactic nucleus. 20 cm line.
AU-041	Uson, J. Bagri, D. Cornwell, T.	Search for redshifted "21 cm" emission from Zel'dovich pancakes. 90 cm line.
AV-187	van der Werf, P. (MPIfEP, Garching) Genzel, R. (MPIfEP, Garching)	HI observations of M17 and NGC 2023. 20 cm line.
AW-249	Wills, B. (Texas) Shastri, P. (Texas)	Core variability in lobe-dominated quasars. 6 cm.

No.	Observers	Programs
AW-269	Wilkinson, P. (Manchester) Polatidis, A. (Manchester) Readhead, A. (Caltech) Pearson, T. (Caltech) Xu, W. (Caltech)	Survey of strong sources. 6 cm.
AW-273	Wootten, H. A. Sahai, R. (Onsala)	Circumstellar chemistry of cyanopolyynes: HC_5N. 1.3, 3.8 cm line.
AW-275	White, S. (Maryland) Kundu, M. (Maryland) Gopalswamy, N. (Maryland) Schmahl, E. (Maryland)	Coronal magnetic fields above solar active regions. 2, 3.8, 6, 20 cm.
AW-276	Willson, R. (Tufts) Kile, J. (Tufts) Noto, J. (Tufts)	Microwave studies of BY Draconis stars. 20 cm.
AW-277	Wilson, T. (MPIR, Bonn) Gaume, R. (NRL) Pauls, T. (NRL) Johnston, K. (NRL)	NH_3 observations toward W30H: the (1,1), (2,2), and (3,3) lines. 1.3 cm line.
AW-279	Wiseman, J. (Harvard) Ho, P. (CFA)	Extended structure and high velocity outflows in OMC-1. 1.3 cm line.
AW-280	Womble, D. (Calif., San Diego) Dickey, J. (Minnesota) Burbidge, E. (Calif., San Diego)	Probing the extent of galaxies: Ca II absorption vs HI emission. 20 cm line.
AW-282	Worrall, D. (CFA) Murray, S. (CFA) Birkinshaw, M. (Harvard)	The Eridanus Einstein deep survey field. 6, 20 cm.
AW-283	Wrobel, J. Olszewski, E. (Arizona)	Radio sources in and beyond the galaxy's dwarf spheroidals. 3.8 cm.
AW-287	Wilson, A. (Maryland) Ulvestad, J. (JPL)	Deep image of NGC 1068. 3.8 cm.
AW-289	White, S. (Maryland) Kundu, M. (Maryland)	M Dwarf binary Gliese 890. 2, 6, 20 cm.
AW-290	White, S. (Maryland) Kundu, M. (Maryland) Pallavicini, R. (Arcetri)	Radio spectra and polarization of naked T Tauri stars. 2, 3.5, 6, 20 cm.
AY-035	Yin, Q. Thuan, T. (Virginia)	Blue compact dwarf galaxies. 6 cm.

No.	Observers	Programs
AY-041	Yun, M. (CFA) Ho, P. (CFA) Lo, K. (Illinois)	HI synthesis mapping of the M81-M82-NGC 3077 system. 20 cm line.
AZ-044	Zhao, J. Ekers, R. (Australia Telescope) Goss, W. M. Lo, K. (Illinois) Narayan, R. (Arizona)	Flux density variations caused by RISS in Sgr A. 1.3, 2, 3.6, 6, 20 cm.
AZ-050	Zhou, S. (Texas) Evans, N. (Texas) Mangum, J. (Texas) Wang, Y. (Texas)	Formaldehyde in low-mass dense cores. 6 cm line.
AZ-052	Zhao, J. Goss, W. M. Lo, K. (Illinois) Ekers, R. (Australia Telescope)	Galactic center region. 1.3, 3.8 cm.
UAH-003	Phillips, R. (Haystack)	HD 283447. 3.8 cm.
UAH-004	Lonsdale, C. (Haystack) Lonsdale, C. (Caltech) Smith, H. (Calif., San Diego)	NGC 3690. 3.6 cm.

E. THE VERY LONG BASELINE ARRAY

No.	Observers	Programs
BB-002	Brown, R. Benson, J.	Structure of SgrA. 6, 1.3 cm.
BT-001	Taylor, G. (UCLA) Perley, R.	3C 295 hot spot observations. 21 cm.
BY-001	Yusef-Zadeh, F. (Northwestern) Melia, F. (Northwestern) Walker, R. C.	SgrA*. 3.8, 1.3 cm.

