NATIONAL RADIO ASTRONOMY OBSERVATORY

Quarterly Report

July 1, 1989 - September 30, 1989

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A. TELESCOPE USAGE

The NRAO telescopes have been scheduled for research and maintenance in the following manner during the third quarter of 1989.

	140-ft	12-m	VLA
Scheduled observing (hrs)	1850.00	568.25	1704.3
Scheduled maintenance and equipment changes	165.00	23.75	248.1
Scheduled tests and calibrations	142.75	1263.25	225.7
Time lost	138.25	57.00	89.3
Actual observing	1711.75	511.25	1615.0

B. 140-FOOT OBSERVING PROGRAMS

The following continuum program was conducted during this quarter.

No.	Observer(s)	Program
C-255	Condon, J. Broderick, J. (VPI&SU) Seielstad, G.	Sky survey at 4.85 GHz covering $-45° <= \delta <= +5°$.

The following line programs were conducted during this quarter.

No.	Observer(s)	Program
C-256	Clark, F. (Kentucky) Mann, P. (Kentucky) LaHaise, W. (Kentucky)	Observations at 6 cm of formaldehyde in infrared objects.
H-263	Haynes, M. (Cornell) Giovanelli, R. (NAIC) Salzer, J. (NAIC) da Costa, L. (CNPq, Brazil) Mathewson, D. (Mt. Stromlo) Ford, V. (Mt. Stromlo) Savage, A. (Schmidt, UK) Lynch, T. (Cornell) Ogle, P. (Harvey Mudd) Sakai, S. (Cornell)	Observations of HI in Sc Galaxies.
K-321	Kassim, N. (NRL) Magnani, L. (Arecibo) Anantharamaiah, K.	Survey near 220 MHz for hydrogen recombination lines in the inner galaxy.
M-288	Bally, J. (Bell Labs) Maddalena, R.	Observations of neutral HI toward selected areas of Orion and Monoceros.

No.	Observer(s)	Program
S-330	Schloerb, F. (Massachusetts) Tacconi-Garman, L. (NFRA)	OH observations of Comets P/Brorsen-Metcalf and C/Osaki-Levy-Rudenko.
T-272	Turner, B. Rickard, L. J (NRL) Xu, L. (Beijing)	Studies at 6 cm of H_2CO in Cirrus Clouds.

The following pulsar programs were conducted during this quarter.

No.	Observer(s)	Program
B-484	Backer, D. (Berkeley) Foster, R. (Berkeley) Taylor, J. (Princeton)	Timing observations at 1330 MHz of PSR 1821-24 and other millisecond pulsars.
B-523	Backer, D. (Berkeley) Fairhead, L. (Berkeley) Foster, R. (Berkeley) Holliman, J. (Berkeley)	Dispersion measures, spectra, and scintillation of millisecond pulsars at 10, 18, and 80 cm.
T-265	Taylor, J. (Princeton) Stinebring, D. (Princeton) Dewey, R. (JPL) Nice, D. (Princeton) Thorsett, S. (Princeton)	Pulsar timing observations over the ranges 110-250 and 390-500 MHz.

The following very long baseline programs were conducted, and the stations used for the observations are coded as follows:

A - Arecibo 1000 ft
B - Effelsburg, MPIR 100 m
F - Fort Davis 85 ft
G - Green Bank 140 ft
H - Hat Creek 26 m
I - Iowa 60 ft
Jb - Jodrell Bank MK II 25 m
Km - Haystack 120 ft
Kp - Kitt Peak 25 m
N - NRL Maryland Pt. 85 ft
No - Noto, Sicily
O - Owens Valley 130 ft
Pt - Pie Town 25m
R - Crimea, USSR 30 m
So - Onsala 25 m
X - Itapetinga 20 m
Yn - Socorro n=1-27x25 m

No.	Observer(s)	Program
A-23V	Alberdi, A. (MPIR) Marcaide, J. (Astrofisica, Spain) Marscher, A. (Boston) Shaffer, D. (Interferometrics)	Evolutionary studies at 1.3 cm of the superluminal quasar 4C 39.25, with telescopes B, So, No, Km, G, N, O, Y_{27}, and Pt.

No.	Observer(s)	Program
A-25V	Akujor, C. (Nigeria) Porcas, R. (MPIR)	Investigation at 6 cm of optically quiet quasars, with telescopes B, So, Wn, Jb, R, Km, G, F, O, and Y_1.
B-94V	Barthel, P. (Groningen) de Bruyn, A. (NFRA) Schilizzi, R. (NFRA) O'Dea, C. (NRFA) Wieringa, M. (Leiden)	Studies at 6 cm of the cores in giant core-dominated quasars, with telescopes B, Wn, Jb, So, Km, G, H, I, O, F, and Y_{27}.
C-52V	Corey, B. (MIT) Elosegui, P. (Astrofisica, Spain) Falco, E. (CFA) Gorenstein, M. (Millipore Corp.) Rogers, A. (MIT) Shapiro, I. (MIT) Campbell, R. (Harvard)	Observations at 6 cm to determine the time delay for gravitational images of 0957+561, with telescopes B, Wn, Km, G, O, and Y_{27}.
C-54V	Conway, J. (Caltech) Unwin, S. (Caltech) Pearson, T. (Caltech) Readhead, A. (Caltech)	Observations at 6 cm of the compact double 0710+439, with telescopes B, So, Wn, Jb, Km, G, O, F, I, Y_{27}, Pt, and Kp.
C-55V	Conway, J. (Caltech) Readhead, A. (Caltech) Venturi, T. (Bologna) Marr, J. (Berkeley) Backer, D. (Berkeley) Wright, M. (Berkeley) Wrobel, J. (NMIMT) Phillips, R. (Haystack) Porcas, R. (MPIR) Baath, L. (Onsala) Mantovani, F. (Bologna)	Multi-epoch 1.3 cm observations of 3C 84 with telescopes B, So, No, Km, G, O, Y_1, Pt, and Kp.
F-22V	Fanti, C. (Bologna) Fanti, R. (Bologna) Peruj, A. (Bologna) Cotton, W. Schilizzi, R. (NFRA) Foley, A. (NFRA) Spencer, R. (Manchester)	Polarization studies at 6 cm of 3C 138, with telescopes B, Wn, Jb, So, Km, G, O, Y_{27}, and Pt.
G-60V	Giovannini, G. (Bologna) Wehrle, A. (Caltech) Comoretto, G. (Arcetri) Feretti, L. (Bologna) Venturi, T. (Bologna)	Observations at 6 cm of a sample of Fanaroff-Riley Type I radio galaxies, with telescopes at B, Jb, So, Wn, Km, G, F, O, Y_{27}, and Pt.

