NATIONAL RADIO ASTRONOMY OBSERVATORY

QUARTERLY REPORT

January 1, 1995 - March 30, 1995

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Appendix A. Preprints

A. TELESCOPE USAGE

NRAO telescopes have been scheduled for research and maintenance in the following manner during the first quarter of 1995.

	140 Foot	12 Meter	VLA	VLBA
Scheduled Observing (hours)	1820.75	2160	1567.4	921
Scheduled Maintenance and Equipment Changes	184	25.5	248.3	194
Scheduled Tests and Calibrations	124.75	126.5	334.2	324
Time Lost	154.5	358.5	61.1	26
Actual Observing	1666.25	1801.5	1506.3	895

B. 140 FOOT TELESCOPE

The following continuum programs were conducted during this quarter.

No.	Observer(s)	Program
D186	de Pater, I. (Calif., Berkeley) Heiles, C. (Calif., Berkeley) Maddalena, R. Wong, M. (Calif., Berkeley)	Monitoring the Comet-Jupiter crash at 21 cm.

The following line programs were conducted during this quarter.

No.	Observer(s)	Program
B609	Bania, T. (Boston) Rood, R. (Virginia) Balser, D.	X-band measurements of the cosmic abundance of ^{3}He.
B622	Bell, M. (NRC, Herzberg) Avery, L. (NRC, Herzberg) Feldman, P. (NRC, Herzberg)	Observations to detect C_6H in absorption against Cas A and other sources.
B637	Barnbaum, C. Morris, M. (UCLA) Omont, A. (IAP, Paris)	OH and H_2O masers from circumstellar envelope of U Equ.
F124	Frayer, D. (Virginia) Brown, R. Vanden Bout, P.	A 12-20 GHz survey of molecular oxygen at high redshift.
L298	Levine, D (UCLA) Taylor, G . (Caltech) Morris, M. (UCLA) Schulman, E. (Michigan)	A search for H_2O masers towards the galactic center.

No.	Observer(s)	Program
M373	Murphy, E. (Virginia) Lockman, F. J. Savage, B. (Wisconsin)	A 21 cm deep search for high velocity clouds.
M382	Magnani, L. (Georgia) Onello, J. (SUNY)	CH observations of four high-latitude molecular clouds plus several similar lines of sight.
M385	Murphy, E. (Virginia) Lockman, F. J.	The magnetic field in galactic HI.
R255	Rood, R. (Virginia) Bania, T. (Boston)	A search for SETI beacons.
R258	Reach, W. (NASA/GSFS) Magnani, L (Georgia)	3.3 GHz observations of molecules in an interstellar cirrus cloud.
S399	Shah, R. (Boston) Bania, T. (Boston) Jackson, J. (Boston)	C92α studies of photodissociation regions: density and temperature structure of the partially ionized medium.
T346	Turner, B.	C_2S study of cirrus cores and small galactic plane clouds.
T347	Turner, B.	A search for HC_4O.
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. (Cornell) Nice, D.	Observations at 550 MHz of the orbital fluctuations in the eclipsing pulsar binary PSR B1957+20.
A117	Arzoumanian, Z. (Cornell) Nice, D. Taylor, J. (Princeton)	Timing of seven newly discovered millisecond pulsars at 575 and 810 MHz.
A118	Arzoumanian, Z. (Cornell) Nice, D. Taylor, J. (Princeton)	Bimonthly timing of 63 pulsars at 810 MHz.
B617	Backer, D. (Calif., Berkeley) Sallmen, S. (Calif., Berkeley) Foster, R. (NRL) Matsakis, D. (NRL)	Pulsar timing array observations at 800 and 1395 MHz.
S395	Sallmen, S. (Calif., Berkeley) Backer, D. (Calif., Berkeley)	800 MHz polarization observations of millisecond pulsars using the CDRP.

No.	Observer(s)	Program
S400	Sayer, R. (Princeton) Shrauner, J. (Princeton) Camilo, F. (Princeton) Taylor, J. (Princeton) Thorsett, S. (Princeton) Arzoumanian, Z. (Cornell) Nice, D.	70 MHz observations of relativistic effects in binary pulsars and timing of recently discovered pulsars.
S401	Sayer, R. (Princeton) Taylor, J. (Princeton) Nice, D.	370 MHz timing observations of a new relativistic binary pulsar.

The following very long baseline interferometry programs were conducted.

No.	Observer(s)	Program
A120	Altunin, V. Migenes, V. (CSIRO) Slysh, V. (Lebedev)	OH masers VLBI survey.
C293	Clark, T., (NASA/GSFC) Ryan, J. (NASA/GSFC) Gordon, D. (Hughes/STX) Himwich, W. (NVI, Inc.) Varney, D. (NVI, Inc.) Vandenberg, N. (NVI, Inc.)	140 Foot, 85-3, and 20 meter Green Bank geodetic ties.
GD009	Dallacasa, D., *et al.*	Observations of bright peaked spectrum sources below turnover frequencies.
GR010	Rupen, M., *et al.*	VLBI imaging of supernova 1993J in M81.

C. 12 METER TELESCOPE

The following line programs were conducted during this quarter.

No.	Observer(s)	Program
A125	Apponi, A. (Arizona State) Ziurys, L. (Arizona State)	Unraveling nitrogen chemistry: mapping of NO and N_2O in the galactic center.
B632	Balonek, T. (Colgate) Dent, W. (Massachusetts)	Study of the evolution of extragalactic radio sources at millimeter wavelengths.
B633	Brinks, E. Taylor, C. (Minnesota)	CO observations of a sample of HII galaxies.
B634	Bergman, P. (Arizona) Aalto-Bergman, S. (Arizona) Black, J. (Arizona)	Study of formaldehyde in NGC 253.
B635	Aalto-Bergman, S. (Arizona) Black, J. (Arizona) Heikkila, A. (Chalmers, Onsala)	Study of HCN excitation in IR-luminous galaxies.

