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NATIONAL RADIO ASTRONOMY OBSERVATORY

Quarterly Report

1 July 1994 - 30 September 1994

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A. TELESCOPE USAGE

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

	140 Foot	12 Meter	VLA	VLBA
Scheduled observing (hours)	1774.25	484.25	1693.2	705.00
Scheduled maintenance and equipment changes	225.75	1403.00	258.1	235.00
Scheduled tests and calibrations	204.00	370.75	262.9	255.00
Time lost	20.25	35.00	72.8	38.00
Actual Observing	1754.00	449.25	2620.4	667.00

B. 140 FOOT TELESCOPE

The following line programs were conducted during this quarter.

No.	Observer(s)	Program
A119	Avery, L. (NRC, Herzberg) Bell, M. (NRC, Herzberg) Feldman, P. (NRC, Herzberg) MacLeod, J. (NRC, Herzberg)	A search for C_6H and C_8H to verify the identity of carriers of the diffuse interstellar bands.
B623	Braatz, J. (Maryland) Wilson, A. (Maryland)	A survey of H_2O megamasers in nearby AGN.
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.
F124	Frayer, D. (Virginia) Brown, R. Vanden Bout, P.	A K-band survey of molecular oxygen at high redshift.
H299	Heiles, C. (Calif., Berkeley) Briggs, F. (Pittsburgh) Sorar, E. (Pittsburgh)	21 cm mapping of a high positive velocity cloud.
M361	Murphy, E. (Virginia) Lockman, F. J.	21 cm observations of the magnetic field in galactic HI.
M373	Murphy, E. (Virginia) Lockman, F. J. Savage, B. (Wisconsin)	A 21 cm deep search for high velocity clouds.

R255	Rood, R. (Virginia) Bania, T. (Boston)	A search at 8.7 GHz for SETI beacons.
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.
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) Matsakis, D. (NRL)	Pulsar timing array observations at 800 and 1395 MHz.
B629	Backer, D. (Calif., Berkeley) Sallmen, S. (Calif., Berkeley)	Test and polarization observations with UCB coherent dispersion removal processor (CDRP).
G336	Gwinn, C. (Calif., Berkeley) McKinnon, M. Desai, K. (Calif., Santa Barbara) Diercks, A. (Calif., Berkeley)	Observations of the scattering of young pulsars and supernova remnants at 0.32 and 1.42 GHz.
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.
S384	Stinebring, D. (Oberlin College) Faison, M. (Oberlin College) Francavilla, L. (Oberlin College) Hovis, J. (Oberlin College)	Diffractive scintillation observations of eleven pulsars.

The following very long baseline interferometry programs were conducted.

No.	Observer(s)	Program
BR028	Rupen, M., *et al.*	3.6 cm VLBI observations of supernova 1994I in M51.
GC015	Conway, J., *et al.*	6 cm measurements of subluminal velocities in the CSO 0108+388.
GP012	Pauliny-Toth, I., *et al.*	3.6 cm VLBI monitoring of the quasar 3C 54.3 in connection with ROSAT measurements.
GR004	Rupen, M., *et al.*	VLBI imaging of supernovae 1993J in M81.
GV013	Venturi, T., *et al.*	6 cm monitoring of superluminals 3C 216 and 1642+690.
GV014	Vermuelen, R., *et al.*	A 6 cm Caltech-Jodrell snapshot survey of superluminal motion.
GW011	Wehrle, A., *et al.*	Evolution of parsec-scale radio jet in 3C 279.
GZ011	Zensus, J. A., *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.	Observers	Programs
`B614	Baan, W. (NAIC) Freund, R.	Study of the molecular content of OH megamaser nuclei.
B632	Balonek, T. (Colgate) Dent, W. (Massachusetts)	Study of the evolution of extragalactic radio sources at millimeter wavelengths.
C284	Chambers, K. (Hawaii) Swanson, J. (Hawaii)	CO observations of high redshift radio galaxies.
F126	Frayer, D. (Virginia) Brown, R. Vanden Bout, P.	A search for molecular oxygen in F10214+4724.
T338	Turner, B.	Study of the chemistry of cirrus cores and small galactic plane clouds: Sulfur chemistry.
W339	Womack, M. (Northern Arizona) Lutz, B. (Northern Arizona) Ziurys, L. (Arizona State)	Study of origin of species: CO, CH_3OH, and H_2CO in comets.
W343	Wootten, H. A. Fuller, G.	Mass and morphology of high column density gas in the ρ Ophiuchi cloud.

D. VERY LARGE ARRAY

Third Quarter 1994 was spent in the following configurations: B configuration July 1 to September 12, CnB configuration September 12 to September 30.

The following 131 research programs were conducted with the VLA during this quarter:

No.	Observer(s)	Program
AA164	Andre, P. (CNRS, France) Bontemps, S. (CNRS, France) Cernicharo, J. (Yebes Obs.) Knee, L. (Onsala) Nordh, L. (Stockholm) Russell, S. (Dublin) Saraceno, P. (CNR, Italy) Ward-Thompson, D. (MRAO) Wootten, H. A.	Deep VLA search for the youngest low-mass protostars: an ISO ground-based preparatory program.
AA169	Antonucci,R. (Calif.,Santa Barbara) Barvainis, R. (Haystack)	Nature of the optical/ultraviolet emission in AGN. 1.3 cm
AA177	Afflerbach, A. (Wisconsin) Churchwell, E. (Wisconsin)	Radio recombination lines toward G10.62 and G29.96. 3.6 cm line
AA178	Adler, D. Wakker, B. (Illinois) Westpfahl, D. (NMIMT)	HI in NGC 628. 20 cm line
AA183	Anglada, G. (Barcelona) Rodriguez, L. (Mexico/UNAM) Curiel, S. (CFA) Estalella, R. (Barcelona) Torrelles, J. (IAA, Andalucia)	Spectral index of the exciting source of selected bipolar outflows. 2, 6 cm
AB628	Becker, R. (Calif., Davis) Helfand, D. (Columbia) White, R. (STScI) Perley, R.	Survey of the north galactic cap. 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. 20 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

AB715	Bagchi, J. (TIFR, Pune) Kumar, A. (TIFR, Pune) Kapahi, V. (TIFR, Pune)	Gravitationally lensed radio arcs in distant Abell clusters. 20 cm
AB717	Barvainis, R. (Haystack) Antonucci, R. (Calif., Santa Barbara)	Test of the molecular torus model for AGNs. 1.3 cm line
AB719	Brown, A. (Colorado/JILA) Slee, B. (ATNF) Jones, K. (Queensland) Linsky, J. (Colorado/JILA) Skinner, S. (ISAS, Japan) Stewart, R. (ATNF)	Multiband observations of HR1099. 3.6, 6, 20 cm
AB723	Brown, A. (Colorado/JILA) Walter, F. (SUNY)	Naked T Tauri stars in the upper Sco association. 3.6, 6, 20 cm
AB724	Bouvier, J. (Grenoble) Andre, P. (CNRS, France) Pelletier, G. (Grenoble)	Accretion columns onto the T Tauri star DR Tau. 3.6, 6, 20 cm line
AC373	Chen, H. (CFA) Taylor, A. R. (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. 6 cm
AC386	Conway, J. Blanco, P. (Calif., San Diego) Diamond, P.	Search for redshifted OH absorption/stimulated emission in FRIIs. 20 cm line
AC387	Crane, P. (Interferometrics) Cowan, J. (Oklahoma) Primini, F. (CFA) Roberts, D. (Illinois) Dickel, J. (Illinois)	Variability of the nuclear source in M31. 3.6 cm
AC393	Cox, A. (Wisconsin) Sparke, L. (Wisconsin) van Moorsel, G. Sackett, P. (Princeton)	Neutral hydrogen observations of the polar-ring galaxies. 20 cm line
AC394	Cox, A. (Wisconsin) Sparke, L. (Wisconsin) van Moorsel, G.	Radio continuum survey of polar ring galaxies. 20 cm
AC395	Chambers, K. (Hawaii)	IRAS deep survey galaxies. 6 cm
AC409	Chandler, C. Beasley, A. Claussen, M.	Search for OH masers associated with T Tauri and Herbig Ae/Be stars. 20 cm line

