NATIONAL RADIO ASTRONOMY OBSERVATORY

QUARTERLY REPORT

1 January 1994 - 31 March 1994

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A. TELESCOPE USAGE

The NRAO telescopes have been scheduled as follows during the first quarter of 1994.

	140 Foot	VLA	VLBA	12 Meter
Scheduled observing (hours)	1941.50	1590.20	750	1938.00
Scheduled maintenance and equipment changes	174.75	266.00	261	48.00
Scheduled tests and calibrations	17.00	294.00	276	174.00
Time lost	328.00	101.77	38	175.25
Actual observing	1613.50	1488.43	722	1762.75

B. 140 FOOT TELESCOPE

The following continuum program was conducted during this quarter.

No.	Observer(s)	Program
W289	Wilkinson, D. (Princeton) Page, L. (Princeton) Wollack, E. (Princeton) Jarosik, N. (Princeton) Staggs, S. (Princeton)	Anisotropy of cosmic microwave radiation at 26-36 GHz.

The following line programs were conducted during this quarter.

No.	Observer(s)	Program
B565	Baan, W. (NAIC) Haschick, A. (Haystack) Burdyuzha, V. (Astro Cosmic Center, Moscow) Komberg, B. (Astro Cosmic Center, Moscow) Khersonsky, V. (Lebedev)	Observations at 500 MHz of OH megamasers in IRAS galaxies at high redshifts.
B609	Bania, T. (Boston) Rood, R. (Virginia) Balser, D. (Boston)	X-band measurements of the cosmic abundance of ^{3}He.
B618	Bell, M. (NRC, Herzberg) Watson, J. (NRC, Herzberg) Avery, L. (NRC, Herzberg) Feldman, P. (NRC, Herzberg) MacLeod, J. (NRC, Herzberg)	Observations at 20-24 GHz in an attempt to identify the carrier of U-lines detected in TMC-1.
B620	Barnbaum, C. Jura, M. (UCLA) Balm, S. (CFA)	A 23.7 GHz search for circumstellar NH_3 in carbon stars with oxygen-rich circumstellar envelopes.

No.	Observer(s)	Program
B621	Brown, R. Frayer, D. (Virginia) Vanden Bout, P.	Cosmology with redshifted CO emission at K-band.
B623	Braatz, J. (Maryland) Wilson, A. (Maryland/STScI)	A survey of H_2O megamasers in nearby AGN.
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.
F116	Frayer, D. (Virginia) Brown, R. Vanden Bout, P.	A search for redshifted CO emission from a sample of confirmed damped Lyman alpha absorption line systems.
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.
M370	Matthews, L. (SUNY) Gallagher, J. (Wisconsin) Littleton, J. (West Virginia)	HI survey of extreme late-type galaxies.
M373	Murphy, E. (Virginia) Lockman, F. J. Savage, B. (Wisconsin)	A 21 cm deep search for high velocity clouds.
V083	van Zee, L. (Cornell) Haynes, M. (Cornell) Maddalena, R.	HI observations of galaxies with extended hydrogen envelopes.
W280	Wootten, H. A.	H_2O monitoring in star forming cores in Rho Oph.

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.
B559	Biggs, J. (Curtin U.) Salter, C. (NAIC) Foster, R. (NRL)	Observations at 1420 MHz to monitor HI absorption spectra.
B617	Backer, D. (Calif., Berkeley) Sallmen, S. (Calif., Berkeley) Foster, R. (NRL) Matsakis, D. (USNO)	Pulsar timing array observations at 800 and 1395 MHz.
K345	Kaspi, V. (Princeton) Sayer, R. (Princeton) Taylor, J. (Princeton) Nice, D.	A search for pulsar companions to OB stars.
M368	McKinnon, M.	Timing the young pulsar PSR B1823-13.
N11	Nice, D. Sayer, R. (Princeton) Taylor, J. (Princeton)	A 350-420 MHz survey of the northern sky for millisecond pulsars.
N14	Navarro, J. (Caltech) Kulkarni, S. (Caltech) de Bruyn, G. (NFRA)	400 MHz observations of PSR 0214+42 — a new field millisecond pulsar.
S384	Stinebring, D. (Oberlin) Faison, M. (Oberlin) Francavilla, L. (Oberlin) Hovis, J. (Oberlin)	Diffractive scintillation observations of eleven pulsars at 800 MHz.
T302	Taylor, J. (Princeton) Nice, D. Thorsett, S. (Caltech) Arzoumanian, Z. (Princeton)	Pulsar timing observations at 1400 MHz.

The following very long baseline interferometry programs were conducted.

No.	Observer(s)	Program
GP012	Pauliny-Toth, et als.	Further 1.3 cm VLBI monitoring of the quasar 3C 454.3 in connection with ROSAT measurements.

No.	Observer(s)	Program
GR004	Rupen, et als.	VLBI imaging of supernovae 1993J in M81.
GW011	Wehrle, et als.	Evolution of parsec-scale radio jet in 3C 279.
GZ011	Zensus, et als.	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
B594	Barnes, P. (CFA)	A search for CO emission from the Pluto-Charon system.
B600	Barnes, P. (CFA) Lada, E. (Maryland) Myers, P. (CFA)	Isotopic spectroscopy of dense cores in L1030-55 clouds.
B606	Balonek, T. (Colgate) Dent, W. (Massachusetts)	Study of the evolution of extragalactic radio sources at millimeter wavelengths.
B611	Brown, R. Vanden Bout, P. Cutri, R. (Arizona) Huchra, J. (CFA) Frayer, D. (Virginia)	Study of CO in the ultraluminous galaxy.
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.
D184	Dayal, A. (Arizona) Bieging, J. (Arizona)	CO observations of very young planetary nebulae.
F119	Fuente, A. (Yebes Obs.) Martin-Pintado, J. (Yebes Obs.) Gaume, R. (NRL)	A chemical study of the reflection nebulosities NGC 2023, NGC 2068, VDB 118, and NGC 6914B.
F121	Fuller, G. Latter, W.	The high velocity HCO^+ in HH7-11: Stellar wind or shocked cloud material?
F122	Frayer, D. (Virginia) Brown, R. Vanden Bout, P.	Study of molecular gas in the early universe.

No.	Observer(s)	Program
G337	Gao, Y. (SUNY) Solomon, P. (SUNY)	An HCN survey in nearby CO and IR bright and luminous galaxies.
G339	Gensheimer, P. (Illinois)	Observations of the CO envelope around alpha Ori.
G340	Gensheimer, P. (Illinois)	Search for HCCNC in IRC+10216.
K344	Kobulnicky, H. (Minnesota) Dickey, J. (Minnesota) Conti, P. (Colorado)	Study of CO in Wolf-Rayet galaxies.
L279	Latter, W. Jewell, P.	A spectral bandscan of IRC+10216 in the 1.2 mm window.
L286	Latter, W. Walker, C. K. (Arizona) Maloney, P. (NASA/Ames)	Study of CO^+ and HCO^+ in NGC 7027 and M17.
L288	Liszt, H. Lucas, R. (IRAM)	Study of HCO^+ emission toward extragalactic continuum sources.
L289	Levine, D. (UCLA) Hurt, R. (UCLA) Turner, J. (UCLA) Martin, R. (Arizona)	Molecular mapping of the barred galaxy IC 342.
M353	Minh, Y. (Daeduk, Korea) Turner, B. Kim, K. (Chungnam U.) Irvine, W. (Massachusetts)	Study of the chemistry of cirrus cloud cores.
M357	Mangum, J. (Arizona) Latter, W.	Study of the derivation of the physical conditions in the Serpens molecular cloud.
M358	Mangum, J. (Arizona) Ho, P. (CFA)	Study of kinetic temperature in galactic nuclei.
M371	Minh, Y. (Daeduk, Korea) Irvine, W. (Massachusetts) McGonagle, D. (Massachusetts)	Measurement of the ortho/para ratio for formaldehyde in dark clouds.
M372	McMullin, J. (Maryland) Mundy, L. (Maryland) Blake, G. (Caltech)	Study of high temperature/shock chemistry in IRAS 05338-0624.
M374	Menten, K. (CFA) Alcolea, J. (Yebes Obs.)	Search for an unidentified species in NGC 7027 and Sgr B2.
P162	Pound, M. (Maryland) Blitz, L. (Maryland)	The continued search for proto-brown dwarfs.