No.	Observer(s)	Program
H-48V	Hough, D. (JPL) Readhead, A. (Caltech)	Measurements of superluminal motion at 2.8 cm in weak nuclei of double-lobed quasars 3C 190, 3C 208, 3C 249.1, and 3C 247, with telescopes B, Km, G, O, and Pt.
H-52V	Hummel, C. (MPIR) Schalinski, C. (MPIR) Krichbaum, T. (MPIR) Quirrenbach, A. (MPIR) Witzel, A. (MPIR) Johnston, K. (NRL)	Attempt at 1.3 cm to determine whether S5-quasar 1928 + 73 is a black hole, with telescopes B, So, R, No, Km, G, O, N, Y_{27}, Pt, and Kp.
L-49V	Lestrade, J-F. (JPL) Boloh, R. (JPL) Mutel, R. (Iowa) Niell, A. (Haystack) Preston, R. (JPL)	Observations at 6 cm of 15 RS CVn binaries for mapping and astrometry, with telescopes B, G, O, and Y_{27}.
M-103V	Mutel, R. (Iowa) Spangler, S. (Iowa)	Measure at 2.8 cm the inner scale of interstellar turbulence, with telescopes B, No, Km, G, O, and F.
M-106V	Marscher, A. (Boston)	Contemporaneous 2.8 cm and X-ray observations of quasar NRAO 140, with telescopes B, No, Km, G, O, H, and F.
O-5V	O'Dea, C. (NRFA) Baum, S. (NFRA) Murphy, D. (JPL)	Observations at 6 cm of gigahertz peaked spectrum sources, with telescopes B, Wn, Jb, So, Km, G, O, F, Y_{27}, and Pt.
P-92V	Pauliny-Toth, I. (MPIR) Alberdi, A. (MPIR) Zensus, A. Cohen, M. (Caltech)	Monitor at 2.8 cm quasar 2134+004, with telescopes B, R, No, Km, G, F, O, H, Pt, and X.
P-94V	Pauliny-Toth, I. (MPIR) Alberdi, A. (MPIR) Zensus, A. Cohen, M. (Caltech)	Mapping at 1.3 cm of quasar 2134+004, with telescopes B, So, R, No, Km, G, O, Y_{27}, Pt, and Kp.
P-96V	Pauliny-Toth, I. (MPIR) Porcas, R. (MPIR) Zensus, A. Kellermann, K.	Observations at 2.8 cm of 3C 454.3, with telescopes B, R, No, Km, G, O, H, Pt, Kp, and X.

No.	Observer(s)	Program
Q-3V	Quirrenbach, A. (MPIR) Witzel, A. (MPIR) Krichbaum, T. (MPIR) Hummel, C. (MPIR)	Observations at 6 cm of the rapidly varying pulsar 0917+624, with telescopes B, So, Wn, Km, G, O, H, F, N, Y_1, Pt, and PT.
S-83V	Schilizzi, R. (NFRA) Barthel, P. (Groningen) Miley, G. (Leiden)	Studies at 6 cm of the structure and evolution of the small-scale core morphology in 3C 236, with telescopes B, Wn, So, Jb, Km, G, O, Y_{27} and Pt.
S-84V	Sakurai, T. (Iowa) Spangler, S. (Iowa) Cairns, I. (Iowa) Mutel, R. (Iowa) Armstrong, J. (JPL)	Studies at 6 cm of the density turbulence in the outer corona and solar wind, with telescopes Km, G, N, I, F, O, H, and Y_{27}.
S-85V	Schalinski, C. (MPIR) Witzel, A. (MPIR) Hummel, C. (MPIR) Krichbaum, T. (MPIR) Quirrenbach, A. (MPIR) Alberdi, A. (MPIR) Johnston, K. (NRL)	Observations at 6 cm of the superluminal quasar 1928+73, with telescopes B, So, Wn, Jb, R, Km, G, H, I, F, O, Pt, and Kp.
W-52V	Wehrle, A. (Caltech) Unwin, S. (Caltech) Cohen, M. (Caltech)	Monitor of the superluminal motion in 3C 345 at 1.3 cm, with telescopes B, So, No, Km, G, O, Y_1, N, and Pt.
Z-19V	Zensus, A.	Observations at 1.3 cm of the quasar 3C 273, with telescopes B, So, No, Km, G, N, O, and Pt.

C. 12-METER TELESCOPE OBSERVING PROGRAMS

The following line programs were conducted during this quarter.

No.	Observer(s)	Program
A-92	Avery, L. (Herzberg) Vallee, J. (Herzberg) Koempe, C. (Herzberg)	Search for dense molecular disks associated with three bipolar outflows.
B-520	Balonek, T. (Colgate) Robson, E. (Lancashire Polytech) Hughes, D. (Lancashire Polytech)	Simultaneous millimeter-submillimeter-infrared-optical spectra of a small sample of Blazars to test specific relativistic jet emission models.

No.	Observer(s)	Program
B-527	Blitz, L. (Maryland) Gir, B. (Maryland) Hobbs, L. (Chicago) Welty, V. (Chicago)	Study of stars toward high latitude clouds and the nature of infrared excess clouds.
D-165	Dent, W. (Massachusetts) Balonek, T. (Colgate)	Study of the evolution of extragalactic radio sources at millimeter wavelengths.
I-13	Israel, F. (Leiden) Tacconi-Garman, L. (NFRA)	A CO (J=1-0) survey of dwarf galaxies.
I-14	Israel, F. (Leiden)	CO observations of molecular globules near the unique nebula S157.
L-237	Li, G. (Toronto) Seaquist, E. (Toronto)	CO J=1-0 observations of elliptical galaxies.
S-234	Sage, L. (NMIMT)	A fully-sampled CO J=1-0 map of NGC 5195.
V-69	Verter, F. (GSFC) Rickard, L. J (NRL) Verschuur, G. (Unaffiliated) Leisawitz, D. (GSFC)	Study of CO emission associated with high-latitude cloud complex MBM 15.
W-267	Walker, C. (Arizona) Martin, R. (Arizona) Carlstrom, J. (Berkeley)	A proposal to study the extended CS emission in infrared luminous galaxies.

D. VLA OBSERVING PROGRAMS

Third quarter 1989 was spent in the following configuration: BC configuration from July 01 to September 30, and the following research programs were conducted with the VLA.

No.	Observer(s)	Program
AA-91	Appleton, P. (Iowa State) Joseph, R. (Imperial College)	Mapping the HI in infrared active/inactive pairs. 20 cm line.
AA-101	Aschwanden, M. (Colorado) Benz, A. (ETH) Bastian, T. Dennis, B. (GSFC)	Decimetric solar radio bursts: Coordinated with the Zurich microwave spectrometer. 18 and 20 cm.
AA-103	Andernach, H. (INPE)	3C 40 and NGC 7385. 90 cm.

