NATIONAL RADIO ASTRONOMY OBSERVATORY

QUARTERLY REPORT

1 April 1994 - 30 June 1994

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A. TELESCOPE USAGE

The following telescopes have been scheduled for research and maintenance in the following manner during the first quarter of 1994.

	140 Foot	12 Meter	VLA	VLBA
Scheduled observing (hours)	1942.25	1982.75	1663.1	637
Scheduled maintenance an equipment changes	178.00	15.00	257.9	200
Scheduled tests and calibration	61.25	186.25	263.0	366
Time lost	78.25	214.50	-	28
Actual observing	1864.00	1768.25	1663.1	609

B. 140 FOOT TELESCOPE

The following continuum programs were conducted during this quarter.

No.	Observer(s)	Program
A122	Albright, G. (Virginia) Richards, M. (Virginia)	An 8.4 GHz radio survey of flaring events on Algol secondaries.
F123	Frail, D. Kulkarni, S. (Caltech) Fishman, G. (NASA/MSFC) Kouveliotou, C. (NASA/MSFC) Meegan, C. (NASA/MSFC)	A 6 cm search for the radio counterparts to gamma ray bursters.

The following line programs were conducted during this quarter.

No.	Observer(s)	Program
B609	Bania, T. (Boston) Rood, R. (Virginia) Balser, D. (Boston)	X-band measurements of the cosmic abundance of ^{3}He.
B615	Burrows, D. (Penn State) Gou, Z. (Penn State)	21 cm emission line observations of X-ray absorbing clouds.
B616	Braun, R. (NFRA) Carilli, C. (Leiden)	500 MHz observations of molecular gas in the early universe.
B626	Bell, M. (Herzberg)	8 GHz observations of the excitation temperature of long carbon-chain molecules in W51.

No.	Observer(s)	Program
B627	Burton, W. B. (Leiden) Heiles, C. (Calif., Berkeley) Murphy, E. (Virginia) Lockman, J. F.	HI observations of the dwarf spheroidal galaxy centered near 19^h, -30°.
B628	Burton, W. B. (Leiden)	Observations of broad HI emission accelerated away from star-forming regions.
D183	Danly, L. (STScI) Kuntz, K. (STScI) Heiles, C. (Calif., Berkeley) Levenson, N. (Calif., Berkeley)	HI mapping of the intermediate velocity (IV) arch.
D185	de Pater, I. (Calif., Berkeley) Heiles, C. (Calif., Berkeley) Bolton, S. (JPL) Klein, M. (JPL)	1.4 GHz observations of Jupiter's synchrotron radiation before, during, and after the comet Shoemaker-Levy collision.
H292	Heiles, C. (Calif., Berkeley) Reach, W. (NASA/GSFC) Koo, B-C. (Seoul National U.)	Mapping "worms" in RRL emission.
H293	Haynes, M. (Cornell) Hogg, D. Maddalena, R. Roberts, M.	Evaluating galactic HI envelopes and a search for faint companions.
L291	Langston, G. Fisher, J. R.	Observations at 1.0 - 1.42 GHz to test for velocity dispersion of gravitational lenses.
M361	Murphy, E. (Virginia) Lockman, J. F.	21 cm observations of the magnetic field in galactic HI.
M370	Matthews, L. (SUNY) Gallagher, J. (Wisconsin) Littleton, J. (West Virginia)	HI survey of extreme late-type galaxies.
M373	Murphy, E. (Virginia) Lockman, J. F. Savage, B. (Wisconsin)	A 21 cm deep search for high-velocity clouds.
S386	Stocke, J. (Colorado)	21 cm search for metal absorption line in quasar ZW2.
V083	van Zee, L. (Cornell) Haynes, M. (Cornell) Maddalena, R.	HI observations of galaxies with extended hydrogen envelopes.

The following pulsar programs were conducted during this quarter.

No.	Observer(s)	Program
A116	Arzoumanian, Z. (Princeton) Nice, D.	Observations at 550 MHz of the orbital fluctuations in the eclipsing pulsar binary PSR B1957+20.
A118	Arzoumanian, Z. (Princeton) Nice, D. Taylor, J. (Princeton)	Bimonthly timing of 63 pulsars at 550 MHz.
A121	Arzoumanian, Z. (Princeton) Taylor, J. (Princeton)	575 MHz observations measuring relativistic effects in binary pulsar systems.
B617	Backer, D. (Calif., Berkeley) Sallmen, S. (Calif., Berkeley) Foster, R. (NRL)	Pulsar timing array observations at 800 and 1395 MHz.
G336	Gwinn, C. (Calif., Santa Barbara) McKinnon, M. Desai, K. (Calif., Santa Barbara) Diercks, A. (Calif., Santa Barbara)	1420 MHz observations of the scattering of young pulsars and supernova remnants.
L296	Lundgren, S. (NRL) Zepka, A. (Cornell) Cordes, J. (Cornell) Foster, R. (NRL)	Timing observations at 800 and 1400 MHz of the new millisecond pulsar PSR J0751+18.
M368	McKinnon, M.	Timing the young pulsar PSR B1823-13.
N011	Nice, D. Sayer, R. (Princeton) Taylor, J. (Princeton)	A 350-420 MHz survey of the northern sky for millisecond pulsars.
N014	Navarro, J. (Caltech) Kulkarni, S. (Caltech) de Bruyn, G. (NFRA)	400 MHz observations of PSR 0214+42 — A new field millisecond pulsar.
N015	Nice, D. Sayer, R. (Princeton) Taylor, J. (Princeton) Fruchter, A. (Princeton) Backer, D. (Calif., Berkeley)	A search at 1400 MHz for pulsed radio emission from gamma-ray point sources.

The following very long baseline programs were conducted.

No.	Observer(s)	Program
BR017	Ratner, *et al.*	The astrometry of HR 5110 for the NASA/Stanford gravity probe-B relativity gyroscope experiment.

No.	Observer(s)	Program
FAH01	Ficarra	6 cm compact source test for Bologna correlator.
GR004	Rupen, *et al.*	VLBI imaging of supernovae 1993J in M81.
GZ011	Zensus, *et al.*	Monitoring the parsec-scale jet structure of 3C 345.

C. 12 METER TELESCOPE

The following line programs were conducted during this quarter.

No.	Observer(s)	Program
B605	Backer, D. (Calif., Berkeley) Wright, M. (Calif., Berkeley) Plambeck, R. (Calif. Berkeley) Welch, W. J. (Calif., Berkeley) Kellermann, K. Emerson, D. Carlstrom, J. (Calif., Berkeley) Padin, S. (Caltech) Moran, J. (CFA) Rogers, A. (Haystack)	VLBI observations of Sgr A* at λ 3 mm.
B606	Balonek, T. (Colgate) Dent, W. (Massachusetts)	Study of the evolution of extragalactic radio sources at millimeter wavelengths.
B614	Baan, W. (NAIC) Freund, R.	Study of the molecular content of OH megamaser nuclei.
B624	Brown, R. Frayer, D. (Virginia)	Study of CO associated with the z = 0.437 absorption system toward 3C 196.
C283	Clancy, R. T. (Colorado) Sandor, B. (Colorado) Muhleman, D. (Caltech)	Microwave spectroscopy of terrestrial planetary atmospheres.
C287	Crutcher, R. (Illinois) Troland, T. (Kentucky)	Tests for CN Zeeman observations.
F120	Fuller, G. Chernin, L. (Calif., Berkeley)	Study of the properties of sulphur monoxide in outflows.
H294	Holdaway, M.	Study of linear polarization of flat spectrum quasars at 90 GHz.
H296	Hogg, D. Roberts, M.	Study of the nature of the interstellar medium in early-type galaxies.

No.	Observer(s)	Program
H297	Higdon, J. Lord, S. (IPAC) Rand, R. (Maryland)	Study of the molecular gas content of ring galaxies.
H298	Helfer, T. (Maryland) Blitz, L. (Maryland)	Mapping CO and HCN in NGC 1068.
L279	Latter, W. Jewell, P.	Study of a spectral bandscan of IRC+10216 in the 1.2 mm window.
L294	Liszt, H.	Study of the association between neutral and ionized gas in Sgr A.
L295	Liszt, H.	J=1-0 HCO^+ emission survey of the inner galactic plane.
P164	Papadopoulos, P. (Toronto) Seaquist, E. (Toronto)	A CO (1-0) survey of a complete AGN sample.
P167	Papadopoulos, P. (Toronto) Seaquist, E. (Toronto)	Study of CO J=1-0, 2-1 in Seyfert galaxies.
P168	Paglione, T. (Boston) Jackson, J. (Boston)	HCN 3-2 observations of galaxies: dense gas—starburst correlation.
S358	Salter, C. (NAIC) Sinha, R. (TIFR) Emerson, D. Jewell, P. Kerr, F. (NASA/GSFC)	Continuum observations of the galactic center at λ 3 mm.
S373	Shepherd, D. (Wisconsin) Churchwell, E. (Wisconsin)	A search for CO (1-0) emission from tidal plumes.
S374	Snyder, L. (Illinois) Miao, Y. (Illinois) Kuan, Y. (Illinois)	A map of ethyl cyanide in the Sgr B2 molecular clouds.
S379	Shepherd, D. (Wisconsin) Churchwell, E. (Wisconsin)	Follow-up proposal to observe molecular outflows associated with ultracompact HII regions.
S380	Smith, B. (Texas) Walker, C. E. (Arizona)	CO (1-0) observations of the QSO-galaxy pair 3C 232/NGC 3067.
S383	Sanders, D. (Hawaii) Evans, A. (Hawaii) Mazzarella, J. (Caltech) Graham, J. (Calif., Berkeley) Chambers, K. (Hawaii)	CO observations of high-z, powerful radio galaxies: 3C 368 (z=1.1), 4C 23.56 (z=2.5), 4C 28.58 (z=2.9), and B 20902 (z=3.4).