No.	Observer(s)	Program
S366	Slysh, V. (Moscow) Val'tts, I. (Moscow) Kalenskii, S. (Moscow) Dzura, A. (Moscow)	Study of methanol lines at 157 GHz.
S370	Sahai, R. (JPL) Ziurys, L. (Arizona State)	A study of the excitation and chemistry of AlF in IRC+10216.
S373	Smith, B. (Texas) Higdon, J.	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.
S375	Snyder, L. (Illinois) Miao, Y. (Illinois) Kuan, Y. (Illinois) Lovas, F. (Nat'l Inst. Stds. & Tech.)	Confirmation of conformer I glycine in Sgr B2.
T296	Turner, B. Amano, T. (NRC, Herzberg) Avery, L. (NRC, Herzberg) Feldman, P. (NRC, Herzberg)	A 2 mm spectral survey of Orion, Sgr B2, W51M, and IRC+10216.
T324	Turner, B.	Study of the chemistry of cirrus cores and of small galactic plane clouds: CS, C_3H_2, and HC_3N.
T331	Turner, B. Steimle, T. (Arizona State)	A confirmation of silylene (SiH_2) in IRC+10216.
T332	Turner, J. (UCLA) Martin, R. (Arizona) Ho, P. (CFA)	Study of CO in M83.
W335	Windhorst, R. (Arizona State) Brown, R. Vanden Bout, P. Frayer, D. (Virginia)	Study of CO in the radio galaxy 53W002.
W336	Wootten, H. A. Turner, B.	CH_2D^+ in interstellar space: Verification.
W337	Wootten, H. A. Mangum, J. (Arizona)	Study of the structure of dense gas envelopes in millimeter, continuum-bright, low-mass, star-forming regions.
W338	Walker, C. E. (Texas) Black, J. (Arizona) Bechtold, J. (Arizona)	Studies of optically selected absorption line systems at millimeter wavelengths.

No.	Observer(s)	Program
Z105	Ziurys, L. (Arizona State) Apponi, A. (Arizona State) Yoder, T. (Arizona State) Pascarelle, S. (Arizona State)	A proposal to complete a 270-300 GHz spectral-line survey of Orion.
Z110	Ziurys, L. (Arizona State) Apponi, A. (Arizona State) Jarrold, M. (Northwestern)	A renewed search for interstellar HOC^+.

D. VERY LARGE ARRAY

First quarter 1994 was spent in the following configurations: D configuration from January 1 to February 7; A configuration from February 7 to March 31.

No.	Observer(s)	Program
AA156	Antonucci, R. (Calif., Santa Barbara) Barvainis, R. (Haystack)	Molecular gas in high-redshift quasars. 1.3, 2 cm line
AA166	Anglada, G. (Barcelona) Estalella, R. (Barcelona) Torrelles, J. (IAA, Andalucia) Rodriguez, L. (Mexico/UNAM)	The double radio source in the L723 outflow. 1.3 cm line
AA167	Afflerbach, A. (Wisconsin) Churchwell, E. (Wisconsin)	H65α observations of eleven ultra-compact HII regions. 1.3 cm line
AA171	Anglada, G. (Barcelona) Estalella, R. (Barcelona) Girart, J. (Barcelona) Torrelles, J. (IAA, Granada) Rodriguez, L. (Mexico/UNAM)	Do FU Ori stars drive outflows? 3.6 cm
AB456	Burke, B. (MIT) Hewitt, J. (Haystack) Roberts, D. (Brandeis)	Monitoring 0957+561 A,B.
AB685	Bowen, D. (STScI) Brinks, E. Steidel, C. (Calif., Berkeley) Dickinson, M. (Calif., Berkeley)	A dwarf galaxy near the sightline of PKS 0454+039. 20 cm line
AB692	Bastian, T. Frail, D. Beasley, A. Bookbinder, J. (CFA)	Search for pulsations or QPO in AE Aquarii. 3.6 cm
AB697	Beasley, A. Claussen, M. Dhawan, V.	A 43 GHz survey of active RS CVn systems. 0.7, 1.3, 2, 3.6 cm

No.	Observer(s)	Program
AB698	Blanco, P. (Calif., San Diego) Conway, J. Pedlar, A. (Manchester) Nishida, N. (Kyoto)	Atomic and molecular absorption in the core of Cygnus A. 6, 20 cm line
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) Jackson, N. (Leiden) Miley, G. (Leiden)	Search for gravitational lenses. 3.6 cm
AB703	Butler, B. (Caltech) Muhleman, D. (Caltech) Slade, M. (JPL)	South polar ice on Mercury. 3.6 cm line
AB704	Burke, B. (MIT) Avruch, I. (MIT) Becker, D. (MIT) Conner, S. (MIT) Fletcher, A. (MIT) Herold, L. (MIT) Turner, E. (Princeton)	MG VLA gravitational lens search. 3.6 cm
AB705	Burke, B. (MIT) Becker, D. (MIT) Lehar, J. (Cambridge) Hewitt, J. (MIT) Roberts, D. H. (Brandeis) Roberts, D. A. (Illinois)	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
AB707	Browne, I. (Manchester) Patnaik, A. (MPIR, Bonn) Walsh, D. (Manchester) Wilkinson, P. (Manchester)	Monitoring smallest lens 0218+357: A step to measuring H_o. 2, 3.6 cm
AB712	Borkowski, K. (Maryland) White, S. (Maryland) Harrington, J. (Maryland)	X-ray bright planetary nebulae. 2 cm

No.	Observer(s)	Program
AC308	Condon, J. Cotton, W. Perley, R.	All sky survey. 20 cm
AC373	Chen, H. (Calgary) Taylor, A. (Calgary) Dougherty, S. (Calgary)	Sensitive radio survey of Be stars. 3.6 cm
AC374	Carilli, C. (Leiden) van Ojik, R. (Leiden) Miley, G. (Leiden) Rottgering, H. (Cambridge) van Breugel, W. (Caltech) McCarthy, P. (CIW)	Polarimetric imaging of high redshift radio galaxies. 3.6, 6 cm
AC379	Chambers, K. (Hawaii) Swanson, J. (Hawaii)	The nature of high redshift radio galaxies. 3.6, 20 cm
AC382	Curiel, S. (CFA) Rodriguez, L. (Mexico/UNAM) Moran, J. (CFA) Canto, J. (Mexico/UNAM)	Monitoring the Serpens radio jet. 2, 3.6, 6 cm
AD322	Duric, N. (New Mexico) Irwin, J. (Queens) Bloemen, H. (Leiden)	Disk-halo interface in NGC 3556, NGC 5775, and NGC 3079. 6, 20 cm
AD323	Dickey, J. (Minnesota) Frail, D.	The spin temperature of the warm neutral medium. 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. 20 cm
AD334	Dhawan, V. Beasley, A.	Fluxes at 43 GHz and spectral indices of millimeter VLBI sources. 0.7, 2 cm
AD335	Dwarakanath, K. Owen, F. van Gorkom, J. (Columbia)	What is causing the HI absorption in Hydra A? 20 cm line
AD337	Drake, S. (USRA/NASA) White, S. (Maryland)	Search for emission from very low-mass stars and brown dwarfs. 6, 20 cm
AE097	Eilek, J. (NMIMT) Loken, C. (NM State) Owen, F.	The ends of Type I radio tails. 90 cm