No.	Observer(s)	Program
AB-414	Becker, R. (Calif., Davis) White, R. (STScI)	Monitoring HD193793 and P Cygni. 2 and 6 cm.
AB-456	Burke, B. (MIT) Hewitt, J. (Haystack) Roberts, D. (Brandeis)	Monitoring 0957+561. 6 cm.
AB-525	Braun, R. (NFRA) van Gorkom, J. (NRAO & Columbia) Walterbos, R. (Berkeley) Kennicutt, R. (Steward) Norman, C. (STScI)	The interstellar media of nearby galaxies. 20 cm line.
AB-532	Bridle, A. Fomalont, E.	Polarimetry of lobes of 3C 288. 2 and 3.5 cm.
AB-534	Baum, S. (NFRA) Leahy, P. Perley, R. Riley, J. (MRAO) Scheuer, P. (MRAO)	A survey of nearby hotspots. 3.5 cm.
AB-536	Bosma, A. (Marsielle) Anthanassoula, E. (Marsielle)	Flaring HI disks. 20 cm line.
AB-540	Birkinshaw, M. (Harvard) Davies, R. (Oxford)	Elliptical galaxies. 6 cm.
AB-548	Briggs, F. (Pittsburgh) Garwood, R. (Pittsburgh) Wolfe, A. (Pittsburgh)	HI absorption at z~3 in PKS 0336-017. 90 cm line.
AB-550	Baum, S. (NFRA) O'Dea, C. (NFRA)	A search for extended emission around gigahertz-peaked spectrum radio sources. 6 and 20 cm.
AB-551	Berkhuijsen, E. (MPIR) Beck, R. (MPIR) Hummel, E. (NRAL)	Structure of the magnetic field in the central region of M31. 6, 20, and 90 cm.
AC-230	Cummins, N. (Maine) Owen, F.	3C 442 (NGC 7236/7237/Anon). 90 cm.
AC-231	Claussen, M. (NRL) Gaume, R. (NRL) Johnston, K. (NRL) Wilson, T. (MPIR)	The W3 (continuum) star-forming region. 1.3, 2, 6, and 18 cm.

No.	Observer(s)	Program
AC-246	Carilli, C. van Gorkom, J. (NRAO & Columbia) Stocke, J. (Colorado)	The quasar-galaxy pair, 3C 232, NGC 3067. 6 and 20 cm.
AC-251	Curiel, S. (CFA) Raymond, J. (CFA) Rodriguez, L. (UNAM) Canto, J. (UNAM)	Spectral index of radio sources associated with molecular outflows. 2 and 6 cm.
AC-252	Carignan, C. (Montreal)	HI studies of gas-rich dwarf irregulars. 20 cm line.
AC-253	Carilli, C. van Gorkom, J. (NRAO & Columbia) Stocke, J. (Colorado)	Deep HI imaging of the quasar galaxy pair 3C 232-NGC 3067. 20 cm line.
AC-254	Cordova, F. (Penn State) Hjellming, R.	Serendipitous X-ray source E0458+65. 2, 3.6, 6, and 20 cm.
AC-255	Cool, A. (Harvard) Ho, P. (Harvard)	NH_3 condensations in the Orion KL nebula. 1.3 cm line.
AC-257	Corbelli, E. (Cornell) Schneider, S. (Massachusetts)	HI in the outer disks of galaxies. 20 cm line.
AD-188	Drake, S. (SASC) Simon, T. (Hawaii) Florkowski, D. (USNO) Stencel, R. (Colorado) Bookbinder, J. (CFA) Linsky, J. (Colorado)	Monitoring M Supergiant Alpha Ori. 2 and 6 cm.
AD-236	Dickel, J. (Illinois) Williamson, C. (Illinois) Mufson, S. (Indiana)	Magnetic field orientation in SNR IC 443. 6 cm.
AD-237	Drake, S. (SASC) Simon, T. (Hawaii)	Survey of the open cluster NGC 2264. 3.5 and 6 cm.
AE-58	Edelson, R. (Colorado)	CFA Seyfert galaxies. 90 cm.
AE-61	Eilek, J. (NMIMT) Owen, F. Leahy, P.	Abell clusters without cooling cores. 3.5 and 6 cm.
AF-156	Fich, M. (Waterloo) Taylor, A. (Manchester)	A complete survey in the galactic plane. 6 and 20 cm.

No.	Observer(s)	Program
AF-167	Frail, D. (Toronto) Seaquist, E. (Toronto) Bode, M. (Lancashire Polytech) Roberts, J. (Lancashire Polytech)	Nova remnant GK Persei. 6 and 20 cm.
AF-180	Fey, A. (Iowa) Spangler, S. (Iowa)	Enhanced interstellar scattering due to HII regions. 6 and 20 cm.
AF-182	Fruchter, A. (Carnegie) Goss, W. M. Stinebring, D. (Princeton) Taylor, J. (Princeton)	Eclipsing millisecond pulsar. 90 cm.
AG-269	Ge, J. (NMIMT) Owen, F.	High Faraday rotation in cooling flow clusters. 3.6, 6, and 20 cm.
AG-275	Gottesman, S. (Florida) Hunter, J. (Florida) Mahon, M. (Florida)	Peculiar spindle galaxy NGC 2685. 21 cm line.
AG-288	Gussie, G. (Calgary) Taylor, A. (Calgary)	Survey of circumnebular neutral hydrogen absorption in planetary nebulae. 20 cm line.
AG-289	Ge, J. (NMIMT) Owen, F. O'Dea, C. (NFRA)	Survey of Abell distance class 4. 20 cm.
AG-290	Goss, W. M. Cowan, J. (Oklahoma) Ekers, R. (Australia Telescope) Sramek, R. Roberts, D.	A search for very young supernova remnants in our galaxy. 20 cm.
AG-294	Gregorini, L. (Bologna) Padrielli, L. (Bologna) Parma, P. (Bologna)	Radio galaxies of intermediate strength. 20 cm.
AH-295	Habing, H. (Leiden) Goss, W. M. Winnberg, A. (Onsala) van Langevelde, H. (Leiden)	Monitoring OH, IR stars at the galactic center. 18 cm line.
AH-301	Hjellming, R. Gehrz, R. (Minnesota) Taylor, A. (Calgary) Seaquist, E. (Toronto)	Monitoring radio novae. 1.3, 2, 3.6, 6, and 20 cm.

No.	Observer(s)	Program
AH-343	Holmes, G. (NRAL) Garrington, S. (NRAL) Saikia, D. (NRAL) Conway, R. (NRAL)	Low and intermediate luminosity (FR1) radio sources. 6, 18, and 21 cm.
AH-350	Hjellming, R. Cordova, F. (Penn State)	HI absorption study of the Gem-Mon remnants. 21 cm line.
AH-352	Hoffman, G. (Lafayette College) Salpeter, E. (Cornell) Wakamatsu, K. (Gifu)	Giant arc around IC 1209. 20 cm.
AH-353	Hurt, R. (UCLA) Turner, J. (UCLA)	Maffei 2.2, 6, and 20 cm line.
AH-354	Hurford, G. (Caltech) Gary, D. (Caltech)	Optically thin solar burst sources. 1.3 and 2 cm.
AH-355	Hewitt, J. (Princeton) Cappallo, R. (Haystack) Corey, B. (Haystack) Lonsdale, C. (Haystack) Niell, A. (Haystack) Phillips, R. (Haystack) Lestrade, J. (JPL) Preston, R. (JPL)	VLBI reference sources near dMe stars. 3.5 and 20 cm.
AH-358	Hunter, D. (Lowell) Gallagher, J. (Lowell) van Woerden, H. (Kapteyn)	The spatial distribution of HI in amorphous irregular galaxies. 20 cm line.
AH-359	Hunter, D. (Lowell) Gallagher, J. (Lowell) van Woerden, H. (Kapteyn)	Star formation and HI in irregular galaxies. 20 cm line.
AH-361	Hughes, V. (Queen's) MacLeod, G. (Queen's) Moriarty-Schieven, G. (Queen's)	New HII regions. 6 cm.
AH-362	Hines, D. (Texas) Wills, B. (Texas)	IRAS quasars radio structure and optical polarization. 6 cm.
AH-364	Hunt, G. Patnaik, A. (NRAL) Salter, C. (TIFR) Shaver, P. (ESO)	High surface brightness SNRs and SNRs with "blow-outs." 90 cm.
AH-366	Hjellming, R. Han, X. (NMIMT)	X-ray nova V404 Cyg: Monitoring Cyg X-3. 3.5, 6, and 20 cm.