No.	Observer(s)	Program
T296	Turner, B. Steimle, T. (Arizona State)	A 2 mm spectral survey of Orion, Sgr B2, W51M, and IRC+10216.
T331	Turner, B. Steimle, T. (Arizona State)	A confirmation of silylene (SiH_2) in IRC+10216.
T333	Turner, B. Steimle, T. (Arizona State)	A search for KCN in IRC+10216.
T334	Turner, B.	A search for sodium hydride (NaH) in IRC+10216.
V84	van Breugel, W. (Caltech) Lehnert, M. (Caltech) Dey, A. (Calif., Berkeley)	CO observations of radio/IRAS post-starburst AGN and high z quasars.
W322	Walker, C. K. (Arizona) Jewell, P. Narayanan, G. (Arizona)	An experiment to detect linear polarization of millimeter emission lines.
W341	Wilner, D. (CFA) Welch, W. J. (Calif., Berkeley) Forster, R. (Calif., Berkeley)	Study of the environments of a sample of UC HII regions observed with BIMA.
W342	Wilner, D. (CFA) Reynolds, S. (N.C. State) Moffett, D. (NMIMT)	Interaction of the supernova remnant 3C 391 with a molecular cloud?
Z110	Ziurys, L. (Arizona State) Apponi, A. (Arizona State) Jarrold, M. (Northwestern)	A renewed search for interstellar HOC^+.
Z111	Ziurys, L. (Arizona State) Snyder, L. (Illinois) Hollis, M. (NASA/GSFC)	A search for interstellar N_2O.
Z113	Ziurys, L. (Arizona State) Steimle, T. (Arizona State) Apponi, A. (Arizona State)	Confirmation of interstellar MgCN.

D. VERY LARGE ARRAY

No.	Observer(s)	Program
AA169	Antonucci, R. (Calif., Santa Barbara) Barvainis, R. (Haystack)	Nature of the optical/ultraviolet emission in AGN. 3.6 cm

No.	Observer(s)	Program
AA174	Anantharamaiah, K. (Raman Institute) Duroachoux, P. (CNRS, France) Dwarakanath, K. Wallyn, P. (CNRS, France)	Radio counterpart of EXS 1737-2952. 6, 20 cm
AA179	Andre, P. (CNRS, France) Wootten, H. A. Despois, D. (Bordeaux Obs)	Compact circumstellar dust structures in Rho Ophiuchi. 0.7 cm
AB612	Biretta, J. (STScI) Owen, F.	Monitoring of proper motions in the M87 jet. 2 cm
AB628	Becker, R. (Calif., Davis) Helfand, D. (Columbia) White, R. (STScI) Perley, R.	Survey of the north galactic cap. 20 cm
AB699	Beasley, A. Owen, F. Voges, W. (MPIfEP, Garching)	X-ray selected intermediate redshift clusters. 20 cm
AB700	Bondi, M. (Manchester) Dallacasa, D. (NFRA) Della Ceca, R. (Johns Hopkins) Stanghellini, C. (Noto, Italy)	High sensitivity observations of radio selected BL Lac objects. 3.6, 20 cm
AB701	Browne, I. (Manchester) Wilkinson, P. (Manchester) Nair, S. (Manchester) Myers, S. (Caltech) Readhead, A. (Caltech) Pearson, T. (Caltech) Blandford, R. (Caltech) de Bruyn, A. (NFRA) Schilizzi, R. (NFRA) Miley, G. (Leiden) Jackson, N. (Leiden)	Search for gravitational lenses. 3.6 cm
AB705	Burke, B. (MIT) Becker, D. (MIT) Lehar, J. (Cambridge) Hewitt, J. (MIT) Roberts, D. (Brandeis)	Time delay of the gravitational lens 0957+561. 3.6, 6 cm
AB706	Biretta, J. (STScI) Zhou, F. (NMIMT)	Proper motions in extragalactic jets: Preliminary FR-I Survey. 3.6 cm

No.	Observer(s)	Program
AB707	Browne, I. (Manchester) Patnaik, A. (MPIR, Bonn) Walsh, D. (Manchester) Wilkinson, P. (Manchester)	Monitoring smallest lens 0218+357: A step to measuring Ho. 2, 3.6 cm
AB708	Backer, D. (Calif., Berkeley) Sramek, R.	Proper motion of Sgr A*. 3.6, 6 cm
AB713	Brown, R. Cutri, R. (Arizona) Huchra, J. (CFA) Low, F. (Arizona) Vanden Bout, P.	Candidate protogalaxies. 3.6 cm
AB721	Brown, D. (Northwestern) Yusef-Zadeh, F. (Northwestern) Perez, M. (NASA/GSFC)	Herbig Ae star HD 163296. 3.6, 20 cm
AC346	Crane, P. (ESO) Peletier, R. (ESO) Perley, R.	3C 264: a new optical synchrotron jet. 2 cm
AC363	Curiel, S. (CFA) Rodriguez, L. (Mexico/UNAM) Eiroa, C. (Madrid) Canto, J. (Mexico/UNAM)	Radio continuum emission associated with YSOs. 6 cm
AC373	Chen, H. (CFA) Taylor, A. (Calgary) Dougherty, S. (Liverpool JMU)	Sensitive radio survey of Be stars. 3.6 cm
AC379	Chambers, K. (Hawaii) Swanson, J. (Hawaii)	The nature of high redshift radio galaxies. 3.6, 20 cm
AC384	Ciliegi, P. (CFA) Elvis, M. (CFA) Boyle, B. (Cambridge) Maccacaro, T. (Milano)	Complete ROSAT X-ray selected sample of AGN. 20 cm
AC389	Clements, D. (Oxford) Saunders, W. (Oxford) Sutherland, W. (Oxford) McMahon, R. (Cambridge) Maddox, S. (Cambridge) Efstathiou, G. (Oxford) Rowan-Robinson, M. (Imperial College)	A new sample of ultraluminous IRAS galaxies. 20 cm

No.	Observer(s)	Program
AC390	Combes, F. (Meudon) Viallefond, F. (Meudon)	Flaring of HI planes in 10 edge-on galaxies. 20 cm line
AC391	Conway, J. Frail, D.	Search for radio emission from extra-solar Jovian planets. 90 cm
AC394	Cox, A. (Wisconsin) Sparke, L. (Wisconsin) van Moorsel, G.	Radio continuum survey of polar ring galaxies. 6, 20 cm
AD328	Dickey, J. (Minnesota) Brinks, E. Rupen, M. Sramek, R. Bowen, D. (STScI) Roth, K. (STScI)	SN 1993J in M81. 20 cm line
AD333	Duric, N. (New Mexico) Goss, W. M. Viallefond, F. (Meudon) Lacey, C. (New Mexico) Gordon, S. (CFA)	A multi-wavelength survey of SNRs in nine nearby galaxies. 6, 20 cm
AD334	Dhawan, V. Beasley, A.	43 GHz fluxes and spectral indices of millimeter VLBI sources. 0.7, 2 cm
AD337	Drake, S. (USRA/GFSC) White, S. (Maryland)	Search for emission from very low mass stars and brown dwarfs. 6, 20 cm
AD344	de Pater, I. (Calif., Berkeley) Heiles, C. (Calif., Berkeley) Bolton, S. (JPL) Klein, M. (JPL)	Comet — Jupiter crash. 20, 90 cm
AE097	Eilek, J. (NMIMT) Loken, C. (NMSU) Owen, F.	The ends of type I radio tails. 90 cm
AE098	Eyres, S. (Manchester) Davis, R. (Manchester) Kenny, H. (Canadian Military) Bode, M. (Liverpool JMU) Dougherty, S. (Liverpool JMU) Bang, M. (Liverpool JMU) Taylor, A. (Calgary)	Multi-frequency observations of symbiotic novae. 1.3, 3.6 cm