No.	Observer(s)	Program
AF211	Fiedler, R. (NRL) Dennison, B. (VPI&SU) Johnston, K. (NRL)	Extreme scattering events/target of opportunity. 6, 20 cm
AF227	Fey, A. (NRL) Gaume, R. (NRL) Claussen, M. Nedoluha, G. (NRL) Johnston, K. (NRL)	"Cometary" HII regions. 2 cm
AF241	Feretti, L. (Bologna) Andernach, H. (Canarias) Giovannini, G. (Bologna) Perley, R.	Jets in 3C 31 and 3C 449. 20 cm
AF254	Fey, A. (NRL) Gaume, R. (NRL) Claussen, M. Johnston, K. (NRL)	Radio recombination line observations of G34.3+0.2. 3.6 cm line
AF256	Fomalont, E. Kellermann, K. Partridge, R. B. (Haverford) Windhorst, R. (Arizona State)	The radio sky at microjansky levels. 3.6 cm
AF257	Fomalont, E. Goss, W. M. Lyne, A. (Manchester) Manchester, R. (CSIRO)	Pulsar proper motions — 4th epoch. 20 cm line
AF260	Frail, D. Goss, W. M. Slysh, V. (IKI, Moscow) Dubner, G. (IAR, Buenos Aires) Claussen, M. Gaume, R. (NRL)	Shock-excited maser emission from supernova remnants. 20 cm line
AF261	Fiebig, D. (Heidelberg Obs.) Menten, K. (CFA)	Confirming the detection of a masing protostellar disk. 1.3 cm line
AF263	Feretti, L. (Bologna) Giovannini, G. (Bologna) Parma, P. (Bologna) Laing, R. (Cambridge) Bridle, A. Perley, R.	Tests for kiloparsec-scale jet deceleration using 3C 31. 20 cm
AF264	Fruchter, A. (STScI) Thorsett, S. (Caltech) Goss, W. M.	Pulsar proper motions. 20 cm

No.	Observer(s)	Program
AG389	Guedel, M. (Colorado/JILA) Schmitt, J. (MPIfEP, Garching) Benz, A. (SFIT, ETH)	Radio and X-ray activity in two dMe binaries. 3.6, 6 cm
AG395	de Geus, E. (Maryland) Digel, S. (CFA) Puche, D. (CFA)	An HII region beyond the optical disk of the galaxy. 6, 20 cm line
AG400	Goldschmidt, P. (Queen Mary) Miller, L. (Edinburgh)	Quasar evolution at radio and optical wavelengths. 6 cm
AG402	Golla, G. (MPIR, Bonn) Hummel, E. (Edinburgh) Dettmar, R. (STScI) Kronberg, P. (Toronto)	Filamentary radio halos of NGC 4632 and UGC 9579. 20 cm
AG408	Gallimore, J. (Maryland) Baum, S. (STScI) O'Dea, C. (STScI) Brinks, E. Pedlar, A. (Manchester)	HI, OH, H_2O absorption in nearby Seyferts. 6, 20 cm line
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
AH502	Hofner, P. (Wisconsin) Cesaroni, R. (Arcetri) Kurtz, S. (Mexico/UNAM) Churchwell, E. (Wisconsin) Walmsley, C. M. (MPIR, Bonn)	Hot ammonia in G45.47+0.05 and G45.12+0.13. 1.3 cm line
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
AH510	Hewitt, J. (MIT) Chen, G. (MIT)	Faraday rotation measurements in gravitational lens MG1131+0456. 3.6, 6 cm
AJ233	Jones, M. (Cambridge) Saunders, R. (Cambridge) Grainge, K. (Cambridge)	Search for arcminute primordial fluctuations. 3.6, 6 cm
AJ234	Jacobson, A. (Los Alamos) Mercier, C. (Meudon) Erickson, W. (Maryland)	Geoplasma dynamics. 90 cm

No.	Observer(s)	Program
AJ235	Jaffe, W. (Leiden) van Langevelde, H. (Leiden) Israel, F. (Leiden)	Narrow HI and OH absorption in radio galaxy nuclei. 20 cm line
AK319	Katz-Stone, D. (Minnesota) Rudnick, L. (Minnesota)	Three-frequency mapping of FR 1 radio galaxy 3C 449. 6 cm
AK324	Kollgaard, R. (Penn State) Feigelson, E. (Penn State) Laurent-Muehleisen, S. (Penn State) Chester, M. (Penn State) Brinkmann, W. (MPIfEP, Garching) Hertz, P. (NRL)	Optically quiet quasars. 1.3, 2, 3.6, 6, 20 cm
AK330	Katz-Stone, D. (Minnesota) Rudnick, L. (Minnesota)	The low-energy end of the spectrum of relativistic electrons. 3.6 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
AK346	Kulkarni, S. (Caltech) Frail, D. Kassim, N. (NRL) Murakami, T. (ISAS, Japan)	Possible radio counterpart of SGR 1900+14. 20, 90 cm
AK347	Knapp, J. (Princeton) Rupen, M. Holdaway, M.	Neutral hydrogen at high galactic latitudes. 20 cm line
AK350	Kellermann, K. Shaver, P. (ESO) Wall, J. (RGO)	High-z quasars. 3.6 cm
AK353	Kronberg, P. (Toronto) Sawicki, M. (Toronto) Dyer, C. (Toronto) Perley, R.	Polarization symmetry breaking due to lensing. 3.6, 6 cm
AK357	Kulkarni, S. (Caltech) Vasisht, G. (Caltech) Frail, D.	Is the soft gamma repeater 1806-20 a young pulsar? 3.6, 20 cm
AK358	Kulkarni, S. (Caltech) Vasisht, G. (Caltech) Frail, D.	Monitoring SGR 1806-20 = SNR 10.0-0.3. 3.6, 6, 20 cm
AL150	Lestrade, J.-F. (JPL) Preston, R. (JPL)	Statistical properties of RSCVn stars.

No.	Observer(s)	Program
AL294	Leone, F. (Catania) Trigilio, C. (Noto, Italy) Umana, G. (Noto, Italy)	Testing the proposed models for radio emission from CP stars. 1.3, 2, 6, 20 cm
AL296	Lehnert, M. (Laval) Armus, L. (Caltech)	The radio halo of NGC 660 — evidence for supernova-driven winds. 6 cm
AL309	Lang, K. (Tufts) Willson, R. (Tufts) Kile, J. (Tufts)	VLA-Yohkoh SXT observations of dynamic structures on the sun. 20, 90 cm
AL314	Liang, E. (Rice) Hjellming, R.	Search for radio jets and variations in the annihilator 1H1822-371. 2, 3.6, 6, 20 cm
AL317	Langston, G. Kochanek, C. (CFA)	Giant arcs near clusters of galaxies. 20 cm
AL320	Lim, J. (Caltech) Bieging, J. (Arizona)	Search for nonthermal emission from O, B, and Wolf-Rayet stars in close binary systems.
AL322	Longair, M. (Cambridge) Rottgering, H. (Cambridge) Best, P. (Cambridge) Riley, J. (Cambridge)	3CR radio galaxies at z = 1. 3.5 cm
AL323	Lim, J. (Caltech) White, S. (Maryland)	Search for radio emission from K dwarf stars in the Pleiades. 3.6 cm
AM348	Mehringer, D. (Illinois) Palmer, P. (Chicago) Yusef-Zadeh, F. (Northwestern) Goss, W. M.	Sgr B1/B2. 3.6, 6, 20 cm
AM418	McIntyre, V. (CFA) Puche, D. (CFA) Huchra, J. (CFA)	Star formation and internal kinematics of irregular galaxies. 20 cm line
AM422	McMullin, J. (Maryland) Mundy, L. (Maryland)	Radio continuum emission from IRAS 05338-0624. 1.3, 2, 6 cm
AM429	Menten, K. (CFA)	Search for CS(1,0) in the z = 2.286 galaxy IRAS 10214+4724. 2 cm line
AM430	Mangum, J. (Arizona) Wootten, H. A.	S106FIR: YSO, protostar, or molecular debris? 1.3 cm line
AM432	Marti, J. (Barcelona) Rodriguez, L. (Mexico/UNAM)	Radio HH systems associated with young massive stars. 3.6 cm