F. SCIENTIFIC HIGHLIGHTS

Green Bank

Discovery of New Methanol Maser Transition - The 140-Foot Telescope was used to observe the 6.6 GHz transition of methanol. The goal was to understand the excitation mechanism of interstellar masers, a 20-year pursuit already. The supposition was that this particular transition would be seen in absorption and that would help reveal the population of various energy levels in this complicated molecule. Instead, the transition turned out to be masing. In fact, spectral lines second only in strength to some water maser lines were detected. The masing methanol is widespread:

its presence was detected in approximately 80 galactic regions. This was a line that radio astronomy technology could have discovered 25 years ago. That the second strongest line escaped detection for this long indicates how poorly studied the centimeter wavelength band is. This bodes well for the future of the Green Bank Telescope.

Investigator: K. Menten (CFA)

Socorro

NH_3(3,3) Maser Emission Toward DR21 (OH) - Recent VLA D-configuration observations of the DR21 (OH) star-forming region reveal what appears to be non-thermal emission in the NH_3(3,3) emission towards the source. If confirmed, this would represent the first detection of (3,3) maser emission from the main isotopomer of ammonia in the interstellar medium. Already suspected to be in a very early state of stellar evolution, dense gas in the DR21(OH) molecular ridge forms a shell-like structure incorporating eighteen distinct molecular cores, possibly under the influence of an unidentified outflow source in the region. The suspected maser feature shows no corresponding (1,1), (2,2), or (4,4) emission but is coincident in position and velocity with other CH_3OH maser features. The extremely narrow linewidth (0.3 km/s FWHM) and size (< 3.5") of the suspected maser emission feature suggests that it arises in a smaller, calmer region than other molecular cores in DR21 (OH). The peak brightness temperature of the line reaches 65 K. (3,3) maser emission is thought to be collision induced in a manner sensitive to the ortho/para mixture of the molecular hydrogen colliders. Since the ortho-H_2/para-H_2 ratio evolves with time, the newly discovered NH_3(3,3) maser may be useful as an "interstellar chronometer."

Investigators: J. Mangum (U. Texas); H. A. Wootten (NRAO)

Tucson

Search for Protostellar Collapse Motions - The 12-Meter Telescope was used at 3 mm and 1.3 mm wavelengths to search for gravitational collapse motions in protostars. Although such collapse motions are assumed to occur, numerous searches for gravitational collapse have been fruitless, or at best ambiguous. Other recent searches have attempted to identify collapse motions from absorption line profiles that are expected in some circumstances. Unfortunately, such profiles can arise through a variety of mechanisms, unrelated to gravitational collapse. Terebey took a different approach, searching for emission line profiles characteristic of collapse as predicted by synthetic model profiles. The 12-m beam size was ideally suited for this project given the size of nearby candidate sources.

Investigator: S. Terebey (Caltech)

Chemistry and Distribution of Molecules in the Envelope of IRC+10216 - The 12-Meter Telescope was used to obtain images of the envelope about the evolved star IRC+10216 in the emission of several different molecular species. A variety of different chemical processes occur in circumstellar envelopes, including thermodynamic reactions, ion-molecule reactions, and photo-dissociation reactions. These different types of reactions usually occur at different radii from the star. For example, the thermodynamic reactions occur close to the star whereas the photo-dissociation reactions occur far out in the envelope. A number of such species were examined to determine the chemical processes in action, and the distribution of the species within the envelope. The 12-m results will be combined with interferometry results obtained with the BIMA observatory at Hat Creek.

Investigator: J. Beiging (Arizona)

G. PUBLICATIONS

Attached as Appendix A is a tabulation of all preprints received in the NRAO Charlottesville library authored by NRAO staff or based on observations obtained on NRAO telescopes during the reporting period.

H. CENTRAL DEVELOPMENT LABORATORY

Amplifier Development

A new design of a 38-45 GHz amplifier has been tested and performs very well. The production of these amplifiers continues, as well as those for the frequency bands: 1.2-1.8 GHz, 12-18 GHz, and 26-36 GHz. Two of the 12-18 GHz amplifiers have been modified to allow for acceptable performance in the 16-20 GHz frequency range.

A summary of amplifier deliveries in this quarter is given in the table below:

FREQUENCY BANDS	NUMBER OF AMPLIFIERS	COMMENTS
1.2-1.8	2	
12-18	8	Two modified for 16-20 GHz operation.
26-36	3	
38-45	3	New design
Grand Total	16	

Superconducting (SIS) Millimeter-Wave Mixer Development

Millimeter-wave work in Charlottesville this quarter has focused mainly on construction of four 2-mm receiver inserts for the new multi-band SIS receivers being installed on the 12-Meter Telescope. After completing these, two spare inserts will be made for each band.