No.	Observer(s)	Program
C289	Casoli, F. (Paris Obs.) Boselli, A. (Paris Obs.) Dickey, J. (Minnesota) Lequeux, J. (Paris Obs.)	Study of the CO luminosity of isolated spirals.
C291	Clancy, R. T. (Colorado) Sandor, B. (Colorado)	Microwave spectroscopy of terrestrial planetary atmospheres.
D187	Dayal, A. (Arizona) Bieging, J. (Arizona)	CO observations of young planetary and proto-planetary nebulae.
E58	Evans, A. (Hawaii) Sanders, D. (Hawaii) Mazzarella, J. (Caltech) Graham, J. (Calif., Berkeley)	CO observations of high-z, powerful radio galaxies (z=1-4): 3C 368 (z=1.1), 3C 68.2 (z=1.6), 4C 48.48 (z=2.3), 4C 23.56 (z=2.4), and 4C 41.17 (z=3.8).
E59	Emerson, D. Jewell, P. Martin, R. (Arizona) Salter, C. (NAIC) Ghosh, T. (NAIC)	A high-resolution, large-scale survey of ^{12}CO emission from M31.
F130	Frayer, D. (Virginia) Brown, R. Vanden Bout, P.	Study of CO in damped Lyα systems.
F131	Frayer, D. (Virginia) Brown, R. Vanden Bout, P.	A search for molecular oxygen in F10214+4724, Part 2.
G342	Guélin, M. (IRAM) Ziurys, L. (Arizona State)	Confirmation of ^{26}AlF: testing nucleosynthesis in AGB Stars I.
H302	Holdaway, M. Owen, F. Rupen, M.	Study of strong continuum sources at 90 GHz.
H307	Higdon, J. Lord, S. (IPAC) Rand, R. (Maryland)	Study of the molecular content of ring galaxies.
K348	Kutner, M. (RPI) Mead, K. (Union College) Carey, S. (RPI)	Study of dense cores in outer galaxy molecular clouds.
K349	Kutner, M. (RPI) Verter, F. (NASA/GSFC)	Study of strong molecular source in M31.
L297	Liszt, H. Lucas, R. (IRAM)	Study of λ3 mm HCO^+ and other emission lines toward ζ Oph.

No.	Observer(s)	Program
L299	Latter, W. (NASA/Ames) Jewell, P.	Study of a spectral bandscan of IRC+10216 in the 1.2 mm window.
L300	Levine, D. (UCLA) Hurt, R. (UCLA) Martin, R. (Arizona) Turner, J. (UCLA)	Molecular mapping of the barred spiral IC 342.
M353	Minh, Y. (Daeduk, Korea) Turner, B. Kim, K. (ChungNam U.) Irvine, W. (Massachusetts)	Study of the chemistry of cirrus cloud cores.
M376	Mangum, J. (Arizona) Latter, W. (NASA/Ames) McMullin, J. (Maryland) Mundy, L. (Maryland)	A derivation of the physical conditions in the Serpens molecular cloud.
M388	Minchin, N. (Queen Mary) White, G. (Queen Mary) O'Brien, P. (Queen Mary)	A fractionation study of the PDRs associated with NGC 1977, NGC 7538, NGC 2024 and NGC 7822 regions.
N17	Narayanan, G. (Arizona) Walker, C. (Arizona)	Detection of multiple outbursts towards Cepheus A molecular outflow system.
P169	Paglione, T. (Boston) Jackson, J. (Boston) Heyer, M. (Massachusetts) Ho, P. (CFA)	Study of dense gas in the galactic center.
R261	Roberts, D. (Illinois) Crutcher, R. (Illinois) Troland, T. (Kentucky)	Zero and short spacing observations of S106 and W3.
S393	Shepherd, D. (Wisconsin) Churchwell, E. (Wisconsin)	Mapping high velocity molecular gas in high mass star formation regions.
S397	Snyder, L. (Illinois) Mehringer, D. (Illinois) Miao, Y. (Illinois) Kuan, Y-J. (Illinois)	Study of acetone in Sgr B2.
S398	Saucedo, J. (Arizona) Bieging, J. (Arizona)	CO (1-0) observations of a sample of isolated early-type galaxies.
S403	Snyder, L. (Illinois) Hollis, J. M. (NASA/GSFC) Miao, Y. (Illinois) Lovas, F. (NBS) Jewell, P.	Extending the search for interstellar glycine sources beyond Sgr B2.

No.	Observer(s)	Program
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.
T331	Turner, B. Steimle, T. (Arizona State)	A confirmation of silylene (SiH_2) in IRC 10216.
T338	Turner, B.	The chemistry of cirrus cores and small galactic plane clouds: sulfur chemistry.
T342	Turner, J. (UCLA) Martin, R. (Arizona) Ho, P. (CFA)	Study of CO in M83.
W347	Walker, C. F. (Texas) Bechtold, J. (Arizona) Black, J. (Arizona) Tanner, A. (Arizona) Ge, J. (Arizona)	Studies of IRAS selected absorption line systems at millimeter wavelengths.
W349	Wootten, H. A. Fuller, G.	Mass and morphology of high column density $C^{17}O$ J=2-1 gas in the ρ Ophiuchi cloud cores.
W351	Wootten, H. A. Mangum, J. (Arizona)	Study of origin of broad formaldehyde line emission in millimeter-bright low mass star-forming regions.
Z117	Ziurys, L. (Arizona State) Apponi, A. (Arizona State) Jarrold, M. (Northwestern)	Confirmation of interstellar HOC^+: revision of ion-molecule chemistry?
Z118	Ziurys, L. (Arizona State) Apponi, A. (Arizona State)	Closing the nitrogen chemistry network: searches for interstellar NO_2 and NO^+.
Z120	Ziurys, L. (Arizona State) Guélin, M. (IRAM)	Confirmation of circumstellar NaF: testing fluorine nucleosynthesis in AGB stars.

D. VERY LARGE ARRAY

First quarter, 1995 was spent in the following configurations: C-configuration from January 1 to January 3; DnC-configuration from January 3 to February 21; D-configuration from February 21 to February 28.