No.	Observer(s)	Program
AM437	Moffett, D. (NMIMT) Reynolds, S. (NC State) Dubner, G. (IAR, Buenos Aires) Giacani, E. (IAR, Buenos Aires) Reynoso, E. (IAR, Buenos Aires) Winkler, P. F. (Middlebury College) Goss, W. M.	Expansion of Tycho's SNR, 3C 10. 20 cm
AM445	Moore, C. (MIT) Hewitt, J. (MIT)	Time delays in the gravitational lens MG0414+0534. 3.6 cm
AM446	Mirabel, F. (Saclay, France) Rodriguez, L. (Mexico/UNAM)	GRS1915+105: Possible hard X-ray counterpart of a soft gamma repeater. 3.6, 20 cm
AM447	Mirabel, F. (Saclay, France) Rodriguez, L. (Mexico/UNAM)	Hard X-ray transient GRS1716-249. 6, 20 cm
AM449	Menten, K. (CFA)	Search for CH absorption toward star-forming regions. 6 cm line
AN063	Norton, L. (Illinois)	HI in NGC 185. 20 cm line
AO118	Oren, A. (Calif., San Diego) Wolfe, A. (Calif., San Diego)	Faraday rotation mapping of 3C 196. 3.6 cm
AP253	Puche, D. (CFA) Westpfahl, D. (NMIMT) Carignan, C. (Montreal)	Incipient spiral structure in UGC 2259. 20 cm line
AP263	Patnaik, A. (MPIR, Bonn) Browne, I. (Manchester) Muxlow, T. (Manchester) Wilkinson, P. (Manchester)	Monitoring the gravitational lens B1422+23.1. 2 cm
AP273	Philp, C. (North Carolina) Evans, C. (North Carolina) Frail, D. Leonard, P. (Los Alamos)	Pulsar companions to runaway OB stars. 6, 20 cm
AP276	Pedlar, A. (Manchester) Mundell, C. (Manchester)	Continuum observations of NGC 3281. 2, 3.6 cm line
AP281	Palmer, P. (Chicago) de Pater, I. (Calif., Berkeley) Snyder, L. (Illinois)	OH emission from Comet Encke. 20 cm line
AP282	Patnaik, A. (MPIR, Bonn) Browne, I. (Manchester) Wilkinson, P. (Manchester) Wrobel, J.	Phase calibrators for Merlin. 3.6 cm

No.	Observer(s)	Program
AP285	Pedlar, A. (Manchester) Muxlow, T. (Manchester) Sanders, E. (Manchester) Axon, D. (STScI)	Study of the diffuse component and extended SNR in M82. 3.6, 20 cm
AP289	Parma, P. (Bologna) de Ruiter, H. (Bologna) Fanti, R. (Bologna) Laing, R. (Cambridge)	Brightness asymmetries of jets in low luminosity radio galaxies. 6 cm
AR302	Rao, S. (Pittsburgh) Briggs, F. (Pittsburgh)	Observations at 21 cm of large-diameter spirals. 20 cm line
AR303	Rao, S. (Pittsburgh) Briggs, F. (Pittsburgh)	The HI edge of NGC 628. 20 cm line
AR306	Reipurth, B. (Chile) Rodriguez, L. (Mexico/UNAM) Marti, J. (Barcelona)	Proper motions of radio condensations in HH80-81. 3.6, 6 cm
AR310	Rudnick, L. (Minnesota) Keohane, J. (Minnesota) Perley, R.	Evolutionary studies of Cas A. 6, 20 cm
AR312	Reid, M. (CFA) Menten, K. (CFA)	SiO masers and stellar disks of red giants. 0.7 cm
AR317	Ratner, M. (CFA) Bartel, N. (York U.) Lestrade, J.-F. (JPL/Meudon) Lebach, D. (CFA) Shapiro, I. (CFA)	Monitor IM Peg, Lambda, for NASA/Standford gravity probe-B use. 3.6 cm
AS333	Sramek, R. Weiler, K. (NRL) van der Hulst, J. (Groningen/Kapteyn) Panagia, N. (STScI)	Statistical properties of radio supernovae. 2, 6 cm
AS518	Stocke, J. (Colorado/JILA) Carilli, C. (Leiden) Urry, M. (STScI) Donahue, M. (Carnegie) Shull, J. (Colorado/JILA)	HI imaging of a low redshift Lyman alpha forest cloud. 20 cm line
AS521	Seaquist, E. (Toronto) Roelfsema, P. (Groningen/Kapteyn)	Observations of recombination line emission in M82. 90 cm line
AS525	Sramek, R. Weiler, K. (NRL) Van Dyk, S. (NRL) Panagia, N. (STScI)	The properties of radio supernovae. 1.3, 2, 3.6, 6, 20 cm

No.	Observer(s)	Program
AS526	Stocke, J. (Colorado/JILA) Perlman, E. (Colorado/JILA) Wurtz, R. (Colorado/JILA)	MS0205-135: A gravitationally lensed BL Lac? 3.6, 6 cm
AS527	Stahler, S. (Calif., Berkeley) Andre, P. (Saclay, France)	Origin of the youngest naked T Tauri stars. 3.6 cm
AS529	Swain, M. (Rochester) Bridle, A. Baum, S. (STScI)	Radio galaxy 3C 353. 3.6 cm
AS530	Smith, H. (Air and Space Museum) Lonsdale, C. (Haystack) Lonsdale, C. (IPAC, Pasadena)	Fine-scale radio structure of ultraluminous IR galaxies. 1.3, 2 cm
AT139	Taylor, C. (Minnesota) Brinks, E. Skillman, E. (Minnesota)	BCDs: Search for neutral hydrogen companions. 20 cm line
AT153	Tafalla, M. (Calif., Berkeley) Bachiller, R. (Yebes Obs.) Martin-Pintado, J. (Yebes Obs.)	High-velocity ammonia in the young bipolar outflow L1157. 1.3 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
AU055	Uson, J. Goss, W. M.	Observations of ^{3}He in the galactic HII regions W3 and W43. 3.6 cm line
AU056	Uson, J. Bagri, D. Cornwell, T.	Further observations of a proto-cluster of galaxies. 90 cm line
AV209	Velusamy, T. (JPL) Kuiper, T. (JPL) Langer, W. (JPL) Migenes, V. (CSIRO)	CCS ($J_N = 2_1 \rightarrow 1_0$) spectral line mapping of clumps in dark cloud cores. 1.3 cm line
AW348	Wolszczan, A. (Penn State) Frail, D.	Further astrometric observations of PSR 1257+12. 20 cm
AW350	Wills, B. (Texas) Shastri, P. (Calif., Berkeley)	Core variability in lobe-dominated quasars. 3.6 cm
AW359	Wilcots, E. Hodge, P. (Washington) Miller, B. (Washington)	High resolution HI study of IC 10. 20 cm line

No.	Observer(s)	Program
AW368	Wilcots, E.	HI observations of barred Magellanic spiral galaxies. 20 cm line
AW372	Wagner, S. (Heidelburg Obs.) Quirrenbach, A. (NRL)	What causes asymmetries in low luminosity jets of Seyfert galaxies? 3.6, 20 cm
AW374	Wood, D.	Observations at 7 mm of ultracompact HII regions. 0.7, 3.6 cm
AY057	Yun, M. (Caltech) Bryant, P. (Caltech) Scoville, N. (Caltech)	Tidal remnants around ultraluminous IRAS galaxies. 20 cm line

E. VERY LONG BASELINE ARRAY

No.	Observer(s)	Program
BK021	Kemball, A. (HartRAO) Taylor, G. (Caltech) Pearson, T. (Caltech) Readhead, T. (Caltech) Vermeulen, R. (Caltech)	VLBI search for inter-day variability. 6 cm
BR016	Readhead, A. (Caltech) Vermeulen, R. (Caltech) Backer, D. (Calif., Berkeley)	Observations of 3C 84. 1.3, 3.6 cm
GJ006	Junor, B. (New Mexico) Biretta, J. (STScI)	Evolution of M87 nuclear jet on light-month scales. 1.3, 6 cm
GK011	Krichbaum, T. (MPIR, Bonn) Otterbein, K. (MPIR, Bonn) Witzel, A. (MPIR, Bonn) Fricke, K. (Gottingen) Kollatschny, W. (Gottingen) Zensus, J. A.	Imaging of a flux density limited sample of Seyfert 2 galaxies. 6 cm
	Marcaide, J. (Valencia, Spain) Ros, E. (Valencia, Spain) Alberdi, A. (IAA, Granada) Guirado, J. (IAA, Granada) Rius, A. (IAA, Granada) Shapiro, P. (CFA) Whitney, A. (Haystack) Perez, E. (Canarias) Krichbaum, A. (MPIR, Bonn) Schilizzi, R. (NFRA) Elosegui, P. (CFA)	SN1993J: Distance to M81. 1.3 cm