No.	Observer(s)	Program
AF263	Feretti, L. (Bologna) Giovannini, G. (Bologna) Parma, P. (Bologna) Laing, R. (RGO) Bridle, A. Perley, R.	Tests for kiloparsec-scale jet deceleration using 3C 31. 3.6, 6, 20 cm
AF267	Felli, M. (Arcetri) Tofani, G. (Arcetri) Goldsmith, P. (NAIC) Olmi, L. (NAIC)	IR cluster in Cepheus B — S155 interface. 2, 3.6 cm
AF270	Fruchter, A. (STScI) Goss, W. M.	Dual wavelength observation of Terzan 5. 20, 90 cm
AG403	Gomez, Y. (Mexico/UNAM) Rodriguez, L. (Mexico/UNAM) Garay, G. (Chile, U. of)	Search for radio continuum emission in selected OH/IR stars. 3.6 cm
AG404	Greenhill, L. (CFA) Menten, K. (CFA) Alcolea, J. (Yebes Obs)	SiO maser and compact H II regions in W51-IRS2. 0.7 cm line
AG409	Giovannini, G. (Bologna) Feretti, L. (Bologna) Venturi, T. (Bologna)	Cores of radio galaxies 1144+35 and 3C 338. 3.6, 6, 20 cm
AG412	Grossman, A. (Maryland) Clancy, R. T. (Colorado/JILA) Muhleman, D. (Caltech)	Mapping seasonal variation of Mars water vapor. 1.3 cm line
AG413	Grossman, A. (Maryland) Muhleman, D. (Caltech) Gurwell, M. (Caltech)	Impact of comet Shoemaker — Levy 9 on Jupiter. 3.6, 6 cm
AG416	Guedel, M. (SFIT, ETH) Guinan, E. (Villanova) Dorren, J. (Villanova) Schmitt, J. (MPIfEP, Garching) Elias, N. (USNO)	Sun in time project: variability in active ZAMS G star EK Dra. 3.6 cm
AG417	Giacani, E. (Buenos Aires) Dubner, G. (Buenos Aires) Goss, W. M. Winkler, P. F. (Middlebury College) Frail, D.	Multi-frequency observations of the SNR W44. 20 cm
AG421	Gaume, R. (NRL) Fischer, J. (NRL)	Monitoring the radio continuum flux density of NGC 2024-IRS2. 1.3, 2, 3.6, 6, 20 cm

No.	Observer(s)	Program
AG422	Ghez, A. (UCLA) Fuller, G. Bieging, J. (Arizona)	Radio survey of T Tauri binary star systems. 3.6 cm
AH492	Hjellming, R. Gehrz, R. (Minnesota) Seaquist, E. (Toronto) Taylor, A. (Calgary)	Image and light curve evolution of the novae Puppis 1991 and Cygni 1992. 1.3, 2, 3.6, 6, 20 cm
AH505	Hofstadter, M. (JPL)	Continuum mapping of Uranus at 2 and 6 cm. 2, 6 cm
AH507	Hankins, T. (NMIMT) Moffett, D. (NMIMT)	Nanosecond time resolution observations of Crab pulsar giant pulses. 2, 3.6, 6, 20 cm
AH509	Hajian, A. (Cornell) Terzian, Y. (Cornell)	Planetary nebula expansion parallax distances. 6 cm
AI050	Ivison, R. (Toronto) Seaquist, E. (Toronto)	Images of RX Puppis during a phase of low excitation. 1.3, 3.6 cm
AI051	Ivison, R. (Toronto) Seaquist, E. (Toronto) Hall, P. (ATNF)	OH mapping of the symbiotic OH/IR star, H1-36. 20 cm line
AI053	Ivison, R. (Toronto) Seaquist, E. (Toronto) Hall, P. (ATNF)	Imaging the water maser in R Aquarii. 1.3 cm line
AJ229	Jaffe, W. (Leiden) McNamara, B. (Groningen/Kapteyn)	HI in N4261 = 3C 270. 20 cm line
AJ234	Jacobson, A. (Los Alamos) Mercier, C. (Meudon) Mercier, C. (Paris Obs.) Erickson, W. (Tasmania)	Geoplasma dynamics. 90 cm
AJ236	Jowett, F. (Manchester) Spencer, R. (Manchester) Vermeulen, R. (Caltech) Schilizzi, R. (NFRA)	SS433: observations in conjunction with VLBI and Merlin. 1.3 cm
AJ238	Johnston, K. (NRL) Gaume, R. (NRL) Nedoluha, G. (NRL) Wilson, T. (MPIR, Bonn) Collison, A. (Illinois)	Spatial structure of Orion CH_3OH maser. 1.3 cm line
AK319	Katz-Stone, D. (Minnesota) Rudnick, L. (Minnesota)	Three-frequency mapping of FR 1 radio galaxy 3C 449. 90 cm

No.	Observer(s)	Program
AK331	Kobulnicky, C. (Minnesota) Dickey, J. (Minnesota) Conti, P. (Colorado/JILA)	Spectral index mapping of Wolf-Rayet galaxies. 20, 90 cm
AK340	Kenny, H. (CMC, Kingston) Taylor, A. (Calgary) Seaquist, E. (Toronto)	Outburst flux measurements of the stellar jet source, CH Cygni. 2, 6, 20 cm
AK354	Koerner, D. (Caltech) Sargent, A. (Caltech) Chandler, C.	Radial structure and dust properties of protoplanetary disks. 0.7, 1.3, 3.6 cm
AK355	Kurtz, S. (Mexico/UNAM) Garay, G. (Chile) Lizano, S. (Mexico/UNAM)	Are UC HII regions photovaporating accretion disks? 3.6, 6, 20 cm
AK356	Katz, C. (MIT) Hewitt, J. (MIT)	Gravitational lens MG0414+0534. 1.3 cm
AK359	Kollgaard, R. (Penn State) Kedziora-Chudczer, L. (ATNF) Feigelson, E. (Penn State) Gabuzda, D. (Calgary) Urry, C. (STScI) Pesce, J. (STScI)	Multifrequency monitoring of PKS 2155-304. 1.3, 2, 3.6, 6 cm
AK360	Kollgaard, R. (Penn State) Bade, N. (Hamburger Sternwarte) Brinkman, W. (MPE, Munich) Feigelson, E. (Penn State) Reimers, D. (Hamburger Sternwarte)	Snapshot observations of radio-weak BL Lacertae objects. 6 cm
AK362	Kobulnicky, H. (Minnesota) Dickey, J. (Minnesota) Conti, P. (Colorado) Sargent, A. (Caltech)	High-resolution HI mapping of HE2-10. 20 cm line
AL314	Liang, E. (Rice) Hjellming, R.	Search for radio jets and variations in the annihilator 1H1822-371. 2, 3.6, 6, 20 cm
AL320	Lim, J. (Caltech) Bieging, J. (Arizona)	Search for nonthermal emission from early type stars in close binaries. 3.6, 6, 20 cm
AL323	Lim, J. (Caltech) White, S. (Maryland)	Search for radio emission from K dwarf stars in the Pleiades. 3.6 cm

No.	Observer(s)	Program
AL327	Laurent-Muehleisen, S. (Penn State) Kollgaard, R. (Penn State) Feigelson, E. (Penn State) Siebert, J. (MPE, Munich) Brinkman, W. (MPE, Munich)	Completing the ROSAT-selected sample of radio loud AGN in GB survey. 6 cm
AL328	Lazio, T. (Cornell) Cordes, J. (Cornell) Frail, D.	Origin of interstellar scattering towards the galactic center. 6, 20 cm
AM397	Molnar, L. (Iowa) Niermann, S. (Iowa) Kniffen, D. (Hampden-Sydney) Mattox, J. (NASA/GSFC)	Radio counterparts of EGRET gamma ray point sources. 3.6, 20 cm
AM405	Miranda, L. (Madrid) Torrelles, J. (IAP, Granada) Eiroa, C. (Madrid)	H92α in proto-PNs and very young PNs. 3.6 cm line
AM418	McIntyre, V. (CFA) Puche, D. (CFA) Huchra, J. (CFA)	Star formation and internal kinematics of irregular galaxies. 20 cm line
AM435	Mehringer, D. (Illinois) Palmer, P. (Chicago) Goss, W. M.	SiO masers in W51 and electron temperature of the ultracompact HII region complex Sgr B2 F. 0.7, 18 cm
AM440	Marscher, A. (Boston) Moore, E. (Boston) Bania, T. (Boston)	Variable molecular absorption to extragalactic continuum sources. 2, 6 cm line
AM441	Menten, K. (CFA) Reid, M. (CFA)	44 GHz methanol masers. 0.7 cm line
AM442	Menten, K. (CFA) Reid, M. (CFA)	VLA 43 GHz observations of the compact Orion-KL radio sources. 0.7 cm line
AM445	Moore, C. (MIT) Hewitt, J. (MIT)	Time delays in the gravitational lens MG0414+0534. 3.6 cm
AM446	Mirabel, F. (CNRS, France) Rodriguez, L. (Mexico/UNAM)	GRS1915+105: possible hard X-ray counterpart of a soft gamma repeater. 3.6, 20 cm
AM447	Mirabel, F. (CNRS, France) Rodriguez, L. (Mexico/UNAM)	Hard X-ray transient GRS1716-249. 6, 20 cm