No.	Observers(s)	Program
AA156	Antonucci, R. (Calif., Santa Barbara) Barvainis, R. (Haystack)	Molecular gas in high-redshift quasars. 1.3 cm line.

No.	Observer(s)	Program
AA181	Alexander, P. (MRAO) Green, D. (MRAO) Clemens, M. (MRAO)	Star-formation history in interacting galaxies NGC 4490/NGC 4485. 3.6, 6, 20 cm line.
AA185	Acord, J. (MPIR, Bonn) Wood, D. Walmsley, C. M. (MPIR, Bonn) Churchwell, E. (Wisconsin)	SiO towards G5.89-0.39 and W3IRS5. 0.7 cm line.
AB705	Burke, B. (MIT) Becker, D. (MIT) Lehar, J. (MRAO) Hewitt, J. (MIT) Roberts, D. (Brandeis)	Time delay of the gravitational lens 0957+561. 3.6, 6 cm.
AB725	Bastian, T. Chiuderi-Drago, F. (Florence) Alissandrakis, C. (Athens)	Search for linearly polarized microwave emission from the sun. 3.6, 6 cm line.
AB728	Baumgardt, K. (Cornell) Broeils, A. (Cornell) Haynes, M. (Cornell)	HI study of the internal kinematics of Sa galaxies. 20 cm line.
AB735	Benz, A. (SFIT, ETH) Gudel, M. (Villigen) Schmitt, J. (MPE, Munich)	Neupert effect in the corona of an active star. 3.6 cm.
AB739	Benz, A. (SFIT, ETH) Keller, C. (NOAO) Bastian, T. Krucker, S. (SFIT, ETH) Bernasconi, P. (SFIT, ETH)	Chromosphere and corona above the network of the quiet Sun. 1.3, 2, 3.6 cm.
AB741	Braatz, J. (Maryland) Wilson, A. (Maryland)	Mapping of H_2O megamasers in active galaxies. 1.3 cm line.
AB742	Balser, D. Rood, R. (Virginia) Bania, T. (Boston) Wilson, T. (MPIR, Bonn)	Search for $^3He^+$ in planetary nebulae. 3.6 cm line.
AB744	Brown, A. (Colorado/JILA) Jeffries, R. (Birmingham) Deeney, B. (Colorado/JILA) Bromage, G. (Lancashire)	Two young, rapidly rotating late-type dwarfs. 3.6 cm.
AC308	Condon, J. Cotton, W. Perley, R.	All sky survey. 20 cm.

No.	Observer(s)	Program
AC399	Cayatte, V. (Paris Obs) Boselli, A. (Paris Obs) Balkowski, C. (Paris Obs) van Gorkom, J. (Columbia)	HI distribution in the anemic galaxy NGC 4548. 20 cm line.
AC414	Cayatte, V. (Paris Obs) van Gorkom, J. (Columbia) Bravo, H. (Paris Obs) Balkowski, C. (Paris Obs) Amram, P. (Marseille Obs)	HI distribution of the brightest spirals in the Coma cluster. 20 cm line.
AC417	Chengalur, J. (NFRA) Lu, N. (Caltech)	Extended emission in the warped disk of NGC 5403. 20 cm line.
AD333	Duric, N. (New Mexico) Goss, W. M. Viallefond, F. (Meudon) Lacey, C. (New Mexico) Gordon, S. (CFA)	A multi-wavelength survey of SNRs in nine nearby galaxies. 6 cm.
AD348	Drake, S. (NASA/GFSC) Lim, J. (SA/IAA, Taiwan) Linsky, J. (Colorado/JILA)	Combined ROSAT/ATCA/VLA study of magnetic Bp star MR 5624. 2, 3.6, 6, 20 cm.
AD351	Dahlem, M. (STScI) Domgorgen, H. (Bonn U.) Dettmar, R-J. (Bochum)	ISM in NGC 2188 – Case study of disk-halo interactions. 20 cm line.
AD353	Della Ceca, R. (Johns Hopkins) Stanghellini, C. (Bologna) Bondi, M. (Manchester) Dallacasa, D. (NFRA)	Search for arcminute scale emission from radio selected BL Lac objects. 20 cm.
AD356	DePree, C. (North Carolina) Wood, D. Goss, W. M.	7 mm line and continuum from two ultracompact HII regions.
AD357	DePree, C. (North Carolina) Wood, D. Goss, W. M.	7 mm observations of the circumstellar disks of massive star outflows.
AD358	DePree, C. (North Carolina) Wood, D.	Fast molecular outflows of Sgr B2. 0.7 cm line.
AD360	DePree, C. (North Carolina) Goss, W. M.	A "new" source in K3-50C. 2 cm.
AE101	Echevarria, L. (UCLA) Morris, M. (UCLA)	Probing the nature of the galactic center threads. 3.6, 6, 20 cm.

No.	Observer(s)	Program
AF275	Fomalont, E. Kellermann, K. Partridge, R. B. (Haverford College) Windhorst, R. (Arizona State)	High-resolution image of deep field at 8.4 GHz. 3.6 cm line.
AF279	Frail, D. Goss, W. M.	Deep VLA imaging around PSR 1823-13. 90 cm.
AF280	Frail, D. Bietenholz, M. (York U.) Markwardt, C. (Wisconsin) Ogelman, H. (Wisconsin)	Matched radio/x-ray images in the vicinity of the Vela pulsar. 90 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.
AF285	Forveille, T. (Grenoble) Cox, P. (Marseille Obs.) Huggins, P. (SUNY) Bachiller, R. (Yebes Obs.) Omont, A. (IAP, Paris)	Search for HI in the Helix planetary nebula. 20 cm line.
AG421	Gaume, R. (USNO) Fischer, J. (NRL)	Monitoring the radio continuum flux density of NGC 2024-IRS2. 1.3, 2, 3.6, 6, 20 cm.
AG437	Gray, A. (DRAO)	Detailed imaging and polarimetry of G357.1-00.2, a possible SNR. 6 cm.
AG439	Grossman, A. (Maryland) Clancy, R. T. (Colorado/JILA)	Mapping Mars water vapor at opposition. 1.3 cm.
AG441	Garay, G. (Chile) Brown, R. Lizano, S. (Mexico/UNAM) Gomez, Y. (Mexico/UNAM)	The C^+ recombination line emission from S88 B. 3.6 cm line.
AG444	Ge, J-P. (Brandeis) Mao, S. (CFA) Loeb, A. (CFA)	Searching for magnetic fields in the Abell cluster 2390. 2, 3.6, 6 cm.
AG447	Goodman, A. (Harvard) Benson, P. (Wellesley College) Fuller, G. Mardones, D. (Harvard) Wilner, D. (CFA) Myers, P. (CFA) Tafalla, M. (CFA)	Internal structure of dense cores. 1.3 cm line.

