US/GR BK/

NATIONAL RADIO ASTRONOMY OBSERVATORY

QUARTERLY REPORT

1 October - 31 December 1991

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A. TELESCOPE USAGE

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

	140 Foot	12 Meter	VLA
Scheduled observing (hrs)	1869.75	1777.25	1626.60
Scheduled maintenance and equipment changes	139.75	36.25	220.50
Scheduled tests and calibrations	106.50	280.70	304.40
Time lost	56.50	329.75	73.20
Actual observing	1813.25	1447.50	1553.40

B. 140 FOOT TELESCOPE

The following line programs were conducted during this quarter.

No.	Observers	Programs
B554	Brown, R.	Observations between 4.8 and 5.0 GHz for recombination lines from QSO's and AGN sources.
B558	Brown, R. Fisher, J. R.	Complete 750-1000 MHz survey for HI absorption in the redshift interval $0.4 < z < 0.9$.
L246	Lockman, F. J. Savage, B. (Wisconsin)	Observations of 21 cm hydrogen toward QSO's.
L262	Lockman, F. J. Reynolds, R. (Wisconsin)	Observations of HI toward selected globular clusters.
M324	Magnani, L. (Georgia) La Rosa, T. (NASA-MSFC)	Observations at 4830 MHz of H_2CO in MBM16.
P158	Petuchowski, S. (NASA/GSFC) Kogut, A. (NASA/GSFC) Bennett, C. (NASA/GSFC)	Search at 4.83 GHz for formaldehyde absorption in ten nearby galaxies to provide a base for multi-transitional studies.
T282	Turner, B. Yamamoto, S. (Nagoya U.) Saito, S. (Nagoya U.) Mangum, J. (Texas) Wootten, H. A.	Search at 10.8 GHz for C_3D as a test for hydrocarbon-ion-molecule chemistry.

No.	Observers	Programs
T284	Tifft, W. (Arizona) Cocke, W. (Arizona)	Observations at 21 cm of precision redshifts with applications to basic studies of the redshift.
T295	Turner, B.	Search at 310 MHz for OD in TMC-1 and L183.
T309	Thaddeus, P. (CFA)	Search at 9.0627, 9.09832, and 18.1292 GHz for a new carbon chain radical, HCCCO.
Y10	Yanny, B. (Princeton) Carilli, C. Rupen, M. (CFA) York, D. (Chicago) Brown, R.	Search over the range 0.8-1.0 GHz for redshifted HI.

The following pulsar programs were conducted during this quarter.

No.	Observers	Programs
B550	Backer, D. (Berkeley) Van Hook, S. (Berkeley) Foster, R. (NRL)	Measurements at 800 and 1330 MHz of the timing of an array of pulsars.
B559	Biggs, J. (NASA/GSFC) Salter, C. Foster, R. (NRL)	Observations at 1420 MHz to monitor pulsar HI absorption spectra.
F105	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.
F107	Foster, R. (NRL) Wood, K. (NRL)	Observations at 1330 MHz of X-ray binary source 4U0115+63.
K333	Kulkarni, S. (Caltech) Phillips, A. (Caltech) Vasisht, G. (Caltech)	Multi-frequency observations at 800 and 1330 MHz of PSR 1829-10.
T302	Taylor, J. (Princeton) Nice, D. (Princeton) Thorsett, S. (Caltech) Arzoumanian, Z. (Princeton) Shrauner, J. (Princeton) Wan, L. (Princeton)	Pulsar timing observations over the range 1300-1350 MHz.

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

A	- Arecibo, 300 m
B	- Effelsburg, MPIR 100 m
C	- Algonquin 45 m
Dc	- Canberra DSS43 64 m
Dm	- Goldstone DSS14 64 m
Dr	- Madrid DSS61 63 m
Ds	- Madrid DSS63 64 m
Dv	- Goldstone DSS13 26 m
Fairbanks	- Fairbanks, AK NASA
G	- Green Bank 140 ft
Jb	- Jodrell Bank 250 ft
Ki	- Haystack 46 m
Km	- Haystack 120 ft
Kw	- Westford 18 m
Lb	- Bologna 25 m
Lm	- Medicina 32 m
No	- Noto, Sicily 32 m
O	- Owens Valley 130 ft
R	- Crimea, Russia 30 m
Richmond	- Richmond, FL USNO
Sn	- Onsala 20 m
T	- Torun, Poland 15 m
Usuda	- Japan NASA
VLBA	- All available VLBA 25 m
Wn	- Westerbork n=1-14x26 m
Yn	- Socorro n=1-27x25
85-3	- Green Bank 85-3 85 ft

No.	Observers	Programs
C271	Clark, T. (NASA/GSFC) Ryan, J. (NASA/GSFC) Vandenberg, N. (Interferometrics) Shaffer, D. (Interferometrics)	Observations at 2.02 and 8.08 GHz to measure the stability of the North American plate and to study deformation along the western margin of the plate, with telescopes G, Kw, Fairbanks, Richmond, and 85-3.
GB3	Bartel, N. (CFA Rupen, M. (CFA) Shapiro, I. (CFA) Preston, R. (JPL) Rius, A. (INTA-NASA, Madrid) Hirabayashi, H. (ISAS, Japan) Kobayashi, H. (NRO)	Observations at 3.6 cm to attempt to make a movie of an exploding star, with telescopes B, T, No, Km, G, O, Y27, Dm, Ds, C, and Usuda.
GB4	Bloom, S. (Boston) Marscher, A. (Boston) Gear, W. (Royal Obs.)	VLBI/JCMT/ROSAT observations at 3.6 cm of strong millimeter sources, with telescopes B, Sn, Lb, No, Jb, Ki, G, O, Y1, and VLBA.
GB9	Barthel, P. (Groningen, Kapteyn) De Bruyn, A. (NFRA) Schilizzi, R. (NFRA) O'Dea, C. (STScI) Wieringa, M. (Leiden) Bogers, W. (Groningen, Kapteyn)	Observations at 3.6 cm to map the core radio morphology of the galaxy 1245+67, with telescopes B, W14, Lm, Jb, Sn, G, O, Y27, and Km.
GF2	Fanti, C. (Bologna) Fanti, R. (Bologna) Schilizzi, R. (NFRA) van Breugel, W. (Caltech) Rendong, N. (Beijing) Dallacasa, D. (Bologna) Spencer, R. (Manchester)	Observations at 18 cm of the detailed morphology of the compact steep spectrum quasars 3C 43 and 3C 298, with telescopes Sn, Wn, B, Jb, Lm, T, G, K, Y27, O, and VLBA.