No.	Observers	Program
GM 107 continued	Mantovani, F. (IdR, Italy) Davis, R. (Manchester) de Bruyn, G. (NFRA) Diamond, P. Jones, D. (JPL) Preston, R. (JPL) Rogers, A. (Haystack) Trijilio, C. (IdR, Italy) Witzel, A. (MPIR, Bonn) Zensus, J. A.	
GP012	Pauliny-Toth, I. (MPIR, Bonn) Unwin, S. (Caltech) Wehrle, A. (Caltech) Zensus, J. A. Nicolson, G. (HartRAO)	Monitoring of quasar 3C 454.3. 1.3 cm
GR004	Rupen, M. Bartel, N. (York U.) Conway, J. Beasley, A. Sramek, R. Romney, J. Bietenholz, M. (York U.) Weiler, K. (NRL) Van Dyk, S. (NRL) Davis, R. (Manchester) Panagia, N. (STScI) Rius, A. (IAA, Granada) Altunin, V. (JPL) Cannon, W. (ICS) Graham, D. (MPIR, Bonn) Jones, D. (JPL) Popelar, J. (Ottawa) Titus, M. (Haystack) Venturi, T. (Bologna)	SN 1993J in M81. 2, 3.6, 6 cm
GW011	Wehrle, A. (JPL/IPAC) Unwin, S. (Caltech) Gabuzda, D. (Calgary) Zook, A. (Pomona College)	Evolution of parsec-scale radio jet in 3C 279. 1.3, 6 cm
GZ011	Zensus, J. A. Lobanov, A. (Lebedev) Leppanen, K. (Helsinki) Unwin, S. (Caltech) Wehrle, A. (JPL/IPAC)	Monitoring the parsec-scale jet structure of 3C 345. 1.3, 3.6, 6 cm

F. SCIENTIFIC HIGHLIGHTS

Green Bank

An all-sky survey for new pulsars has yielded its first detection: PSR B0531+04, a pulsar with a period of 0.9s and a dispersion measure of 84. This is the first pulsar to be discovered with the 140 Foot Telescope. It was detected in a survey designed to find new milli-second period pulsars in heretofore unsearched regions of the sky. "Slow" pulsars, such as B0531+04, are detected along with the fast ones. Advances in computing power and the sensitivity of the spectral processor make it possible to detect new pulsars even with the modest collecting area of the 140 Foot. This survey is expected to find several new milli-second pulsars, plus a few slower ones. So far only 10 percent of the data have been reduced.

Investigators: R. Sayer (Princeton), D. Nice (NRAO), J. Taylor (Princeton).

Tucson

Detection of Interstellar CH_2D^+. The 12 Meter and the CSO telescopes have been used to detect CH2D+, the deuterated form of CH_3^+. The CH_3^+ ion, produced directly from the fundamental ion H_3^+ by reaction with C, is of extreme importance in astrochemistry because it initiates the formation of hydrocarbons. Because it is symmetric CH_3^+ cannot be directly observed, but because deuterium is bound to CH_2D^+ much more strongly than to H_2D^+, CH_2D^+ remains heavily fractionated to much higher temperatures than H_2D^+. The deuteration of CH_3^+ is quite well understood, so that its observation leads directly to an estimate of the important CH_3^+ abundance. The investigators have detected all three transitions of CH_3^+ accessble from the ground (101-000 at 278 GHz, 211-212 at 201 GHz, and 110-111 at 67 GHz) in the warm star-forming regions of Orion- KL, $SgrB_2N$, and W51M. The results yield column densities of 10^{14} to 10^{15} cm^{-2} fractional abundances consistent with those of current chemical models of $CH3^+$ abundances and the expected degree of deuteration. They are also consistent with DCN/HCN ratios, implying that HCN may be formed via $CH_3^+ + N$ rather than the more commonly held process $C^+ + NH_3$.

Investigators: H. A. Wootten and B. Turner (NRAO)

Detection of Interstellar Methylene (CH_2). The 12 Meter Telescope has been used to detect the methylene radical (CH_2) in the Orion and W51 interstellar clouds. In both sources, three hyperfine components have be resolved at a frequency near 68 GHz and a blended feature has been detected near 71 GHz. CH_2 proved a difficult molecule to observe owing to the high energy levels from which the emission arises and the frequency of the transitions with respect to atmospheric absorption bands. Improvements in receiver sensitivity and tuning flexibility allowed the authors to confirm their tentative results from several years ago. CH_2 is a parent molecule to several other interstellar species. A reaction of CH_2 and molecular oxygen produces HCO, which is in turn a structural component of several other more complex molecules, including formaldehyde, formic acid, and methyl formate. CH_2 is formed in one branch of an electronic recombination reaction with CH_3+ that also produces the well-known interstellar molecule CH.

Investigators: J. M. Hollis (NASA-Goddard), P. Jewell (NRAO), F. Lovas (NIST)

Socorro

VLBA Reveals Counterjet Feature in 3C 84. A VLBA observation of 3C 84 with eight antennas, intended as a test experiment for a "first science" run of the VLBA correlator, has revealed a new feature. The 8.4 GHz continuum image, processed with the final hardware of the VLBA, has a dynamic range of about 4000, and is among the best that have been made with VLBI. The newly revealed feature has been independently confirmed at 22 GHz by VLBI Network observations. The feature apparently can be explained as the symmetric counterpart in the receding jet to the brightest feature in the approaching jet. The feature's

spectral properties, and to some extent its morphology, can be explained by free-free absorption in an intervening medium, perhaps the accretion disk. If so, this can provide powerful constraints on the physical parameters of such an accretion disk.

Investigators: R. C. Walker, J. Romney, J. Benson (NRAO).

Superluminal Motion Detected in M87's Jet. The jet in M87 has been monitored with the VLA since 1982. Seven images were obtained at 15 GHz between 1982 and 1993, and the most recent of them clearly demonstrate the presence of superluminal motion for several small features within the jet. The detected speeds approach 3 c for some features, while speeds between 0.5 c and 1.0 c predominate. In addition, new emission features have been seen to form spontaneously within the first few hundred parsecs of the jet. The new observations provide the basis for constructing improved physical models for the motions.

Investigators: F. Zhou (STScI and NM Tech); J. Biretta (STScI), F. Owen (NRAO).

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

Three prototype 3.95-5.85 GHz amplifiers have been fabricated and delivered to Smithsonian (SAO) for evaluation as IF amplifiers for submillimeter array SIS mixers. This amplifier was designed primarily for the GBT Gregorian receiver. Measurements indicate T_{min} = 7.3 K and T_{avg} = 9.3 K across the band.

Work has begun on the prototype 290-395 MHz balanced amplifier which is similar to the existing 680-920 MHz design. This amplifier is being designed for the GBT.

Work is continuing on the PC-based amplifier test station for amplifiers to 26 GHz.

Production of the 40-50 GHz amplifiers for the VLA continued this quarter (8 units). The design of the 75-95 GHz amplifier has been completed and assembly is in progress. The design of the WR10 waveguide-to-microstrip transition has been tested (it is part of the 95-20 GHz amplifier) and found to work well over the 75-120 GHz bandwidth.

Evaluation of other InP HFET devices from Martin Marietta and Hughes continued this quarter.

86 GHz VLBA Receiver

Most RF components ordered for this receiver have been received. Testing of the LO/mixer components is progressing. The dewar and receiver package have been manufactured, and assembly of a prototype receiver is in progress.

Superconducting (SIS) Millimeter-Wave Mixer Development

We have installed Sonnet *em*, a program for analyzing planar electromagnetic circuits. This is now being heavily used in designing a new broadband tunerless SIS mixer for the 200-300 GHz band, for which greater accuracy is required than can be achieved using the standard microwave circuit simulators such as MMICAD or Touchstone.

Modifications were made to the DC wiring of two more SIS receiver inserts. The feed-through filters and 4 K wiring heatsinks were replaced with new more reliable designs. The four receiver modules for 68-90 and 90-116 GHz, now on the 12 Meter Telescope, still remain to be modified.