A new set of SIS mixers is in fabrication at UVa. This set contains mixers primarily for operation at 200-300 GHz, including *tunerless* mixers (*i.e.*, requiring no mechanical tuning) for the new SIS eight-beam 230 GHz receiver, and a few small chips for 130-170 GHz. Design of a second mask set, containing small chip and integrated (tunerless) designs specifically for the 130-170 GHz bands, is now nearly complete.

We have started building a new, more versatile SIS mixer test set based on a closed-cycle JT refrigerator made in Tucson. The new test set will allow us to measure the conversion loss and noise of the WR-12 mixers used for the 68-90 GHz band, which will not fit in our small NASA liquid helium test cryostat.

During this quarter we have built (or rebuilt) and tested a total of 11 SIS mixers operating from 68-260 GHz. In addition, we have fabricated 6 triplers using experimental planar (whiskerless) varactor diodes made at UVa. Planar diodes are expected to be used in local oscillator frequency multipliers for the Millimeter Array.

OVLBI Earth Station Project

Most of the quarter was taken up with completing the preliminary design of critical subsystems, including the feeds and optics, the two-way timing link, and the computer control system.

A prototype frequency selective surface was designed and fabricated, and awaits testing at the end of the quarter. Arrangements were made for an FSS design study to be carried out at JPL on a consulting basis.

Breadboard tests of direct digital synthesizers continued with construction of a second DDS. These are needed for the timing links.

The evaluation of computer operating systems was completed and VENIX (a real-time UNIX) was selected as the platform for the control system. A report on this was prepared and distributed.

The last several weeks of the quarter were used to prepare for the preliminary design review on July 2. A detailed report on the preliminary design was completed.

Electromagnetic Support

The throat section of the VLBA 14 GHz feed was redesigned for better VSWR. Pattern and return loss measurements were completed. The teflon radome thickness was optimized.

Time was spent on detailed spillover calculations of Gregorian and Cassegranian geometries of the GBT for presentation at the AP-S Symposium in London, Ontario.

A mode matching program for analyzing corrugated horns was installed on the Convex and a Sparc station at the CDL. Design of the L-band compact horn for the GBT is proceeding.

I. GREEN BANK ELECTRONICS

Green Bank Telescope

A major project is underway to replace the collapsed 300-Foot Telescope with a state-of-the-art 100-m telescope. The Green Bank electronics division is supplying expertise to the design effort in a few areas.

A draft design for the electronics equipment to be located in the feed arm receiver room was completed and distributed for technical review within NRAO. As this draft is refined, it will serve as a starting point for the detailed designs to follow. A proposal for a revision of the design of the receiver room and turret design was put forth (GBT Memo No. 63), and has been presented to the contractor as NRAO's preferred approach.

Two demo commercial-frequency synthesizers were obtained and tested for possible application in the LO system. One attractive candidate is the HP 83600 series that has several models providing up to 50 GHz with 1 Hz resolution in a single package. However, an anomaly was identified in the controls of the demo model, and we are currently attempting to resolve this problem with the manufacturer.

Three samples of radome material were obtained and some testing was completed. Two Gore-Tex samples, one with a fabrication seam and a fiberglass based material, were mounted on frames and tested in front of the feeds of low-noise receivers at Green Bank. No absorption was measurable at 1.5 or 4.8 GHz from any of the samples. (Sensitivity was such that increase of noise temperatures as little as 0.1 K would have been seen.)

Progress continued on the active surface design. Life testing of prototype actuators was completed. Three of five of the vendors survived this test. One of each type of actuator was subsequently subjected to several other tests, including backlash and maximum load survival. All actuators had minor problems which are currently being addressed by the manufacturers. The accuracy and repeatability of the position transducers (LVDT's) used in the active surface are critical in properly setting the surface under "open loop" conditions. During this quarter testing of various sample LVDT and associated cables and electronics continued. Development of a laser ranging instrument to measure the telescope's surface and pointing continues. Three instruments are under construction. The goal is to use the three together to locate points in three dimensions.

Autocollimators will be used on the GBT to measure and correct for pointing errors introduced by the foundation, track, and alidade structure. Initial tests of an autocollimator in an outdoor range were performed during the quarter. Time variability and its spectrum were measured. Best results were on the order of 1 arcsec rms. However, several

measurements were considerably worse. Work is presently underway to construct a long tube in which the laser beam will travel. This should improve the variability.

A holographic technique will be used to measure the surface accuracy of the GBT. During this quarter, a high speed A/D board was prototyped.