No.	Observers	Programs
GK3	Krichbaum, T. (MPIR, Bonn) Witzel, A. (MPIR, Bonn) Schalinski, C. (MPIR, Bonn) Standke, K. (MPIR, Bonn) Steffen, W. (MPIR, Bonn)	Observations at 1.3 cm of superluminal motion along a curved path in 1803+78, with telescopes B, Sn, Lm, K, G, O, Y27, and VLBA.
GM6	Marcaide, J. (IAA, Granada) Elosegui, P. (IAA, Andalucia) Alberti, A. (IAA, Granada) Guirado, J. (IAA, Granada) Witzel, A. (MPIR, Bonn) Ratner, M. (CFA) Shapiro, I. (CFA) Preston, R. (JPL)	A complete 3.6 cm sample of the triplet 1803+784/1928+738/2007+777, with telescopes B, Sn, Lm, No, Ki, G, Y27, O, Dv, Dr, and VLBA.
GP4	Pauliny-Toth, I. (MPIR, Bonn) Unwin, S. (Caltech) Zensus, J. A.	Monitoring at 3.6 cm of the quasar 3C 454.3 in connection with ROSAT measurements, with telescopes B, Sn, No, Km, G, O, Y1, and VLBA.
GP6	Porcas, R. (MPIR, Bonn) Garrett, M. (Manchester)	Observations at 18 cm of the gravitational lens system of 1042+178 and 2016+112, with telescopes B, Jm, Lm, G, Y27, O, A, and Wn.
GP7	Wilkinson, P. (Manchester) Readhead, A. (Caltech) Polatidis, A. (Manchester) Xu, W. (Caltech) Pearson, T. (Caltech)	A large-scale VLBI snapshot survey (part 3) at 18 cm, with telescopes B, Lb, Sn, Wn, Jb, R, G, Km, O, Y1, and VLBA.
GV7	Venturi, T. (Bologna) Pearson, T. (Caltech)	Observations at 3.6 cm of the morphological evolution of the superluminal radio sources 3C 216 and 1642+690, with telescopes B, Wn, Sn, Jb, Lm, No, Ki, G, Y27, O, and VLBA.
GZ7	Zensus, J. A. Unwin, S. (Caltech) Wehrle, A. (JPL)	Observations at 1.3 cm to monitor the jet in quasar 3C 345, with telescopes B, Sn, Lm, No, Km, G, O, Y1, R, and VLB.
UA2	Andre, P. Lestrade, J-F. (Meudon) Phillips, R. (Haystack) Klein, K. (Meudon)	Observations at 3.6 cm to compare the magnetosphere of the magnetic B stars Sigma Ori E and S1, with telescopes B, G, Y27, Dc, and Kp.
UAH6	Vermeulen, R. (Caltech)	Observations at 3.6 cm for a phase reference source fringe test, with telescopes B, G, Ki, Y27, and VLBA.

No.	Observers	Programs
UAH7	Unwin, S. (Caltech)	Observations at 1.3 cm to monitor the quasar 3C 279, with telescopes Ki, G, Y1, and VLBA.
UG1	Greenhill, L. (Berkeley) Moran, J. (CFA) Reid, M. (CFA) Argon, A. (CFA) Menten, K. (CFA) Gwinn, C. (Berkeley) Inoue, M. (NRO)	Observations at 1.35 cm to measure the distance to M33, with telescopes Km, G, Y27, O, B, and Ma.
UH1	Hough, D. (Trinity) Zensus, J. A. Vermeulen, R. (Caltech) Porcas, R. Rius, A. (INTA-NASA) Readhead, A. (Caltech)	Search at 3.6 cm for superluminal motion in very weak nuclei of selected double-lobed quasars, with telescopes B, Km, G, Y27, Dm, and Ds.
UM1	Marscher, A. (Boston) Zhang, Y-F. (Boston) Roberts, D. (Brandeis) Wardle, J. (Brandeis) Shaffer, D. (Interferometrics) Flatters, C. Marcaide, J. (IAA, Granada) Alberdi, A. (IAA, Granada) Elosegui, P. (IAA, Andalucia)	Polarization observations at 3.6 cm of 4C 39.25, with telescopes B, K, G, O, Dm, Ds, Y27, and VLBA.
US2	Shaffer, D. (Interferometrics) Ma, C. (NASA/GSFC)	Observations at 18 cm to map sources 0218+357 and 1413+135, with telescopes Y1, G, and VLBA.

C. 12 METER TELESCOPE

The following line programs were conducted during this quarter.

No.	Observers	Programs
A107	Adler, D. Leisawitz, D. (Penn State)	Study of the structure and composition of galactic molecular clouds projected onto background star clusters.
A109	Adler, D. Lo, K-Y. (Illinois)	A search for molecular gas in dwarf irregular galaxies.
A110	Andre, P. Cabrit, S. (Grenoble) Lada, C. (CFA)	A correlation between molecular outflow energetics and circumstellar disk mass?

No.	Observers	Programs
B543	Baan, W. (NAIC-Arecibo) Henkel, C. (MPIR, Bonn) Freund, R.	Study of molecular gas in the nuclei of active starburst OH megamaser galaxies.
B552	Brown, R. Vanden Bout, P.	Study of CO and CI in the z = 2.286 galaxy IRAS 10214+4724.
B553	Brown, R. Vanden Bout, P.	Search for CO from high-z galaxy.
B560	Barsony, M. (CFA) Andre, P.	Study of the pre-main-sequence stellar age segregation in cluster surrounding LKHα101.
B561	Berkhuijsen, E. (MPIR, Bonn) Beck, R. (MPIR, Bonn) Kutner, M. (Rensselaer) Verter, F. (NASA/GSFC)	Study of molecular clouds and magnetic fields in M31.
B562	Balonek, T. (Colgate) Dent, W. (Massachusetts) McGrath, N. (Colgate) Strom, C. (Colgate)	Study of the evolution of extragalactic radio sources at millimeter wavelengths.
C273	Clancy, R. T. (Colorado) Muhleman, D. (Caltech)	Microwave spectroscopy of the terrestrial mesosphere.
D169	de Geus, E. (Maryland) Rudolph, A. (Maryland) Brand, J. (Arcetri) Wouterloot, J. (Cologne)	CO and CS observations of outer-galaxy massive star-forming clouds.
D170	Dickinson, D. (Lockheed) Jewell, P.	A search for SiO masers in OH/IR stars.
G321	Gordon, M. Martin-Pintado, J. (Yebes)	Monitoring program for the RRL maser in MWC 349.
G322	Graham, J. (Caltech) Sanders, D. (Hawaii) Djorgovski, S. (Caltech) Mazzarella, J. (Caltech)	CO observations of powerful radio galaxies.
H277	Hollis, J. M. (NASA/GSFC) Jewell, P.	Confirmation of interstellar methylene - CH_2.
K334	Kislyakov, A. (Nizhny Novgorod State U.) Turner, B.	Investigation of a difference in brightness distribution of HCN and CO as a function of galactocentric radius.
L250	Loren, R. (unaffiliated) Wootten, H. A.	Study of molecular abundances in oxygen-rich cores in ρOph cloud.

No.	Observers	Programs
M313	McGonagle, D. (Massachusetts) Irvine, W. (Massachusetts) Ziurys, L. (Arizona State) Minh, Y-C. (Daeduk, Korea)	Study of the chemistry of interstellar NS.
M328	Mead, K. (Union College) Carey, S. (Rensselaer) Kutner, M. (Rensselaer)	Sensitive survey of arm and interarm clouds in the outer galaxy.
M330	McMullin, J. (Maryland) Mundy, L. (Caltech)	Mapping $C^{34}S$ J = 2-1 emission from young stellar objects in Serpens.
S345	Snyder, L. (Illinois) Hollis, J. M. (NASA/GSFC) Ziurys, L. (Arizona State) Kuan, Y-J. (Illinois)	A proposed search for new interstellar nitroxyl sources.
T299	Turner, B.	A confirmation of a detection of SiN in IRC 10216.
T301	Turner, B.	A search for HNSi (iminosilicon).
W292	Wilner, D. (Berkeley) Welch, W. J. (Berkeley) Bieging, J. (Arizona)	A multi-transition study of OMC-N.
W300	Williams, J. (Berkeley) Blitz, L. (Maryland)	Continued mapping of a giant molecular cloud in the outer galaxy.
W302	Wilson, C. (Maryland)	Study of molecular interstellar medium in NGC 6822.
W303	Wilson, C. (Maryland) Thornley, M. (Maryland)	Study of the molecular gas content of NGC 2403.
W304	Wilson, C. (Maryland) Walker, C. (Texas)	Study of the $^{12}CO/^{13}CO$ ratio in M33: Constraining the diffuse CO emission.
W305	Wolf, G. (Arizona)	Study of dense gas in the Mon OB1 dark cloud.
Z86	Ziurys, L. (Arizona State)	Confirmation of interstellar AlO.
Z95	Ziurys, L. (Arizona State) Irvine, W. (Massachusetts)	Study of SiO as tracer of high temperature chemistry.