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

Electromagnetic Support

GBT Project: The effect of gravity-induced deformations of the elevation structure on Model 95, rev. B, was studied. Resulting gain loss can be recovered by translating the subreflector. The optimum position for the subreflector at zenith and horizon has been located. The maximum loss in efficiency after correction is less than 1 percent.

A prototype of the C-band orthomode transducer (OMT) was fabricated and measured. This prototype has return loss better than 18 dB. This design was analyzed using HFSS software in order to get an insight of the higher order modes present in the OMT.

An L-band OMT to cover the 1.15-1.75 GHz range was designed.

VLA Project: A preliminary design study on feeds to cover the new bands as specified for the VLA upgrade was carried out. Layout drawings have been started to study the feasibility of installation of these feeds.

GBT Spectrometer

The design problem with the 1024-lag correlator chip intended for use in the GBT spectrometer has been identified and corrected (on paper). The NRAO chip test fixture was used in the analysis of the chip problem, and software for this test fixture was mostly completed in this quarter.

Talks with Hewlett Packard, who provides the silicon foundry used in production of the correlator chip, to identify the cause of the low yield experienced in the chip manufacturing process have been started. It is not determined at this time if the yield from the first wafer run is typical for the chip design and must be lived with or if a better yield can be expected. A second wafer run for the correlator chip is expected to be started later in the spring.

The 2 GHz sampler layout is about two-thirds complete, and the first two printed circuit boards should go out for manufacture in about two weeks.

The OVLBI frame decoder has been completed and delivered to Green Bank. Engineering support to fix remaining hardware and software bugs will be provided in the next few months.

OVLBI Support

Tests of a clock recovery system using AD804 IC's, as mentioned in the report for the previous quarter, were made. However, as with the T7023 IC's, it was not found possible to get the two IC's for the two output signals from the Costas loop to work in phase with a single clock in a reliable manner. It was therefore decided to build up the required clock recovery system with discrete components, and such a unit has now been completed and satisfactorily tested. It remains to package the Costas loop and clock recovery units in a single module with interface circuitry for monitor and control. Metal parts for the module have been obtained and customized, and assembly and testing of the module is expected to be completed during April.

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 first step planned is installation of the GBT 18-26.5 GHz receiver in April. If all goes well, installation of the GBT 8-10 GHz and 12-15.4 GHz receivers will follow this summer.

Sixteen receiver changes were scheduled and completed this quarter.

GBT Development

Assembly of the first prime-focus front-end continues. Testing of the IF router, optical driver, and optical receiver modules continues. Prototype broadband square-law detector and video amplifier were developed for the optical driver module. Generation of fabrication drawings for the 3.95-5.85 GHz and 1.15-1.73 GHz front-ends continued, and the 3.95-5.85 GHz quad-ridged OMT was completed. Design, procurement, and assembly work on the revised prototype feed rotator and controller was completed and debugged; a few weeks of life testing will soon begin.

Work on electronics for the open-loop active surface continued. Assembly of the actuator room control panels continues. In conjunction with the actuator motor supplier, a problem with the motor was identified and a fix developed. To keep the actuator production line moving, 147 motors already in Green Bank were removed and returned, and a container of 1200 actuators also was returned to be retrofit.

Development of the continuum backend continued. Assembly of printed circuit boards is underway, and development of real-time control software is beginning.

A design error which appears to have caused the problems with the initial 1024 lag correlator chips has been identified and corrected. The problem was in certain parameters input to the circuit simulation program which caused the simulator to fail to predict failure of one signal path at high speeds. Correction of these parameters accurately predicts the measured chip performance and allowed the designers to correct the design problems with that signal distribution. Another chip fabrication run will be required and preparations for that are underway.

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. In conjunction, site timing equipment will be consolidated at the Interferometer control building from which time-of-day and frequency reference signals will be distributed. The materials for the conduit installation and some major components for the timing center have been received. Installation of the first leg of conduit has begun. An RFQ for the fiber cable has been issued, and plans for construction of a maser/clock room in the Interferometer control building were completed. Testing of the digital clock/IRIG generator was completed in conjunction with the spectral processor, and development of temperature stable 10 MHz splitter/buffer amplifiers completed.

Maintenance, repair, and installation support was supplied to the 140 Foot, Interferometer, and site computer facilities. Work continues on construction of new S/X receivers for the support of USNO operations.

J. TUCSON ELECTRONICS

New 3 mm Polarimeter

In response to a demand from observers, a polarimeter has been constructed for the telescope. This is implemented in optics, consisting of a rotating grid and plane mirror combination. By changing the grid-mirror spacing, the device can be tuned to any wavelength from 1 mm to > 3 mm. It can be made sensitive to circular or to linear polarization, and is applicable to both continuum and spectral line observations. Initial tests were made in March 1994, and were very successful. After further testing, the polarimeter will be released to observers in late May of this year.

Millimeter Wavelength VLBI

We continue to support millimeter wave VLBI in conjunction with the international network. In 1993, we installed a temporary cable link, using coaxial cable obtained from the surplus list, between the 12 Meter Telescope and the Kitt Peak VLBA antenna. For 12 Meter VLBI observations, the maser local oscillator reference is sent from the VLBA control building to the 12 Meter, and the IF signal is sent back from the 12 Meter to the VLBA recorders. During 1994 we will replace this temporary cable link with a connection using armored fiber-optic cable, which should be both more phase stable and much more durable. There is increasing pressure for observing time for VLBI experiments using the 12 Meter Telescope, which currently require a great deal of effort to set up. We aim to make this mode of operation much easier for future experiments.

In spite of extremely poor weather, VLBI fringes were detected on all baselines involving the 12 Meter Telescope during the 1993 experiments. We have just completed another millimeter wavelength VLBI session and expect another session in the autumn of 1994.

On-The-Fly Mapping Update

We continue to make progress in implementing the new on-the-fly mapping techniques in which the telescope is scanned continuously across a field, rather than stepped between discrete points. The technique is more efficient with respect to observing overhead and should produce higher quality data. This technique has become feasible only recently owing to the power and flexibility of the new telescope control system and the sensitivity of the SIS receiver systems. The staff has observed several high-quality maps in both the spectral line and continuum modes. With regard to the telescope control and data aquisition systems, this technique is debugged and available now for continuum observations and filter bank spectroscopy.

A current impediment to the use of on-the-fly observing comes at the data analysis stage. The new modes produce data acquisition rates at least an order of magnitude higher than conventional methods. The inclusion of hybrid spectrometer on-the-fly mapping, planned for the summer of 1994, will aggravate this problem. We do not have the CPU power to adequately deal with the processing requirements for these data, nor is a complete suite of analysis software available. At present, we have available some UniPops procedures and some *ad hoc* image display programs. In the short term, we will build an interface, within the framework of UniPops, into the existing AIPS analysis system; this is being done with temporary help hired from Steward Observatory. The long-term solution is dependent on the successful outcome of the AIPS++ project.

K. SOCORRO ELECTRONICS

VLA 1.3 - 1.7 GHz Receiver Improvements

All 28 VLA antennas now have the new improved front-ends. We will complete two additional spare front ends in 1994.

VLA 40 - 50 GHz Receivers

Eight receivers have been installed on antennas. The ninth receiver has been assembled and the cooled low-noise amplifiers were received from the Central Development Lab and will be installed on antenna 22 soon.

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 17. 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 alarms detailing "antenna number," "arm," "generator," "UPS," "HVAC," "problem," etc. Operators interface via a touch screen, 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 slice microprocessor, a Modcomp computer, and an 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 prototyped in 1994.

VLA Antenna B-Rack Shields and Optical Fibers

The VLA machine shop completed most of the metal work for twenty B-rack RFI shields. One shield has been completely assembled and a second unit started. Fiber cable and the optical transmitters and receivers are assembled and tested. The first unit will be installed in antenna 28 in early April.

VLBA Recorders and Playback Drives

More than half of the new order of 450 thin tapes has arrived. An extensive effort is underway to transfer these tapes to glass reels so that they can be released to the tape pool. Recent tests indicate improved performance with new recorder and formatter firmware which is now in place at all sites. The last playback drive is scheduled for shipment from Haystack soon.