Interferometer Upgrade

The USNO is funding the upgrade of the Interferometer to improve their time-keeping capabilities. As part of this upgrade, the three antennas have been outfitted with cooled S/X receivers. Receivers for 327 MHz and 610 MHz have been added to the 85-3 antenna. The 85-3 telescope is operated as a VLBI terminal in conjunction with other USNO antennas and as a single dish pulsar timing antenna. The 85-1 and 85-2 antennas are operated as a connected interferometer to continue a long-term flux monitoring program. Another aspect of the upgrade is the provision of a data acquisition terminal for the VLBI data. This terminal will consist of a VLBA data acquisition rack, longitudinal recorder, and control computer. Also, NRAO is presently constructing a second VLBA terminal and an S/X receiver for a USNO VLBI antenna in Hawaii which is to be used in conjunction with the 85-3 antenna.

During this quarter, the VLBA data acquisition rack went into routine production. Construction of baseband converters for the second VLBA data acquisition rack continued. Construction of the S/X receiver continued.

140-Foot Cassegrain Receivers

The current 140-Foot cassegrain receiver systems use parametric upconverters and 18-25 GHz masers to cover the 5-25 GHz frequency range. A project is underway to replace the upconverters with HEMT amplifiers and to also extend the frequency range to greater than 30 GHz. The masers will be retained because of their significantly superior noise performance over current HEMT technology.

During this quarter testing of components for the second LO system continued.

Miscellaneous

The third VLBA 43 GHz receiver was shipped and the fourth is assembled and being tested. A fifth unit is under construction.

J. 12-METER ELECTRONICS

Receiver Status

During this quarter the new 90-115 GHz SIS receiver was tested on the telescope. The performance was satisfactory, but the tests revealed several minor problems that are presently being resolved. The 68-90 GHz inserts will be added to this receiver in the next few weeks, and further telescope tests will be conducted.

Work on the 130-170 GHz inserts is progressing, and we hope to add these to the receiver in the next two months.

Work on the 8-beam, 230 GHz SIS receiver continues, but progress is slow due to the effort being expended on the 68-115 GHz receiver.

Design work has started on a quasi-optical image dropping system for our 200-270 GHz SIS receiver. We hope to have this installed in time for the high-frequency observing season.

K. VLA ELECTRONICS

Improvements in Antenna Pointing

Antenna pointing errors degrade the performance of synthesis telescopes at both low and high frequencies. At low frequencies strong background sources are randomly located in the primary beam and pointing errors then limit the achievable dynamic range.

At high frequencies the pointing errors become a significant fraction of the primary beamwidth so the source being imaged is affected directly. For example, at 44 GHz a 20" pointing error causes a 30 percent change in amplitude. Solar-induced tilts, which used to dominate our pointing errors, have been greatly reduced through external insulation of the antenna yoke and base support.

Pointing problems such as an antenna tilt caused by constant wind force, may be corrected in the future by an active correction scheme utilizing electronic tilt-meters mounted on the antenna structure. Testing of the stability of the redesigned tilt-meter units show a long-term stability of about 3 arcseconds. Eight have been fabricated and tested. Two VLA antennas have been outfitted with two sets of tilt-meters on each antenna. In order to provide more information about these antennas, 32 temperature probes have been installed at various locations on these antennas by the last quarter of this year. Further system testing will continue through 1991.

RFI Improvements

The sensitivity of the 327 MHz and 75 MHz systems will be limited partly by radio-frequency interference locally generated at each antenna. Modifications to various modules to reduce this interference and increase the instantaneous usable bandwidth were investigated. A modification to allow the monitor and control system to free run eliminated most of the coherent RFI between antennas. However, the remainder still limits use of the 327 MHz system, so enclosing the radiating components with RFI shields is necessary.

Four RFI enclosures for the vertex mounted "B" racks have been purchased and tested. These RFI enclosures eliminate the remaining antenna-generated interference at 327 MHz. There is still some locally generated RFI noticeable at 75 MHz. The remaining twenty-four RFI enclosures have not been procured due to an increase in cost by a factor of two. An in-house design for a new RFI enclosure is complete. Construction of a prototype was completed in the third quarter of last year, and lab testing of this enclosure is complete. The unit has been installed on an antenna and system testing is under way. Three more units were ordered and received, with all remaining units installed this quarter for a total of eight enclosures. The remaining enclosures will be constructed and installed as funding permits.

1.3-1.7 GHz T_{sys} Improvements

HI imaging is the most important class of spectral line project at the VLA. The observation of HI in emission (either galactic of extragalactic)is almost always sensitivity limited, either because the HI has to be followed to the faint outermost regions of galaxies or because more angular or frequency resolutions are desirable.