No.	Observer(s)	Program
AM450	Molinari, S. (Bologna) Brand, J. (Bologna) Cesaroni, R. (Arcetri) Palla, F. (Arcetri) Palumbo, G. (Bologna)	Very young massive stars. 2, 6 cm
AM454	McMahon, R. (Cambridge) Lonsdale, C. (Haystack) Rowan-Robinson, M. (Imperial College) Lehar, J. (Cambridge)	Search for high redshift IR luminous galaxies. 20 cm
AP263	Patnaik, A. (MPIR, Bonn) Browne, I. (Manchester) Muxlow, T. (Manchester) Wilkinson, P. (Manchester)	Monitoring the gravitational lens B1422+23.1. 2 cm
AP283	Phillips, R. (Haystack) Lonsdale, C. (Haystack) Hand, J. (Kansas)	The nonthermal radio luminosity function for lower mass WTT stars. 3.6 cm
AP284	Perlman, E. (Colorado) Stocke, J. (Colorado) Burns, J. (NMSU)	Clusters of galaxies at high redshift: search for lensing. 3.6, 6, 20 cm
AP291	Paredes, J. (Barcelona) Marti, J. (Barcelona) Taylor, A. (Calgary) Peracaula, M. (Calgary) Coe, M. (Southhampton) Strickman, M. (NRL)	Concurrent radio, X-ray, and infrared observations of LSI+61 303. 1.3, 2, 6, 20 cm
AP293	Perlman, E. (Colorado) Stocke, J. (Colorado) Burns, J. (NMSU)	Imaging the highest redshift clusters of galaxies known. 20 cm
AP294	Pooley, G. (Cambridge) Hardcastle, M. (Cambridge) Riley, J. (Cambridge) Alexander, P. (Cambridge)	Constraining the luminosity function of jets in FRII radio galaxies. 3.6 cm
AR277	Rodriguez, L. (Mexico/UNAM) Gomez, Y. (Mexico/UNAM) Canto, J. (Mexico/UNAM) Lizano, S. (Mexico/UNAM) Escalante, V. (Mexico/UNAM)	First images of protoplanetary disks. 0.7, 3.6 cm
AR310	Rudnick, L. (Minnesota) Keohane, J. (Minnesota) Perley, R.	Evolutionary studies of Cas A. 6, 20 cm

No.	Observer(s)	Program
AR312	Reid, M. (CFA) Menten, K. (CFA)	SiO masers and stellar disks of red giants. 0.7 cm
AR313	Roberts, D. (Illinois) Crane, P. (Interferometrics) Cowan, J. (Oklahoma) Dickel, J. (Illinois)	VLA search for a nuclear source in M32. 3.6, 20 cm
AR316	Rich, M. (Columbia) Forster, K. (Columbia) van Gorkom, J. (Columbia)	HI column densities in BAL active galaxies. 20 cm line
AR317	Ratner, M. (CFA) Bartel, N. (York) Lestrade, J. F. (JPL/Meudon) Lebach, D. (CFA) Shapiro, I. (CFA)	Monitor IM Peg, Lambda, for NASA/Stanford gravity probe-B use. 3.6 cm
AR318	Rucinski, S. (York U.)	Survey of contact binary stars. 3.6 cm
AR319	Roberts, D. (Illinois) Mehringer, D. (Illinois) Crutcher, R. (Illinois) Troland, T. (Kentucky) Goss, W. M.	HI Zeeman observations of SGR B2. 20 cm line
AR320	Roberts, D. (Illinois) Crutcher, R. (Illinois) Troland, T. (Kentucky) Goss, W. M.	High resolution HI Zeeman observations of W3. 20 cm line
AS522	Seaquist, E. (Toronto) Ivison, R. (Toronto)	Observations of 43 GHz SiO maser emission in R Aqr. 0.7, 2 cm line
AS525	Sramek, R. Weiler, K. (NRL) Van Dyk, S. (NRL) Panagia, N. (STScI)	The properites of radio supernovae. 1.3, 2, 3.6, 6, 20 cm
AS534	Sevenster, M. (Leiden) Lindquist, M. (Leiden) Habing, H. (Leiden) van Langevelde, H. (NFRA)	1612 MHz OH survey to complete IRAS/OH surveys. 20 cm line

No.	Observer(s)	Program
AS535	Scheuer, P. (Cambridge) Laing, R. (RGO) Dennet-Thorpe, J. (Cambridge) Bridle, A.	Jet and spectral-index asymmetries in nearby FRII radio galaxies. 20 cm
AS540	Sjouwerman, L. (Leiden) van Langevelde, H. (Leiden) Diamond, P. Lindquist, M. (Leiden) Winnberg, A. (Chalmers/Onsala)	SiO maser emission in galactic centre OH/IR stars. 0.7 cm line
AT154	Thorsett, S. (Caltech) Taylor, J. (Princeton) McKinnon, M. Hankins, T. (NMIMT) Stinebring, D. (Oberlin)	Timing fast pulsars at the VLA. 6, 20, 90 cm
AT159	Tongue, T. (NMIMT) Westpfahl, D. (NMIMT)	Resolving a non-thermal super bubble in Holmberg II. 20 cm
AV205	van der Werf, P. (MPIfEP, Garching)	Imaging of the starburst nucleus in M83. 6 cm
AW350	Wills, B. (Texas) Shastri, P. (Calif., Berkeley)	Core variability in lobe-dominated quasars. 3.6 cm
AW362	White, S. (Maryland)	The stellar activity cycle on active stars. 3.6, 6, 20 cm
AW372	Wagner, S. (Heidelburg Obs.) Quirrenbach, A. (IRAM)	What causes asymmetries in low luminosity jets of Seyfert galaxies? 3.6, 20 cm
AW374	Wood, D.	Observations of ultracompact HII regions. 0.7, 3.6 cm
AW375	Wootten, H. A. Mangum, J. (Arizona)	Cool dust and star-forming cores in DR21(OH). 0.7, 3.6 cm
AW380	Wilson, T. (MPIR, Bonn) Gaume, R. (NRL) Johnston, K. (USNO) Dickel, H. (Illinois)	Continuum emission from protostars in NGC 2024 at 7 mm.
AW382	Wood, D. Karovska, M. (CFA)	Imaging of R Aquarii. 0.7, 3.6 cm
AW384	Wilcots, E. Miller, B. (Washington)	HI observations of barred magellanic-type galaxies. 20 cm line
AW388	Willson, R. (Tufts) Kile, J. (Tufts) Lang, K. (Tuffs)	Active stars. 3.6, 6, 20 cm

No.	Observer(s)	Program
AY064	Yin, Q.-F. Condon, J.	Supernovae in NGC 3690. 3.5, 6, 20 cm
AZ066	Zepka, A. (Cornell) Lundgren, S. (Cornell) Cordes, J. (Cornell)	Astrometry of new pulsars found in X-ray selected fields. 20 cm

E. VERY LONG BASELINE ARRAY

No.	Observer(s)	Program
BD002	Diamond, P. Kemball, A. (HartRAO) Benson, J. Junor, W. Zensus, J. A.	Monitoring the structure of SIO masers with VLBA. 0.7 cm line
BK015	Katz-Stone, D. (Minnesota) Rudnick, L. (Minnesota)	Low-energy end of the spectrum of relativistic electrons in 3C 67 and 3C 190. 90 cm
BL004	Lazio, T. (Cornell) Cordes, J. (Cornell)	Angular broadening in the galactic anticenter. 20, 90 cm phased array
BM019	Miyoshi, M. (Nobeyama) Inoue, M. (Nobeyama) Nakai, N. (Nobeyama) Moran, J. (CFA) Greenhill, L. (CFA) Diamond, P.	H_2O maser features in the galaxy NGC 4258. 1.3 cm
BM029	McMahon, P. (MIT) Chen, G. (MIT) Hewitt, J. (MIT)	VLBA imaging of the Einstein ring MG1131+0456. 20 cm phased array VLBI
BM033	Marcaide, J. (Valencia, Spain) Alberdi, A. (IAA, Granada) Guirado, J. (IAA, Granada) Diamond, P. Jones, D. (JPL) Krichbaum, T. (MPIR, Bonn) Mantovani, F. (Bologna) Preston, R. (JPL) Rius, A. (IAA, Granada) Rogers, A. (Haystack) Ros, E. (Valencia, Spain) Schilizzi, R. (NFRA) Shapiro, I. (CFA) Trigilio, C. (Bologna) Whitney, A. (Haystack) Witzel, A. (MPIR, Bonn)	Supernova 1994I in M51. 2 cm phased array VLBI

No.	Observer(s)	Program
BR017	Ratner, M, (CFA) Bartel, N. (CFA) Lebach, D. (CFA) Lestrade, J. F. (JPL/Meudon) Shapiro, I. (CFA)	Astrometry of HR 5110 for the NASA/Stanford gravity probe-B. 3.6, 6 cm
BR027	Rupen, M. Bartel, N. (York U.) Conway, J. Beasley, A. Sramek, R. Altunin, V. (JPL) Bietenholz, M. (York U.) Cannon, W. (York U.) Davis, R. Graham, D. (MPIR, Bonn) Jones, D. (JPL) Panagia, N. (STScI) Popelar, J. (Ottawa) Rius, A. (IAG, Madrid) Romney, J. Titus, M. (Haystack) Umana, G. (Noto, Italy) Van Dyk, S. (Calif., Berkeley) Venturi, T. (Bologna) Weiler, K. (NRL)	Supernova 1994I in M51. 3.8, 6 cm
FAH001	Ficarra, A. (Bologna) Mantovani, F. (Bologna)	Tests of Bologna Mark 2 correlator. 6 cm
GG024	Giovannini, G. (Bologna) Feretti, L. (Bologna) Venturi, T. (Bologna) Cotton, W. Lara, L. (IAA, Granada) Wehrle, A. (JPL)	B2 0836+29 and 3C 469. 3.6, 6 cm
GL009	Lestrade, J. F. (JPL/Meudon) Phillips, R. (Haystack) Jones, D. (JPL) Preston, R. (JPL)	Astrometric observations of stars to tie in HIPPARCOS. 3.6 cm phased array VLBI