AC411	Camilo, F. (Princeton)	Astrometry of PSR J1023+10. 20 cm
AD324	De Pree, C. (North Carolina) Goss, W. M. Mehringer, D. (Illinois)	H92α and H66α radio recombination line observations of W49. 3.6 cm line
AD334	Dhawan, V. Beasley, A.	43 GHz fluxes and spectral indices of millimeter VLBI sources. 0.7, 2 cm
AD339	Danner, R. (Caltech) Kulkarni, S. (Caltech) Hamilton, T. (Caltech)	ROSAT deep galactic survey unusual sources. 20 cm
AD341	Dettmar, R.-J. (STScI) Domgorgen, H. (Bonn U.) Dahlem, M. (Johns Hopkins)	ISM in NGC 2188: A case study for disk-halo interaction. 20 cm line
AD342	Dwarakanath, K. Owen, F.	Radio emission and the Butcher-Oemler effect. 20 cm
AD344	de Pater, I. (Calif., Berkeley) Heiles, C. (Calif., Berkeley) Bolton, S. (JPL) Klein, M. (JPL)	Comet-Jupiter crash. 20, 90 cm
AD347	Dougherty, S. (Liverpool JMU) Waters, L. (Amsterdam, U. of) Taylor, A. R. (Calgary)	Long wavelength radio spectrum of the Be star Psi Persei. 20 cm
AE097	Eilek, J. (NMIMT) Loken, C. (New Mexico State) Owen, F.	The ends of type I radio tails. 90 cm
AF246	Frail, D. Cornwell, T. Goss, W. M.	Does the crab have a shell? 90 cm
AF269	Florkowski, D. (USNO) Johnston, K. (USNO) de Vegt, C. (Hamberger Sternwarte)	Detection survey of Algol type binary stars. 3.6 cm
AF272	Frail, D.	Possible radio counterparts of gamma ray bursters. 6, 20 cm
AF281	Frail, D. Goss, W. M. Slysh, V. (Lebedev) Dubner, G. (IAFE, Buenos Aires)	OH (1720 MHz) maser emission toward supernova remnants. 20 cm line
AF284	Foster, R. (NRL) Wolszczan, A. (Penn State)	Pulsar in SNR S147. 20 cm

AG402	Golla, G. (Toronto) Hummel, E. (Royal Obs.) Dettmar, R.- J. (STScI) Kronberg, P. (Toronto)	Filamentary radio halos of NGC 4632 and UGC 9579. 6, 20 cm
AG412	Grossman, A. (Maryland) Clancy, R. T. (Colorado) 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
AG420	Gaume, R. (NRL) Fey, A. (NRL) Claussen, M.	RRL observations of the G34.3+0.2 complex. 3.6 cm line
AG421	Gaume, R. (NRL) Fischer, J. (NRL)	Monitoring the radio continuum flux density of NGC 2024-IRS2. 1.3, 2, 3.6, 6 cm
AG434	Guedel, M. (ETH) Schmitt, J. (MPIfEP, Garching)	Rapidly rotating F dwarf HR 581. 3.6, 6 cm
AG435	Gregorini, L. (Bologna) de Ruiter, H. (Bologna) Parma, P. (Bologna) Vettolani, G. (Bologna) Sadler, E. (Sydney) Ekers, R. (ATNF)	Dumbbell and multiple nuclei galaxies in rich clusters. 6 cm
AH492	Hjellming, R. Gehrz, R. (Minnesota) Seaquist, E. (Toronto) Taylor, A. R. (Calgary)	Image and light curve evolution of radio novae. 1.3, 2, 3.6, 6, 20 cm
AH511	Habbal, S. (CFA) Esser, R. (CFA) Gonzalez, R. (CFA) Karovska, M. (CFA) Kohl, J. (CFA) Strachan, L. (CFA)	The solar wind: Observations with SPARTAN 201-2. 6, 20, 90 cm
AH513	Hunter, D. (Lowell Obs) Gallagher, J. (Wisconsin) van Woerden, H. (Kapteyn)	HI cloud cores and star formation in the irregular NGC 4449. 20 cm line
AH515	Horellou, C. (Meudon) Combes, F. (Meudon) Casoli, F. (Meudon)	Atomic gas distribution in the ring galaxy Arp 119. 20 cm line
AH516	Higdon, J. Ghigo, F.	HI observations of the ring galaxy NGC 2793. 20 cm line

AH518	Hutchings, J. (DAO) Neff, S. (NASA/GSFC) Gower, A. (Victoria)	Cosmic evolution of radio galaxies. 3.6, 6, 20 cm
AH526	Holdaway, M. Liszt, H.	Galactic center radio continuum mosaic at 1.4 GHz. 20 cm
AH527	Hibbard, J. (Hawaii) Yun, M. (Caltech)	Mapping tidal HI in ultraluminous IR galaxies. 20 cm line
AJ234	Jacobson, A. (Los Alamos) Mercier, C. (Meudon) Erickson, W. (Tasmania)	Geoplasma dynamics. 90 cm
AJ238	Johnston, K. (USNO) Gaume, R. (NRL) Nedoluha, G. (NRL) Wilson, T. (MPIR, Bonn) Collison, A. (Illinois)	Spatial structure of Orion CH_3OH maser. 1.3 cm line
AJ239	Jenness, T. (Cambridge) Scott, P. (Cambridge) Padman, R. (Cambridge)	Studies of H_20 masers in the vicinity of FIR cores. 1.3 cm
AJ240	Jackson, N. (Leiden) Bremer, M. (Leiden) Roland, J. (Paris)	Towards an unbiased sample of high redshift galaxies. 6 cm
AK329	Kurtz, S. (Mexico/UNAM) Churchwell, E. (Wisconsin) Hofner, P. (Wisconsin) Wood, D.	The IRAS 18032-2032 complex absorption distance. 1.3, 3.6, 20 cm line
AK331	Kobulnicky, H. (Minnesota) Dickey, J. (Minnesota) Conti, P. (Colorado)	Spectral index mapping of Wolf-Rayet galaxies. 6, 20 cm
AK340	Kenny, H. (Canadian Military) Taylor, A. R. (Calgary) Seaquist, E. (Toronto)	Outburst flux measurements of the stellar jet source CH Cygni. 2, 6, 20 cm
AK350	Kellermann, K. Shaver, P. (ESO) Wall, J. (Cambridge)	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
AK354	Koerner, D. (Caltech) Sargent, A. (Caltech) Chandler, C.	Radial structure and dust properties of protoplanetary disks. 0.7, 3.6 cm

AK355	Kurtz, S. (Mexico/UNAM) Garay, G. (Chile) Lizano, S. (Mexico/UNAM)	Are UC HII regions photo-evaporating accretion disks? 3.6, 6, 20 cm
AK361	Kobulnicky, H. (Minnesota) Dickey, J. (Minnesota)	Molecular and atomic absorption toward the inner galaxy. 20 cm line
AK362	Kobulnicky, H. (Minnesota) Dickey, J. (Minnesota) Conti, P. (Colorado) Sargent, A. (Caltech)	High resolution HI mapping of HE2-10. 20 cm line
AK370	Kundu, M. (Maryland) Alissandrakis, C. (Athens) Enome, S. (Nobeyama Obs.) Gopalswamy, N. (Maryland) Hudson, H. (Hawaii) Nitta, N. (Lockheed) Raulin, J.-P. (Maryland) Shibaski, K. (Nobeyama Obs.) White, S. (Maryland)	Sunspot umbral-associated soft x-ray emission compared to microwaves. 2, 3.6, 6 cm
AK377	Kellermann, K. Wall, J. (RGO) Shaver, P. (ESO)	Optical double quasar. 3.6 cm
AL319	Lawrence, A. (Queen Mary) Johnson, R. (Queen Mary) Meurs, E. (MPIfEP, Garching) Carter, D. (RGO) Terlevich, R. (RGO) Elvis, M. (CFA) Fabbiano, G. (CFA)	A nuclear census of nearby galaxies. 20 cm
AL324	Laine, S. (Florida) Gottesman, S. (Florida)	High resolution study of NGC 7479 gas dynamics. 20 cm
AL326	Lizano, S. (Mexico/UNAM) Canto, J. (Mexico/UNAM) Escalante, V. (Mexico/UNAM) Gomez, Y. (Mexico/UNAM) Rodriguez, L. (Mexico/UNAM)	Search for the neutral disk of MWC 349A in absorption. 0.7, 1.3, 2, 3.6 cm line
AL329	Liu, M. (Calif., Berkeley) Skinner, C. (Lawrence Livermore)	MWC 922, a possible Herbig Be star. 3.6, 6, 20 cm
AL330	Longair, M. (Cambridge) Rottgering, H. (Cambridge) Best, P. (Cambridge) Riley, J. (Cambridge)	Larger-scale structure of 3CR radio galaxies at z~1. 3.6 cm
AL336	Liszt, H. Lucas, R. (IRAM)	Galactic OH absorption toward 7 extragalactic continuum sources. 20 cm line