The VLA 18-21 cm wavelength receiver currently has system temperatures of approximately 60 K. A significant fraction of this system temperature results from the need to locate all front-ends in the same cryogenic dewar. This results in polarization splitters from being cooled.

For example, using cryogenically cooled HEMT amplifiers on the fully optimized VLBA antennas, the measured system noise temperature is 30 K at 18-21 cm. Although some effects, such as subreflector diffraction, will prevent VLA noise temperatures from ever being quite as low as these VLBA values, a VLBA front-end installed on a VLA antenna gave a system temperature of about 35 K.

Presently seven VLA antennas have the improved VLBA-style receiver installed. Three more of the new front-end systems are now in the assembly process. By the end of this year ten VLA antennas should have the improved VLBA style receivers.

L. AIPS

The NRAO hosted a meeting to discuss the directions of the new AIPS2 project in Charlottesville in June. In order to encourage cooperation with other observatories, participants from many national and international organizations were invited to the discussion. There was discussion on a wide range of topics, ending in a general consensus on the direction of the project. In particular, the programming language C++ was the language of choice.

The 15APR91 release of the current AIPS (AIPS1) was completed a little behind schedule. Since this will probably be the last major release of AIPS1 for a while, the AIPS group paid special attention to ironing out the most serious known bugs. However, shipments of the 15APR91 release to Unix sites began in June. The release is being made available over the Internet to sites who already have AIPS licenses. This release includes support for remote tape drives on systems with similar architecture. The AIPS TV's for workstations were also enhanced.

A new version of the AIPS dirty dozen test (DDT) suite is being developed. This will be useful in evaluating the performance of supercomputers, especially for the upcoming VLBA computer procurement. In addition, a DDT suite to test spectral line observations was developed. Testing and evaluation is still in progress.

Development of the tasks to read the data from the VLBA correlator into AIPS are progressing well. The specification for the new table format (which will be used to handle the data from the VLBA correlator) has been circulated to all interested parties. This format may be formally approved in the fall by the International Astronomical Union. The task to write these tables is complete; the task to read the tables into AIPS1 internal format should be complete next quarter.

M. VLA COMPUTER

Developments this quarter in the online area included the installation of TCP/IP networking software from Modcomp for the online systems. This will greatly simplify both logins and transferring files between the Modcomps and other computers at both the VLA and the AOC. In addition, planning has begun for the purchase of a Sun workstation at the VLA, which will be used as a development platform for near-real-time data visualization, utilizing the new communications with the Modcomps. A small team of programmers and scientists has been formed to design and produce this much-requested facility, which we anticipate will take nearly a year to implement. A partial system should be in use by early 1992.

Networking to the VLA telescope site has vastly improved with the addition of a new leased line and two router boxes to connect the AOC and the VLA. Together with the installation of the site Ethernet, this has allowed the computers at the VLA to become an official part of the Internet. As well as the Modcomps, the VAX 11/750, and two Macintosh computers used by the operators have been successfully connected.

In the AOC, a new two-gigabyte disk was installed on the general- purpose Solbourne server. This made available considerable space for serving AIPS executables to various workstation architectures, as well as doubling the amount of storage provided for the users. Early in the quarter, all VLA Sun workstations were upgraded to the latest release of the operating system, the last provided by Sun for the Sun 3 Motorola-based computers. The two Convex C1's were also updated. The Ingres relational database package has been ordered, primarily for developing a UNIX-based system for telescope and other maintenance records. In addition, the VLBA computing procurement process was begun with a formal Announcement of Opportunity in late May, and by the end of the quarter the initial Request for Comment was nearing completion.

N. VERY LONG BASELINE ARRAY

Antennas and Site Preparation

The Pie Town NM, Kitt Peak AZ, Los Alamos NM, and Fort Davis TX antennas are staffed to routinely support Network observations. The North Liberty IA and Owens Valley CA antennas are available for observations on a "best effort" basis. Outfitting of the Brewster WA antenna was completed during this quarter, and the site declared operable in June. Antenna erection at the Hancock NH site is scheduled for completion in July 1991. At St. Croix VI, reflector panels are being installed on the antenna, which is scheduled for September 1991 completion. At Mauna Kea HI, the antenna foundation and site preparation construction are well underway. Antenna erection at Mauna Kea is scheduled to start in August 1991. Extensive MkII and MkIII fringe testing of the operable VLBA antennas is underway to debug the various systems of the sub-array, with current emphasis on signal path, pointing, and timing stability.