No.	Observer(s)	Program
AH-383	Hjellming, R.	Recurrent nova V745 Sco. 3.6, 6, and 20 cm.
AI-38	Irwin, J. (Herzberg)	NGC 4775/4 system. 20 cm line.
AJ-177	Johnston, K. (NRL) Gaume, R. (NRL) Walmsley, C. (MPIR) Wilson, T. (MPIR) Henkel, C. (MPIR)	The "PIG" in Orion. 1.3 cm line.
AJ-179	Johnston, K. (NRL) Webster, W. (NASA) Seidelman, P. (USNO) Altenhoff, W. (MPIR)	Spectra of minor planets. 1.3, 2, and 3.5 cm.
AK-225	Klein, U. (Bonn) Reuter, U. (MPIR) Wielebinski, R. (MPIR) Kronberg, P. (Toronto) Lesch, H. (Heidelberg)	Tracing the magnetic field in M82. 2, 6, 20 and 90 cm.
AK-228	Kenney, J. (Caltech) Wang, Z. (Caltech)	The HI distributions in three HI-rich low-mass spirals. 20 cm line.
AK-229	Kenney, J. (Caltech)	The CO and HI morphology of the barred spiral galaxy NGC 7479. 20 cm line.
AK-230	Katz, N. (Princeton) Wallington, S. (Princeton) Gunn, J. (Princeton) Knapp, G. (Princeton) van Gorkom, J. (NRAO & Columbia)	Elliptical galaxy NGC 855. 6 and 20 cm line.
AK-231	Keto, E. (Livermore Labs) Klein, R. (Berkeley) Bertoldi, F. (Berkeley)	Massive star-forming regions. 3.5 and 20 cm line.
AK-232	Kormendy, J. (Hawaii) Westpfahl, D. (NMIMT) Fisher, J. R. van Gorkom, J. (NRAO & Columbia)	Dark matter in late-type dwarf galaxies. 20 cm line.
AK-238	Kulkarni, S. (Caltech) Goss, W. M.	ZZ Ceti variable G29-38. 20 cm.
AL-150	Lestrade, J. (JPL) Preston, R. (JPL)	Statistical properties of RSCVn stars. 6 cm.

No.	Observer(s)	Program
AL-174	Lawrence, C. (Caltech) Davies, R. (Manchester) Lasenby, A. (Cambridge) Myers, S. (Caltech) Readhead, A. (Caltech)	MWB fields. 3.5 cm.
AL-200	Leahy, P. Muxlow, T. (NRAL)	Spectral mapping of classical radio sources. 2 and 3.6 cm.
AL-202	Lewin, W. (MIT) Tan, J. (MIT) Hjellming, R. Mitsuda, K. (ISAS) Penninx, W. (Amsterdam) van Paradijs, J. (Amsterdam)	Low mass X-ray binary GX5-1. 3.6, 6, and 20 cm.
AL-205	Leous, J. (Penn State) Feigelson, E. (Penn State) Montmerle, T. (Saclay) Myers, P. (CFA)	Young stars near molecular cores in Taurus. 6 and 20 cm.
AL-210	Lewin, W. (MIT) Tan, J. (MIT) Hjellming, R. Mitsuda, K. (ISAS) Penninx, W. (Amsterdam) van Paridijs, J. (Amsterdam)	Low-mass X-ray binary GX13+1. 3.6, 6, and 20 cm.
AL-211	Linsky, J. (Colorado) Brown, A. (Colorado) Doyle, J. (Armagh Observatory) Neff, J. (GSFC)	RS CVn System II Pegasi. 2, 6, and 20 cm.
AM-266	Mirabel, I. (Puerto Rico) Rodriguez, L. (UNAM) Reid, M. (CFA)	Anomalous OH emission in star-forming regions. 18 cm line.
AM-270	Morganti, R. (ESO) Fosbury, R. (ESO) Serego Alighieri, S. (ESO) Tadhunter, C. (ESO)	The radio structures of PKS 2 Jy radio sources. 6 cm.
AM-274	Mangum, J. (Virginia) Wootten, H. A.	Formaldehyde emission in Orion-KL. 6 cm line.
AM-275	McKinnon, M. (NMIMT) Hankins, T. (NMIMT)	Analysis of the pulse core component PSR0329+54. 3.5, 20, and 90 cm.

No.	Observer(s)	Program
AM-277	Masson, C. (CFA) Keene, J. (Caltech)	A search for high velocity ammonia (1,1) emission in L1551. 1.3 cm line.
AN-49	Norris, R. (Australia Telescope) Roy, A. (Sydney) Allen, D. (AAO) Sramek, R.	Extremely luminous but cool far-infrared galaxies. 3 and 18 cm.
AO-84	O'Dea, C. (NFRA) Baum, S. (NFRA)	Radio properties of giant galaxies in cooling flows at 327 MHz. 90 cm.
AO-89	Owen, F. Cummins, N. (Maine)	Radio sources in Zwicky clusters. 20 cm.
AP-164	Palmer, P. (Chicago) Yusef-Zadeh, F. (Northwestern) Goss, W. M. Lasenby, A. (Cambridge) Lasenby, J. (Cambridge)	Sgr B1/Sgr B2 complex of HII regions. 2, 6, and 20 cm.
AP-170	Perley, R. Taylor, G. Inoue, M. (Nobeyama) Kato, T. (Utsunomiya) Tabara, H. (Utsunomiya) Aizu, K. (Rikkyo)	Very large Faraday rotation in Hydra A. 3.5 cm.
AP-174	Partridge, R. B. (Haverford) Danese, L. (Padova)	Galaxies in the CFA deep redshift survey. 20 cm.
AP-176	Puche, D. (Montreal) Carignan, C. (Montreal) Goss, W. M.	HI studies of the M101 group galaxies. 20 cm line.
AP-177	Parma, P. (Bologna) de Ruiter, H. (Bologna) Fanti, R. (Bologna) Morganti, R. (Bologna)	Naked jets. 20 cm.
AP-178	Pauls, T. (NRL) Wilson, T. (MPIR) Johnston, K. (NRL) Gaume, R. (NRL)	Molecular cloud collapse and protostars in Orion-KL. 1.3 cm line.
AP-179	Palmer, P. (Chicago) de Pater, I. (Berkeley) Snyder, L. (Illinois)	Comet Brorsen-Metcalf. 3.5 and 6 cm line.