D. VERY LARGE ARRAY

Fourth quarter, 1991 was spent in the following configurations:

A/B configuration from:	October 1 to November 1
B configuration from:	November 1 to December 31

The following research programs were conducted with the VLA during this quarter.

No.	Observers	Programs
AA123	Andre, 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
AA128	Alexander, P. (Cambridge) Mackay, C. (Cambridge) Leahy, J. (Manchester) Pooley, G. (Cambridge)	Structure of the inner jet of 3C 66B. 2, 3.8 cm
AA129	Akujor, C. (Nigeria)	Depolarization in compact steep-spectrum sources. 6 cm
AA132	Allington-Smith, J. (Durham) Oemler, A. (Yale)	Evolution of galaxies in poor clusters. 20, 90 cm
AA135	Anglada, G. (Barcelona) Estalella, R. (Barcelona) Rodriguez, L. (Mexico/UNAM) Torrelles, J. (IAA, Andalucia)	Double radio source in L723. 3.8, 6 cm
AA137	Andre, P.	Young stellar objects in ρ Oph A. 3.8, 6 cm
AB414	Becker, R. (Calif., Davis) White, R. (STScI)	Monitoring radio stars HD193793 and P Cygni. 2, 6 cm
AB587	Burns, J. (New Mexico State) Clarke, D. (Illinois)	The inner lobes and jet of Centaurus A. 3.8 cm
AB593	Batuski, D. (Maine) Venkatesan, T. (Maine) Hanisch, R. (STScI) Burns, J. (New Mexico State)	Head-tail radio sources in poor clusters of galaxies. 6, 20 cm
AB615	Baum, S. (Johns Hopkins) O'Dea, C. (STScI) de Bruyn, A. (NFRA)	Compact double 0108+338. 3.8, 6, 20 cm
AB616	Becker, R. (Calif., Davis) White, R. (STScI) Deustua, S. (IGPP/LLNL)	A survey of candidate GPS. 3.8, 6, 20, 90 cm
AB618	Baldwin, J. (NOAO/Chile) Wilson, A. (Maryland)	Seyfert galaxy NGC 3393. 3.8, 6, 20 cm
AB620	Bastian, T. Dulk, G. (Colorado) Bookbinder, J. (CFA)	Magnetic CV AE Aqr. 1.3, 2, 3.6, 6 cm

No.	Observers	Programs
AB625	Brown, R. Holdaway, M.	Ionized hydrogen at galactic center: H138β. 6 cm line
AB626	Beck, S. (Tel Aviv) Ho, P. (CFA) Turner, J. (UCLA)	NGC 5253. 3.6, 6 cm
AB627	Bookbinder, J. (CFA) Walter, F. (SUNY) Mutel, R. (Iowa) Neff, J. (Penn State)	RS CVn AR Lac. 1.3, 2, 6, 20, 90 cm
AC278	Carilli, C. Ho, P. (CFA)	Two nuclear starburst galaxies. 20, 90 cm
AC311	Chambers, K. (Hawaii)	5C sample. 3.8, 20 cm
AC312	Chambers, K. (Hawaii)	Polar cap, ultra-steep spectrum survey. 20 cm
AD252	de Pater, I. (Berkeley)	Jupiter patrol. 20 cm
AD254	Dey, A. (Berkeley) van Breugel, W. (IGPP/LLNL)	Radio loud, far-infrared galaxies. 20 cm
AD268	de Pater, I. (Berkeley) Mitchell, D. (Berkeley) Ostro, S. (JPL) Yeomans, D. (JPL) Palmer, P. (Chicago) Snyder, L. (Illinois) Muhleman, D. (Caltech)	Asteroid Bamberga. 3.8 cm
AD269	de Pater, I. (Berkeley) Romani, P. (NASA/GSFC) Atreya, S. (Michigan)	Uranus. 1.3, 2 cm
AD275	Dwarakanath, K.	GEETEE sources. 20, 90 cm
AD276	Dey, A. (Berkeley) van Breugel, W. (IGPP/LLNL)	Nearby galaxies with blue continuum. 3.8, 6 cm
AD277	Diamond, P. Frail, D. Cordes, J. (Cornell) van Langevelde, H. (Leiden)	Highly scattered OH/IR stars at the galactic center. 20 cm

No.	Observers	Programs
AE079	Elosegui, P. (IAA, Granada) Marcaide, J. (IAA, Granada) Guirado, J. (IAA, Granada) Cotton, W. Owen, F.	Optical quasar pair 1038+528A,B. 3.8, 6, 20 cm
AE080	Ellingson, E. (DAO) Hutchings, J. (DAO) Gower, A. (Victoria)	Environment and the radio properties of quasars. 6, 20 cm
AE084	Erickson, W. (Maryland) Grossman, A. (Maryland) Douglas, J. (Texas)	Scintillation by Jupiter's magnetosphere. 90 cm
AE085	Engels, D. (Hamburger Sternwarte) Winnberg, A. (Onsala) Lindqvist, M. (Onsala) Walmsley, C. M. (MPIR, Bonn)	Water masers in circumstellar shells. 1.3 cm line
AE086	Edelson, R. (NASA/GSFC) Quirrenbach, A. (NRL) Madejski, G. (NASA/GSFC) Bregman, J. (Michigan)	Monitoring BL Lac PKS 2155-304. 1.3, 2, 6, 20 cm
AF196	Feretti, L. (IdR, Bologna) Giovannini, G. (IdR, Bologna) Dallacasa, D. (IdR, Bologna)	Radio polarization mapping of head-tail source NGC 4869. 20 cm
AF197	Feretti, L. (IdR, Bologna) Giovannini, G. (IdR, Bologna)	Cluster radio galaxies of small size. 6, 20 cm
AF213	Fernini, I. (New Mexico) Burns, J. (New Mexico State) Bridle, A. Perley, R.	Jet/counterjet ratio in 3CR radio galaxies. 6 cm
AF217	Frail, D. Kulkarni, S. (Caltech) Thorsett, S. (Princeton)	Young pulsar in G5.4-1.2. 6 cm
AG324	Gregory, P. (British Columbia) Scott, W. (British Columbia) Duric, N. (New Mexico) Taylor, A. (Calgary)	New variable galactic radio source with twin jets, GT2318+620. 2, 3.8, 6, 20 cm
AG325	Gavazzi, G. (Milano)	Strong halo galaxies in A1367. 20 cm
AG328	Guedel, M. (Colorado) Benz, A. (ETH, Zurich)	High frequency dMe star radio emission. 2, 3.8, 6, 20 cm

No.	Observers	Programs
AG329	Garay, G. (Chile) Curiel, S. (CFA) Rodriguez, L. (Mexico/UNAM) Torrelles, J. (IAA, Andalucia)	Nonthermal radio emission from the strings in Cepheus A? 2, 6 cm
AG334	Griffiths, R. (STScI) Tolstoy, E. (Leiden) Boyle, B. (Cambridge)	Deep ROSAT fields. 20 cm
AG336	Grunsfeld, J. (Caltech) Gorham, P. (Caltech) Johnson, N. (NRL) Prince, T. (Caltech) Skinner, G. (Birmingham)	1E1740.7-2942. 3.8, 6 cm
AG337	Grossman, A. (Maryland) Muhleman, D. (Caltech) Slade, M. (JPL)	Saturn rings radar. 3.8 cm line
AH390	Hjellming, R. Gehrz, R. (Minnesota) Taylor, A. (Calgary) Seaquist, E. (Toronto)	Monitoring radio novae. 3.8, 6, 20 cm
AH437	Hewitt, J. (MIT) Turner, E. (Princeton) Chen, G. (MIT) Angelus, A. (MIT)	Monitoring the "Einstein Ring" gravitation lens MG1131+0456. 3.8 cm line
AH445	Hankins, T. (NMIMT)	Crab "Giant" pulses. 3.8, 6, 20, 90 cm
AH446	Hofner, P. (Wisconsin) Churchwell, E. (Wisconsin)	Water masers in ultracompact HII regions. 1.3 cm line
AH447	Higdon, J. (Texas)	Cartwheel. 20 cm line
AH450	Hofstadter, M. (Caltech) Gulkis, S. (JPL) Muhleman, D. (Caltech)	Neptune. 3.8, 6 cm
AH451	Hazard, C. (Cambridge) Condon, J. McMahon, R. (Cambridge) Irwin, M. (Cambridge)	QSOs with $z > 4$. 20 cm
AH452	Hes, R. (Groningen/Kapteyn) Barthel, P. (Groningen/Kapteyn) Bridle, A. Perley, R. Zensus, J. A.	Morphology and QSR/radio galaxy unification. 3.8, 6 cm