Electronics

The prototype of the new-design front end to cover both the 15 GHz band and the methanol line at 12.178 GHz has been completed and is in final testing as the quarter ends. (Note that this unit is now being referred to as the 14 GHz front end since the frequency range extension results in a center frequency of 14 GHz.) It will be shipped to Socorro for installation on the antenna at Pie Town. A prototype of the converter module for this front-end has also been constructed and is under test. Because of the extended frequency range of this band, the converter module must now incorporate a series of switched filters to eliminate image responses in the frequency conversion.

The increased use of the array for astronomical observations as more antennas are brought into service is helping to reveal areas where further adjustments are required. For example, a modification of the parameters in one of the phase locked loops in the local oscillator system is being made as a result of observations during the quarter. These changes involve minor components only and do not affect the schedule of outfitting of antennas. Also, it has been decided to replace a series of analog switches on the A/D buffer board of the formatter by digital switches. In addition to improving the reliability, this redesign will release enough board space to accommodate circuitry for the extraction of the phase calibration signals injected at the front ends. The redesign of the board has been subcontracted to the Haystack Observatory team who originated the formatter design.

Electronics construction has now reached a point at which, for at least one-third of the various types of front ends and modules, all required units are complete. The number of each type of front end and module being constructed includes spares for maintenance as well as the units required at the antennas and in the laboratory test system. At least one extra front end for each frequency band and three modules of any given type are required for spares.

Data Recording

Final shipments from the second production run of recorder units was completed except for one acquisition and one playback unit held back for long-term testing at Haystack. Procurement of parts for the third production run, units Nos. 22-32, is mostly completed. Analysis, engineering, and performance tests on critical systems of the recorder unit continue at Haystack Observatory.

Monitor and Control

During the second quarter 1991 the on-line observing system has at last started acting like a real, unattended, process control system, and is no longer a major barrier in the way of accomplishing other objectives in the checkout of the VLBA.

We now have Internet communications to the Pie Town, Kitt Peak, North Liberty, Fort Davis, and Los Alamos antennas. Owens Valley is also reachable with the Internet, but is not yet fully communicating with the AOC's array control computer because of a peculiar and difficult routing problem, which is being worked on by consultants at cisco

Systems Inc. (the router manufacturer) and Fresno State (the host institution). The culprit is believed to be unusually complex protocol security features implemented by CSU Fresno.

A new pointing correction equation has been put into the antenna pointing routines. A program is available to use the databuffer in the VLBA formatter as a spectrum analyzer. An add-on feature of this program will write the data to disk, to serve as input to a real-time fringe search routine. We anticipate that the real-time fringe search software will be available soon after the second databuffer hardware is delivered.

Support for VLBA format tapes has been included in the formatter control software, but checkout is incomplete because of difficulties with the formatter firmware. A sustained effort has been mounted to improve the checker system by fine-tuning the checks to reduce the number of checker messages without serious content. We have started to work on an implementation of the screens package for Unix systems.

Correlator

Hardware construction shifted, as this quarter began, from a fabrication and checkout mode to a concentration on integration. Initial system tests in the one nearly complete rack, using modules previously checked out individually, revealed a variety of weaknesses in backplane control interconnections, primarily cases of excessive cross-talk which could be corrected through replacement by twisted pairs. All problems found in these initial system tests were resolved, and additional backplane wiring to the correlator control bus interfaces, the integrator, and the digital output filter was added. Data connections among bins were completed with the procurement of commercially fabricated cables. These actions brought the scheduled first phase of correlator integration to an end. The three remaining racks were cabled for power, clock, and control-signal distribution.

Software development was concentrated in two areas. Work resumed on the loading, scheduling, initialization and termination of correlator "jobs." In the course of this work, it became necessary to review and revise several of the tasks completed previously, particularly the tape task and the task-support utilities. Secondly, coding started on a new "array task," which supervises all the data manipulation at the backend of the correlator, from the short-term accumulators through the integrator and filter, and into the archive. An unusual joint development was started by the programming and engineering staff, intended to optimize the control protocols for efficient data flow.

Two new features became available for tests of existing code. The PBI firmware made it possible for the first time to operate the playback drives in a closed-loop mode; previous tests of the tape-control tasks had been limited to dead reckoning. And more generally, a hardware generated interrupt allowed coordinated tests of software tasks with their associated hardware components. The software oscillator used in earlier tests was retained, however, because it facilitates parallel development work and is specifically useful in evaluating performance margins.

The correlator software team visited Haystack Observatory. Among the objectives of the trip were: to expose the three members without observational VLBI experience to an operational correlator environment; to discuss the interfaces from the correlator's real-time control system to the playback-drive controller provided by Haystack; and to study the bar code readers under evaluation for use in automatic tape reel identification.