No.	Observer(s)	Program
AR-205	Reynolds, S. (NC State)	Young supernova remnants. 6, 20, and 90 cm.
AR-208	Rudnick, L. (Minnesota) Anderson, M. (Minnesota) Wang, Y. (Minnesota)	3C 33 North hot spot. 6 and 20 cm.
AR-209	Reipurth, B. (ESO) Rodriguez, L. (UNAM)	HH 80-81 spectral indices. 2, 3.5, 6, and 20 cm.
AS-333	Sramek, R. Weiler, K. (NRL) van der Hulst, J. (Westerbork) Panagia, N. (STScI)	Statistical properties of radio supernovae. 2, 6, and 20 cm.
AS-369	Shaw, M. (Manchester) Richter, O. (STScI) Sparke, L. (Wisconsin)	HI observations of warped spiral UGC 7170. 20 cm line.
AS-374	Scalise, E. (INPE) Rodriguez, L. (UNAM)	IRAS sources with detected H_2O maser emission. 2 and 6 cm.
AS-375	Strauss, M. (Berkeley) Partridge, R. B. (Haverford)	Radio flux and morphology of ultra-luminous IRAS galaxies. 6 and 20 cm.
AS-378	Seaquist, E. (Toronto) Taylor, A. (Calgary)	Survey of symbiotic stars at 8.4 GHz. 3.5 cm.
AS-379	Stanford, A. (Wisconsin) Code, A. (Wisconsin)	HI in colliding galaxies. 20 cm line.
AS-382	Schmelz, J. (Lockheed) Gonzalez, R.	Solar bursts. 3.5, 6 and 20 cm.
AS-384	Strom, R. (NFRA) van Paradijs, J. (Amsterdam) van der Klis, M. (Amsterdam)	Double radio sources associated with X-ray binaries. 1.3, 2, 3.6, and 6 cm.
AT-95	Terzian, V. (Cornell) Bignell, R. C. van Gorkom, J. (NRAO & Columbia) Phillips, T. (Cornell)	Angular expansion of planetary nebulae/Epoch II. 6 cm.
AU-35	Ulvestad, J. (JPL)	Thermal emission from Markarian 231. 2, 6 and 20 cm.
AV-165	Velusamy, T. (TIFR)	CTB 80. 90 cm.
AV-166	Velusamy, T. (TIFR)	G18.95-1.1. 6, 20, and 90 cm.

No.	Observer(s)	Program
AV-167	Vallee, J. (Royal Observatory) MacLeod, J. (Herzberg)	Study of the HII region S64=W40. 20 and 92 cm line.
AV-168	Vallee, J. (Royal Observatory) Avery, L. (Herzberg) Irwin, J. (Herzberg)	Ionized disks and jets associated with multi-lobed outflows. 2 cm.
AV-169	van Moorsel, G. (ESO) Zinnecker, H. (MPI, Garching) Johansson, L. (ESO)	Blue compact dwarf galaxies with broad HI profiles. 20 cm line.
AW-234	Williams, B. (Delaware) van Gorkom, J. (Columbia)	HI synthesis of compact groups of galaxies. 20 cm line.
AW-238	Wolter, A. (CFA) Gioia, I. (CFA) Maccacaro, T. (CFA) Stocke, J. (Colorado) Morris, S. (Mt. Wilson)	BL Lac objects. 2, 6, 20, and 90 cm.
AW-241	Willson, R. (Tufts) Lang, K. (Tufts)	UX Ari: a search for thermal plasma. 2, 3.8, 6, and 20 cm.
AY-24	Yusef-Zadeh, F. (Northwestern) Palmer, P. (Chicago)	Mosaic the Orion nebula. 2 and 6 cm.

E. SCIENTIFIC HIGHLIGHTS

Green Bank

OH Observations of Comet P/Brorsen-Metcalf *(Schloerb and Tacconi-Garman)*. Following major advances in understanding comets resulting from observations of Halley's Comet, investigators were excited to confirm the new models they had generated. Comet P/Brorsen-Metcalf offered a perfect opportunity, since it followed a trajectory with similar heliocentric and geocentric parameters to Halley's. A specific test was proposed to measure outflow velocity of OH as a function of gas production rate and heliocentric distance.

August 1989 observations easily detected OH, but September observations failed to detect any. The gas production rate had decreased by a factor three in about two weeks, in defiance of theoretical expectation. Models for comets therefore need revision.

Detection of Interstellar C_4D *(B. Turner)*. Deuterated molecules remain interesting for several reasons, high among which are their implications for interstellar ion-molecule chemistry. Recently five hyperfine transitions of C_4D were detected in TMC-1 at frequencies near 17.6 GHz with the 140-foot telescope, its two maser amplifiers, and a dichroic beam splitter. Peak line strengths were

only a few thousandths of a degree Kelvin, so their detection represented a considerable technical feat.

The abundance ratio C_4D/C_4H was only about one-twentieth of the ratio C_3HD/C_3H2 in the same source. This confirms theoretical expectations that the ratio decreases as the number of carbon atoms in the molecule increases, but in other respects poses severe challenges to astrochemistry.

Socorro

On 11 September 1989, the VLA was used in support of the launch of the Normal Incidence X-ray Telescope (NIXT; Leon Golub, principal investigator, SAO), to observe the sun at 20 cm. The successful launch of the NIXT provided X-ray images of the sun's corona with an angular resolution of roughly one second of arc, the best ever obtained. T. Bastian used the VLA approximately two hours after the NIXT launch to serendipitously observe a powerful flare near the center of the sun's disk at 20 cm. The radio images revealed the presence of extremely intense, compact, and highly circularly polarized components; one component was essentially 100 percent right-circularly polarized and reached a maximum brightness temperature in excess of 10^{10} K. The initiation of each component coincided with the rise to maximum of hard X-ray emission (26-430 keV) as measured by the Hard X-ray Burst Spectrometer aboard NASA's Solar Maximum Mission Satellite.

The characteristics of the observed microwave emission are indicative of coherent emission processes (e.g., cyclotron maser or plasma radiation). The importance of the VLA observation is that, for the first time, a coherent microwave source has been directly imaged. Together with the NIXT, SMM, and ground-based optical observations, the coherent emission mechanism responsible for the observed microwave emission and the coronal conditions which allowed it to operate may be identified with a high degree of confidence.

Tucson

Summer Shutdown: The emphasis of this summer's shutdown was correction of the telescope pointing and test of the new control system modules.

During the past observing season, the pointing accuracy of the telescope had steadily deteriorated. This summer careful inspection of the telescope structure revealed a number of flexing joints, which were then welded closed. These contributed to a hysteresis component in the flexure of the feed legs and, correspondingly, to pointing problems. A new, more precise, focus and rotation mount was installed at the prime focus.

Other pointing-related projects included further work on an optical pointing and guiding system, a testing of inclinometers as a potential method of sensing telescope tilts, a laser measurement system to sense abnormal motions of the apex of the feed legs, and an online weather system to determine the atmospheric refraction more accurately.

Some progress was made on the new telescope control system. The hardware and basic software for the new antenna tracking and servo system were completed.