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. Stability measurements made with respect to maser #1 show excellent short and mid term sigmas (1-2000 sec). The 10,000 sec sigmas will probably improve as the new physics packages age. Typically IF level degradations take 4-6 months to reach acceptable rates after reworking the physics hardware.

Interference

The Electronics Division added an electromagnetic compatibility (EMC) engineer position to its staff. A proposal to control locally generated interference at the VLA is being drafted. 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

The 15JAN94 release of "Classic AIPS" was made available only a little more than a month late. By the end of March, we had shipped the release to 44 institutions, 9 by magnetic tape (of 4 kinds) and 35 by electronic file copies. The installations of the new release appear to be occurring without difficulty. In addition, two sites have subscribed to the 15JUL94 release that is under active development by the AIPS Group. The copies of AIPS at the California Institute of Technology and the Center for Astrophysics are now updated automatically and electronically on a nearly daily basis. These two institutions have a particular need to track the latest developments in software for the VLBA Correlator and calibration.

There were three new tasks added to AIPS in this quarter. MAPBM is used to make images of the single-dish beam in all four Stokes polarizations using holography-mode observations. Images made from VLA snapshot observations may then be corrected for the (considerable) polarization of the single-dish beam using VLABP. This task does not work on images from multiple scans because of the rotation of the single-dish polarization with hour angle. The third new task, MODVF, is used to model the velocity field of galaxies observed, particularly in neutral hydrogen. It uses a tilted ring model to describe the warping of the plane of the galaxy. In contrast to most existing software of this kind, MODVF allows the user to describe the warp using parameters which are fully independent of the location of the observer with respect to the galaxy.

Much effort during the quarter was expended on the task FITLD which translates VLBA correlator data into AIPS for calibration and imaging. It was made more robust for handling multiple output data streams, for cleaning up on termination, and for handling and correcting IM and other tables on input. VLBI calibration tasks were improved and corrected, including adding additional calibration-table corrections to CLCOR, generalizing the calibration using auto-correlations in ACFIT, adding geometric delay computations to the rebuilding of calibration tables in INDXR, and improving the display of calibration tables by SNPLT. The tape indexing task PRTTP was generalized to handle unknown formats reasonably and was cleaned up to report all errors on the printer and to continue functioning whenever possible despite various error conditions. The port to the Linux operating system on personal computers was completed, including the cleaning up of a poor, but widespread coding practice through large parts of AIPS.

M. AIPS++

During the past quarter, the AIPS++ project has made significant progress in a number of areas, despite some technical setbacks. One item of interesting trivia: the project passed the 100,000 lines of code mark sometime during January this year! Progress has focused in several areas of design and implementation:

User Interface and Visualization Tools

As the underlying structure of AIPS++ has clarified over the past few months, work on the design and prototype of the AIPS++ user interface (UI) has begun. A preliminary answer to the question "What will a user see when AIPS++ is running?" has been worked out, with a working prototype scheduled for testing in early April, thanks to our colleagues at the University of Illinois (UI). The UI will combine a fully programmable command line interface (CLI) with a graphical user interface (GUI).

Users will be able to work in either or both environments, depending on their personal preference. The AIPS++ UI will provide the following set capabilities and applications initially:

Control Hub:	Communication, Startup, Process control
CLI:	Command Line Interpreter (extended Glish), fully programmable, with control structures, conditionals, etc.
Task manager:	GUI interface to the control hub, CLI, applications and objects.
Catalog manager:	An object manager with a file management paradigm
Visualization:	Visualization tools will be integrated with the UI
Table Browser:	Provide low level GUI access to AIPS++ data
Help/Documentation:	Based on NCSA Mosaic, both GUI and terminal access
Parameter editor:	Edit, manage task parameters.

Users will have access to AIPS++ classes (subroutines) in at least two ways when developing high-level applications: (1) Used AIPS++ classes via calls to the control hub from the CLI; and (2) Wrapped into a stand-alone program. The control hub will be based on Glish (Paxson, 1993), which provides the concept of a "software bus" for communication between processes.

System Development

The AIPS++ project has been struggling with a number of problems related to buggy compilers and unreliable debuggers. As the amount of AIPS++ code and its complexity increased, the time required for a compile-edit-debug loop was becoming intolerable. Happily, these problems have been largely resolved by a combination of clever tools developed by the AIPS++ project, and improvements in operating systems and compilers from various vendors. During the past months, substantial improvements were achieved in how the project uses a number of language features, particularly templated classes. These problems have caused some delays; we are still assessing their impact on the project schedule.

AIPS++ can now support multiple architectures. The AIPS++ beta release (scheduled for distribution near the end of 1994) will support at least SUN (both SunOS and Solaris) and IBM architectures. Later releases will support additional machine types, with the priorities still to be determined.

Implementation Milestones

Several important goals were achieved during the past quarter, despite the technical difficulties that compilers and operating systems were causing the project. The design and coding of an early version VLA Archive Measurement Set (MS) is complete. This is the preliminary implementation of the data structure using AIPS++ Tables which will store VLA data. The VLA MS is especially important because it serves as a prototype for other MS's from other instruments in the AIPS++ consortium, including ATNF, WSRT, BIMA, DRAO, and GMRT.

A number of other pieces of AIPS++ have also been completed: AIPS++ classes required for FITS I/O have been completed and are under test. These classes provide I/O for FITS images, random groups, and binary tables. Recently, during testing, a VLBA data set was imported into an AIPS++ table and browsed using the AIPS++ table browser. A Hogbom Clean tool (using AIPS++ arrays) was completed recently; implementation of a Clark Clean will be done in the coming weeks.

The AIPS++ project is large enough to benefit from application of some formal methodologies from software engineering. Since late last year, exploration of formal software engineering techniques has been ongoing, with the goal of insuring the maintainability of AIPS++, while at the same time preserving the overall flexibility desired for AIPS++. Of general interest are the ideas developed to provide modular classification and documentation of AIPS++ classes into software "Modules." A module will consist of a group of classes related by function (e.g., the classes used by the Table system). This will improve the overall accessibility of AIPS++ for programmers by providing clear distinction between externally useful classes and classes used internally by AIPS++ subsystems. The software engineering effort has also pointed the way towards implementing formal procedures for change notification and automatic testing of classes.

Plans

We are still assessing the impact of various technical delays on the schedule for this year. The basic goals laid out for this year (an internal prototype release this June, and a publicly available beta release at the end of this year) remain the same at this writing. It still appears that no major schedule changes will be required, although some minor delays may occur.

We are just beginning the process of updating the design documents for AIPS++, with a focused effort on the astronomical design of AIPS++. The result of this effort should be available in about two months. This new document will guide our efforts over at least the coming year or so, much as the previous documents have done. Our experience is that the detailed design documents should not get too far in front of the prototyping and coding efforts, else the design may be based on incorrect technical assumptions. When the latest overall design document is completed, it should then be possible to fill in the details on the implementation of AIPS++ in a subsequent document. That second document should be available sometime this summer, but its exact scope has not yet been defined.

N. SOCORRO COMPUTING

A new powerful IBM 580 workstation called piro was installed at the AOC. With its 128 MByte memory and 15 GByte disk space, piro is — after hopi and kiowa — the third machine of its kind. All three are primarily aimed at VLBA data reduction, but sometimes may be used for large VLA spectral line projects as well.

We expect to upgrade all AOC Sun workstations to Solaris 2 in late April or early May. Though this inevitably will cause some interruptions, we will try to make the switch as painless as possible. An upgrade of the Arana server, which is required to satisfy the increased demands of a Solaris installation, is under way.

In February, 15JAN94 AIPS was released, with numerous additions and fixes, which are listed in the most recent AIPS newsletter. One outstanding feature is the support of Linux AIPS, which allows AIPS to run on 486 PCs. This should bring full AIPS reduction capabilities within the reach of those institutes which cannot afford full workstations.

The VLA online system now fully supports Q-band observations, and the relevant AIPS tasks were modified to handle these data. Good progress was made on the new VLBA Observe program, which will prepare observe files for both VLBA and VLA. It is nearing completion, and the first release for in-house use is expected early April.