No.	Observer(s)	Program
AG448	Greenhill, L. (CFA) Henkel, C. (MPIR, Bonn)	Monitoring the acceleration of water megamaser features in NGC 4258. 1.3 cm line.
AH492	Hjellming, R. Gehrz, R. (Minnesota) Seaquist, E. (Toronto) Taylor, A. R. (Calgary)	Image and light curve evolution of the novae Puppis 1991 and Cygni 1992. 1.3, 2, 3.6, 6, 20 cm.
AH524	Hoernes, P. (MPIR, Bonn) Berkhuijsen, E. (MPIR, Bonn) Beck, R. (MPIR, Bonn)	Polarization and RM in the SW arms of M31. 6 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.
AH538	Higdon, J. Wallin, J. (George Mason)	Radio continuum study of the Cartwheel ring galaxy. 2, 3.6, 6 cm.
AH539	Higdon, J. Wallin, J. (George Mason)	Neutral hydrogen in the optical jets of NGC 1097. 20 cm line.
AH542	Ho, P. (CFA) Szczepanski, J. (MIT)	Ammonia in the neighborhood of the galactic center. 1.3 cm line.
AH543	Holdaway, M. Rupen, M.	An HI mosaic of AO355, dwarf companion to IC 342. 20 cm line.
AH546	Harper, G. (Colorado/JILA) Brown, A. (Colorado/JILA) Hummel, C. (USNO) Walder, R. (SFIT, ETH)	Search for radio emission from eclipsing binary Zeta Aurigae. 3.6, 6 cm.
AH547	Higdon, J. Wrobel, J.	HI observations of spiral-elliptical pairs Arp 102 and Arp 104. 20 cm line.
AI054	Irwin, J. (Queens) Giguerre, D. (Queens)	High-z HI in the edge-on galaxy NGC 3556. 20 cm line.
AI056	Ivison, R. (Edinburgh) Seaquist, E. (Toronto) Papadopoulos, P. (Toronto) Eales, S. (Cardiff)	Search for redshifted CO emission from high redshift objects. 1.3 cm line.
AJ238	Johnston, K. (USNO) Gaume, R. (USNO) Nedoluha, G. (NRL) Wilson, T. (MPIR, Bonn) Collison, A. (Illinois)	Spatial structure of Orion CH_3OH maser. 1.3 cm line.

No.	Observer(s)	Program
AJ244	Jaffe, W. (Leiden) Ford, H. (Johns Hopkins)	Search for water megamasers in radio galaxies. 1.3 cm line.
AJ245	Johnston, H. (Utrecht) Strom, R. (NFRA) Verbunt, F. (Utrecht)	An x-ray knot expelled by the Vela supernova. 20 cm line.
AK364	Kollgaard, R. (Penn State) Feigelson, E. (Penn State) Urry, C. (STScI) Pesce, J. (STScI) Wehrle, A. (IPAC)	Intensive radio monitoring of the blazar 3C 279. 1.3, 2, 3.6, 6, 20 cm.
AK369	Kenny, H. (Canadian Military) Taylor, A. R. (Calgary) Ivison, R. (Edinburgh) Seaquist, E. (Toronto)	CH Cygni: Monitoring of the radio jet in outburst. 1.3, 3.6 cm.
AK372	Knapp, G. (Princeton)	Continuum observations of evolved stars. 2, 3.6, 6 cm.
AK376	Kulkarni, S. (Caltech) Frail, D.	Search for the radio counterparts of gamma ray bursters wavelengths. 20 cm.
AK382	Kundu, M. (Maryland) Nitta, N. (Lockheed) White, S. (Maryland) Gopalswamy, N. (Maryland)	Radio spectrum of solar x-ray bright points. 2, 6, 20 cm.
AK383	Koo, B-C. (Seoul National U.)	Do ultracompact HII regions have diffuse envelopes? 20 cm.
AK384	Kundu, M. (Maryland) Gopalswamy, N. (Maryland) Shibata, K. (NAO, Japan)	Radio signatures of coronal x-ray jets. 2, 3.6, 20, 90 cm.
AK386	Kurtz, S. (Mexico/UNAM)	Molecular outflows from massive stars. 2, 3.6 cm.
AK389	Kuiper, T. (JPL) Velusamy, T. (JPL) Langer, W. (JPL) Migenes, V. (CSIRO)	CCS spectral line mapping of B335. 1.3 cm line.
AK391	Kellermann, K. Schmidt, M. (Caltech)	Are there radio silent quasars? 3.6 cm.
AK393	Knapp, G. (Princeton) Bowers, P. (NRL)	The circumstellar envelope of CRL 2688. 3.6 cm line.
AL333	Leitch, E. (Caltech) Myers, S. (Caltech) Readhead, A. (Caltech)	VLA survey of OVRO microwave background fields. 3.6 cm.