F. 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.

G. CENTRAL DEVELOPMENT LABORATORY

Cooled HEMT Amplifier Development

Another four K-band HEMT amplifiers have been built this quarter. During the next quarter, we expect to complete the construction of additional amplifiers. During the period 1986-1989, almost 100 K-band amplifiers have been built. We expect to retrofit some of the early units with HEMT's during 1990. This will result in no K-band amplifier on the VLA with a T_{AV} greater than 80 K. Some of the latest amplifiers being used in the VLBA receivers have a T_{AV} less than 40 K.

A prototype of a 25-35 GHz amplifier for the Green Bank 140-foot telescope receiver has been built and tested. It exhibits a minimum noise temperature of 36 K at the band center and less than 50 K from 27 to 35 GHz. A similar version of the 40-45 GHz amplifier is about to be completed. Also, a prototype version of a wideband, 1-2 GHz amplifier has been built and tested. It exhibits a noise temperature of less than 5 K across the band with a minimum of 2.7 K in the band center. Both prototypes use soft substrate technology.

Assembly work on the last 12 (of a total of 91) of the Voyager-style 8.4 GHz amplifiers, two 8-18 GHz amplifiers, and two 25-35 GHz amplifiers is near completion.

The FARANT program has been supplemented with a program and subroutine to facilitate the data acquisition from the HP-8810B network analyzer.

Superconducting (SIS) Millimeter-Wave Mixer Development

Much effort this quarter has gone into making the six SIS receiver modules for the three-band receiver to be installed on the 12-meter telescope early next year. This receiver will cover 68-90, 90-115, and 200-260 GHz, with two polarizations in each band. Initial tests using Hypres junctions with integrated tuning structures gave overall receiver noise temperatures $19 \leq T_R \leq 30$ K DSB over most of the range 90-120 GHz. A similar receiver for 68-90 GHz gave $46 \leq T_R \leq 70$ K DSB, which we hope to improve. In the 230 GHz band, using the new receiver, we have obtained $120 \leq T_R \leq 200$ K DSB over 200-230 GHz--about 60 K higher than in our old laboratory test receiver. We believe this to be a result of the slightly elevated mixer temperature and higher than expected loss in the teflon IR filter. The receiver noise temperature increases rapidly with frequency above 230 GHz, and we are now investigating the cause of this.

Collaboration on SIS mixer development continues with UVa, IBM Watson Research Center, and the University of Illinois/UC Berkeley. We have also been approached by IRAM to explore the possibility of collaborating as they develop a niobium-

based process for fabricating SIS junctions. Collaboration is also being discussed with the Smithsonian Astrophysical Observatory to develop mixers for their submillimeter array.

During this quarter we have tested a total of 39 SIS mixers operating from 68-260 GHz.

Schottky Diode Millimeter-Wave Mixers and Multipliers

In support of the 12-meter telescope and millimeter-array site testing radiometers, we have built (or re-built) and tested a total of 16 Schottky mixers and multipliers in the 230, 300, and 345 GHz bands during this quarter.

Acousto-Optical Spectrometer Project

During this quarter, assembly of the electronics for control, integration, and readout of the spectrometer was completed. Tests showed that all circuits are performing as expected. The CCD scanning is properly synchronized to the integrator, and accurate sampling and digitizing of the CCD output has been verified. A small amount of firmware for the microcontroller has been written and debugged. This should be sufficient to allow initial testing of the complete spectrometer, which is expected to occur during the next quarter.

H. GREEN BANK ELECTRONICS

Interferometer Upgrade

The USNO is funding the upgrade of the Interferometer to improve their time keeping capabilities. A major part of this upgrade includes the design and construction of new cryogenic receivers for the Green Bank three-element interferometer. The 85-3 telescope is to be operated as a VLBI terminal in conjunction with other USNO antennas. The 85-1 and 85-2 antennas are to be 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.

The construction and testing of the second and third S/X receivers were completed during the quarter. Both receivers were installed on the antennas and tested. Fringes were obtained at both wavelengths and on both polarizations. Fringe stability was acceptable. The receiver backends are currently being repackaged into final form.

Construction of modules for the data acquisition terminal continues. The control computer was purchased during the quarter.

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, and the design and development of, the LO system continued. The level of effort on this project has been scaled down significantly due to manpower limitations.

Spectral Processor

The Spectral Processor is a high time resolution spectrometer capable of producing two 40 MHz spectra each 25.6 μs. A fair amount of flexibility, in terms of bandwidth, number of channels, and averaging time, is included to make the instrument useful for spectroscopy. It has special signal averaging capabilities built-in to facilitate its use as a pulsar back-end.

A subsystem consisting of two IF to video converters and half of the digital electronics has been in operation for several months. The remaining seven IF to video converters are in various stages of testing and construction. Digital cards for the second half of the system and for spares are all assembled and more than half have been tested.

Green Bank Telescope

A major project is underway to replace the collapsed 300-foot telescope with a state of the art 100-meter class telescope. The Green Bank electronics division is supplying expertise to the design effort in a few areas. Several configurations of optics for an offset geometry telescope are being defined and evaluated. Tests of atmospheric stability at various frequencies are being conducted. Options for realizing an active surface are being evaluated.

Seven-Feed, 5 GHz Receiver

The amplifiers on this receiver were recently upgraded to HEMT's. Subsequent tests at the 140-foot were satisfactory except for long-term stability of a few of the detected outputs. A significant effort is under way to isolate the causes of the instability. Also, common mode rejection of the detected power cables has been enhanced.

Miscellaneous

Construction of L-band VLBA receivers continues, with serial numbers 10 an 11 (the final two) nearing completion. Construction of the 2 to 16 GHz VLBA local oscillators continues. Of the twelve units that we undertook to build this year, six are built and tested, and the remaining six are built and still require some testing.

I. 12-METER ELECTRONICS

Development of the next generation SIS receivers continues. The new receivers will be self-contained, modular units. During this summer a 230 GHz module was built and tested. The initial tests gave a receiver temperature of 100 K (DSB) at 200 GHz and 135 K (DSB) at 230 GHz. Also constructed was a 4 K closed-cycle refrigerator and dewar suitable for telescope use. The initial cooling tests indicate that its performance will be satisfactory for the new receivers.

One improvement to the 12-meter telescope this summer was the installation of a centrally located hot load. Formerly, each receiver was equipped with its own hot load. The new hot load operates in conjunction with the central tertiary mirror near the telescope vertex. It will be used by all receivers and hopefully standardize temperature calibration as well as simplifying the operating receiver systems.

In addition the position of the central tertiary mirror has been automated. Now the operator can change the mirror's position to direct the incoming beam to any one of the receiver bays remotely, making the change procedure between receivers much faster.

J. 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 beam width, 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 use to dominate our pointing errors, have been greatly reduced through external insulation of the antenna yoke and base support.

An important pointing problem which is being investigated now is the occurrence of tilts of up to 20 arcsecs in the azimuth axis of a few antennas at certain azimuth angles. This effect is believed to be caused by deformations or perturbations in the azimuth bearings. This, and other problems such as an antenna tilt caused by constant wind force, could be corrected in the future by an active correction scheme utilizing electronic tilt-meters mounted on the antenna structure. Testing of the stability of two redesigned tilt-meter units showed that the temperature control of the tiltmeter meter unit is now adequate and the components for several more tilt-meter units were on order with fabrication completed during the second quarter of 1989. Further testing will continue into the fourth quarter of 1989.