Playback drives Nos. 3 and 4 were received from Haystack. Both units included full complements of the specialized playback modules, but had to be delivered without VME Monitor modules, for which production has been suspended pending redesign. One such module was borrowed from the second recorder at the Kitt Peak station, and another can be obtained similarly when necessary. Inadequate power distribution in the first two playback drives was upgraded. A malfunctioning headstack assembly was returned to Haystack for evaluation and repair.

Data Processing

After the preliminary definition of the VLBA archive and distribution format on a Digital Audio Tape drive (DAT), we developed the software to read and write this format in AIPS. This VLBA format reader is still not as sophisticated as we would like, but if presented with a tape from the VLBA correlator tomorrow we could read it.

There has been some progress in the development of the polarization calibration software for VLBI datasets. A complete system now exists, although it is, as yet, cumbersome to use. However images of the polarized emission from radio sources have been produced. We hope to streamline the process over the next few months.

O. PERSONNEL

New Hires

Haynes, M. P.	Visiting Scientist	06/01/91

Promotions

Milner, M. R.	Head VLA Computer Division	06/04/91

PREPRINTS RECEIVED, APRIL - JUNE 1991

AAQUIST, O.B.; KWOK, S. High Resolution Radio Continuum Observations of Compact Planetary Nebulae.

BIEGING, J.H.; WILNER, D.; THRONSON, H.A. JR The Molecular Envelope of NGC 7027.

BIETENHOLZ, M.F.; FRAIL, D.A.; HANKINS, T.H. Does thje Vela Pulsar Have "Wisps"?

CONDON, J.J.; BRODERICK, J.J. Radio Properties of Extragalactic IRAS Sources.

DE PATER, I. Radio Images of Jupiter's Synchrotron Radiation at 6, 20, and 90 cm.

FELLI, M.; MASSI, M. VLBI Observations of HD 193793.

FELLI, M.; MASSI, M.; CATARZI, M. Intercontinental VLBI Observations of Theta(1) Orionis A.

FERNINI, I.; LEAHY, J.P.; BURNS, J.O.; BASART, J.P. Depolarization Asymmetry in the Quasar 3C 47.

FINDLAY, J.W. History of Antenna Metrology.

FOMALONT, E.B.; GALDZAHLER, B.J. The Radio 'Lobes' of Scorpius X-1 Are Unrelated Background Sources.

FOMALONT, E.B.; WINDHORST, R.A.; KRISTIAN, J.A.; KELLERMANN, K.I. The Micro-Jansky Radio Source Population at 5-GHz.

FRAIL, D.A.; CORDES, J.M.; HANKINS, T.H.; WEISBERG, J.M. HI Absorption Measurements Toward 15 Pulsars and the Radial Distribution of Diffuse Ionized Gas in the Galaxy.

GOPALSWAMY, N.; WHITE, S.M.; KUNDU, M.R. Large Scale Features of the Sun at 20 cm Wavelength.

HANKINS, T.H.; IZVEKOVA, V.A.; MALOFEEV, V.M.; RANKIN, J.H.; ET AL Microstructure-Determined Pulsar Dispersion Measures and the Problem of Profile Alignment.

HAYNES, M.P.; GIOVANELLI, R. The Distribution of Galaxies Around NGC 5846.

HAYNES, M.P.; GIOVANELLI, R. Neutral Hydrogen Observations of Galaxies in Superclusters.

INAGAKI, S.; ITOH, M.; SASLAW, W.C. Gravitational Clustering of Galaxies: Comparison Between Thermodynamic Theory and N-body Simulations. III. Velocity Distributions for Different Mass Components.

KIRCHBAUM, T.P.; QUIRRENBACH, A.; WITZEL, A. Intraday Variability of Compact Extragalactic Radio Sources.

KRICHBAUM, T.P.; WITZEL, A. Structural Variability of Active Galactic Nuclei at 43 GHz.

LEAHY, J.P.; PERLEY, R.A. VLA Images of 23 Extragalactic Radio Sources.

LEOUS, J.A.; FEIGELSON, E.D.; ANDRE, P.; MONTMERLE, T. A Rich Cluster of Radio Stars in the rho Ophiuchi Cloud Cores.

LINDQVIST, M.; WINNBERG, A.; HABING, H.J.; MATTHEWS, H.E. OH/IR Stars Close to the Galactic Centre I. Observational Data.

LORD, S.D.; KENNEY, J.D.P. A Molecular Gas Ridge Offset from the Dust Lane in a Spiral Arm of M83.