No.	Observers	Programs
AJ200	Jacobson, A. (Los Alamos) Erickson, W. (Maryland) Mercier, C. (Meudon)	Ionospheric dynamics. 90 cm
AJ214	Johnston, H. (Caltech) Kulkarni, S. (Caltech) Cornwell, T. Perley, R.	Pulsar content of globular clusters. 90 cm
AK249	Klein, U. (MPIR, Bonn) Brinks, E. Skillman, E. (Minnesota)	Low frequency spectral indices of blue compact dwarfs. 20, 90 cm
AK270	Kronberg, P. (Toronto) Sramek, R.	Flux density monitoring of 30 brightest compact sources in M82. 1.3, 2 cm
AK272	Kassim, N. (NRL) Perley, R. Taylor, G. (UCLA) Erickson, W. (Maryland) Dwarakanath, K.	Synthesis of strong radio sources at 4 m wavelength. 400 cm
AK284	Katgert, P. (Leiden) Den Hartog, R. (Leiden) Sjouwerman, L. (Leiden)	Candidate narrow angle tail sources. 20 cm
AK285	Koo, B-C. (CFA) Yun, M. (CFA) Ho, P. (CFA) Kumar, P. (NCAR) Heiles, C. (Berkeley)	Structure of HII region G5.48-0.24. 20 cm
AK287	Kundu, M. (Maryland) White, S. (Maryland) Gopalswamy, N. (Maryland) Lin, R. (Berkeley)	Solar flares. 2, 3.8, 6 cm
AK288	Kollgaard, R. (Penn State) Feigelson, E. (Penn State) Hertz, P. (NRL) Brinkmann, W. (MPIEP, Munich) Wielebinski, R. (MPIR, Bonn)	North ecliptic pole. 20 cm
AK289	Kollgaard, R. (Penn State) Feigelson, E. (Penn State)	X-ray selected BL Lac objects. 20 cm
AK290	Koribalski, B. (MPIR, Bonn) Dickey, J. (Minnesota) Dahlem, M. (Hamburger Sternwarte)	HI absorption in NGC 1808. 20 cm line

No.	Observers	Programs
AK291	Kulkarni, S. (Caltech) Phillips, J. (Caltech) Vasisht, G. (Caltech)	Polarization monitoring of PSR 1829-10. 20 cm
AL150	Lestrade, J-P. (JPL) Preston, R. (JPL)	RSCVn stars. 6 cm
AL246	Lo, K-Y. (Illinois) Plante, R. (Illinois) Yun, M. (CFA) Ho, P. (CFA)	HI Zeeman in M82 nuclear ring. 20 cm line
AL247	Lang, K. (Tufts) Willson, R. (Tufts) Kile, J. (Tufts)	Solar corona. 20, 90 cm
AL248	Lang, K. (Tufts) Willson, R. (Tufts) Kile, J. (Tufts)	Sun: during 2 MAX 91 campaigns. 2, 3.8, 6, 20, 90 cm
AL249	Longley, D. (Manchester) Pedlar, A. (Manchester) Hummel, E. (Royal Obs.) van der Hulst, J. (Groningen/Kapteyn)	Compact flat spectrum core sources in spiral nuclei. 2, 3.8 cm
AL250	Lo, K-Y. (Illinois) Plante, R. (Illinois) Killeen, N. (AT, Australia) Crutcher, R. (Illinois)	OH and HI Zeeman measurements in Sgr A. 20 cm line
AL251	Langston, G.	Gravitational lens 2016+112. 3.8, 6 cm
AL252	Ledlow, M. (New Mexico) Owen, F.	Radio galaxies in rich clusters. 20 cm
AL254	Leous, J. (Penn State) Andre, P. Stine, P. (Bloomsburg State) Barsony, M. (CFA)	LkHα 101. 3.8 cm
AL255	Lowenthal, J. (Arizona) Green, R. (KPNO/NOAO)	Ly-α galaxy at z=2.3. 3.8, 6 cm
AM305	Molnar, L. (Iowa) Mutel, R. (Iowa) Deng, J. (Iowa)	A survey of interstellar scattering in the Cygnus X region. 3.8 cm
AM326	McCullough, P. (Berkeley) Heiles, C. (Berkeley)	Deuterium towards Cas A. 90 cm line

No.	Observers	Programs
AM330	Marcha, M. (Manchester) Browne, I. (Manchester) Patnaik, A. (Manchester) Wrobel, J.	BL Lac objects and flat spectrum radio galaxies. 20 cm
AM342	McHardy, I. (Southampton U.) Lehto, H. (Southampton U.)	Globular cluster X-ray sources. 3.8, 6, 20 cm
AM344	Menon, T. (British Columbia)	Galaxies in high density environments. 20 cm
AM345	Mirabel, I. (CNRS, France) Rodriguez, L. (Mexico/UNAM) Cordier, B. (CNRS, France) Paul, J. (CNRS, France) Lebrun, F. (CNRS, France)	1E 1740.7-2942. 3.8, 6, 20 cm
AM346	Morris, D. (IRAM) Anantharamaiah, K. (Raman Institute) Radhakrishnan, V. (Raman Institute) Dwarakanath, K. Mirabel, F. (CNRS, France)	Positronium search in 1E 1740-2942. 6 cm line
AM348	Mehringer, D. (Chicago) Palmer, P. (Chicago) Yusef-Zadeh, F. (Northwestern) Goss, W. M.	Sgr B1/B2. 3.8, 6, 20 cm
AM351	Mulchaey, J. (Maryland) Mushotzky, R. (NASA/GSFC)	Galaxy-IGM interactions. 20 cm
AM352	Muhleman, D. (Caltech) Grossman, A. (Maryland) Clancy, R. T. (Colorado) Weisstein, E. (Caltech)	Venus water vapor. 1.3 cm line
AM353	Moffett, D. (NMIMT) Goss, W. M. Reynolds, S. (North Carolina State)	SN 1006 - expansion. 20 cm
AM354	Molnar, L. (Iowa) Allen, J. (Iowa) Taylor, A. (Calgary) Kenny, H. (Calgary) Hjellming, R.	Monitoring a cycle of LSI +61 303. 1.3, 2, 3.8, 6, 20 cm
AO087	Owen, F. Eilek, J. (NMIMT) Cornwell, T.	Observations of M87. 90 cm