No.	Observer(s)	Program
GM017	Shapiro, I. (CFA) Marcaide, J. (Valencia, Spain) Alberdi, A. (IAA, Granada) Davis, R. (Manchester) de Bruyn, G. (NFRA) Diamond, P. Elosegui, P. (CFA) Guirado, J. (IAA, Granada) Jones, D. (JPL) Krichbaum, T. (MPIR, Bonn) Mantovani, F. (Bologna) Perez, E. (IAC, Spain) Preston, R. (JPL) Rius, A. (IAA, Granada) Rogers, A. (Haystack) Ros, E. (Valencia, Spain) Schilizzi, R. (NFRA) Trigilio, C. (Bologna) Whitney, A. (Haystack) Witzel, A. (MPIR, Bonn) Zensus, J. A.	SN1993J: Distance to M81. 1.3, 3.6 cm
GR004	Rupen, M. Bartel, N. (CFA) Bartel, N. (York U.) Conway, J. Beasley, A. Sramek, R. Romney, J. Bietenholz, M. (York U.) Weiler, K. (NRL) Altunin, V. (JPL) Bietenholz, M. (York U.) Cannon, W. (York U.) Davis, R. Graham, D. (MPIR, Bonn) Jones, D. (JPL) Panagia, N (STScI) Popelar, J. (Ottawa) Rius, A. (Madrid) Romney, J. Titus, M. (Haystack) van Dyk, S. (NRL) Venturi, T. (Bologna) Weiler, K. (NRL)	Supernova 1993J in M81. 2, 3.6, 6, 21 cm
GZ011	Zensus, J. A. Leppanen, K. (Helsinki) Lobanov, A. (Lebedev) Unwin, S. (Caltech) Wehrle, A. (JPL)	Monitoring the parsec-scale jet structure of 3C 345. 1.3, 3.6, 6 cm

F. SCIENTIFIC HIGHLIGHTS

Green Bank

Recent maps of the galactic soft X-ray background by the ROSAT satellite have revealed a number of "shadows" — regions where the X-rays appear to be absorbed by intervening interstellar matter. Measurements of the HI 21 cm line using the 140 Foot Telescope have shown that most of the shadows can be identified with distinct HI clouds whose velocity can be measured precisely. Given the velocity, a cloud's distance can be determined by searching for the cloud's absorption in optical lines against stars at different distances. The first results of a program of this sort in the Eridinus region indicate that most of the absorption occurs at a distance of about 100 pc, consistent with the model in which the bulk of the observed soft X-ray background originates in a hot bubble of gas surrounding the sun.

Investigators: D. N. Burrows and Z. Guo (Penn State University)

Tucson

Detection of Interstellar N_2O: "Laughing Gas" in the Galactic Center — A new interstellar molecule has been detected which contains an N-O bond. Nitrous oxide (N_2O), otherwise known as "laughing gas," has been observed towards $SgrB_2M$, using the 12 Meter Telescope. The J=3-2, 4-3, 5-4, and 6-5 transitions of this species were measured at 75, 100, 125, and 150 GHz, respectively. The column density derived for N_2O in $SgrB_2$ is NL = 10(15) cm^2, which corresponds to a fractional abundance of about 10(-9), relative to H_2. This value implies abundance ratios of N_2O/NO of 0.1 and N_2O/HNO of 3 in the galactic center. N_2O is the third interstellar molecule discovered to date which contains an N-O bond, along with NO and HNO. All three species are most prevalent in $SgrB_2$, and it is likely that their chemistries are related. Observation of nitrous oxide is additional evidence that N-O bonds are not so rare in interstellar chemistry as previously thought.

Investigators: L. M. Ziurys (Arizona State), J. M. Hollis (NASA/Goddard), and L. E. Snyder (Illinois)

Socorro

VLA Detects Early Emission From SN1994I — Responding quickly to word of the discovery of Supernova 1994I in M51, a team used the VLA to successfully detect radio emission from the supernova within 24 hours of its optical discovery on 2 April. The supernova subsequently has been detected and VLA light curves produced for 1.3, 2, 3.6, 6, and 18 centimeter wavelengths. The first light-curve peak, at 1.3 cm, occurred on 9 April and peaks at longer wavelengths followed, with 6 cm emission peaking on 10 May.

Investigators: M. L. Rupen and R. A. Sramek (NRAO), K. W. Weiler (NRL), N. Panagia (STScI), and S. D. van Dyk (U Berkeley)

VLA Sky Survey Maps Available to Astronomical Community — The first maps from the NRAO VLA Sky Survey (NVSS), a project involving 2,500 hours of observing time, became available to the astronomical community in June. This D-configuration survey will have observed 82 percent of the sky by the end of 1996. The data products from this survey are being released as soon as they are produced and verified. NRAO is making the data available in an electronic repository available by anonymous ftp. The availability of NVSS data is being made known through newsletters, the Internet, an IAU circular, and the news media to ensure that this service gains wide and effective use.

Investigators: J. J. Condon, W. D. Cotton, and E. Greisen (NRAO) and J. Broderick (VPI&SU)

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. CHARLOTTESVILLE ELECTRONICS

Amplifier Development, Design, and Production

The 3.95-5.85 GHz amplifier is presently in the production stage. The production units have demonstrated improvements in noise temperature and stability over the prototype units.

Other amplifiers produced this quarter include the following: 12.0-18.0 GHz (17 units), 330 MHz (5 units), and 611 GHz (3 units).

Work is progressing on the 290-395 MHz balanced amplifier. The prototype unit is currently under construction. Additional balanced amplifiers presently under development include the following designs: 385-520 MHz, 510-690 MHz, 910-1230 MHz, and 1.15-1.73 MHz. These amplifiers are required for the GBT.

Work is continuing on the PC-based automated amplifier test station. Most of the hardware has now been purchased or constructed in-house. Several commercial data-acquisition hardware and software packages have been evaluated. One such package has been chosen for this project and is currently being integrated into the amplifier test station. The data- acquisition package will also be used in an automated SIS mixer test station planned for the near future.

A production run of twenty-four 40-50 GHz amplifiers for VLA Q-band receivers has been completed, with the last five units being built and tested this quarter.

Evaluation of InP HFET devices from Martin-Marietta and Hughes continued. Performance of the 0.1 x 300 μm InP Hughes device has been demonstrated in the 12-18 GHz amplifier (7 K at 15 GHz). Also, passivated InP devices from Hughes have been evaluated in the 40-50 GHz amplifier.

Prototypes of a single-stage and a five-stage 60-90 GHz amplifier have been assembled and are being tested.

Work has started on the S-parameter and noise measurement system at cryogenic temperatures.

Superconducting (SIS) Millimeter-Wave Mixer Development

A series of "workshop" meetings were held with members of the UVA Semiconductor Device Laboratory (the source of most of the multiplier diodes used worldwide in millimeter and submillimeter astronomy). Considerable progress was made on the design of single-chip series-diode multipliers. In particular, it was realized that two uniformly doped Schottky diodes in anti-series connection cannot operate as a tripler. In recent years, considerable effort in many laboratories has gone into trying to build such a multiplier. The design of anti-series diode pairs using delta-doped diodes was studied and some initial designs produced, which will be fabricated at UVA.

Work continues on the design of broadband tunerless SIS mixers. In addition to the conventional single-ended type of mixer, we are exploring the feasibility of balanced mixers covering a full waveguide band. Balanced mixers have a separate LO port and do not need the LO diplexer required by single-ended mixers. This would permit considerable simplification of the receiver optics in the planned Millimeter Array.

We are investigating the possibility of generating high levels of broadband noise by up-conversion. High level broadband noise sources are not available at the shorter millimeter wavelengths, so this approach may provide useful high level calibration signals for use in tuning a telescope receiver, determining the sideband ratio, and monitoring the receiver gain.

During this quarter, we have built (or rebuilt) and tested a total of three SIS mixers and two SIS receiver inserts.

Electromagnetic Support

GBT Project: The individual effects of spillover and phase distortion in the telescope aperture, contributing to gain loss when the telescope deforms due to gravity, have been studied. Almost all of the loss comes from phase distortion, and thus can be corrected by translation of the subreflector. Also, a study was undertaken to design a tertiary reflector for the purposes of beam switching and correcting for wind-induced pointing errors.

VLA Project: An analysis has been performed of the current design of the L-band feed, which incorporates a lens. The purpose of this study was to determine the effects of installing a shield around the feed between the feed aperture and the bottom of the lens in order to reduce the ground contribution to the system temperature. A shield that appears suitable has been designed and can be tested on one of the antennas.

140 Foot Telescope: A feed with extremely low cross-polarization, to work at 1.666 GHz for Zeeman-effect measurements, has been designed. Measurements of the radiation pattern were made on a similar feed at 1.42 GHz to investigate some of the effects that have been observed on the telescope.

GBT Spectrometer

NRAO is still waiting for the second wafer run on the 1024-lag correlator chip to begin. Otherwise, the GBT spectrometer project design is progressing.

Design of two multi-layer PC cards for the spectrometer was completed during the quarter and an RFP released for their layout and manufacture. As a result of the RFP, a vendor was selected and actual layout of the PC cards should start within two weeks.

The design and the initial survey for a vendor for two custom wirewrap panels were done during the quarter. These panels will be used for control-logic PC cards in the GBT spectrometer where most of the logic must work with a 125 MHz clock rate.

The 2 GHz sampler design was completed during the quarter and a prototype has been constructed. Testing of this prototype will start shortly. The design of the 125 MHz sampler was also completed and work is under way to construct a prototype of this unit.