MANGUM, J.G.; WOOTTEN, A.; MUNDY, L.G. Synthesis Imaging of the DR21(OH) Cluster. I. Dust Continuum and C18O Emission.

NAN RENDONG; SCHILIZZI, R.T.; FANTI, C.; FANTI, R. VLBI Observations of 24 3CR CSS Radio Sources at 50 cm.

OKUMURA, K.; ISHIGURO, M.; FOMALONT, E.B.; HASEGAWA, T.; ET AL A Finger-Like Extension of the 20 km S-1 CLoud Toward the Galactic Center.

PADRIELLI, L.; EASTMAN, W.; GREGORINI, L.; MANTOVANI, F.; SPANGLER, S. VLBI Structures of Low Frequency Variable Sources at 608 MHz.

ROELFSEMA, P.R.; GOSS, W.M.; POTTASCH, S.R.; ZIJLSTRA, A. Radio Recombination Line Observations of the Planetary Nebula NGC 7027.

ROWAN-ROBINSON, M.; BROADHURST, T.; LAWRENCE, A.; MCMAHON, R.G.; ET AL Discovery of an IRAS Galaxy at z = 2.286 of Phenomenal Luminosity: Hidden Quasar of Protogalaxy?

SAGE, L.J.; MAUERSBERGER, R.; HENKEL, C. Extragalactic 18O/17O Ratios and Star Formation: High Mass Stars Preferred in Starburst Systems?

PREPRINTS RECEIVED, APRIL - JUNE 1991

SAHAI, R.; WOOTTEN, A.; SCHWARZ, H.E.; CLEGG, R.E.S. The Bipolar Planetary Nebula IC 4406 - CO, Optical, and Dust Emission.

SAKURAI, T.; SPANGLER, S.R.; ARMSTRONG, J.W. VLBI Measurements of Plasma Turbulence in the Solar Wind.

SASLAW, W.C.; CRANE, P. The Scale Dependence of Galaxy Distribution Functions.

SEAQUIST, E.R. A Lower Limit on the Distance to the Young Planetary Nebula Vy 2-2 by Expansion Parallax.

SEAQUIST, E.R.; ODEGARD, N. A Synchrotron Halo Around M82.

SOPP, H.M.; ALEXANDER, P. The Radio Structure of Ultraluminous IRAS Galaxies.

STACEY, G.J.; GEIS, N.; GENZEL, R.; LUGTEN, J.B.; ET AL The 158 Micron [C II] Line: A Measure of Global Star Formation Activity in Galaxies.

TAN, J.; LEWIN, W.H.G.; HJELLMING, R.M.; PENNINX, W.; ET AL Simultaneous X-ray and Radio Observations of GX 5-1.

TAYLOR, A.R.; GREGORY, P.C.; DURIC, N.; TSUTSUMI, T. GT 2318+620, a Variable Galactic Source with a Radio Jet.

TURNER, B.E. Extraterrestrial SiN.

ULVESTAD, J.S. Phasing the Very Large Array on Galileo in the Presence of Jupiter's Strong Radio Emission.

ULVESTAD, J.S.; ANTONUCCI, R.J.R. Second-Epoch VLA Observations of Compact Radio Sources in NGC 253.

USON, J.M.; BAGRI, D.S.; CORNWELL, T.J. A Search for Redshifted Hydrogen from Protoclusters of Galaxies.

VAN DRIEL, W.; VAN DEN BROEK, A.C.; DE JONG, T. A Study of Southern Extreme IRAS Galaxies II. Radio Continuum Observations.

WELLS, D.C. Archiving at NRAO's VLA and VLBA Telescopes.

WILLSON, R.F.; SCHMELZ, J.T.; GONZALEZ, R.D.; LANG, K.R.; SMITH, K.L. Multi-Waveband SMM-VLA Observations of an M2 Flare and an Associated Coronal Mass Ejection.

WILSON, A.S.; HELFER, T.T.; HANIFF, C.A.; WARD, M.J. The Starburst Ring Around the Seyfert Nucleus in NGC 7469.

WILSON, T.L.; JOHNSTON, K.J.; MAUERSBERGER, R. The Internal Structure of Molecular Clouds: The W3(OH)/W3(H2O) Region.

WOOD, C.A.; MUFSON, S.L.; DICKEL, J.R. The Magnetic Structure of the Filaments in the Supernova Remnant IC 443.

ZHAO, J.-H.; GOSS, W.M.; LO, K.Y.; EKERS, R.D. Evidence for Intrinsic Activity of Sgr A* at the Galactic Center.

ZIURYS, L.M. SiS in Outflow Regions: More High Temperature Silicon Chemistry.