No.	Observers	Programs
AO098	Owen, F. Perley, R.	B3 classical doubles. 3.8 cm
AO103	O'Donoghue, A. (St. Lawrence) Eilek, J. (NMIMT) Owen, F.	Spectral index observations of 3C 465. 90 cm
AO105	Okorogu, A. (Nigeria) Akujor, C. (Nigeria) Garrington, S. (Manchester)	Radio jets without hotspots. 6 cm
AP209	Parijskij, Y. (Leningrad) Soboleva, N. (Leningrad) Temirova, A. (Leningrad) Goss, W. M.	RATAN-600 sources. 6 cm
AP214	Pedlar, A. (Manchester) Longley, D. (Manchester) Kukula, M. (Manchester) Baum, S. (Johns Hopkins) O'Dea, C. (STScI)	NGC 4151. 2 cm
AP216	Puche, D. Westpfahl, D. (NMIMT) Carignan, C. (Montreal)	Dwarf galaxy DDO 47. 20 cm line
AP219	Perlman, E. (Colorado) Stocke, J. (Colorado) Burns, J. (New Mexico State)	Radio galaxies in distant clusters. 20 cm
AP221	Payne, H. (STScI) Erickson, W. (Maryland) Anantharamaiah, K. (Raman Institute)	Carbon recombination lines in front of Cas A. 90 cm line
AQ006	Quirrenbach, A. (NRL) Wegner, R. (MPIR, Bonn) Witzel, A. (MPIR, Bonn)	Jet and halo of BL Lacertae object 0716+714. 6 cm
AR233	Rodriguez, L. (Mexico/UNAM) Canto, J. (Mexico/UNAM) Torrelles, J. (IAA, Andalucia) Ho, P. (CFA)	HL Tau protoplanetary disk. 1.3 cm
AR242	Rucinski, S. (York U.)	Close binary ER Vul. 2, 3.8, 6, 20 cm
AR256	Roberts, D. (Oklahoma) van der Werf, P. (MPIEP, Garching) Dickel, H. (Illinois) Goss, W. M.	HI absorption in DR21. 20 cm line

No.	Observers	Programs
AR257	Reynolds, R. (Wisconsin) Lockman, F. J. Langston, G.	HI absorption toward globular clusters. 18, 20 cm line
AR258	Rupen, M. (CFA) Condon, J.	Radio supernova search. 6 cm
AS333	Sramek, R. Weiler, K. (NRL) van Dyk, S. (NRL) Panagia, N. (STScI)	Statistical properties of radio supernovae. 2, 6 cm
AS437	Seaquist, E. (Toronto) Odegard, N. (NASA/GSFC)	Synchrotron emission from galactic superwinds. 20 cm
AS451	Schilizzi, R. (NFRA) Miley, G. (Leiden) de Bruyn, A. (NFRA) Rottgering, H. (Leiden)	AGNs with peaked radio spectra. 2, 20 cm
AS453	Smith, B. (Texas)	HI in "ripple" galaxy NGC 2782. 20 cm line
AS454	Schmidt, M. (Caltech) van Gorkom, J. (Columbia) Schneider, D. (Princeton) Gunn, J. (Princeton)	Optically selected high-redshift quasars. 20 cm
AS455	Sramek, R. Barthel, P. (Groningen/Kapteyn) Mirabel, I. (CNRS, France) Sanders, D. (Hawaii)	ELF-QSO connection. 2, 3.8 cm
AS456	Singh, K. (TIFR, Bombay) Patnaik, A. (Manchester) Harris, D. (CFA)	ZW 0335+096. 90 cm
AT110	Torrelles, J. (IAA, Andalucia) Rodriguez, L. (Mexico/UNAM) Canto, J. (Mexico/UNAM) Ho, P. (Harvard) Gomez, J. (IAA, Andalucia)	Ammonia observations of protoplanetary disks. 1.3 cm line
AT114	Taylor, A. (Calgary) Dougherty, S. (Calgary)	Monitoring of radio variable Be stars. 3.8 cm
AT118	Thorsett, S. (Princeton) Taylor, J. (Princeton) McKinnon, M. (NMIMT)	Binary pulsar timing measurements: pulsars not accessible to Arecibo. 20, 90 cm

No.	Observers	Programs
AT127	Thorsett, S. (Princeton) Taylor, J. (Princeton) Hankins, T. (NMIMT) Stinebring, D. (Oberlin)	Timing fast pulsars. 6, 20, 90 cm
AU042	Ulvestad, J. (JPL) Antonucci, R. (Calif., Santa Barbara)	Compact radio sources in NGC 253. 1.3, 2, 3.8, 6 cm
AU044	Umana, G. (CNR, Bologna) Trigilio, C. (CNR, Bologna) Hjellming, R. Catalano, S. (Catania U.) Frasca, A. (CNR, Bologna)	Algol-type systems: RZ Cas. 1.3, 2, 3.8, 6, 20 cm
AU045	Uson, J. Bagri, D. Cornwell, T.	HI clump at z = 3.4. 90 cm line
AU046	Uson, J. Bagri, D. Cornwell, T.	Absorption in galaxies/QSOs at z = 3.3. 90 cm line
AV189	van Breugel, W. (IGPP/LLNL) Sutherland, W. (Oxford U.) Heckman, T. (Johns Hopkins)	Southern quasar and radio galaxy survey. 20 cm
AW249	Wills, B. (Texas) Shastri, P. (Texas)	Core variability in lobe-dominated quasars. 6 cm
AW290	White, S. (Maryland) Kundu, M. (Maryland) Pallavicini, R. (Arcetri)	Radio spectra and polarization of naked T Tauri stars. 2, 3.5, 6, 20 cm
AW291	White, G. (Queen Mary) Liseau, R. (IFSI, Italy)	Radio spectrum of the protostellar candidate N1333 IRAS 1. 1.3, 2, 6, 20 cm
AW292	Wolfe, A. (Calif., San Diego) Brinks, E. Garwood, R. Briggs, F. (Pittsburgh)	Search for 21 cm absorption in damped Ly-α system towards MG 0201+11. 90 cm line
AW301	Wilson, A. (Maryland) Bland-Hawthorn, J. (Rice)	Ultra luminous galaxy NGC 6240. 3.6, 6, 20 cm
AW302	Weisberg, J. (Carleton College) Weisberg, J. (Carleton College) Frail, D. Johnston, S. (CSIRO) Cordes, J. (Cornell)	HI absorption toward pulsars in the inner galaxy. 20 cm line

No.	Observers	Programs
AW303	Wood, D. Churchwell, E. (Wisconsin) Van Buren, D. (IPAC, Pasadena) Mac Low, M. (NASA/Ames)	Proper motions of ultra compact HII regions. 3.8 cm
AW308	Wang, Z. (Caltech) Kenney, J. (Caltech) Burton, M. (AAO, Sydney)	HI around IC 443. 20 cm line
AY043	Yusef-Zadeh, F. (Northwestern)	High-resolution mosaic of the Sgr A complex. 3.8 cm
AY044	Yin, Q-Y. Xu, L. (Beijing) Heeschen, D.	Nearby starburst galaxies. 3.8 cm
AY046	Yusef-Zadeh, F. (Northwestern)	Proper motions in SgrA. 2 cm
AZ044	Zhao, J. Ekers, R. (AT, Australia) Goss, W. M. Lo, K. (Illinois) Narayan, R. (Arizona)	Flux density variations in Sgr A. 3.8, 6, 20 cm
AZ054	Zhang, Y-F. (Boston) Marscher, A. (Boston)	GPS source 1404+286=OQ208. 20 cm

E. VERY LONG BASELINE ARRAY

No.	Observers	Programs
BK001	Kemball, A. Diamond, P.	Mapping the circumstellar structure of OH 17.7-2.0. 20 cm
BW001	Wrobel, J.	PC-scale twist in the radio galaxy Mrk 501. 6 cm
BZ001	Zhang, Y-F. (Boston) Marscher, A. (Boston)	Spectral investigation of a complete sample of compact doubles. 1.3, 3.8, 18 cm
GS005	Standke, K. (MPIR, Bonn) Alef, W. (MPIR, Bonn) Krichbaum, T. (MPIR, Bonn) Schalinski, C. (MPIR, Bonn) Quirrenbach, A. (USNO) Wegner, R. (MPIR, Bonn) Zensus, J. A. Witzel, A. (MPIR, Bonn)	Image wandering in the intraday variable quasar 0917+624. 1.3, 3.6 cm

F. SCIENTIFIC HIGHLIGHTS

Socorro

Ice on Mercury? Yet another successful collaborative experiment has been carried out between the X-band radar transmitting 70 m DSN antenna at Goldstone and the VLA high resolution receiving system. Over 70 percent of the surface of Mercury was mapped during the two day experiment; most of the surface had never been previously photographed optically. The most unexpected feature seen on the planetary images is a very bright structure at the north pole, giving rise to the speculation that water ice may be sheltered there. Outgassed volatiles from the intense solar heat may collect at the cold poles, where the sun is always on the horizon. Two other new features seen at temperate latitudes may be the result of impact basins.