The OVLBI frame decoder has been working in Green Bank since last March and some support engineering has been necessary. A test card for the decoder was designed, built, and programmed during the quarter. This test card is general in nature and may be used for testing of OVLBI hardware in addition to that in Green Bank.

OVLBI Support

During this quarter the various parts of the demodulator module were assembled in a double-width, VLA-type module. These included the Costas loop, the clock recovery unit, and the monitor and control interface. Some redesign of the lock detector for the Costas loop was required, but satisfactory operation was obtained for this function. During the last week of the quarter, the demodulator module was taken to Green Bank and installed in the ground station system for testing. The basic functioning of the module was confirmed, but some details require further work. In particular, the loop is sensitive to transients in the power supplies that can cause drop-outs of the phase lock lasting for a few milliseconds. A series of further tests are planned to check the effects of noise on the IF signal, variation in the signal level, etc. This work is in progress as

the third quarter opens.

I. GREEN BANK ELECTRONICS

140 Foot Operations

A decision was made early this year to phase out operation of the K-band maser amplifiers. Both of the 4 Kelvin refrigeration systems have become increasingly unreliable during the past months, which has resulted in lost observing time. Because of the early completion of several GBT cryogenic HFET receivers and the delay in the GBT antenna completion, there is an obvious opportunity to install the GBT receivers on the 140 Foot. This will allow thorough evaluation of the GBT receivers prior to the availability of the GBT, and also should improve the 140 Foot reliability while decreasing the manpower required to maintain operations. The GBT 18-26.5 GHz receiver has been installed and was used in scheduled observations in late June. Performance was as expected, and plans will now proceed for installation of the 8-10 GHz and 12-15.4 GHz receivers.

Twenty-one receiver changes were scheduled and completed this quarter. A significant amount of effort was required to repair problems with the old Modcomp computer system still in use at the 140 Foot.

GBT Development

Assembly of the first prime-focus front-end continues, but has been delayed due to operational responsibilities of the personnel involved. The 3.95-5.85 GHz front-end dewar was cooled down and found to have satisfactory cool-down characteristics. Assembly of the remainder of this front-end is 90 percent complete; the cooled HFET amplifiers have been delayed approximately three months, but are now expected in July.

Testing of the IF router, optical driver, and optical receiver modules was done this quarter. Noise tests of an operating receiver were done successfully with the IF going through the entire chain. Final module layout for the optical driver was completed. Module layouts for the optical receiver and 1-8 GHz converter modules are underway. The final circuit boards and cases for the broadband square-law detector and video amplifier were designed for the optical driver module.

Laboratory testing of the 12-15.4 GHz front-end and outdoor testing of the feed rotator systems identified several problems with purchased components. These have been corrected and further testing is underway.

Work on electronics for the open-loop active surface continued. Twenty of the fifty-two required actuator room control panels have been constructed and twelve have been fully tested. Ten other panels are in various stages of construction.

Development of the continuum backend continues. The Xilinx implementation of the timing generator and integrating counters has been completed and tested. Design and layout of the VME boards which will hold the Xilinx chip and support circuitry is underway.

Work on the new GBT spectrometer continues both at NRAO and at the correlator chip design facility. The next chip fabrication run has been contracted and initial chips for evaluation are expected in October. Design of the supporting circuit boards continues at NRAO.

Site Operations

A plan has been produced, and is being implemented, for a site-wide optical fiber installation. This includes installation of a buried multi-cell conduit, and single-mode and multimode optical fiber cables to the major buildings and antennas. Site timing equipment will be consolidated at the Interferometer control building from which time-of-day and frequency reference signals will be distributed. Installation of the first leg of conduit has been completed. The fiber cable has been ordered, and

a maser/clock room in the Interferometer control building has been built. Passive temperature stabilization within this room reduces short-term air temperature changes from more than 3 degrees centigrade to less than 0.5 degrees centigrade.

Maintenance, repair, and installation support was supplied to the 140 Foot, Interferometer, and site computer facilities. Significant repair effort at the Interferometer and 140 Foot facilities was caused by lightning strikes. Work continues on construction of a new S/X receiver for the support of USNO operations.

J. TUCSON ELECTRONICS

On-the-Fly Observing

Both spectral line and continuum on-the-fly (OTF) observing techniques have matured over the past few months. In this observing mode, the telescope is driven continuously back and forth across a field. Data are recorded very rapidly (10 times a second) and are tagged with the actual antenna encoder position. The images are regridded in the analysis stage and so do not require perfect telescope tracking. For many projects, this is a superior observing technique. One advantage, for example, is that observing overhead is very low. Source fields can be covered rapidly, minimizing the effects of receiver, sky, and pointing drifts. Such drifts are often easier to correct globally from map to map than within one conventional map that is observed more slowly. The required integration time is built up by repeating each rapid map as necessary.

The largest hurdle in on-the-fly observing is coping with the data analysis and storage. When in OTF mode, the filter bank spectrometers generate about 1 MB for each minute of observing time. When the hybrid spectrometer is included in OTF (expected later this year), the data rate will approach about 5 GB per day. Even a modest spectral line map taken in a half-hour will contain in excess of 50,000 complete spectra before gridding. The large data rates, the required reduction effort, and the reduction techniques used are comparable to those of a large aperture synthesis images. Despite the large processing load, we feel that it is important that observers be able to reduce their data as they are taken so that they can make on-line judgments, as is normal with millimeter-wave, single dish observing.

To process on-the-fly data, we are developing a data reduction pipeline utilizing Classic AIPS. The first version of this is available for tests; we are still streamlining the process. We are also acquiring faster computers and more disk storage capacity to facilitate this observing technique. Although development is still in progress, the data acquisition and analysis systems are already suitable for use by visiting observers.

Polarimeter Update

The rotating grid polarimeter has been completed and was inaugurated by three observing groups in late May and early June. Although we still have things to learn about the instrument and how to utilize it best, all indications are that it is performing extremely well. From our initial observations, it appears that we should be able to integrate down to very low polarization percentages in both continuum and spectral line modes.

The device consists of a rotating wire grid backed by a plane mirror. The separation between the wire grid and mirror can be adjusted to make the polarimeter sensitive to either linear or circular polarization. The grid rotation is under full computer control. We are in the process of automating the grid/mirror separation control. Compared to conventional half-wave or quarter-wave transmission plates, this reflective device has lower losses and is more broad band. At present, the wire grid is appropriate for observations in the 3 mm band. If there is interest, grids for shorter wavelength bands may be constructed in the future.

Summer Shutdown Plans

This year's summer shutdown plans include major projects in receiver development and repackaging, computer enhancements, and dome repairs. In the receiver area, we hope to finish the 8-beam receiver upgrade. The 3 mm and 2 mm

receivers will be combined into one package, which will make room for the 8-beam receiver on the telescope without having to change receiver boxes between observing programs. We are also planning a simple optics upgrade to the 3 mm receivers which will allow them to be used together as a 4-beam receiver for lines and continuum near 90 GHz. In the computer area, we are enhancing the user interface to the control system to allow observers to write observing scripts and to control the telescope themselves, if they so choose, through a GUI interface. We also hope to install a digital signal processing (DSP) card in the hybrid spectrometer computer to allow on-line FFTs, which are needed for the on-the-fly observing mode discussed above. The major renovation project of the summer is replacing the fabric on the dome door. The 12-year-old fabric has lasted longer than expected, but has now become cracked and tattered and must be replaced. The fabric covering the rest of the dome is not subjected to folding as is the fabric on the door and is still holding up. Other renovation projects are planned, including some remodeling of the control room to create more work areas for both observers and operators.

Multi-Feed Systems Workshop

The Multi-Feed Systems Workshop was held on May 16-18 and was a great success. About 100 participants from 14 countries and 5 continents attended. The presentations were most stimulating and informative. The proceedings are being compiled and soon will be published in the ASP Conference Series.

K. SOCORRO ELECTRONICS

VLA 1.3 - 1.7 GHz Receiver Improvements

All twenty-eight VLA antennas now have the new improved front-ends. We completed one additional spare front end this quarter. The second spare will be used for cryogenic testing of ortho mode transducers to suppress spurious resonances.

VLA 40 - 50 GHz Receivers

Ten receivers including a working spare have been installed on ten antennas. The Central Development Lab completed two spare cooled low-noise amplifiers.

VLA Waveguide

Efforts continue to improve anode bed efficiency for more reliable cathodic protection of the wye waveguide from electrolytic corrosion. The cryogenics/waveguide group rebuilt the azimuth and elevation rotary joints on antenna 18. Twenty-five steel culverts are on hand for replacement of concrete manholes in 1994.

VLA Wye Monitor

The Wye Monitor provides the VLA Operator with voice phrase alarms detailing antenna number, arm, generator, UPS, HVAC, problem, etc. Operators interface via a touchscreen, bringing up windows for detailed information on monitored systems. Next quarter we expect to complete the interface to the correlator air conditioner, which will complete the project.

New VLA Correlator Controller

The current correlator controller consists of a wire wrapped 16-bit microprocessor, a Modcomp computer, and a FPS-AP120 B array processor. A single VME computer will replace the above equipment which is nearing the end of its repairable life. We received the VME array processor card and began testing and designing the interface. Two VME prototyping cards are in use. We plan to have several interfaces to the correlator proto-typed in 1994.