AL339	Lim, J. (Caltech)	Radio properties of a very short-period, binary dMe system. 3.6, 6, 20 cm
AL340	Laurent-Muehleisen, S. (Penn State) Kollgaard, R. (Penn State) Feigelson, E. (Penn State) Siebert, J. (MPIfEP, Garching) Brinkmann, W. (MPIfEP, Garching)	Faint sources in ROSAT-selected sample of radio-loud AGN. 6 cm
AL341	Lundgren, S. (NRL) Foster, R. (NRL) Kassim, N. (NRL) Camilo, F. (Princeton) Mattox, J. (NASA/GSFC)	Radio imaging of unidentified EGRET gamma-ray sources. 20, 90 cm
AM418	McIntyre, V. (CFA) Puche, D. (CFA) Huchra, J. (CFA)	Star formation and internal kinematics of irregular galaxies. 20 cm line
AM434	Mehringer, D. (Illinois) Goss, W. M. Palmer, P. (Chicago)	Search for formaldehyde masers in methanol emission regions. 6 cm line
AM437	Moffett, D. (NMIMT) Reynolds, S. (North Carolina State) Dubner, G. (IAFE, Buenos Aires) Giacani, E. (IAFE, Buenos Aires) Reynoso, E. (IAFE, Buenos Aires) Dickel, J. (Illinois) Goss, W. M. Winkler, P. F. (Middlebury College)	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. (CNRS, France) Rodriguez, L. (Mexico/UNAM)	GRS1915+105: Possible hard x-ray counterpart of a soft gamma repeater. 3.6, 20 cm
AM451	Maiolino, R. (Florence) Rieke, G. (Arizona) Ruiz, M. (Arizona) Rieke, M. (Arizona)	Relation between Seyfert activity and circumnuclear star formation. 6 cm
AM452	Marscher, A. (Boston) Moore, E. (Boston) Bania, T. (Boston)	Variable ammonia absorption toward extragalactic continuum sources. 1.3 cm line
AM453	Mirabel, F. (CNRS, France) Rodriguez, L. (Mexico/UNAM)	Brightening of the lobes of 1E1740.7-2942. 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
AM455	Moffett, D. (NMIMT) Hankins, T. (NMIMT)	Sb-microsecond time resolution observations of low DM pulsars. 3.6, 6, 90 cm
AM456	Miley, G. (Leiden) deBruyn, G. (NFRA) Rottgering, H. (Cambridge) Bremer, M. (Leiden) Rengelink, R. (Leiden)	Ultra steep spectrum source–search for high-z radio galaxies. 6 cm
AM457	Muhleman, D. (Caltech) Grossman, A. (Maryland) Slade, M. (JPL) Butler, B.	Radar measurement of Titan's spin vector. 3.6 cm line
AM458	Mundy, L. (Maryland) Blake, G. (Caltech)	NGC 1333 IRAS 4: dust emission. 0.7 cm
AM463	McMahon, R. (Cambridge) Lonsdale, C. (Caltech) Rowan-Robinson, M. (Imperial College) Beeharry, G. (Cambridge) Lehar, J. (Cambridge)	Search for high redshift infrared luminous galaxies. 20 cm
AM465	Mirabel, F. (CNRS, France) Rodriguez, L. (Mexico/UNAM)	Superluminal source GRS 1915+105. 3.6, 20 cm
AO117	Olling, R. (Columbia) Rupen, M. van Gorkom, J. (Columbia)	The edge-on dwarf galaxy NGC 5023. 20 cm line
AO119	O'Dea, C. (STScI) Baum, S. (STScI) Gallimore, J. (STScI/Maryland) Maloney, P. (Colorado/JILA) Jackson, J. (Boston)	Search for OH in cooling flows. 20 cm line
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

AP291	Paredes, J. (Barcelona) Marti, J. (Barcelona) Taylor, A. R. (Calgary) Peracaula, M. (Calgary) Coe, M. (Southhampton) Strikman, M. (NRL)	Concurrent radio, x-ray and infrared observations of LSI+61°303. 1.3, 2, 6, 20 cm
AP296	Preston, R. (JPL) Folkner, W. (JPL)	Earth based observation of Galileo probe for Jupiter wind estimation: phase coherence tests. 3.6 cm
AP299	Purcell, W. (Northwestern) Yusef-Zadeh, F. (Northwestern) Ulmer, M. (Northwestern)	Search for radio emission around the pulsar 1952+29. 3.6, 20 cm
AP304	Patnaik, A. (MPIR, Bonn) Narayan, R. (CFA) Schneider, P. (MPIfEP, Garching)	VLA observations of 2345+007: test of gravitational lens hypothesis. 3.6 cm
AP305	de Pater, I. (Calif., Berkeley) Silva, A. (Calif., Berkeley) Lissauer, J. (SUNY) Showalter, M. (NASA/Ames) Graham, J. (Calif., Berkeley)	Saturn's main ring system. 2 cm
AR311	Reynolds, S. (North Carolina State) Jenkins, G. (North Carolina State) Kassim, N. (NRL) Moffett, D. (NMIMT)	330 MHz observations of bright supernova remnants. 90 cm
AR317	Ratner, M. (CFA) Bartel, N. (York) Lestrade, J.- F. (JPL) Lebach, D. (CFA) Shapiro, I. (CFA)	Monitor IM Peg for NASA/Stanford gravity probe-B use. 3.6 cm
AR321	Rottgering, H. (Cambridge) van Breugel, W. (Caltech) Miley, G. (Leiden)	The most distant radio galaxies—the steepest radio spectra? 6 cm
AS525	Sramek, R. Weiler, K. (NRL) Van Dyk, S. (Calif., Berkeley) Panagia, N. (STScI)	The properites of radio supernovae. 1.3, 2, 3.6, 6, 20 cm
AS532	Smith, B. (Texas)	HI mapping of the interacting galaxy pair NGC 7714/5. 20 cm line
AS534	Sevenster, M. (Leiden) Lindqvist, M. (Leiden) Habing, H. (Leiden) van Langevelde, H.	1612 MHz OH survey to complete IRAS/OH surveys. 20 cm line

AS536	Schiminovich, D. (Columbia) van Gorkom, J. (Columbia) van der Hulst, J. (Groningen-Kapteyn)	HI observations of shell galaxies. 20 cm line
AS539	Schilizzi, R. (NFRA) Snellen, I. (Leiden) Miley, G. (Leiden) de Bruyn, A. (NFRA) Rottgering, H. (Cambridge)	WENSS sample of faint peaked spectrum sources. 2, 3.6, 6 cm
AS544	Scuderi, S. (STScI) Panagia, N. (STScI) Stanghellini, C. (Noto, Italy) Umana, G. (Noto, Italy) Trigilio, C. (Noto, Italy)	Radio observations of stellar winds of early type stars. 2, 3.6, 6 cm
AT154	Thorsett, S. (Caltech) Taylor, J. (Princeton) McKinnon, M. Hankins, T. (NMIMT) Stinebring, D. (Oberlin College)	Timing fast pulsars at the VLA. 6, 20, 90 cm
AT165	Taylor, G. (Caltech) Readhead, A. (Caltech) Vermeulen, R. (Caltech) Pearson, T. (Caltech) Henstock, D. (Manchester) Wilkinson, P. (Manchester)	Kiloparsec-scale structure of the second Caltech-Jodrell Bank survey. 6, 20 cm
AT166	Taylor, G. (Caltech) Ge, J. (Brandeis) Barton, E. (Caltech)	Searching for cluster magnetic fields in cooling flow of A119, 3C129. 2, 3.6, 6 cm
AT167	Tongue, T. (NMIMT) Westpfahl, D. (NMIMT) Adler, D. Henning, P. (New Mexico)	HI mapping of M33: topology of neutral medium. 20 cm line
AW350	Wills, B. (Texas) Shastri, P. (Calif., Berkeley)	Core variability in lobe-dominated quasars. 3.6 cm
W360	Wilcots, E. Hodge, P. (Washington) Miller, B. (Washington)	High resolution continuum study of IC 10. 20 cm
AW362	White, S. (Maryland)	The stellar activity cycle on active stars. 3.6, 6, 20 cm
AW374	Wood, D.	Subarcsecond 7 mm observations of ultracompact H II regions.
AW383	Wilcots, E. Hodge, P. (Washington) Miller, B. (Washington)	High resolution HI study of IC 10. 20 cm line