75 MHz Array Development

The proposed array will provide a major, new observing capability by giving 20" resolution at a frequency where the current best resolutions are many arcminutes. This capability will enable useful observations of thousands of previously unresolved extragalactic, galactic, and solar system objects. Current capabilities at this frequency enable only total fluxes from the stronger objects, so the proposed array will be truly a ground-breaking instrument. In particular, the array will be especially useful in observing the extended steep-spectrum emission associated with extragalactic radio sources, galactic objects such as supernova remnants, and small-scale, time-variable emission from the Sun, Jupiter, and nearby stars.

The single, major obstacle to using such an array lies in the calibration of the data. It is felt that modern computers with self-calibration techniques provide the means to remove the strong phase perturbations introduced by the ionosphere. However, testing of these techniques at these low frequencies is required to better understand the type of algorithm needed. To do this, we wish to equip the current 25-meter antennas with simple dipole-type feeds. If modest efficiency results (anything more than 15 percent will be adequate), we should be able to collect sufficient data from the 25-meter antennas at this frequency for testing purposes. Note that if every 25-meter antenna had such a feed, the entire 3C and 4C catalog could be mapped at 75 MHz with the same resolution as the original 1400 MHz aperture synthesis catalog done at Cambridge. The cost of this outfitting is very modest.

Two new dipole feeds have been designed; one a crossed dipole type, the other a quad dipole type. The crossed dipole was chosen as the easiest to implement, and testing of this feed and its effect on other frequencies will continue into next quarter. With the new feed installed near the focus of the antenna, locally generated radio frequency interference became a significant problem (see RFI Improvements). Four antennas are equipped with the 75 MHz system. NRAO has an agreement with NRL for further outfitting. The first level of funding (for four more systems) has been received and components have been procured, and one more system has been installed.

VLA 327 MHz Receiver

This project has been completed. (See RFI improvements)

VLA 8-GHz Receivers

This project has been completed.

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 useable 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 prototype RFI enclosures for the vertex mounted "B" racks have been installed and tested. The remaining RFI enclosures have not been procured due to an increase in cost by a factor of two. These RFI enclosures eliminate the remaining antenna generated interference at 327 MHz. There is still some locally generated RFI noticeable at 75 MHz. A method to reduce this interference is being investigated. No progress has been made during this quarter.

1.3 cm Receiver Upgrade

This project has been completed.

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 or 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 feed 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 longer input waveguide runs than would usually be required and prevents the polarization splitters from being cooled. For example, using similar cryogenically cooled HEMT amplifiers as those used on the VLBA, it is predicted that the fully optimized receivers on the VLBA will have system noise temperatures of 29 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, it does seem worthwhile to investigate the possibility of replacing the VLA receivers with separate, optimized receivers. It is planned to use a VLBA front-end to test their performance for use on the VLA. Another worthwhile area of investigation would be a modification to the 18-21 cm feed to improve its spillover performance.

A VLBA front-end receiver dewar assembly has been received from the Green Bank Electronics Division. This dewar assembly along with a VLBA polarizer was installed on VLA Antenna 23. Satisfactory testing of this receiver was completed during the past year, resulting in a system temperature of about 35 K. Two more systems modifications of this type are scheduled this year.

High Time Resolution Processor

We have been planning for some time to instrument the VLA with a High Time Resolution Processor (HTRP). The system is planned for observations of the time varying phenomena like flare stars, pulsars, etc., and monitoring radio frequency interference (RFI). As an intermediate step a system has been designed that will utilize existing components such as the analog sum phase array outputs of the VLA,

and VLBI MK III IDF-Video converter system, used as tunable filters with selectable bandwidths. This would provide 14 pairs of RCP and LCP frequency signals from the phased array VLA. Total power detectors and cross multipliers are used to measure all four products with integration periods of 25 microseconds to 5 milliseconds. Prototypes of these circuits have been tested and components for the mass production are on order. The data acquisition system is a 64 channel multiplexer and a 12 bit analog to digital converter with maximum sampling rate of 100,000 samples/second, installed in a 386 based 20 MHz clock speed personal computer with 140 MB hard disk. The data acquisition system has been used to obtain 2-channel phased array VLA signals for developing software and understanding the system stability problems. Fabrication of the interfacing sub-system was started in the second quarter of this year, and is expected to be completed during the fourth quarter.

K. AIPS

We anticipate releasing the 15OCT89 version of AIPS as the first public distribution of the overhauled version of the software. We feel that improvements made during the last quarter makes this reasonable. Also, progress has been made on the user agreements which will be required with this release.

During the past quarter two programmers spent several months in Australia coordinating NRAO software with that of the Australia Telescope. The managment of the AIPS project was reorganized to provide better coordination with operations at the AOC. A deputy project manager has been appointed in Socorro who is responsible for managing AIPS operation and development in the AOC. We feel this will greatly improve the response to problems arising at the AOC.

Numerous problems were fixed with the calibration system. The capability to remove the effects of the ionospheric Faraday rotation from the data were added. A number of routines developed by the Australia Telescope group were put in the standard release of AIPS.

L. VLA COMPUTER

In preparation of the VLA on-line computer systems for the Voyager II fly-by of Neptune, the final item was the acceptance of the backup clock at the beginning of the quarter. The on-line software was frozen on June 8, as per the agreement with NASA for an unchanging operational environment during the fly-by. The next addition to the system is planned for October at the earliest. Although development has continued through the summer, much manpower was dedicated to the on-site support of the successful fly-by.

All peripherals for the new CONVEX C1-XP computer ("Yucca") have now been installed. All six tape drives procured for the use on the two CONVEXES are usable in principle, but unfortunately two of them have suffered teething problems; parts to be replaced under warranty are needed before they are truly operational. All image displays (three SUN workstations and three International Imaging Systems devices) for these computers are now in operation.

The DEC-10 has functioned perfectly since the maintenance contract was discontinued at the end of July. When this old workhorse is powered down for the last time, it will be the end of an era. This is planned for October 15. The Pipeline computers were finally removed from service at the end of August.

The observation preparation program (OBSERVE) is now usable, many bugs having been ironed out during the summer. A preliminary set of documentation has been written and distributed. A complete set of on-screen help text is also available. The program may be readily copied over the national networks by users who wish to run it on VAX computers at their home institution. A special export version is maintained for this purpose.

M. VERY LONG BASELINE ARRAY

Antennas and Site Preparation

The Los Alamos antenna observed "first light" on August 10, and first fringes with Pie Town and the VLA at 6 cm on September 10. It is expected to be declared operational for the Network in October. The Pie Town antenna participated in three 24-hour Crustal Dynamics observations during August and September. During the September 13-30 Network run, the Pie Town and Kitt Peak antennas participated in the 1.3 and 6 cm observations, and Pie Town in the 2.8 cm observations.