VLA Antenna B-Rack Shields and Optical Fibers

The VLA machine shop completed the metal work for twenty B-rack RFI shields and continues to assemble units. Electronics has installed and tested shields and optical fibers in antennas 24 and 28. We expect to continue installations at a rate of one per month, depending on available staff and telescope scheduling.

VLBA Recorders and Playback Drives

Work continued on understanding and improving playback performance with differing combinations of drives and tapes. We completed installing run-time metering on all recorders and playback drives for evaluating headwear.

VLBI/MKII

We continue to support the MKII formatter/recorder systems at Mauna Kea, Saint Croix, Hancock, North Liberty, Owens Valley, Brewster, Pie Town, and the VLA. However, as major failures occur, we will reduce the number of MKII sites to those most important for MKII VLBI. Several Panasonic VCRs have failed, but a commercial service shop has, so far, successfully repaired them.

VLBA Atomic Clock and Frequency Standard

Maser #11 was repaired by the manufacturer, Sigma Tau Standards Corp., and returned to Socorro in March. Early stability measurements made with respect to Maser #1 showed excellent short and mid-term sigmas (1-2000 sec). The 10,0000 second sigmas will probably improve as the new physics packages age. Typically, IF level degradations take four to six months to reach acceptable rates after reworking the physics hardware. Maser #11 still has excessive IF level degradation and the dissociator twice required retuning. Monitoring continues.

Interference

A proposal to control locally generated interference at the VLA was issued as VLA Test Memo #188. Most local RFI comes from digital (microprocessor) devices and radio devices. We began monitoring the VLA spectral environment from 150 MHz to 3 GHz to support the preparation of a proposal for a major upgrade. Frequency coordination efforts through the National Science Foundation Spectrum Management Office and our informal network have concentrated on major radar installations, several military systems, and harmonic emissions from TV transmitters.

L. AIPS

By 28 June 1994, the 15JAN94 release of "Classic AIPS" had been shipped to 80 institutions, 17 by magnetic tape and 63 by electronic copies. Preparations for releasing the 15JUL94 version are now well under way. Nothing has arisen so far to suggest that it will be delayed significantly. The AIPS programming group in Socorro was increased by the addition of an expert on VLBI spectral-line polarimetry.

During the quarter, we began the substantial work of rewriting the user manual called the "AIPS CookBook." A number of new chapters will appear in the 15JUL94 release. All chapters of the CookBook are made available via the World Wide Web (WWW) as well. Users can fetch the new chapters as they are actually completed by fetching the files via the WWW (or via anonymous ftp).

A port of AIPS to SGI computers was added to the system during the quarter. As usual, the magnetic tape routines are uncertain, but the rest of the port has checked out well. The magnetic tape routines for our ports to the DEC Alpha (OSF/1) and LINUX (PCs) systems were completed, and the former were then thoroughly tested and used. A number of bugs in the code to convert floating-point binary formats were corrected and several sources of floating underflows were corrected. Our

dependence on non-standard system software was reduced by our adding programs to AIPS to convert printer files for printing on plain text and PostScript printers.

During the quarter, two new verbs were added to AIPS. They are TVSTAR to plot positions from star extension files directly on the TV display and CHKNAME to allow procedure to test for a file's existence and, thereby, avoid untimely terminations. New tasks this quarter include VBGLU to paste MKIII mode VLBA data, correlated in multiple passes, back together and FXPOL to reformat dual-polarization data from the VLBA correlator. New task CPYRT adds copyrights to images, primarily for the D and B array surveys, while task MFPRT prints information from Model-Fit extension files (produced by SAD) for use by external modeling programs. The automatic source finding and fitting task SAD was enhanced to produce more reliable and correct solutions. A significant bug in the handling of parallactic angle in calibrating both VLA and VLBA polarization was corrected.

M. AIPS++

The AIPS++ project continues to progress, with a number of significant accomplishments during the past quarter.

Data Handling and Storage

Early versions of the data structures (measurement sets) for the VLA and the Australia Telescope National Facility (ATNF) were finished. These allowed the importation of FITS and AT data (the latter directly from the on-line RPFITS format) into AIPS++ tables for further processing. A visibility set (VS) in AIPS++ contains generic UV data. Using a preliminary version of the design for an AIPS++ VS (with multi-frequency and multi-polarization capability), the data were imaged using a simple UV imaging routine.

Imaging and Cleaning

A member of the ATNF staff used high level AIPS++ classes and created a set of clean tools (Hogbom, Clark, and Steer-Dewdney-Itoh algorithms) for image deconvolution. He was able to do this in less than three weeks; adding the SDI clean took only a few additional days. This experience is a promising hint that AIPS++ will eventually be as programmable as everyone hopes. A couple days of further effort for optimization yielded correct results on the same data used by the AIPS medium-sized DDT test, with comparable processing time.

Glish

Glish is a "Software Bus for High-Level Control" (Paxson, 1993 in the Proceedings of the 1993 International Conference on Accelerator and Large Experimental Physics Control Systems). We have selected Glish to provide the underlying control and communications needed by AIPS++ to link processes and tasks. Besides providing an interactive, programmable environment for process and task control, Glish also provides support for distributed processing. In particular, it will provide the mechanism to connect AIPS++ to on-line control systems. This will allow for nearly transparent use of AIPS++ for near-real-time data analysis, the sort of processing often needed by observers at telescopes. Interestingly, other radio astronomy projects are also seriously considering Glish for use in their control systems. (Glish will be used by the monitor and control group for the Green Bank Telescope to provide interprocess communications and compatibility with AIPS++.)

Other Recent Progress

- FITS I/O Classes (images, binary tables, and random groups fully compliant with the newly approved IAU standard for FITS);
- Image Class: dummy version created, coordinates in progress;
- Revised design for the AIPS++ table system (implementation nearly complete);
- Units and (astronomical) coordinates: progress on design and implementation;
- Compiler problems largely resolved;

- Support for multiple architectures in place;
- Selection of Glish for communication and process control.

Command Line Interface Plans

- Design and initial prototype of user interface, graphical user interface;
- AIPS++ arrays, math classes, utilities, distribution system, and revision control stabilizing;
- Initial version of the AIPS++ table browser (read-only) completed.

Release Plans

The table below summarizes our current release plans for AIPS++, with target dates. There is a degree of optimism built into these dates, but we hope that AIPS++ can achieve them barring unforeseen technical problems. This plan reflects the effects of recent personnel and organizational changes experienced by the project. In the short term, the NRAO part of the AIPS++ project will be concentrating on the overall AIPS++ infrastructure along with some single dish applications with a view to testing out the relevant infrastructure. In particular, we will use on-the-fly mapping as the test application for August 1994. Non-NRAO members of the AIPS++ consortium are focusing on other key areas: UV imaging and calibration, visualization, and image analysis.

Target Date	Release	Comments
August 1994	Version 0.1 ("Friendly Astronomer") (Internal use only)	Demonstration AIPS++ applications for early user feedback Basic tools for application development Key classes needed for image analysis Documentation system framework
January 1995	Version 0.5 ("Alpha Release")	Basic user interface Useful programmable command line Graphical user interface prototype Core single dish applications GUI tools: 1- and 2-D display, some feedback Sample interferometric applications Spectral imaging Cleaning Antenna based calibration (I pol) Sample image analysis applications Image geometry correction, regridding Line and component fitting Basic documentation
July 1995	Version 0.9 ("Beta Release")	User interfaces Command line, graphical Core single dish applications Core UV applications Image analysis applications
January 1996	Version 1.0 (full AIPS++ release)	Nearly full AIPS and UniPOPS functionality Comparisons, testing of AIPS++ against AIPS, MIRIAD, UniPOPS, GYPSY, etc.

AIPS++ Organizational Issues:

A change of direction of the AIPS++ project was approved at the recent meeting of the project steering committee. The project will be divided into four application development areas: single dish calibration and imaging, UV (synthesis) calibration and imaging, visualization, and image analysis. These are each heavily dependent on infrastructure development.

In this quarter, we lost two staff members in Socorro from the project. Accordingly, for the next nine months or so, NRAO will concentrate its AIPS++ manpower in Charlottesville, with an emphasis on AIPS++ infrastructure and some demonstration applications. Given the scientific and programming expertise in Charlottesville, as well as some critical NRAO needs for Tucson and Green Bank, these demonstration applications will focus on the single dish arena. Other areas in the AIPS++ effort will continue to develop at other AIPS++ consortium sites.

We plan to rebuild the effort in Socorro in early 1995. One programmer will spend the next few months in Charlottesville. To him we will add a new hire plus two scientific programmers who will be reassigned to the AIPS++ project.

N. SOCORRO COMPUTING

During a small ceremony on April 15, the last NRAO Convex, Yucca, was finally shut down. The Convexes have played a vital role in bridging the gap between the VAX dominated era in the early and middle eighties, and the increased availability of moderately priced workstations in the early nineties. During its last months, Yucca's modest but very useful contribution was to allow the archive copying project to use its tape drives to handle a particular problematic batch of early VLA tapes (see below).

With the demise of the Convexes, some related capabilities have now disappeared as well. This includes the ISIS reduction software, the capabilities of which have now been completely taken over by AIPS, and the ISU unit, which, coupled to the IIS, enabled interactive visualization of images and cubes of images. If and how we are going to replace the functionality of this ISU system is not clear yet.