No.	Observer(s)	Program
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.
AL344	Lang, K. (Tufts) Willson, R. (Tufts) Kile, J. (Tufts) Bogod, V. (Pulkovo Obs) Gelfreikh, G. (Pulkovo Obs)	VLA-RATAN observations of nonthermal sources on the Sun. 2, 3.6, 6, 20, 90 cm.
AL348	Lim, J. (SA/IAA, Taiwan) White, S. (Maryland) Drake, S. (NASA/ISS)	Nonthermal radiation from magnetic Bp star Sigma Ori E. 0.7, 1.3, 2, 3.6, 6 cm.
AL349	Lo, K. (Illinois) Young, L. (Illinois) Sargent, W. (Caltech) Goss, W. M.	The HI medium of faint dwarf galaxies. 20 cm line.
AL350	Lis, D. (Caltech) Menten, K. (CFA)	Search for H_20 masers in Sagittarius C and Sagittarius D. 1.3 cm line.
AL351	Levine, D. (UCLA) Morris, M. (UCLA) Taylor, G. (Caltech) Schulman, E. (Michigan)	Continuing search for H_2O masers towards the galactic center. 1.3 cm line.
AM462	Molinari, S. (Bologna) Brand, J. (Bologna) Cesaroni, R. (Arcetri) Palla, F. (Arcetri) Palumbo, G. (Bologna)	Radio-continuum observations of very young massive stars. 2, 6 cm.
AM465	Mirabel, F. (CNRS, France) Rodriguez, L. (Mexico/UNAM)	Superluminal source GRS 1915+105. 3.6, 20 cm.
AM469	Morrison, G. (New Mexico) Owen, F. Beasley, A. Voges, W. (MPIfEP, Garching)	Radio halos in high redshift very rich Abell clusters. 20 cm.
AM474	Marvel, K. (New Mexico State) Diamond, P.	Monitoring masers in AGB stars. 0.7, 1.3, 20 cm line.
AM475	Menten, K. (CFA) Reid, M. (CFA)	Search for SiO and H_2O stellar masers near the galactic center. 0.7, 1.3 cm.

No.	Observer(s)	Program
AM476	Mirabel, F. (CNRS, France) Chaty, S. (CNRS, France) Marti, J. (Barcelona) Rodriguez, L. (Mexico/UNAM)	Large-scale radio jets from Cygnus X-1. 6 cm.
AM477	Mehringer, D. (Illinois) Menten, K. (CFA)	44 GHz methanol masers and quasi-thermal emission in Sgr B2. 0.7 cm line.
AP302	Pooley, G. (MRAO) Hardcastle, M. (MRAO) Alexander, P. (MRAO) Riley, J. (MRAO)	Jets in nearby FRI radio galaxies. 3.6, 20 cm.
AP310	Martin-Pintado, J. (Yebes Obs) Gaume, R. (USNO) de Vicente, P. (Yebes Obs) Johnston, K. (USNO) Wilson, T. (MPIR, Bonn)	The hot molecular ring around the Sgr B2 star forming cores. 1.3 cm line.
AP311	Patel, N. (Massachusetts) Zhang, Q. (CFA) Ho, P. (CFA) Goldsmith, P. (NAIC)	Water masers associated with the bright rimmed globules of IC 1396. 1.3 cm line.
AP313	Palmer, P. (Chicago) Snyder, L. (Illinois) dePater, I. (Calif., Berkeley)	Observation of OH in comet P/d'Arrest. 20 cm line.
AR310	Rudnick, L. (Minnesota) Keohane, J. (Minnesota) Perley, R.	Evolutionary studies of Cas A. 6, 20 cm.
AR330	Reynolds, S. (N.C. State) Chevalier, R. (Virginia)	Search for nonthermal emission from planetary nebulae. 6 cm.
AR331	Rupen, M. Holdaway, M.	HI mosaics of the Milky Way: small-scale structure in the ISM. 20 cm line.
AS525	Sramek, R. Weiler, K. (NRL) Van Dyk, S. (NRL) Panagia, N. (STScI)	The properites of radio supernovae. 1.3, 2, 3.6, 6, 20 cm.
AS541	Smith, B. (Texas) Higdon, J.	Multi-frequency radio continuum mapping of four nearby spiral galaxies. 6, 20 cm.
AS546	Sjouwerman, L. (Leiden) van Langevelde, H. (Dwingeloo) Diamond, P. Lindqvist, M. (Leiden) Winnberg, A. (Chalmers, Onsala)	SiO masers in galactic center OH/IR stars. 0.7 cm line.

No.	Observer(s)	Program
AS547	Schulman, E. (Michigan) Bregman, J. (Michigan) Brinks, E.	Deep HI observations of NGC 1300 in front of QSO 0318-196. 20 cm line.
AS548	Steiman-Cameron, T. (NASA/Ames) Sparke, L. (Wisconsin) van Gorkom, J. (Columbia) Eder, J. (NAIC) Sackett, P. (Princeton)	HI mapping of the peculiar SO galaxy NGC 4753. 20 cm line.
AS552	Schiminovich, D. (Columbia) van Gorkom, J. (Columbia) van der Hulst, J. (Groningen/Kapteyn)	HI observations of dynamically young ellipticals. 20 cm line.
AS553	Schiminovich, D. (Columbia) van Gorkom, J. (Columbia) vanderHulst, J. (Groningen/Kapteyn) Oosterloo, T. (CSIRO)	HI observations of NGC 474 and five other shell galaxies with disks. 20 cm line.
AS554	Skinner, C. (LLNL) Becker, R. (Calif., Davis) White, R. (STScI) Barlow, M. (U. College London)	Millimeter observations of P Cygni. 0.7 cm.
AS557	Slysh, V. (Lebedev) Dzura, A. (Lebedev) Kalenskii, S. (Lebedev) Valtts, I. (Lebedev) Kogan, L.	Methanol masers and their environment. 0.7 cm line.
AT167	Tongue, T. (NMIMT) Westpfahl, D. (NMIMT) Adler, D. Henning, P. (New Mexico)	HI mapping of M33: topology of neutral medium. 20 cm line.
AT172	Thornley, M. (Maryland) Mundy, L. (Maryland)	Cold gas on sub-kiloparsec scales in nearby flocculent galaxies. 20 cm line.
AT176	Thorsett, S. (Princeton) Taylor, J. (Princeton) McKinnon, M. Hankins, T. (NMIMT) Stinebring, D. (Oberlin College)	Timing fast pulsars at the VLA. 6, 20, 90 cm.
AT179	Taylor, C. (Minnesota) Brinks, E. Skillman, E. (Minnesota)	Search for HI companions to low surface brightness dwarf galaxies. 20 cm line.
AU056	Uson, J. Bagri, D. Cornwell, T.	Further observations of a proto-cluster of galaxies. 90 cm line.