The data archiving project, which eventually will copy all VLA data since 1976 from 9-track tapes in different formats to one uniform format on exabyte tapes, is proceeding well. All data from 1993 to date and from 1976 through 1982 have been reformatted and copied to exabyte. Currently a notoriously low quality batch of tapes is being processed, which requires us to keep Yucca, our remaining Convex machine, in service longer than planned.

O. GREEN BANK TELESCOPE PROJECT

Antenna Construction

The antenna alidade is completed up to the elevation bearing support weldment level. Two of the sixteen wheels have gear boxes and motors installed. Conduit and cable trays are partially installed. All butt welds in the structure have been tested ultrasonically and passed.

The following are installed on level one of the alidade:

Servo equipment room
Cryogenics equipment room

225 kva transformer
125 kW motor generator set
600 kW emergency generator
50 kW emergency generator
Load bank and junction box
Four 450 kva transformers
One 30 kva transformer
One 225 kva transformer
Automatic and manual transfer switches
Breaker boxes and etc.

Remaining on the ground to be installed:

Actuator room
Remaining gear boxes (azimuth and elevation)
Elevation gear rack sections
Stow pin
Two chillers
Heat exchanger
Two elevation bearing support weldments
Two elevation bearing housings
Elevation drive weldment
Two large elevation bearing platforms
90 miles of actuator cable
Two elevation drives

Active Surface and Pointing (Open Loop)

Support of the vendor of the transorb board continued. This board interfaces actuator cables to motor drive and LVDT read-out modules, and provides transient suppression. Delivery of all boards was completed during the period.

A list specifying the routing of actuator cables into the actuator room has been started and is about 50 percent complete.

A system for mounting actuator power supplies to the floor of the actuator control room has been designed in detail. Material for mounting plates has been ordered, and a drawing specifying the drilling requirements for the mounting plates has been completed.

The software effort continues up the learning curve. A milestone was attained this month: the conversion of a Turbo C program to the SUN and VxWorks environment. The program performs low-level tests of the Spectral Processor and is an important diagnostic tool for this instrument. In addition, redesign of the prototype actuator control system was started.

As reported previously, testing of final version actuators continues on the 85-1 Telescope test stand. This month, a minor electronic design flaw, which caused the test to halt about once a week, was uncovered and fixed. The actuators are still operating within the required specification, and both actuators have now exceeded the 2000 hour operational goal by approximately 2000 hours.

The actuator cable lists have been completed and sent to RSI. Data sent to RSI include a cross reference list with the old Loral cable number and the new NRAO cable number. In addition, they were sent an ASCII file of the new cable numbers. The cable fabricator should be able to read this file into a computer to generate the cable labels.

The construction of control panels continues. Six panels were completed in March. One was partially tested. Tests of our method of electronically configuring the modules on the panels were completed.

Burn-in of the power supplies for the motors and the control modules is continuing successfully.

A sample actuator cable connector was assembled by a potential connector assembler. It was evaluated by several members of the active surface group, and several changes in assembly procedure were proposed to the vendor.

Sierracin/Magnedyne, the actuator motor vendor, continues the process of retrofitting approximately 1600 motors. Recently, a container of approximately 1200 actuators was returned to Industrial Devices Corporation for retrofit.

Servo

Effort in this area consists of monitoring the progress of the servo contractor, RSI/PCD. Additional time has been put into understanding the tests of the subreflector positioning mechanism which were witnessed at March Metalfab in December 1993. Tilt discrepancies between indicated and measured were resolved; it was found that only one projection of the total tilt was measured. Also, several teleconferences were held with the servo contractors. Subreflector tests and schedules were discussed. No significant problem areas were identified.

Work is in progress on the Az/El servo factory test procedure. NRAO should receive this soon. The factory acceptance tests have been postponed from April to June. At this time, all electronics for the Az/El servo, except for the motor drive cabinet already in Green Bank, will be demonstrated. Work is proceeding on interfacing to a preliminary version of the PCD software.

Active Surface and Pointing (Closed Loop)

Software. A reference manual has been written for the software controlling the laser rangefinder (GBT Memo 111). This is a draft document that will be updated, probably several times during the next two years.

The controller for the three laser rangefinders in the field has been changed from a PC running windows under DOS to a workstation running UNIX. Communication with the remotely situated rangefinders is by Ethernet, so the system is now very close to that which will be installed on the GBT. The present arrangement supports experimental work well, and we are proceeding with experiments aimed at correlating the changes in measured range with temperature, pressure, and humidity.

The correlation between temperature measured conventionally and by acoustic thermometry is also being measured. Automated graphing capabilities in the software make the results of the experimental work easy to analyze.

Hardware. The three original rangefinders continue to operate continuously in an outdoor environment. The reliability of the system is more than satisfactory. We have had at least one rangefinder in continuous operation since July 1990 and virtually no failures. Various difficulties with the refined version of the rangefinder have delayed the start of mass production, but we hope to proceed with this shortly.

Electronics

Work continued on the 3.95 - 5.85 GHz receiver. Matching of the OMT probes for this receiver was successfully completed. The machine shop is nearing completion of the major dewar parts. The cardcage wiring and the PCB assemblies were completed. The waveguide window and thermal transition assembly were completed and tested.

Testing of two synthesizers, intended for the system's second local oscillator, located a phase stability problem which was not present in an evaluation unit tested earlier. The manufacturer has identified the cause as close-in phase noise on a 100 MHz crystal oscillator in the unit and indicates they will retrofit the synthesizers with higher quality oscillators. Temperature testing of the synthesizers, which will be used for the system's first local oscillator, showed higher phase sensitivity to temperature than acceptable for VLBI observations. We are considering how best to combat this problem.

Testing of components for a 10 MHz distribution system began, including temperature stability tests. Approximately 90 dB of isolation and temperature stabilities of 1-2 ps per degree centigrade are required for the 10 MHz splitters and buffers. These designs are completed, and construction is underway for three six-way buffer modules.

Test of the breadboard optical driver module continued. An acceptable square-law detector and video amplifier design have been identified. Assembly of the breadboard driver module will be completed, and tested with broadband front-end IF signals.

Devices from the first spectrometer correlator wafer run were evaluated. Two severe problems appear to be present: the chip yield is lower than forecast (less than 10%) and the chips do not work at the rate for which they were designed. Evaluation of the new chip appears to have identified the cause of the operating speed problems. The design model had neglected a resistance term which became significant for some long traces at high clock rates. This problem has been corrected. Additional modeling and testing is underway to insure that the next fabrication run will work as expected.

Data Analysis

Data analysis software development continued with progress on GBT data collection, user interface design, and single dish imaging. Routine maintenance and support for the Aips++ installation in Green Bank continued.

The primary activity involved the design of the FITS binary tables needed to support GBT data collection for the spectral processor. This design is mostly complete and will be written up for comments next month. This design will be used to collect data from the spectral processor during the 140 Foot Telescope tests scheduled for June.

There were several meetings on graphics and on graphical user interface design for Aips++. The "glish" interpreter was installed for testing in Green Bank. Tests were run on "glish" as well as on TCL/TK for use in GBT control and analysis software.

Work continued on single dish imaging using data from the OVLBI telescope. FITS binary tables for OVLBI data acquisition were designed and implemented. FITS binary table readers for PV-WAVE were used to read OVLBI data into PV-WAVE. The WCS (World Coordinate System) routines in PV-WAVE were used to generate maps with various coordinate projections.

P. PERSONNEL

New Hires

R. Davis	Visiting Scientist	01/03/94
C. Chandler	Research Associate	01/06/94
N. Erickson	Visiting Scientist	03/01/94
R. Erickson	Visiting Elec. Engineer	03/01/94

Terminations

M. Kesteven	Visiting Scientist	01/14/94
C. Brockway	Electronic Engineer I	01/18/94[1]
B. Marcks	Head/MIS Division	02/25/94
E. Egler	Construction Engineer I	02/28/94[2]

[1] *Retired*
[2] *Due to Reduction in Force*

Transfers

G. Fuller	From Tucson to Charlottesville	01/01/94

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