Investigators: D. Muhleman, Caltech; M. Slade, JPL; B. Butler, Caltech

Neutral Hydrogen at z = 3.4. VLA D configuration observations have recently detected the presence of 21 cm narrow band signals from highly redshifted neutral hydrogen. HI in absorption was detected against a z = 3.395 radio galaxy at the level of 0.89 percent of the broadband emission. The absorption line center is at z = 3.3968 and shows a velocity dispersion (FWHM) of 270 kms^{-1}. One or more absorbing galaxies along the line of sight and with a total mass of about $10^{10}M_{\odot}$ is the likely interpretation of the data.

HI emission at z = 3.3970 has also been detected at a position that is only 33 arc minutes away from the above absorption. The emission is only slightly resolved with the D configuration resolution and has a velocity width (FWHM) of 180 kms^{-1}. With such a narrow velocity width and a calculated mass of about $10^{14}M_{\odot}$the emitting gas may be the first observational evidence of a Zel'dovich pancake.

Investigators: J. Uson, D. Bagri, T. Cornwell

Tucson

Highly redshifted emission from carbon monoxide has been detected at the 12 Meter Telescope in the z = 2.286 galaxy IRAS 10214+4724. The CO (J=3-2) line was identified in this galaxy at 105 GHz, corresponding to the frequency redshift expected from the galaxy's optical redshift. This is by far the highest redshift at which CO has been seen; the previous most distant CO emission was at z ~ 0.3. The total molecular mass in the object is approximately 10^{11} $M_{\odot}$ (assuming a solar [C/H] abundance ratio). These observations suggest that galaxies at high redshift undergo a gas-rich evolutionary phase during which time they are observable and their evolution from clouds of gas to stellar systems can be studied.

Investigators: R. Brown, P. Vanden Bout

Green Bank

A map was completed of the high-latitude cloud MBM16 in the 6 cm formaldehyde line. This mapping project was important to the question of star formation in clouds of this type. If high density cores are common within these clouds, then they are not the diffuse, gravitationally unbound transient structures that dominate the interstellar cirrus clouds. Instead, they are stable regions with the potential for low-mass star formation.

The H_2CO map of MBM16 demonstrated that high-density cores were rare. Individual clumps had masses an order of magnitude less than critical masses determined from virial equilibrium calculations. The study also showed that the standard value of the ratio of atomic hydrogen surface density to integrated carbon monoxide profile area, $N(H_2)/W(CO)$, used for estimating molecular masses in clouds, does not apply to these high-latitude, translucent clouds.

Investigators: L. Magnani, Georgia; T. La Rosa, NASA/MSFC

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

The production of 1.2-1.8 GHz, 12-18 GHz, 21-25 GHz, 26-36 GHz, and 38-45 GHz amplifiers continued. A summary of amplifier deliveries in this quarter is given in the table below:

FREQUENCY BANDS	NUMBER OF AMPLIFIERS
1.2-1.8	2
12-18	5
21-25	1
26-36	2
38-45	8
Grand Total	18

Superconducting (SIS) Millimeter-Wave Mixer Development

The CDL has now completed all but two of the 16 modular SIS receivers ("rockets") for the 4 mm, 3 mm, 2 mm, and 1.3 mm bands. In each band there are four receivers, two on the telescope, and two spares. Still to be completed are the two 2-mm spares.

Two new sets of SIS mixers have been designed. The first contains mixers primarily for 200-300 GHz, including fixed-tuned mixers for the planned eight-beam 230 GHz SIS receiver, and also a small number of tunable mixers for 130-170 GHz. We have just received the first batch of these from UVA, but have not tested them at the time of writing.

The second set of new mixers contains small chip and integrated (tunerless) designs specifically for the 130-170 GHz bands. The masks have been made, and these will be fabricated at UVA early in 1992.

Work continues on the new, more versatile, SIS mixer test set based on a closed-cycle JT refrigerator. The new test set will allow us to measure the conversion loss and noise of new experimental mixers of various sizes and configurations (including 4 K feed horns and lenses, if desired) which will not fit in our present small liquid helium test cryostats.

We have completed a study of three approximations to Tucker's theory of SIS mixers. The results show that an approximation slightly less extreme than the usual three-frequency approximation is acceptable for most SIS mixer design work. This is an important result, especially for designing tunerless mixers, as use of the approximate method can reduce the computational effort needed to design a mixer from hours on a large computer using a full analysis, to minutes on a desktop machine. This work has been possible as a result of Stafford Withington's visit from Cambridge last summer, when he installed his full SIS mixer analysis program on the Charlottesville Polaris computer. Our results will be presented at the 1992 Terahertz Technology Conference.

During this quarter we have built (or rebuilt) and tested a total of seven SIS mixers operating from 68-260 GHz. In addition, we have mounted and evaluated 15 experimental monolithic GaAs frequency multipliers made at Martin-Marietta Labs. Such multipliers may play an important role in the local oscillator chain on the Millimeter Array.

OVLBI Earth Station Project

Work during the quarter involved primarily a continuation of the detailed design of components.

The final member of the technical design team began work in October. He is an electronics engineer and is assigned responsibility for the wideband data subsystem (IF through recording). This brings the technical team to five full-time persons, which should be sufficient to complete the project. Additional part-time and temporary manpower will be recruited as needed from the Observatory staff.

Progress was made during the quarter on the design of various subsystems, including the feeds/optics, the front-ends,the two-way timing, the computer control system, and the wideband data demodulator.

A thorough review of the optics was conducted in November, including analysis of the prototype FSS test data and study of alternative designs. A decision was made to commit to the FSS approach. We are convinced that no alternative offers the prospect of better performance, and all would require more extensive development work than the FSS. This decision allows work to proceed on the cryogenic front-end assemblies. The latter are very similar to the VLBA receivers for 8 and 15 GHz. In December, these designs were reviewed and the variances from the VLBA design were specified.

For the two-way timing system, prototyping of electronic subassemblies continued. Additional tests of the UHF synthesizer (second LO) were conducted, and modifications were made to improve its phase stability. The digital portion of the system, allowing fine control of the uplink and downlink reference phases and digitization and analysis of the measured downlink phase, had been designed and was under construction at the end of the quarter.

The control computer work included satisfactory testing of Monitor and Control Bus communications code and additional benchmarking tests of the operating system. It appears that the Venix operating system will provide satisfactory performance, although a final decision to this effect was still pending at the end of the quarter. Work so far has used a less powerful computer than the one needed for the final system. The machine to be used for further development was ordered at the end of the quarter.

A specification was prepared for the wideband data demodulator and comments were solicited from a large number of companies in the industry. It was hoped that this unit or portions thereof might be procured commercially, but the preliminary result is that our requirements are sufficiently specialized that an in-house design will be needed.

A large fraction of the electronics hardware being built for this project by the VLBA electronics group was delivered in December. This included the VLBA formatter and several support modules as well as some local oscillator modules.