No.	Observer(s)	Program
AV215	Velusamy, T. (JPL) Kuiper, T. (JPL) Langer, W. (JPL) Migenes, V. (CSIRO)	CCS mapping of fragments in dark cloud core TMC-1 and L149. 1.3 cm line.
AW362	White, S. (Maryland)	The stellar activity cycle on active stars. 3.6, 6, 20 cm.
AW401	Wallin, J. (George Mason) Higdon, J.	HI observations of the interacting ring galaxy Arp 10. 20 cm line.
AW405	Wilson, T. (MPIR, Bonn) Gaume, R. (USNO) Johnston, K. (USNO) Tieftrunk, A. (MPIR, Bonn)	Location of H_2O masers in DR 21. 1.3 cm line.
AW406	Wilner, D. (CFA) Dickel, H. (Illinois) Welch, W. J. (Calif., Berkeley) Jackson, J. (Boston)	CS J=1-0 and recombination line mapping of W49A North. 0.7, 1.3, 3.6 cm line.
AW409	Wootten, H. A. Fuller, G.	Deep continuum search for $C^{18}O$ core L1689S-R17. 3.6 cm.
AY068	Yusef-Zadeh, F. (Northwestern) Wardle, M. (Rochester)	Ionization of stellar atmospheres near the galactic center. 3.6 cm.
AY070	Yusef-Zadeh, F. (Northwestern) Uchida, K. (MPIR, Bonn)	Search for shock-excited OH masers toward the galactic center. 20 cm line.
AY071	Yun, J. (Lisbon) Moreira, M. (Lisbon) Torrelles, J. (IAA,Granada)	Search for continuum emission from embedded sources in Bok globules. 3.6 cm.
AZ068	van Zee, L. (Cornell) Broeils, A. (Cornell) Haynes, M. (Cornell) Salzer, J. (Wesleyan U.)	HI mapping of extreme M_H/L galaxies. 20 cm line.

E. VERY LONG BASELINE ARRAY

No.	Observer(s)	Program
BA008	Aaron, S. (Brandeis) Wardle, J. (Brandeis) Roberts, D. (Brandeis)	Linear polarization structure of 3C 309.1 and 1652+398. 6 cm.
BD010	Desai, K. (NRL) Diamond, P. Frail, D. van Langevelde, H. (NFRA)	Angular broadening of OH masers in OH/IR stars. Single antenna VLBI, 20 cm.

No.	Observer(s)	Program
BG028	Gwinn, C. (Calif.,Santa Barbara) Ojeda, M. (Calif.,Santa Barbara) Desai, K. (NRL)	Incoherently-scattered halos of H_20 masers in W49N. Single antenna VLBI, 13 cm.
BG039	Greenhill, L. (CFA) Moran, J. (CFA) Reid, M. (CFA) Lo, K. (Illinois)	The nucleus of NGC 3079. Phased array VLBI, 1.3 cm.
BJ007	Junor, W. (New Mexico) Biretta, J. (STScI) Harris, D. (CFA)	Core and jet in M87. Single antenna VLBI, 90 cm.
BL010	Lo, K. (Illinois) Zhao, J-H. (CFA) Xu, W. (Caltech) Ho, L. (Calif., Berkeley)	Possible "counterparts" of Sgr A* in nuclei of nearby galaxies: M104. Phased array VLBI, 3.6 cm.
BL011	Lonsdale, C. (Haystack) Barthel, P. (Groningen/Kapteyn)	The primary hotspot in 3C 205 south. 20 cm.
BM036	Moran, J. (CFA) Miyoshi, M. (Nobeyama) Inoue, M. (Nobeyama) Nakai, N. (Nobeyama) Hernstein, J. (CFA) Greenhill, L. (CFA) Diamond, P.	Measurement of proper motions of the water vapor masers in NGC 4258. Phased array VLBI, 1.3 cm.
BT006	Taylor, G. (Caltech) Ge, J-P. (Brandeis) Pearson, T. (Caltech) Roberts, D. (Brandeis)	Mapping the high Faraday rotation measures of CSS sources: 3C 318. Single antenna VLBI, 6, 20 cm.
BT012	Thakkar, D. (Caltech) Vermeulen, R. (Caltech) Pearson, T. (Caltech) Readhead, T. (Caltech)	Nuclei of complete sample of low-luminosity radio galaxies. Phased array VLBI, 6, 20 cm.
BW005	Wrobel, J. Conway, J. Terlevich, R. (RGO)	Testing the starburst model for NGC 5548's Seyfert 1 nucleus. Phased array VLBI, 3.6 cm.
BW015	Wardle, J. (Brandeis) Roberts, D. (Brandeis) Ge, J-P. (Brandeis) Aaron, S. (Brandeis) Gabuzda, D. (Calgary)	Emission-line BL Lacs and HPQ/OVV quasars. 6 cm.
GJ007	Junor, W. (New Mexico) Biretta, J. (STScI)	Structure and evolution on light-week scales in nucleus of 3C 274. Phased array VLBI, 0.7 cm.