AW384	Wilcots, E. Miller, B. (Washington)	HI Observations of barred magellanic type galaxies. 20 cm line
AW385	Wood, D. Myers, P. (CFA)	Survey of young stellar objects in Taurus-Auriga. 0.7, 3.6 cm
AW386	White, S. (Maryland) Mundy, L. (Maryland) Grossman, A. (Maryland)	Radio emission of DG TAu and DG Tau B. 2, 3.6 cm
AW390	Wilson, T. (MPIR, Bonn) Gaume, R. (NRL) Johnston, K. (USNO)	Water masers in NGC 2024. 1.3 cm line
AX003	Xu, W. (Caltech) Taylor, G. (Caltech) Readhead, A. (Caltech) Pearson, T. (Caltech)	Search for faint extended structure in compact symmetric sources. 20 cm
AY055	Yun, M. (Caltech) McIntyre, V. (CFA)	Galaxy-scale gaseous collisions and ring galaxies. 20 cm line
AZ067	Zhang, Q. (CFA) Ho, P. (CFA)	Metastable ammonia masers in massive-star forming regions. 1.3 cm line

E. VERY LONG BASELINE ARRAY

No.	Observer(s)	Program
BB014	Brown, R. Benson, J.	Brightness Variations of Sgr A*. 3.6, 6 cm
BB032	Beasley, A. Gudel, M. (ETH, Zurich) Brown, A. (Colorado/JILA) Linsky, J. (Colorado/JILA)	Coordinated VLBA/VLA/ASCA/EUVE Campaign on two bright RS CVn Binaries. 3.6 cm
BC027	Chernin, L. (CFA) Greenhill, L. (CFA)	H_2O masers associated with low mass young stellar objects. 1.3 cm

BR027	Rupen, M. Altunin, V. (JPL) Bartel, N. (York) Beasley, A. Bietenholz, M. (York) Cannon, W. (York) Conway, J. Davis, R. Graham, D. (MPIR, Bonn) Jones, D. (JPL) Panagia, N. (STScI) Popelar, J. (Ottawa) Rius, A. (Madrid) Romney, J. Sramek, R. Titus, M. (Haystack) Umana, G. (Noto, Italy) Van Dyk, S. (Calif., Berkeley) Venturi, T. (Bologna) Weiler, K. (NRL)	Supernova 1994I in M51. 3.6, 6, 20 cm
BR028	Rupen, M. Altunin, V. (JPL) Bartel, N. (York) Beasley, A. Bietenholz, M. (York) Cannon, W. (York) Conway, J. Graham, D. (MPIR, Bonn) Jones, D. (JPL) Panagia, N. (STScI) Popelar, J. (Ottawa) Rius, A. (Madrid) Romney, J. Sramek, R. Van Dyk, S. (Calif., Berkeley) Weiler, K. (NRL)	VLBI Observations of Supernova 1994I in M51. 3.6, 6, 20 cm
GC015	Conway, J. Pearson, T. (Caltech)	Measuring subluminal velocities in the CSO 0108+388.

GM021	Marcaide, J. (Valencia) de Bruyn, G. (NFRA) Alberdi, A. (IAA, Andalucia) Diamond, P. Guirado, J. (IAA, Andalucia) Jones, D. (JPL) Krichbaum, T. (MPIR, Bonn) Mantovani, F. (Noto, Italy) Preston, C. (JPL) Rius, A. (Madrid) Rogers, A. (Haystack) Ros, E. (Valencia) Schilizzi, R. (NFRA) Shapiro, I. (CFA) Trigilio, C. (Noto, Italy) Whitney, A. (Haystack) Witzel, A. (MPIR, Bonn)	Radio-shell expansion in SN 1993J. 3.6 cm
GP012	Pauliny-Toth, I. (MPIR, Bonn) Nicolson, G. (HartRAO) Unwin, S. (Caltech) Wehrle, A (JPL) Zensus, J. A.	Monitoring of quasar 3C 54.3. 1.3, 3.6 cm
GR004	Rupen, M. Bartel, N. (York) Conway, J. Beasley, A. Sramek, R. Altunin, V. (JPL) Bietenholz, M. (York) Cannon, W. (York) Davis, R. Graham, D. (MPIR, Bonn) Jones, D. (JPL) Panagia, N. (STScI) Popelar, J. (Ottawa) Rius, A. (Madrid) Romney, J. Titus, M. (Haystack) Umana, G. (Noto, Italy) Van Dyk, S. (NRL) Venturi, T. (Bologna) Weiler, K. (NRL)	1993J in M81. 2, 3.6, 6 cm
GV013	Venturi, T. (IRA, Bologna) Pearson, T. (Caltech) Unwin, S. (Caltech)	Morphological evolution at 6 cm of the two superluminal radio sources 3C 216 and 1642+690

GV014	Vermeulen, R. (Caltech) Browne, I. (Manchester) Cohen, M. (Caltech) Henstock, D. (Manchester) Pearson, T. (Caltech) Readhead, A. (Caltech) Taylor, G. (Caltech) Wilkinson, P. (Manchester) Xu, W. (Caltech)	Caltech-Jodrell snapshot survey of superluminal motion. 6 cm
GW011	Wehrle, A. (JPL) Gabuzda, D. (Calgary) Unwin, S. (Caltech) Zook, A. (Pomona College)	Evolution of parsec scale radio jet in 3C 279. 1.3, 3.6, 6 cm
GZ011	Zensus, J. (MPIR, Bonn) 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

Observations with the 140 Foot Telescope at 1400 MHz of Jupiter before, during, and after the collision of Comet 1993e (Shoemaker-Levy 9) show a 20 percent increase in flux during the collision with a slow decrease afterwards. The linear polarization changed (by about 2 percent) as did the beaming curve (the variations of intensity during a Jovian rotation). The observations, which started a month beforehand, will continue once a month for about the next year in order to monitor the long-term consequences of the collision to Jupiter's emission.

Observers: I. De Pater, C. Heiles, and M. Wong (California, Berkeley), and R. Maddalena (NRAO)

Tucson

Mass and Morphology of High Column Density Gas in the Rho Ophiuchi Cloud Cores — Observers have used the 12 Meter Telescope to make extensive maps in the $C^{17}O$ and $C^{18}O$ J=1-0 lines toward the Rho Ophiuchi molecular complex. Recent observations with infrared-array cameras have revealed more than 200 young stars embedded in the central region of Rho Oph. Comparison of the spatial distribution of these IR sources with the large-scale distribution of the dense gas from the 12 Meter Telescope observations should yield insight into the process of star formation.

The majority of the data were collected in an on-the-fly mode. In this mode the telescope moves continuously while sampling the filter banks and reading encoder positions every 100 milliseconds. The maps were made in 15 arcminute squares about pre-determined center positions, in such a way that the final maps would overlap. Each of these map units contains nearly 20,000 spectra collected over the course of approximately an hour.

The maps improve upon the well-known maps published by Wilking and Lada ten years ago in that a larger region with pre-determined boundaries has been mapped, the region has been completely sampled, and a somewhat better sensitivity has been achieved in only a few hours observation period. The images define the outlines of the known dense cores in the L1688 cloud quite well. In the heretofore unmapped L1689N region, dense cores which have not been previously studied are well-defined. Comparison of the L1688 maps in the two oxygen isotopes reveals that high column densities of cold gas concentrate near the Oph C core, while high absolute column densities of gas lie in the Oph A core.