Factory fabrication of components for all ten antennas was completed in September. Electronic and mechanical outfitting is in progress at the Fort Davis, TX antenna. At the North Liberty site, the antenna contractor is in the final stages of test and alignment. Erection of the Owens Valley, CA antenna is scheduled to resume in November. Construction at this site had been suspended because contractor staff were required at the earlier antennas for the retrofitting of defective gearboxes. Antenna erection at the Brewster, WA site began in September. Site construction on St. Croix has begun but is suffering a legal delay. Also, delays due to the effects of the recent Hurricane Hugo are not known. At Hancock, NH site preparation is expected to start in October. Efforts to accelerate initiation of site preparation at the Mauna Kea, HI site are underway.

Electronics

Construction of electronics is progressing as planned and more than half of the racks and modules to be built this year are now complete. Of the four front ends for 1.5 GHz being made at Green Bank, two are complete and two are almost complete. The redesign of the 2.3 GHz front end to incorporate the layer CTI refrigerator (Model 350) is complete, and mechanical parts are under construction in the Green Bank machine shop. As the quarter ends, design drawings are being made for the 43 GHz front end, and the first such unit should be ready for testing early in 1990. Construction of front ends for 8.4 and 23 GHz is progressing in Charlottesville, with all parts for this year's build on hand. Rack set No. 5 was tested and shipped to Fort Davis in September, and has just been installed there. These racks included the first Data Acquisition Rack to be constructed by NRAO, to the design by Haystack Observatory. Testing and adjustment of the Baseband Converter modules for this rack has required more time than was initially

expected, but the pace of this work is increasing as more experience is gained. The performance of the hydrogen masers, of which nine have now been delivered, is being carefully monitored, and in a few cases further adjustment under warranty is required. Maser No. 5 is about to be returned to NRAO after repair, and No. 8 will be returned to Sigma Tau for correction of a degrading IF level. Construction of masers 10 and 11 will begin at Sigma Tau in January of next year.

Data Recording

The production work is running on schedule and the first of the "production" recorders is almost ready for checkout. If this continues, recorders will be completed at a rate of one every two weeks, starting in mid-October. Commercially supplied headstacks from Honeywell are not expected until early 1990. It is planned to test the recorders with a "checkout" headstack and install final headstacks as they arrive.

The first phase of recorder characterization is now complete. The sensitivity of tracking to critical machine alignments has been measured and a theory of tape path developed. The next phase, understanding the effects of mechanical tape defects on the tracking, has been completed and recommendations made for improvement in tracking. The third phase, testing of new thin tapes, is now well underway.

A design review was held in August to evaluate the mechanical improvements to the transports, discuss the results of testing the thin tapes and recording at high densities. The main recommendations received from outside experts was to select a new tape and gain operational experience with that tape.

VLBA experiments using the VLBA data acquisition system in the MKIIIA compatibility mode started in the summer of 1988. Correlation processing at Haystack has been completed for many experiments. A frequency switching mode has been developed which allows Pie Town (which has only 8 baseband converters) to participate in geodetic-astrometric experiments using 14 frequency channels at the other participating antennas.

Monitor and Control

During the third quarter 1989 the greatest effort was on the conversion of the array control software to run under the VxWorks operating system. Drivers were written for VxWorks for the terminal interfaces on the VME station computers, for the station monitor/control bus interface, and for the hard and floppy disks on these systems. The tape drive control program (TDC) has also been ported to VxWorks, and work has begun on converting the basic time keeping/antenna pointing task, TIC. Some preliminary effort on the monitor data logging program, LOGER, has been made.

The goal of being sufficiently complete with the conversion to be able to try operation of Pie Town under VxWorks by the end of the year currently looks possible if no snags are encountered.

The code management procedures for the array control software have been agreed to, and implementation has begun. Meanwhile, work continued on the currently

existing, VersaDos, station computer software, primarily in the elimination of bugs. The hardware and software for a watchdog that automatically reboots the station computer in case of trouble, appears to be working.

A combined VLA/VLBA maintenance system is now in operation, although rough spots in the software are still being smoothed out.

Correlator

Initial tests on prototypes of the correlator "FX" chip were performed by the manufacturer, LSI Logic, Inc., in the closing week of the previous calendar quarter. Unsatisfactory results in these as well as in subsequent, more intensive tests indicated that the prototypes contained either a design or manufacturing defect. The failure was investigated by LSI, NRAO, and Hall-Mark Electronics Corp., the nominal vendor for these chips. After some false starts, NRAO engineers identified a flaw in LSI Logic's implementation of the particular on-chip memory configuration used in this design.

A second set of prototypes was completed at the beginning of September. Early tests showed these to be free of the defect found earlier. At least two chips have also been verified by LSI Logic against the manufacturing test vectors developed as part of the design process. On the last day of the third quarter, these same chips were tested at NRAO in a thoroughly different test fixture, which simulates an entire FFT/cross-multiply/accumulate sequence in the correlator using a single chip driven by a PC. These tests confirmed the correctness of the chip design. However, the manufacturing tests also showed the yield in fabricating these prototypes to be extremely and unacceptably low, again due to failures in the on-chip memory. As of this date, the origin of these failures is still under investigation. In the most favorable outcome, it is likely that a third prototype generation will be necessary.

A final version of the document "Software Architecture for the VLBA Correlator" was issued in the correlator memo series on September 29. Procurement of the commercial database management system integral to the correlator software architecture is nearly complete.

Data Processing

The bulk of the software needed for the normal processing of astronomical data from the VLBA is currently available and in routine production use. There are three general areas which need to be developed: 1) the interface to the correlator and monitor data base, 2) calibration and editing of correlator output, and 3) geometric analysis of the data (i.e., astrometry and geodesy).

Software development this quarter consisted of debugging and making minor improvements to the calibration software, especially for spectroscopic applications.

An additional programmer has been employed to allow work on astrometric applications, but a restructuring of the AIPS project management makes further effort in this area uncertain.

It has been decided to postpone the purchase of major computer hardware until fourth quarter 1990, when we should be able to get a third generation mini-supercomputer. Talks with various potential vendors have begun.

N. PERSONNEL

New Hires

Palmer, Patrick	Visiting Scientist	7/01/89
Holdaway, Mark	Assist. Scientist/Socorro Operations	8/11/89
Boughn, Stephen	Visiting Scientist	8/21/89
Machalski, Jerzy	Visiting Scientist	8/23/89
Brinks, Elias	Assist. Scientist/Socorro Operations	9/01/89

Terminations

Farris, Shirell	Sr. Scientific Programming Analyst	7/21/89
Braun, Robert	Assist. Scientist/Socorro Operations	7/31/89
Palmer, Patrick	Visiting Scientist	7/31/89
Hankins, Timothy	Visiting Scientist	8/15/89
Lind, Kevin	Research Associate	8/31/89
Bregman, Joel	Scientist	8/31/89
Batrla, Wolfgang	Assist. Scientist/Green Bank Operations	8/31/89
Weinreb, Sander	Assist. Director/Technical Development	8/31/89
Boughn, Stephen	Visiting Scientist	9/20/89

Other

Perley, Rick	To Deputy Assist. Director/Socorro Opern.	7/17/89
Sramek, Richard	Return from Leave of Absence and to Deputy Assist. Director/Socorro Opern.	7/17/89
van Gorkom, Jacqueline	To Leave of Absence	8/28/89

PREPRINTS RECEIVED, JULY - SEPTEMBER, 1989

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