No.	Observer(s)	Program
GM021	Marcaide, J. (Valencia) Jones, D. (JPL) Ros, E. (Valencia) Alberdi, A. (IAA, Granada) Guirado, J. (IAA, Granada) Rius, A. (IAA, Granada) Diamond, P. Shapiro, I. (CFA) Rogers, A. (Haystack) Whitney, A. (Haystack) Witzel, A. (MPIR, Bonn) Krichbaum, T. (MPIR, Bonn) de Bruyn, G. (NFRA) Schilizzi, R. (NFRA) Mantovani, F. (Bologna) Trigilio, C. (Bologna) Preston, R. (JPL)	Radio-shell expansion in SN 1993J. Phased array VLBI, 6 cm.
GR010	Rupen, M. Bartel, N. (York U.) Conway, J. (Chalmers, Onsala) Beasley, A. Sramek, R. Romney, J. Bietenholz, M. (York U.) Weiler, K. (NRL) van Dyk, S. (Calif., Berkeley) Panagia, N. (STScI) Titus, M. (Haystack) Cannon, W. (York U.) Popelar, J. (Ottawa) Graham, D. (MPIR, Bonn) Venturi, T. (Bologna) Umana, G. (Bologna) Davis, R. (Manchester) Rius, A. (IAA, Granada) Altunin, V. (JPL) Jones, D. (JPL)	VLBI imaging of supernova 1993J in M81. Phased array VLBI, 3.6, 6, 20 cm.

F. SCIENTIFIC HIGHLIGHTS

Green Bank

A recent all-sky survey on the 140 Foot Telescope for millisecond pulsars has resulted in the detection of a pulsar in a binary system. The pulsar, with a period of 41 ms, is in an eccentric 8.6 day orbit around its companion, which may also be a neutron star. Follow up observations on the 140 Foot show evidence for relativistic precession, which will put some constraints on the mass of the system. Only four other such relativistic binary systems are known.

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

Socorro

VLBA Provides "Compelling Evidence" for Black Hole. High-resolution VLBA observations of a disk of water masers surrounding the nucleus of NGC 4258 reveal that the disk is orbiting a central object with a mass density of at least 100 million solar masses per cubic light-year. Such density – at least 10,000 times that of any known star cluster – provides the most elegant and compelling evidence to date for the existence of a black hole.

Investigators: Miyoshi (Mizusawa Astrogeodynamics Observatory), N. Nakai and M. Inoue (Nobeyama), J. Moran, J. Herrnstein and L. Greenhill (CFA), and P. Diamond (NRAO)

Second Galactic Superluminal Source Tracked by VLBA. The x-ray nova GRO J1655-40 has become the second object within the Milky Way to exhibit superluminal motion in radio jets, following the VLA discovery of GRS1915+105 in the spring of 1994. GRO J1655-40 was tracked with the VLBA as a target of opportunity during a radio outburst. The VLBA data reveal complex motions of condensations within the jets that provide constraints for models of the system.

Investigators: R. Hjellming and M. Rupen (NRAO)

Tucson

Detection of Circumstellar MgCN. MgCN, a new metal-bearing free radical, has been discovered in the circumstellar envelope of the evolved carbon star IRC+10216. Metals such as magnesium, iron, and sodium are known to be abundant in the cosmos, and in particular in our own solar system. Such elements must be formed in supernovae and massive stars and are easily detected in stellar atmospheres. Nevertheless, interstellar molecules bearing these elements have been very difficult to detect. In other words, the method by which metals leave stars, enter the interstellar medium, and eventually reappear in new stars and planetary systems is not well-understood. It is likely that most of the metals are condensed onto dust grains, but some may remain in the gas phase. The observing group used the NRAO 12 Meter and IRAM 30 Meter Telescopes to secure the detection of MgCN. Judging from the line profiles, the emission appears to arise from the outer envelope of IRC+10216, although there may be an inner envelope component as well. The outer envelope emission suggests that MgCN might enter the interstellar medium in the gas phase. MgCN is the metastable isomer of MgNC. The observations suggest an abundance ratio [MgNC]/[MgCN] of 22. The high abundance of MgCN implies that it is formed by non-equilibrium chemistry.

Investigators: L. Ziurys and A. Apponi (Arizona State), M. Guelin (IRAM), and J. Cernicharo (Yebes)

Imaging of the Disk of IC 342 in the Carbon Monoxide Molecule. The ^{12}CO J=1-0 emission from the inner disk of the spiral galaxy IC 342 has been imaged using the new spectral line on-the-fly mapping at the NRAO 12 Meter. This technique provides a high-efficiency very uniform method of imaging large fields.

IC 342 is the site of a moderate nuclear starburst, and the central arc-minute of the galaxy, which contains a nuclear molecular bar, has been well-observed. However, the new map covers the large-scale molecular structure in a 15' x 15' field, about the optical extent of the galaxy. The angular resolution of the image is about 1' (~560 pc at 1.8 Mpc). CO emission is detected throughout the field. The CO is centrally peaked, and shows spiral structure and a N-S bar about 7' long.

We have compared the CO map with the 20 cm continuum emission, a tracer of star-formation. The CO and continuum are fairly well-correlated everywhere except in the eastern portion of the disk, where the continuum is notably deficient while the CO is quite symetrically distributed across the galaxy. There is also some evidence of an offset between the molecular and continuum spiral structure to the SW. As might be expected, the ratio of the continuum to the CO is very large at the nucleus and the barlike structure is not obvious in the continuum or ratio maps.

The relative deficiency in 20 cm continuum emission in nearly a quarter of the disk is puzzling. We note that the optical spiral structure is more diffuse in that part of the galaxy, that the HI peaks to the east of IC 342 and that there is a small, distant companion to the SE.

Investigators: D. Levine (IPAC/UCLA), R. Hurt (UC Riverside), R. Martin (Arizona), J. Turner (UCLA), and P. Ho (Harvard)

G. PUBLICATIONS

Attached as Appendix A is a tabulation of all preprints received in the NRAO Charlottesville library authored by NRAO staff or based on observations obtained on NRAO telescopes during the reporting period.