Investigators: *H. A. Wootten and G. Fuller (NRAO)*

Socorro

First Superluminal Source in Milky Way Discovered — A strong X-ray source discovered in 1992 by the Sigma-Granat satellite underwent an outburst at radio wavelengths in the spring of 1994. Observed in March and April by the VLA in the A configuration, the object, GRS 1915+105, displayed a pair of condensations in its radio jets with very large proper motions. At a distance of approximately 12.5 kpc, the condensation in the approaching jet appeared to move at 1.25c, the first-ever superluminal motion to be observed within the Galaxy. Correcting for relativistic effects, the condensations exhibited an actual velocity of 0.92c. This object, presumed to be a binary system with a compact body (neutron star or black hole) at its center, offers an unprecedented opportunity to further study the physics of accretion disks and the ejection of relativistic jets. In addition, it presents an opportunity for unambiguous distance measurement of a superluminal object.

Investigators: I.F. Mirabel (CNRS, Saclay, France) and L.F. Rodriguez (Mexico/UNAM)

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 with NRAO telescopes during the reporting period.

H. CHARLOTTESVILLE ELECTRONICS

Amplifier Development, Design, and Production

The first prototype of the 60-90 GHz amplifier using InP devices from Hughes has been evaluated. The amplifier performs well only to 75 GHz with more than 20 dB gain. Receiver noise (window, horn, amplifier, and room temperature mixer) is 35 K at 60 GHz and increasing to 50 K at 75 GHz. The redesign of this amplifier to extend its performance to 92 GHz is under way.

One of the dewars has been rebuilt and the 26-36 GHz test station was reassembled. Five 26-36 GHz amplifiers were built and tested.

A method of measurement of S-parameters at cryogenic temperatures has been developed and demonstrated. It involves the use of NIST two-tier calibration software, a broadband (1-50 GHz) coaxial dewar transition, and a set of TRL calibration standards (both developed by NRAO).

Amplifiers that were produced this quarter include the 3.95-5.85 GHz (7 units), the 8.0-10.0 GHz (6 units), and the 12.0-18.0 GHz (2 units).

Work is progressing on the 290-395 MHz balanced amplifier. The prototype unit has been evaluated at cryogenic temperatures. This amplifier is for the GBT.

Work continues on the PC-based automated amplifier test station. Software routines are currently being written for data acquisition and system control.

86 GHz VLBA Receiver

The prototype receiver is complete except for the HFET amplifier and some waveguide inside the dewar. The DC control and bias circuits have been checked and some RF measurements of the mixer/LO/IF amplifier chain will be made shortly. As soon as it is determined that no major changes are necessary to the package, the receiver design will be fully documented and two production receivers will be built.

Superconducting (SIS) Millimeter-Wave Mixer Development

To improve the performance of our 260-300 GHz SIS receivers on the 12 Meter Telescope, we have designed a tunable SIS mixer to replace the present tunerless design. The tunable design is based on our successful 2 mm design and uses the same UVA SIS chips that are used in the (tunable) 200-260 GHz receiver. The tunable design is seen as an interim solution until the new tunerless design is ready (the latter has been held up by SIS fabrication difficulties).

In order to increase the bandwidth of the receivers at the 12 Meter Telescope, it has been decided to change from the historical L-band (21 cm) to C-band (actually 4-6 GHz). We are designing a new bias-T for the higher IF, which will also incorporate protective series resistors in all bias wires (as is the practice at OVRO). It is hoped that this will reduce the mortality rate of our receivers.

Electromagnetic Support

GBT Project

A memo titled "Gain Reduction Due to Gravity-Induced Deflections of the GBT Tipping Structure (Model 95, Version B) and Its Compensation" was released.

A ray tracing program which traces the rays from the Gregorian focus feed through the subreflector and the main reflector of the GBT to an exit aperture was modified to analyze the effect of noise shields. The purpose of the noise shields is to block the energy that would otherwise be scattered by the feed arm structure and direct it into the main reflector so that it would be scattered in the vicinity of the main beam of the telescope. A preliminary design of the shields has been developed.

Study on the design of a tertiary reflector for the purpose of beam switching is continuing.

GBT Spectrometer

The GBT spectrometer design progressed during the last quarter. Most of the design work has been completed and some breadboarding has been done. The layout for two multi-layer printed circuit cards was completed during the last month, and designs for two types of ECL wire-wrap cards were completed.

The second wafer run for the 1024-lag correlator chip was completed, and we are awaiting news as to the success of this run.

The 2 GHz sampler prototype for the GBT spectrometer is still being tested.

I. GREEN BANK ELECTRONICS

140 Foot Operations

Two of the GBT cryogenic front-ends have been installed at the 140 Foot vertex cabin, the 18-26.5 GHz and the 8-10 GHz receivers. Both have been used in scheduled observations, and performance was as expected. Preparations are underway to install the third and final planned GBT front-end, the 12-15.4 GHz. A single polarization 25-35 GHz HFET receiver is currently being installed in this dewar, and installation on the telescope is scheduled for November.

Twenty-one receiver or feed changes were scheduled and completed this quarter.

GBT Development

Cooled HFET amplifiers for the 3.95-5.85 GHz front-end were completed, and assembly of this receiver is nearing completion. Fabrication drawings for the 1.15-1.73 GHz receiver are in process.

Fabrication parts which will allow completion of four Optical Driver Modules were finished and assembly is in process. Fabrication drawings for the Optical Receiver Modules were completed and submitted to the shop, and drawings for the 1-8 GHz converter module are nearing completion. A Noise Source Module, which will allow on-line testing of the IF system, was completed.

Work on electronics for the open-loop active surface continued. Twenty of the fifty-two required Actuator Room control panels have been constructed and fully tested. Twenty others are awaiting tests, and the remaining twelve panels are in various stages of construction.

Development of the continuum backend continues. The circuit cards have been completed and tested with development software. Integration of the complete system in the VME chassis remains to be done, as well as the GBT production control software.

Work on the new GBT spectrometer continues both at NRAO and at the correlator chip design facility. Wafers of the second iteration design have left the foundry and are now awaiting tests at a wafer probing facility. A contract for fabrication of the NRAO designed, multi-layer memory card has been let. A strawman design for the IF modules, interconnection scheme, and operating modes has been distributed and is currently being evaluated.

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 multi-mode optical fiber cables to the major buildings and antennas. Site timing equipment has been consolidated at the Interferometer control building. A 1PPS measurement system has been built and installed, and allows measurements of the relative delay between 1PPS signals with one nanosecond resolution. Installation of the conduit has been completed, and the fiber cable is being pulled.

Work continues on the construction of a S/X cryogenic receiver for the new USNO 20-meter antenna under construction in Green Bank. The feed and major subsystems have been completed. Integration of the system should be completed in the fourth quarter.

Maintenance, repair, and installation support were supplied to the 140 Foot, Interferometer, and site computer facilities.

J. TUCSON ELECTRONICS

Summer Shutdown Summary

The 1994 summer shutdown period was busy and productive. The staff undertook major projects in the electronics, computing, and site maintenance areas. The major electronics project was the repackaging of the 2 mm and 3 mm receivers into one cryostat. The principal objective of this project was to free one of the "long" receiver bays for the 8-beam receiver. Now, the 8-beam and 2 and 3 mm receiver can be on the telescope at the same time. Various other cryogenic and compressor upgrades were made during the summer. Other electronics projects included the design and fabrication of a new sampler board for the hybrid spectrometer. We expect this upgrade to reduce some of the baseline flaws seen occasionally in hybrid spectrometer data. Tests will begin shortly.

The major software project this summer was to work toward on-the-fly data acquisition with the hybrid spectrometer. This project is continuing, with completion expected by the end of this year. This project involves acquiring 2048-channel data from the hybrid spectrometer, performing the FFT's, and outputting the results 10 times a second. The computing staff is using a high-speed digital signal processor (DSP) to do this task. This is a challenging project, but initial results are good. Other computing projects included a new operator interface to the control system, repackaging and enhancing the optical pointing system, and developing a new "what's up" display for showing the position of planets and observing sources on an X window display.

The major site project was the replacement of the fabric on the dome door. The old door fabric was worn and was ripping apart at the seams, and had already exceeded its expected lifetime by several years. The fabric on the door folds as the door is opened and is, thus, subjected to more wear than the fabric on the remainder of the dome. The local NRAO staff worked together with the contractor, Sullivan and Brampton, to complete this job quickly and smoothly. In addition to the dome project, the control room was renovated to allow observers more, and better-arranged, work areas.