During March and April the AOC's high-performance Auspex NFS fileserver, which provides SunOS and all our application software to more than ninety workstations, was upgraded with an additional 10 gigabytes of disk space, a high-density Exabyte for backups, and two more Ethernet interfaces. This brings the server to a total of eight Ethernets and 30 GB of disk, which will allow us to proceed with the upgrade to Sun's new operating system, Solaris 2 (aka SunOS 5). We anticipate that the majority of the AOC Suns will be running SunOS 5.3 by the fall. This is later than initially predicted, largely because of limited resources. Our experience with Solaris to date has been quite favorable, and at the time of writing there are eight Suns at the AOC which run this version of SunOS.

The VLA data archiving project has suffered some delay. Main reason was the batch of low quality tapes from 1982 which was handled during the past quarter. It required the use of the, slower, Yucca tape drives, plus additional manual transport over the worst spots. A bug in the format conversion software was discovered which will require us to retrieve antenna files from all pre-1982 tapes handled so far. This requires only around eight minutes per tape, but may delay the whole project by another few months. Estimated time of completion ranges from 1997 to 1999. We are currently looking into ways of speeding up the process, such as adding an extra tape drive, extra disk space, etc.

An important by-product of the VLA Data Archival Project is the catalog database, consisting of header information extracted from each scan. A subset of the detailed header is stored in a database for later queries. A basic INGRES querying system already exists, and further improvements will be implemented in the near future. Initially, a simple VT100 terminal interface will be adopted in order to give user access to the database as quickly as possible. We are aiming to have a character based interface and a Mosaic Forms query system available by September 1994. A more sophisticated graphical user interface such as INGRES Windows 4GL should become available later this fall.

O. GREEN BANK TELESCOPE PROJECT

Antenna

Much of the recent, visible progress on the GBT site has taken place on the ground. The erection platform has taken on a new look as the back-up structure supports have been installed on the hard points. The 22 back-up structure modules will be built on these ground supports and then lifted into place with the derrick crane. In addition, a 60-foot tall tower topped with a survey shack has been built to allow the precise measurement and alignment required during the tipping structure installation. Also, sections of the elevation wheel support members have been arriving from RSI's Mexia (Texas) Fabricators and are being welded on the ground into the 36-inch square, 105-foot long spokes which attach the elevation wheel to the elevation shaft.

On the structure, the elevation bearing platforms have been installed and the manlift is now running to the elevation bearing level. The 80-ton elevation bearing support weldments have been lifted to the tops of the alidade towers and are being prepared for welding. A final adjustment to the location of the tops of the alidade legs may be made before welding. Once the final welding is accomplished, the structure will be ready for the installation of the elevation shaft temporary supports, the elevation shaft, wheel, and box structure. Approximately 90 percent of the electrical conduit and cabling have been installed on the alidade. Preparation is being made to seal the track gaps with a general purpose silicone gel and to flush the pintle bearing with fresh grease.

Panel fabrication has begun at RSI's Sterling (Virginia) facility. Testing has been under way to determine the desired combination of rivets and adhesive to attach the surface skins to the Z-stiffeners. The quality and strength of the adhesive has proven so well that it is now considered a structural connection rather than a flexible shim. This allows a larger spacing between rivets which can lead to better manufacturing accuracy.

Visualization software on the AVS system has allowed the GBT engineers to see on a computer screen what the completed structure will look like and has allowed them to rotate the structure and look through it from different vantage points. This program already has proven useful by helping determine sight paths through the structure to the laser targets on the ground and by identifying a slight interference between the receiver room and the telescope's secondary beam, which will be corrected to provide a truly clear aperture.

Open-Loop Active Surface

The software effort during the period included starting to integrate a manager class (monitor and control written software) with the remainder of the actuator control system in the warehouse. This effort should lead to the ability to control and monitor the actuators through a control panel on a workstation on the network. The goal is to replace the control system written in C with one using the monitor and control group's suite of tools.

Testing of final version actuators continues on the 85-1 telescope test stand. Both actuators under test have now exceeded the 2,000 hour operational goal by over 3,000 hours.

The construction of control panels has resumed. Twenty of the 52 are now constructed. Twelve are fully tested and an additional ten are partially constructed.

Burn-in of the power supplies for the motors and the control modules is continuing. Electrically and thermally, all units checked have performed satisfactorily.

Closed-Loop Active Surface

The past period has seen substantial progress on the active surface/precision pointing effort.

The laser rangefinders are now in full production. The programming for the CNC-lathe and mill has been completed, and these machines are now producing the principal parts for the rangefinder mirror assemblies.

The calibration lab has been equipped with a Hewlett-Packard laser interferometer and a track has been constructed between two monuments, separated by approximately 19 meters. Measurements of the distance between these monuments have been made using both the laser rangefinder and the interferometer. The repeatability of the measured distance is excellent with each instrument (better than 20 microns), but there is a difference between the two instruments of around 200 microns. This is currently being investigated.

The linearity of the NRAO rangefinder has been checked against the HP interferometer at a range of 37 meters over a distance of 2 meters. The rms error of 50 readings over the 2 meters distance was less than 20 microns.

Our three outdoor laser rangefinders have been updated to use the components that will be used in the production version.

A major milestone has been passed in the calibration/software areas. A laser rangefinder is calibrated on the indoor range and parameters associated with the mirror pointing, for example, are measured. Offsets, non-orthagonality of the axes and the relation between the mirror coordinates and the base mounting are recorded in a file associated with that particular rangefinder. When mounted on the outdoor range, the pointing parameters associated with that particular rangefinder are loaded into the controlling software. This results in rangefinders being easily interchangeable. The software that resides within the rangefinders is now close to completion, and the software controlling the rangefinders over the network is well advanced. A recently hired co-op student (a physics major) is using the software constantly, with the result that minor bugs are found and reported.

Work has continued on the development of the surface adjustment tool. This tool will permit the adjustment of the four panel corners to a high precision. Programming of the hand-held PC has continued, and a bar graph reader has been added to enable easy identification of each panel.

A wide-angle retrosphere has recently been completed at the University of Arizona. This component has an acceptance angle of ± 70 degrees and will be installed at the edge of the reflector surface.

Work on an installation on the 140 Foot Telescope has begun. Four laser rangefinders on the ground will track retrospheres mounted both on the edge of the main reflector and on stationary parts of the structure. Hopefully, this experiment will prove our ability to determine the position of a target in a three-dimensional, ground-based coordinate system to around 100 micron accuracy.

Servo

Effort in the servo area consisted primarily of monitoring the progress of the servo contractor, RSI/PCD, usually by means of a teleconference. Work is in progress on the AZ/EL servo factory test procedure, as well as on system integration of the AZ/EL system. Delivery of the test procedure has been delayed until late July. The factory acceptance tests are also postponed to September or October. At this time, all electronics for the AZ/EL servo, except for the motor drive cabinet already in Green Bank, will be demonstrated.

Electronics

Assembly of the 3.95 - 5.85 GHz front-end is nearing completion. Delivery of the HFET amplifiers has been delayed, and is now expected in July. Fabrication drawings for an L-band OMT were completed for the 1.15-1.73 GHz front-end.

The final layout for the optical driver module was completed and parts submitted for fabrication. Layout of the optical driver and 1-8 converter modules is under way.

The digital continuum receiver timing generator and integrating counters were implemented in a Xilinx array and tested successfully on a test card. Design is now under way for VME cards which will house the Xilinx chip and supporting circuitry.

The second correlator chip fabrication run was contracted and initial chip delivery is expected in October. Design of memory and other support cards is proceeding.

Outdoor tests of the feed rotator assembly and controller identified problems with connectors which did not provide waterproof operation as advertised. These have been replaced and the evaluation will be repeated.

Monitor and Control

The core console and component libraries were brought to a state where they can be used to implement console user-interfaces to the IF system. Limited progress was made on the coordinator (the software modules responsible for synchronizing the various devices involved in a scan). The spectral processor at the 140 Foot Telescope is now using GBT software for observing though its interface is much like the original MassComp system. A number of utilities need yet to be implemented to duplicate the functionality on the original system. Debugging and completion of a data storage system still remains. All of this work is a necessary precursor to the software modifications needed to integrate it into the GBT.

Because of the use of the GBT software on the spectral processor, the project must be expanded from a straight development effort to a development plus support effort. This has significant implications for the source control system, i.e., clear differentiation must be made between experimental, development, test, and release code for the first time. Time has been used to organize and create utilities to allow continuation of code production while still supporting users at the 140 Foot Telescope with a stable system.

Work continues on the data collection. Like AIPS++, Glish will be made an integral part of the system. Experiments on Glish's software bus are in progress to see if it meets requirements for handling data as well as control. The effort has begun, in conjunction with the original authors of Glish, to port Glish to VxWorks.

P. PERSONNEL

New Hires

A. Kemball	Assistant Scientist, Socorro Operations	06/10/94

Terminations

D. Briggs	End of Appointment	04/30/94
N. Erickson	End of Appointment	04/30/94
E. Wollman	End of Appointment	05/15/94

Change in Title

P. Shannon	To Scientific Programming Analyst	05/01/94

Other

J. A. Zensus	Leave for Professional Advancement	05/31/94
A. Dowd	Not returning from Leave of Absence	06/01/94

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