A vendor was selected for the two VLBA recorders, and a purchase order was issued. This is the largest single equipment purchase anticipated for the project. A fixed price $79k below the budgeted amount was obtained. Delivery is expected in April 1992.

In October, two members of the group attended the Thirteenth Radioastron Review Meeting in Pushchino, Russia.

Electromagnetic Support

Measurements on the GBT L-band prototype horn were completed. These included copolar beam pattern measurements in the two principal planes, cross-polarization in the 45 degree plane, location of phase center and input return loss.

Analysis of the GBT with feeds translated off the secondary focus was carried out at different frequencies. This was done in order to study the possibility of using more than one feed on the turret without having to rotate the turret. This analysis was also required to see if the subreflector had enough transverse translations that may be used to compensate for the loss in performance of the off-axis feeds.

Cross-polarization levels of the GBT were calculated for off-axis feeds. The feeds in an array or multiple feeds used for beam switching purposes are examples of such off-axis feeds.

I. GREEN BANK ELECTRONICS

Green Bank Telescope

Feeds - Fabrication and measurements on the GBT compact corrugated prototype feed horn were completed. The design was scaled to approximately 4 GHz, and an exact model was machined. The performance was found to agree well with predictions, and planning to construct a full-size L-Band model will now proceed. Design of the Gregorian linear taper feed horns, which will be used above 4 GHz, was completed. Cross-polarization levels of the GBT for off-axis Gregorian feeds were calculated. This performance is important for feeds in an array or multiple feeds used for beam switching purposes.

Receivers - Design work for the prime focus receivers began in some detail. An orthomode transducer for use at 800 MHz has been designed at NRAO and constructed. Tests are underway. As a parallel investigation, specifications and a request for quotations are being prepared and sent to interested bidders. Other components needed for the 680-920 MHz receiver have been selected and ordered. An effort is on-going to optimize the interface between the NRAO prime focus equipment and the mechanisms provided by the contractor.

Holography Backend - Work on the holography backend continued. The correlator has been completed and tested for all possible input values and integration times, using simulated A/D inputs. The Hilbert transformer was completed for the 10 kHz bandwidth system; the 100 kHz transformer is under construction. All of the A/D converters and interface cards have been constructed and tested separately. These sub-systems are currently being integrated into a chassis for system tests. The design of the SSB unit for converting from an IF of 50 MHz to baseband has been done and components ordered.

Active Surface - Evaluation of motor candidates for the actuator was completed. Final selection and ordering of components for the 2400 actuators were completed. Final proposals for a significant fraction of the control system were evaluated and an order was placed for these components. Design, construction, and testing of electronics required for testing the production actuators at the factory was practically completed.

Two second generation laser ranging units were built and tested. Software to control and analyze upcoming triangulation tests was written.

Autocollimator - Tests of the autocollimator system using moving air in a 4 inch pipe to stabilize the path were not as successful as required. It is suspected that turbulence in the path caused the instability. The pipe is presently being temperature stabilized with external heaters and insulation.

Monitor and Control - Block and information flow diagrams have been completed. Costs of the proposed system are being generated. The design of hardware and software for the control busses has begun.

Servo - The bulk of the work in this area continues to be the monitoring of progress made by the RSI/PCD group. In addition, the interface between the RSI and NRAO computers has been defined by NRAO and accepted by RSI. Required velocities and accelerations of the subreflector positioner have been estimated by NRAO. Several suggestions were made by NRAO to improve the az/el step response and tracking smoothness.

Miscellaneous - A microwave frequency synthesizer that had been selected for use in the LO system was purchased and is now being tested to determine how the antenna monitor and control system can best control it. Link analysis for the analog fiber optics IF transmission system was done. Work on the receiver frequency converter designs and LO systems continues.

USNO Green Bank Program

The design of the S/X receiver for the Hawaii antenna was completed and many parts are now on order. Construction and testing of receiver components as well as VLBI backend components continues.

VLBA

The final three S-band and seventh 43 GHz VLBA receivers were completed and shipped. Work is in progress on the eighth and ninth 43 GHz receivers.

140-ft Cassegrain Receivers

Testing of components for the second LO system continues.

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 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. Further system testing and system analysis will continue in to 1992.

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 were purchased. These RFI enclosures eliminate the remaining antenna-generated interference at 327 MHz. There is still some locally generated RFI noticeable at 75 MHz. An in-house design for the remaining 24 RFI enclosures 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. This quarter four more units have been placed on order and will be installed the first quarter of 1992. The remaining enclosures will be constructed and installed as funding permits.

1.3-1.7 GHz T_{sys} Improvements

Presently ten VLA antennas have improved VLBA style L-band receivers installed. Three more of the new front-end systems are now in the assembly process. We expect to install one new front-end system each month in 1992 as funding permits.

K. 12 METER ELECTRONICS

New 3 mm SIS Receiver

The new 3 mm SIS receiver has been completed and is now in service on the 12 Meter Telescope. This is a dual polarization receiver covering two frequency bands, 68-90 GHz and 90-115 GHz. Receiver noise temperatures are typically 80-90 throughout either band. This is the first SIS receiver at the NRAO covering the 68-90 GHz band, and offers a dramatic improvement in sensitivity compared to the Schottky receivers previously in use. In addition, this receiver is substantially more sensitive than the old SIS receiver covering the 90-115 GHz band.

Hybrid Spectrometer Upgrade

An upgrade of the hybrid spectrometer high resolution mode has been finished and is available to users at the 12 Meter Telescope. The original design of the hybrid spectrometer could support (at least) dual polarization I.F.'s at all bandwidths from 600 MHz down to 37.5 MHz. However, to achieve the highest resolution mode of 24 kHz per channel, observers had to place all 1536 spectral channels across one polarization I.F. For certain high resolution experiments, this was a distinct drawback, since one could not average polarization channels in this mode. In the upgrade just finished, observers can now achieve 24 kHz resolutions at 12.5 MHz bandwidths in both orthogonal polarization channels simultaneously.

Control System Upgrade

Phase II of the control system upgrade project has been completed. Telescope control is now handled with modern VME interfaces, and the VAX has been replaced by a Sun workstation running under the Unix operating system. Observers have already noticed a significant improvement in the efficiency of the new system. In addition, the new system is simpler and easier to maintain than the VAX-based system. Because of the design architecture of the new system, it has nearly limitless capacity for expansion to handle, for example, multibeam receivers, large backends, and the associated higher data rates that are anticipated over the next few years.

L. AIPS

The major activities of the AIPS group for this period were:

1) Aid and support of outside AIPS users
2) Debugging and improving VLBI software
3) Improvements to the automated mapping and self-calibration software
4) Implementation of an ellipticity-orientation feed polarization model
5) Creation of a new system for remote tape and file access within AIPS
6) Documentation of AIPS software

7) Creation of a network configuration system, which allows separate computers at a single site to share AIPS software.

The AIPS letters continue to be distributed quarterly, although AIPS software is released annually. The next release, 15APR92, will be frozen in January 1992 and testing will continue until its release in April 92.

There has been a recent flurry of requests for AIPS software, as more and more universities obtain the relatively low cost work stations which can support AIPS. Also we have an increase in the number of foreign sites obtaining AIPS. A large fraction of the AIPS sites now receive it electronically, via File Transfer Protocol.

M. SOCORRO COMPUTING

During the last quarter of 1991, continued progress was made in the area of near-real-time visualization at the VLA. The workstation on which the software is being developed is now ready to move to the site for further work, and the PV-Wave visualization software package has been ordered for it.

Two new Computer Division positions, funded from VLBA Operations, have been filled. One is a systems administration position, needed to handle the increased workload from the influx of new equipment, and the other is a network analyst. This person will be responsible for the day-to-day operations of the VLBA telescope site connections, and the local networking in New Mexico. In addition, offers were made and accepted on two of the three vacant programming positions. This will help to relieve the backlog of programming projects.