Spectral Line On-the-Fly Observing

Several improvements have been made to the spectral line on-the-fly (OTF) observing technique. An OTF map consists of data acquired every 0.1 seconds and tagged with the actual encoder positions as the telescope slews rapidly and continuously over the source. Since we do not assume that the telescope tracks perfectly at high slew rates, OTF data can be considered as pseudo-randomly sampled, and are in this way similar to the uv data acquired through synthesis imaging techniques. Because of this similarity a decision was made last year to use as far as possible existing NRAO image processing packages to analyze OTF data. Data export will normally be in the form of FITS image cubes rather than the UniPOPS sdd data format.

The reduction pipeline through AIPS which was developed last spring has been streamlined and should now be quite palatable to 12 Meter observers; it is available at the telescope now. As a longer term initiative, AIPS++ tasks for OTF analysis are also under development, and will benefit from the experience gained with this earlier implementation. The first OTF observing run was recently completed (see above Tucson Scientific Highlight).

Currently, the time it takes to produce an image from the data is longer than the acquistion time. The primary limitation on the data analysis speed is cpu time. As the 12 Meter will soon upgrade its analysis computer from a Sun IPX to a SPARCStation 20 multi-processor, it will become possible to process the OTF data in less than the time it takes to acquire it. An upgrade in cpu speed will also be necessary for the increased data flow that will result once OTF observing with the hybrid spectrometer is implemented in the near future.

K. SOCORRO ELECTRONICS

VLA 1.3 - 1.7 GHz Receiver Improvements

All 28 VLA antennas now have the new improved front-ends. One of the two remaining spares was completed and tested. The second spare will be used for cryogenic testing of orthomode transducers to suppress spurious resonances. We are investigating the excessive increase in system temperature at low antenna elevations. Simple screens to shield the feed will be tested to determine the source of the spillover or backscatter.

The frequency upconverter scheme from L-band to the first IF at C-band produces intolerable image interference from satellites and microwave links folded about 1600 MHz. For example, an 1800 MHz signal appears in the received spectrum at 1400 MHz. Prototypes of the new frequency converter scheme are installed on three antennas for testing in October. The current F2 converter modules must be retained until all the new F15 converter modules have been installed, since the two schemes will not fringe together because of spectral inversion. Installation should be complete by the end of 1995.

VLA 40 - 50 GHz Receivers

Ten receivers, including a working spare, have been installed on ten antennas. Parts are on order, so the additional front ends could be built and installed in time for the 1995/1996 winter atmosphere.

Considerable effort by electronics, engineering, on-line software, and scientific staff continues in improving the performance of the Q-band systems in time for the 1994/1995 winter season. Most differences between measured total power and interferometric efficiencies were resolved with reductions of local oscillator phase noise in several LO modules. Now all Q-band antennas have SNR > 15 dB, whereas initially some were as poor as 3 dB. A new design using a SC cut VCXO at 5 MHz and other work on improving phase noise on current and future Q-band antennas will continue through next quarter and into 1995. The Electronics Division also is assisting in the analysis of and corrections for sub-reflector offsets and variations with elevation.

VLA Waveguide

Efforts continue to improve anode bed efficiency for more reliable cathodic protection of the wye waveguide from electrolytic corrosion. A corrosion consultant inspected the protection system in September and found no major problems. A few recommended improvements will be implemented next quarter. The cryogenics group rebuilt the azimuth and elevation rotary joints on antenna 9, and assisted Engineering in replacing seven concrete manholes with steel culverts.

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. The monitor was completed this quarter with the addition of the control building HVAC monitoring. Condenser and chilled water temperatures are now on screen. Documentation was completed and will be available in October as VLA Technical Report No. 71.

VLA Pulsar Processor Upgrade

The PC controller for the High Time Resolution Processor (HTRP) was upgraded to a 486 DX2-66 system with two each 16-channel data acquisition boards capable of 1 M samples/sec. The processor speed limits the present rate to ~250 ks/s. New software for the DAQ boards also sets the sampling frequency via LPT2 port controlled, direct digital synthesis frequency generator. VLA Technical Report No. 74 details the upgrade.

New VLA Correlator Controller

The current correlator controller consists of a wire wrapped 16-bit slice microprocessor, a Modcomp computer, and a FPS-AP120B 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

Six shields with optical fibers have been installed in antennas. Fibers were retrofitted into five existing shields. We expect to have completed 17 systems by the end of 1994, depending on available staff and telescope scheduling.

VLBA Recorders and Playback Drives

Much work has been done on improving playback performance at the correlator. The equalizers were modified in all playback drives, resulting in better playback quality. Efforts continue to better understand and improve playback performance. We also continue work on understanding and preventing vacuum losses in recorders at VLBA sites and in the playback drives. Work continues on building one additional recorder for use at the VLA.

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 successfully repaired them.

VLBA Maser Clock and Frequency Standard

Maser #11 had excessive IF level degradation after its repair by Sigma Tau Standards Corp., but modifying the dissociator oscillator in late June reduced it to the normal rate. Stability measurements with respect to maser #1 show excellent results.

VLBA Site Maintenance and Inspection Visits

A maintenance/inspection team of seven New Mexico based staff visited the Hancock VLBA station during the third week in August. This team, representing mechanical, servo, HVAC, cryogenics, and electronics, spent six days performing equipment upgrades, preventive maintenance, and general station inspections. This visit, the third of five planned for 1994, was part of a long-term plan designed to keep the remote VLBA stations upgraded to the latest configuration while minimizing down time.

Interference

One aspect of preventing RFI requires involvement in the drafting of Environmental Impact Statements (EIS) by organizations generating radio emissions potentially harmful to VLA and VLBA observations. Our comments in the scoping and drafting process attempt to achieve explicit recognition that the electromagnetic environment significantly impacts the science of radio astronomy, and may require mitigation (coordination) measures. This quarter, we directed much effort at the draft EIS for the White Sands Missile Range (WSMR) and at the draft EIS for the Army's Theater Missile Defense Extended Test Range at WSMR. We continued monitoring the VLA spectral environment from 150 MHz to 3 GHz to support the preparation of a proposal for a major upgrade. Development of an on-line interference monitoring spectrum analyzer for the VLA has begun. This unit will be remotely controlled and have data recorded at the AOC. After testing at the VLA, similar units will be developed for remote on-line monitoring at selected VLBA sites. 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 3 October 1994, the 15JUL94 release of Classic AIPS had been shipped to 46 institutions, 27 by magnetic tape and 18 by electronic copies. The increase in the use of magnetic tape has been caused by our offer to shorten the installation process by sending a full binary copy of AIPS on tape. The binary versions are currently available for SunOS, Solaris (Sun), AIX (IBM), OSF/1 (DEC Alpha), and Linux (PCs) systems, with an SGI version expected soon. The AIPS programming group in Socorro will be reduced by one by a transfer to the AIPS++ project in January 1995.

The substantial work of rewriting the user manual called the "AIPS CookBook" continued during the quarter. New chapters treating introduction to AIPS, basic tools, calibration, program lists, and the use of NRAO facilities were completed for the 15JUL94 release. In addition, completely rewritten chapters on spectral-line and VLBI/VLBA reductions are under active preparation at this time. All chapters of the CookBook are made available via the World Wide Web. Users can fetch the new chapters as they are actually completed by fetching the files via the WWW (or via anonymous ftp).

During the quarter, nine new tasks were added to Classic AIPS. Two of these represent major advances in VLBI data processing, one to calibrate polarization and the other to do fringe-rate mapping, both for spectral-line VLBI data. Two more of these represent a major enhancement in the processing of single-dish data in Classic AIPS, one to read in "on-the-fly" data from the 12 Meter Telescope and the other to select, project, sort, and grid single-dish imaging data. Numerous fixes were made throughout the code as well to make it more robust for single-dish data. The other new tasks subtract baselines from autocorrelation spectra, clip images, re-grid Digitized Sky Survey (STScI) images to standard coordinates, convert between model-fit and "stars" extension files, and plot convolution functions and their FFT or expected noise.

Pre-existing tasks also received significant attention. The most complex change involved fixing bandpass calibration for the time-dependent shifts in bandpass introduced by the VLBA correlator. The VLBA data reading task was enhanced to correct total-power spectra for defects introduced by the FFT. UV data flagging was extended to single-source and compressed-format files, and a flagging option was added to one of the spectral baseline (continuum) removal tasks. Routines to copy tables taking into account data selection parameters were added and a bug in the stabilization of self-calibration was corrected. The handling and computation of holography data was improved and several bugs affecting byte-swapped computers (e.g., DEC alphas) were exterminated.