Also during this period, responses to the first two Array Computing Plan procurement Request For Proposal documents were received and evaluated. This has resulted in two separate orders, both subject to formal acceptance by AUI/NRAO. The first is for 45 Sun Microsystems IPX workstations, of which approximately 32 will come to the AOC. These will be used for data reduction by visitors and in-house staff. During the past year, a number of visitors have had the opportunity to reduce data using a workstation reserved for them during their stay, and the response has been extremely favorable. Currently we have only two such stations, and this number will increase as a result of this procurement.

The second order is for an Auspex NS/5000 computer, a high-performance NFS server, which is needed to supply operating system support and disk space to both the new and existing workstations. We anticipate that this system will be installed in the AOC in early February 1992.

A third Request For Proposals, for scientific visualization equipment, was issued in November and responses are currently under evaluation.

N. VLBA PROJECT

Antennas and Site Preparation

The first seven VLBA stations are operational: Pie Town, NM; Kitt Peak, AZ; Los Alamos, NM; Fort Davis, TX; North Liberty, IA; Brewster, WA; and Owens Valley, CA. The Hancock, NH station would be operable were it not for one of its azimuth wheel/axle assemblies recently being shipped back to the antenna manufacturer's factory for correction as a construction "punch list" item. At St.Croix, VI the antenna erection is complete. Outfitting of this station is scheduled to start in January 1992. Operability at St. Croix is scheduled for June of 1992. At Mauna Kea, HI antenna erection started in November 1991 and outfitting should be completed before the end of 1992.

Electronics

Construction of the electronic receiving system has progressed satisfactorily during the last quarter. As the quarter ends a large part of the electronics for the VLBA has been completed. All of the racks of type A, B, and C are complete and tested. Of the Data Acquisition racks, only one remains to be assembled, and this is scheduled for completion in the first quarter of 1992.

Construction of front ends is complete except for spare units for 8.4 and 23 GHz, and for 14 GHz and 43 GHz, for which eight units and five units respectively remain to be completed. All front ends are scheduled to be completed by mid-1992. A number of electronic modules including spares, and converters for front ends that have not yet been completed, also remain to be assembled. This work should be largely completed by the end of the first quarter of 1992. Electronics construction that will be completed during 1992 also includes some retrofits and pulse generator modules for the pulse calibration system, which will be among the final items to be fitted to the array.

Data Recording

VLBA recorders through serial #23 were shipped from Haystack Observatory in the last quarter. Deliveries from the third production run (of eleven) through serial #32 are expected to continue in the first quarter of 1992. A change order to Haystack for a fourth and last run of 11 recorders was placed in the last quarter of 1991. Eight additional recorders are scheduled for production at the AOC in 1991 and 1992, in addition to the two recorders currently being completed at the AOC.

Field tests of samples of thin tape from various manufacturers continued for the last three quarters, and will continue through the first two quarters of 1992. These tapes are mixed into VLBI and JPL/GSFC Network tape supplies for participating observatories and processing sites. Durability, magnetic and mechanical performance were monitored. Extensive laboratory tests were also performed at Haystack Observatory under various tape speeds and various values of other transport parameters. Modification of some of the tape control surfaces were installed in recorders at Haystack, Pie Town, and Los Alamos to prevent friction damage of the thin tape.

Monitor and Control

During fourth quarter 1991 we have continued to enhance the on-line software system. Work continues on making the hardware checking algorithm produce more meaningful information about equipment not performing as specified.

The Internet connection to the Hancock, NH site has been completed, and groundwork for the St. Croix, VI link is underway. A network communications backup plan is under development.

The station control computer vxWorks operating system has been upgraded from version 4.0 to version 5.0. The driving factor behind this is for security purposes; version 4.0 is not only insecure in itself, but makes security more difficult in attached systems.

Work is progressing toward inserting relevant log data into the Ingres database. Trial database logs have been given to the Charlottesville correlator group to see if they can be converted into the relevant quantities for the correlator.

Work is in progress on a major revision of the engineering data logging system to provide increased efficiency and ease of usage. A general purpose listing/plotting program is being written to display the engineering data for benefit of the engineers and technicians.

Correlator

Integration and testing of hardware and software elements dominated the entire correlator group's effort during this quarter. Continuing difficulties with the Playback Interface (PBI) firmware restricted this work primarily to the PBI's Track

Recovery and Deformatter modules, and to the software Tape task, until mid-December. At that point, the "inner loop" PBI-PBD speed control servo, and the passing of control between the PBI and the software "outer loop" in the real-time system, had both become sufficiently robust that the first "station spectrum" could be obtained from recorded test observations. This process still required an onerous degree of manual intervention, however, and a high-priority effort was started to complete the integration of all aspects of test correlation to facilitate future testing.

Construction continued on the one outstanding hardware module, the output digital filter. It now retrieves data from the integrator, stores and accesses values in the large data memory, and transmits results to the real-time computer system via a commercial high-performance interface. Work in progress includes implementation of the computation and normalization of the transversal filter itself.

The data path from the correlator into the VLBA post-processing system was completed and debugged on both ends, and is now available for use in future correlator tests. A rudimentary fringe-finding task, operating in the correlator's control computer directly from the standard FITS output format, also was written.

The first phase of an upgrade to the real-time operating system was completed, bringing the correlator software to a stable configuration under the new version, but continuing to use the Sun compilers to generate the code downloaded to the Motorola real-time processors. The next phase will involve switching to the 'gnu' compilers in the near future.

The survey of prospective VLBA users to determine priorities for data distribution media was completed. Responses were received from a broad range of institutions, and of user specialization and degree of experience, so the results of the survey appear to suffice for guiding procurement of the correlator's initial complement of distribution outputs. DAT and "Exabyte" media were the clear preference; these drives will be provided in roughly equal numbers. Not a single respondent cited 9-track tape as a highest priority, and thus it was decided to omit this expensive but obsolete medium from the distribution subsystem. It will still be possible to satisfy occasional user requests for such tapes, however, using drives on other computers in the Array Operations Center.

Several procurements initiated in the previous quarter were received: the Sun-4 system which will provide an upgrade path to prolong the useful life of the correlator group's aging Sun-3 workstations; large SCSI disks for the archive and distribution subsystems; and a first "Exabyte" distribution drive.

Data Processing

The data processing group worked on the following VLBA related items during the last quarter:

(1) The tasks of reading and writing the new VLBA archive-distribution format were completed and tested within the AIPS environment. Tests verified that we can read files written by the correlator group in this format. Preliminary results continue to be very encouraging.

(2) Testing the calibration and analysis software within the AIPS system has also continued. Additional small bugs have been found and fixed.

(3) Writing diagnostics for debug of the VLBA correlator were planned to start in the next quarter.

(4) The group has spent some time defining the next stage of the testing of the software. We need to be able to compare the results of the AIPS fringe-fitting software with those obtained from the Haystack software on the same data sets. This task will also be undertaken in the next quarter.

O. PERSONNEL

New Hires

Beasley, A.	Research Associate	10/14
Hudson, R.	Electronics Engineer I	10/28
Green, P.	Systems Analyst	10/28
Reiland, G.	Electronics Engineer I	11/18
Prewitt, M.	Systems Analyst	12/02

Terminations

Kislyakov, A.	Visiting Scientist	12/18
Andre, P.	Visiting Assistant Scientist	12/31
Ge, J.	Assistant Scientist, Socorro Oper.	12/31

Retirement

Heeschen, D.	Senior Scientist	12/31

Other

Greisen, E.	return from leave of absence	10/01
Payne, R.	transfer from Socorro to Green Bank	10/01

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