M. AIPS++

The Observatory's planning revolves around finishing the project and bringing AIPS++ on-line with full support, as originally planned, for both array and single-dish data. Early next year, NRAO will begin shifting programmers (and interferometry experts) from the AIPS project to the AIPS++ project, as the infrastructure of AIPS++ is completed and the porting of algorithms to AIPS++ begins. Phases required for the delivery of AIPS++ remain clear. AIPS++ must proceed through various release phases before a general release can be done.

There was a goal for August of having demonstration applications. This was actually achieved in early October. The 5-6 week delay was caused by several factors, including unavailability of some key people and some minor rescheduling to overcome small technical problems.

The plans for AIPS++ releases in 1995 remain unchanged, although some slippage in the optimistic schedule presented last quarter is likely. To summarize, there will be an "alpha" release of AIPS++ in early 1995 (the target date is January 1995). This alpha release will be released to selected groups for testing and feedback. By definition, the alpha release will have extremely limited functionality and bugs will be expected; the alpha release will not be of interest to casual users. Assuming the alpha release is reasonably successful, there will be a "beta" release incorporating reasonable functionality, but without all planned features available, and extensive user testing will still be needed. The current target date for the beta release is July 1995. Finally, if a second beta release is not required, a full public release of AIPS++ will be made in early 1996.

Technical Progress - Highlights

Code Acceptance Gate / Code Policing: A formal mechanism for policing code before it is checked into the AIPS++ system was put in place. This has already resulted in improvements in the documentation and test routines for submitted code.

Revised Table System: As planned, major revisions to the AIPS++ Table System were largely completed and checked in by the NFRA group. The changes have improved the programmability of the system, forming the underpinning for progress in other areas. In summary, the new tables have a better and cleaner interface, more flexibility in storage, and virtual columns with no loss of performance. The code is also better documented, with a wealth of documentation in the header files. The first phase of the storage manager for tables is also complete. AIPS++ Tables are a key part of the AIPS++ infrastructure, and must be complete and robust for our planned releases.

Glish: Glish is the control and communications system adopted by AIPS++. Significant extensions to Glish (complex numbers, command line editing, and multi-dimensional arrays) have been completed this quarter. Glish will provide a command line for AIPS++ with whole-array manipulation and programmability.

Image Class: The image class provides the mechanisms needed for storing and manipulating multidimensional images. Completion of the basic version of this class this quarter was a prerequisite for progress during the coming quarter in visualization and image analysis areas.

Single-Dish Calibration and Imaging: All pieces for calibration and gridding of on-the-fly (OTF) data from the NRAO 12 Meter Telescope are now in place (OTF data is collected by continuous raster scanning of the telescope, with spectra being collected every 100 milliseconds). The AIPS++ OTF tasks apply calibration to the data, grid it into a three-dimensional image, and export a FITS image cube. When planned improvements in the interface to the program are completed, either fourth quarter 1994 or first quarter 1995, the AIPS++ OTF program will be installed at the 12 Meter for testing and feedback.

Visualization: The AIPS++ group at BIMA expects to complete a version of a high-end visualization package during the coming quarter. A pre-release version available this quarter allowed the display of multi-dimensional images and manipulation of the transfer function and the color table for raster image display.

Compilers: The AIPS++ group at BIMA have completed a full port of the AIPS++ system to the Silicon Graphics (SGI) operating system. At DRAO, the port to the IBM operating system, AIX, was completed. The AIPS++ development system now runs on Sun computers (both SunOS and Solaris), SGI, and IBM. Ports to other operating systems will be done as necessary during 1995 and beyond.

N. SOCORRO COMPUTING

During the summer several more Sun workstations made the transition to Solaris 2. Our experience with the new environment has been fairly positive, with no problems running our primary applications. As there are nearly 100 Suns at the AOC, it is unlikely we will have the majority of them running under Solaris before the end of 1994.

We are currently busy investigating the possibility of installing faster disks on our IBM 580s. It appears that disk I/O rather than CPU is the limiting factor when running AIPS tasks on large amounts of data on these machines. We have just concluded testing a 14 GByte RAID-3 system. This system boasts a dramatic improvement in disk I/O compared to traditional disks. Our first preliminary results, though, indicate that on average the speed gain on a series of VLBA related tasks is a mere 14 percent compared to using a traditional disk system in which I/O is optimally distributed over different individual disks. We plan to test non-RAID, but very fast disks in the immediate future.

The robustness of real-time data filling using the AIPS task FILLM was increased; at the same time the whole process was made more transparent to the user. Realtime filling allows the user to load data into AIPS on a VLA or AOC workstation while the observation is ongoing, opening possibilities to modify the observing based on the data coming in. A memo explaining the process is currently in preparation.

The VLA data archival project is experiencing delays caused by poor quality tapes which appear to have been in use in the period 1982-1983. We do not know at what time use of these bad tapes was stopped, so we cannot easily predict when this project is likely to be finished.

O. VLBA OPERATIONAL STATUS

An encouraging confirmation of the general health of the VLBA came from monitoring of X-ray transient GRO J1655-40. Seven epochs spread by typically 5-6 days were observed. For this set of expedited observations, the average time between observation and release of the tapes was about 12 days. Data quality was good, with the major problems due to some difficulties with playback quality necessitating recorrelation of one epoch.

A comparison of the results from a 1993 MkIII experiment, independently correlated and analyzed with the Haystack correlator and software and with the VLBA correlator and software, has been completed with very encouraging results. The observed delays, phases and rates were in excellent agreement. The very slight differences are consistent with somewhat different algorithms and data handling in the two systems. A more complete and accurate comparison of the two correlators is now in progress using a 24-hour, dual frequency geodetic-style VLBA experiment. The agreement of the correlated amplitudes between the two correlators has not yet been analyzed in detail.

At the end of September, the rate of releasing tapes was approaching one project per day. The backlog of VLBA-only observations was about 3-4 weeks. The throughput of the VLBA correlator and indeed the whole VLBA has been limited by the self-imposed rule that we scrutinize every project carefully for defects introduced by flaws in the observing system and correlator. This rule was adopted at the beginning of production in the early part of 1994 and was a natural reaction to the large number of problems that were being found. Currently, the correlator is operating sufficiently reliably that most projects suffer principally from problems at record time; while these problems must ultimately be fixed, they either cannot or should not be remedied by adjusting the correlation. Consequently, we have decided to move to a two-track approach to checking the results of correlation: most projects will be checked for good playback and the presence of fringes on a strong calibrator. A quasi-random and limited sample of projects will be examined in depth as we now do. From our experience with the data quality acheived in most projects, we expect that this approach should catch nearly all of the problems that compromise the scientific goals of a project. Since after passing the scrutinization the data tapes will be released immediately, we are committed to re-observing those projects that fail and are not caught in scrutinization. The goal of this new scheme of scrutinization is to sustain a release rate of one VLBA project per day. This translates into an observing duty cycle of 50 percent, and in terms of correlator throughput is about 25 percent of that ultimately possible.

Global projects take more time in preparation since clocks and tape head offsets must be determined. The backlog of unprocessed Global observations is 55 projects. Currently we release about one project every two weeks. Our goal is to double this rate of release by the beginning of December.

The considerable improvement in correlator throughput has come from a freeze of the correlator real-time software. A rationale for the freeze is to allow the software team to concentrate upon the re-design and re-write of some key components of the software. This revision of the software is expected to take at least four months. We can describe reasonably clearly just what type of projects can be processed successfully on the correlator using the current software. We publish a document in the NRAO VLBA Mosaic Home Page that describes the do's and don'ts of scheduling a project. Observers must adhere to these guidelines if the project is to be processed on the correlator. The VLBA Friend for a project will provide advice on scheduling if required.

The drop in recording and/or playback quality first apparent in June and July was found to be a design problem with an equalizer in the playback drives. Once this was discovered, a simple fix was possible and the playback quality improved dramatically. We still suffer from poor playback more often than is ultimately acceptable but the current level of quality does not significantly limit throughput.

P. GREEN BANK TELESCOPE PROJECT

Antenna

Manufacturing drawings for 90 percent of the box structure design have been completed. Detail manufacturing drawings of the wheel structure design have been released, and manufacturing is underway at Mexia. The materials, 3" elevation gear flange support and 2" sectors, have been ordered. The wheel will be trial-assembled in Mexia before shipping.

The tip of the vertical arm above the receiver room level is in detail design now. It will be fabricated and assembled on a concrete foundation in Mexia for testing of the prime focus and subreflector adjustment mechanisms and the feed arm servo system. After the testing, this will be disassembled, shipped, and reassembled in Green Bank on a similar foundation for NRAO use before installation.

UAD now has 15 Autocad designers assigned for detailing the tipping structure. Ten of them are working on the backup structure. Two engineers are working on the erection procedures. Mexia has already fabricated all the kernels and transition sections, and all the large box members in 40-foot lengths.

The alidade has been completely erected, welded, and the welded areas primed and painted. All equipment on Level One is in place. Temporary scaffolding to hold the elevation shaft has been constructed. The stairs and manlift to the top of the elevation bearing weldment on the right side are complete. Most of the conduit, cable trays, A/C ducting, and piping are in place.

Portions of the tipping structure are now on site. They include the actuator building, a large number of weldments for the box/elevation wheel, the W19 beams for the spokes between the elevation bearing area to the counterweight area, and five pieces of the elevation shaft. The elevation axis will be welded together on the ground and installed in two sections. The box structure will be assembled in sub-sections before lifting up to mate with the elevation axis.

Open Loop Active Surface

Approximately 1200 active surface actuators were received earlier this year, with the balance (approximately 1200) due in November. These actuators incorporate the design changes detailed last year to enhance reliability and reduce RFI. The operating goal for the actuators was 2000 hours. Two actuators of the final design were tested in the factory and ran for 3700 hours with no problems. Two others are running under load in an outdoor test fixture in Green Bank. The first failure occurred at 5565 hours, and was due to brush wear in the motor, as was hoped. The motor was replaced, and the actuators now have over 6500 hours without additional failures.

Approximately half of the control modules purchased from Transition Technology Inc. have been incorporated into control panels and functionally tested. Also, motor power supplies have been received, and each one burned in for one week at full load. Performance of the supplies was both consistent from unit to unit and very satisfactory. Finally, all cable interface boards, which include terminal strips to terminate the cables from the actuators, lightning suppressors, and connectors to interface to the control panels, have been manufactured.

In order to get experience with the actuator hardware and with the available software tools, software for the 96 actuator test bed was rewritten using the same tools as are used by the Monitor and Control group. Most of the code written here will be used directly in the final system. C++ classes to control the actuators, actuator control modules, and VME interface are written. A class to convert from the rib and hoop coordinate system for identifying actuator locations to addresses in the control system is complete. A detailed interface to the Monitor and Control system has been written; control will be accomplished using Remote Procedure Calls (RPC's). A class to verify that received position commands will do no harm to the surface, and to change the commands from "ideal" lengths to "real" lengths which take into account the non-linearity, and temperature sensitivity of the position transducers, is also complete.

Closed Loop Active Surface

The production of 20 Laser Rangefinder units is well under way at this time. The most intricate part of the laser rangefinder is the computer controlled mirror assembly. The assembly is being mass produced using numerically controlled machine tools in the Green Bank shop.

In addition, we now have 25 of the oscillator assembly units, each has been fully tested and exceeds our specifications. Twenty transmitter modules have been completed, and the bulk of the twenty receiver modules are finished. Twenty sets of control electronics are nearing completion. Within a month we expect them to be complete.

Retroreflectors

The 2400 one-inch diameter retroreflectors have been acquired and meet all our specifications.

Retrospheres

A second version of the wide angle retrosphere has been produced by the University of Arizona Optical Science Centre. The plan is to have several of these devices situated around the lip of the main reflector in order to connect together the telescope metrology coordinate system and the ground-based coordinates.

Calibration Laboratory

The past few months have seen the establishment of the calibration laboratory in the basement of the old 300 Foot Telescope control building. In order to calibrate individual laser rangefinders as absolute distance instruments, we have established a calibration distance between two monuments separated by a distance of approximately 19 meters. We are attempting to establish this distance exactly (to within 25 microns).

We have acquired an HP interferometer and have constructed a track between the two monuments thereby permitting the distance between the monuments to be measured using the interferometer. This distance is also measured using the laser rangefinder. 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 at present. This is currently being investigated.

The HP interferometer has enabled us to check the linearity of the rangefinder over path length changes of several meters with excellent results. Measurements of a 2 meter “bar” at a range of 37 meters have been made. The RMS error of 50 readings of the 2 meter length was 17 microns.

Outdoor Test Range

The three original rangefinders have continued to operate on the outdoor test range. The presence of this permanent test range has allowed the software and hardware developments to progress in a realistic environment. The rangefinders are controlled over the Ethernet by a workstation using C++ in a UNIX environment.

The test range is in constant use for various experiments and upgrades. Several major milestones should be reported. The first is in the calibrations/software area. A laser rangefinder is calibrated on the calibration range, and parameters associated with the mirror pointing, for example, are measured. Offsets, non-orthoganality of the axes and the relationship 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.

Another significant result using the outdoor test range has been the measurement of the Group Refractive Index (GRI) using the rangefinder as a refractometer. Measurements of temperature, humidity, and pressure are used to calculate the GRI, and these values are compared with those obtained from the rangefinder. Agreement to better than one part per million is routinely achieved.

140 Foot Telescope Experiment

A crucial part of the precision pointing application of the rangefinders is the ability to track a moving target several hundred feet above the ground and generate its three-dimensional position coordinates with a precision of 100 microns. An update rate of around twice per second is required. We have recently started an experiment to track several retrospheres mounted on the moving structure of the 140 Foot Telescope. Four ground-based laser rangefinders will be controlled via the Ethernet from our control building, and range measurements to the various retrospheres will establish the position of the retrospheres with a degree of redundancy.

Software

The software residing within the laser rangefinder is 90 percent complete and is well documented. The three laser rangefinders on our outdoor test range now operate continuously over Ethernet controlled by a Sun workstation running C++ under UNIX. The software is highly developed and is well suited to the experimental work we are undertaking.

Electronics

The GBT electronics development is reported under the Green Bank Electronics Division section of this report.

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 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 has been expanded from a straight development effort to a development plus support effort. This has had significant implications for the source control system, *i.e.,* clear differentiation had to 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 continued on the data collection. Like AIPS++, Glish will be made an integral part of the system. Experiments on Glish's "software bus" were performed to see if it met requirements for handling data as well as control. The effort is continuing in conjunction with the original authors of Glish, to port Glish to VxWorks.

Data Analysis

Maintenance and testing of the AIPS++ development installation in Green Bank continued this period. Since the basic tools for application development under AIPS++ are now scheduled for December, work concentrated on coordinating with Monitor and Control on spectral processor data acquisition. Significant time was spent on designing the FITS binary tables needed to represent the Spectral Processor datasets.

A translation program "SPFITS" was written. This program translated the special data format used by the Spectral Processor into FITS binary tables. Once in FITS format, the data could be inspected using several standard analysis packages. Using the PV-WAVE data analysis, these FITS tables were read into data arrays and displayed using PV-WAVE plotting the display routines. Additional pulsar analysis routines are being developed using PV-WAVE. The "SPFITS" program was taken over by Monitor and Control as part of the spectral processor data collector module for the GBT.

Q. PERSONNEL

New Hires

P. Palmer	Visiting Scientist	07/01/94
B. Butler	Research Associate	07/11/94
K. Ryan	Scientific Programming Analyst	08/01/94
M. Rosales	Electronic Engineer II	08/09/94
R. Taylor	Visiting Scientist	09/01/94
D. Balser	Research Associate	09/01/94
K. Mead	Visiting Scientist	09/19/94

Terminations

P. Palmer	End of Appointment	07/15/94
R. Davis	End of Appointment	09/15/94

Change in Title

R. Perley	To Scientist (tenure)	07/01/94
B. Vance	To Head/GB Computing	07/01/94
J. Kingsley	To Telescope Operations Manager	07/01/94

Other

R. C. Walker	Return from Leave for Professional Advancement	09/01/94
J. Wrobel	Return from Leave for Professional Advancement	09/01/94
N. Bailey	To Leave of Absence	09/01/94

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