H. CHARLOTTESVILLE ELECTRONICS

Amplifier Development, Design, and Production

The evaluation of the AlInAs/GaInAs/InP devices from Hughes continued. The devices were incorporated into several existing amplifier designs: 38-45 GHz, 40-50 GHz, and 60-80 GHz, yielding state-of-the-art performance. There is, however, certain unrepeatability of cryogenic performance across the wafer. For example, the 50 μm wide devices with the interdigitated gate structure yielded performance of only about 17 K at 40 GHz, compared with 10 K for the best devices with T-gate. This variability has been linked to certain d.c. properties of these devices at cryogenic temperatures. At this time, due to a rather limited number of sample devices tested at cryogenic temperatures, it is impossible to predict what percentage of devices exhibit excellent cryogenic performance. It should be stressed, however, that all devices tested so far had better noise performance than the best devices previously available to NRAO in large numbers.

Incorporation of the Hughes/NRAO devices into the existing NRAO amplifier designs has involved, so far, only modification of the amplifier's first stages. Further incorporation of the Hughes/NRAO devices will require new electrical and mechanical designs.

The following projects were continued:

- 60-90 GHz and 90-120 GHz amplifiers.
- Production of 26-36 GHz, 38-45 GHz, and 40-50 GHz amplifiers.
- Cryogenic S-parameter measurement setup.

Initial evaluation of the AlInAs/GaInAs/InP (Hughes) devices in the existing KH-series (22-26 GHz) amplifiers has demonstrated an average noise temperature of 12 K in the 21-26 GHz band. This is approximately a 30 percent improvement in noise temperature as compared with the same amplifier using Starcomm devices. Evaluation is continuing.

Both the XL-series (8-10 GHz) and K_u-series (12-18 GHz) amplifiers are undergoing a redesign to optimize performance using the new Hughes devices. Eugene Lauria, visiting from NAIC, is involved in the redesign of the XL-series.

Two 800 MHz, six 4-6 GHz, and four 22-26 GHz amplifiers have been fabricated this quarter.

Work is continuing on the PC-based automated amplifier test station. A software controller RF/IF switch unit and precision receiver have been fabricated.

86 GHz VLBA Receiver

The prototype version of this receiver is complete and awaiting availability of low-noise amplifiers.

Superconducting (SIS) Millimeter-Wave Mixer Development

Two of the new tuneable 260-300 GHz mixers were supplied to Tucson. This mixer 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.

Parts were fabricated and supplied to Tucson to allow the 270-300 GHz SIS receiver modules to be retrofitted with the new tuneable mixers.

In attempting to understand the apparently large input loss on the 200-300 GHz receivers at the 12 Meter Telescope, we used the 3-D electromagnetic simulator *hfss* to analyze the throat region of the scalar feed horn and the LO coupler (a waveguide branch-line coupler). There was no indication that these components were contributing to the problem.

During this quarter, we have assembled and tested eight SIS mixers and repaired two frequency multipliers. We have also mounted and DC-tested 12 SIS chips from UVA wafers.

Electromagnetic Support

GBT Project: Diffraction analysis on noise shields was completed. These shields redirect spillover energy which otherwise would be scattered by the feed support arm structure into the main reflector and then into the cold sky. The shields are designed on the basis of the feed arm drawing that is currently available. The location and orientation of the shields with respect to the feed axis determine where the energy goes with respect to the main beam. The diffraction analysis confirms the ray tracing analysis carried out earlier. Based on the analysis, a shield which covers the 15 to 23 degree range from the feed axis has been designed. The shield is 1.2 m wide near the subreflector and 3.2 m wide at the far end. A measurement is required on the feed arm structure with the subreflector in order to investigate if the shield has a positive effect on the energy scattered back into the feed.

A preliminary optics design was completed for the proposed 40-50 GHz receiver. A pair of tertiary reflectors which would provide for atmospheric noise suppression and fast pointing corrections is proposed. One of the reflectors is on the axis of the feed array (2x2), while the other is on the subreflector axis. The loss through the tertiary is about 1 percent and beam throw of $\pm$ 4.5 beamwidths at 46 GHz is possible. This pair of tertiary reflectors can be used with a single beam at frequencies down to 22 GHz.

GBT Spectrometer

Circuit board design of the GBT spectrometer was mostly completed in the first quarter of 1995. The only logic card with significant design work remaining is the long-term accumulator. Most parts required to build the system were ordered in March.

Arrangements to start a production run of the 1024-lag correlator chip used in the spectrometer are almost complete. This activity was coordinated with two other observatories interested in production correlator chips.

Work has proceeded on the final test fixture planned for the GBT spectrometer project. An instrument to test samplers for the spectrometer is nearly complete.

I. GREEN BANK ELECTRONICS

GBT Development

The 3.95-5.85 GHz front-end assembly is complete, but not yet tested. The 1.15-1.73 GHz ortho-mode transducer fabrication was completed, and testing has begun. Fabrication of the 1.15-1.73 GHz dewar continues. Construction and testing of several M/C interfaces required for the project was completed.

Significant progress was made in construction of the first eight 1-8 GHz converter modules. The Converter Rack layout was finalized and assembly work began. Design of a X21 Multiplier chain for generation of the 10.5 GHz LO signal needed in the Converter Rack progressed. Work is also underway on construction of the LO Reference distribution system. Our goal is to complete the first of two Converter Racks in the second quarter for use in integration tests at the 140 Foot.

The factors leading to grease migration into the GBT Active Surface actuator motors were identified. The use of a non-sealed bearing and excessive grease packed in the gearbox by the actuator manufacturer were the primary factors. Correction involves disassembly of the already assembled actuators, inspection, and removal of excess grease. The motors of those units showing evidence

of migration are removed, inspected, and sealed bearings are installed. To date some 1200 of the 1800 already assembled actuators have been reworked by NRAO personnel.

Work on the new GBT spectrometer continues. Wafers of the second iteration design were evaluated and accepted. A contract for a second wafer run was let and purchasing of other components for the digital correlator is underway. Components for the 1.6 GHz filter module were selected, and design work is underway for the 100 MHz filter modules.

Site Operations

A plan has been produced, and is being implemented, for a site-wide optical fiber installation. This includes installation of a buried multi-cell conduit and single-mode and multimode optical fiber cables to the major buildings and antennas. Site timing equipment 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 1 nanosecond resolution. The fiber cable has been installed to the 140 Foot, OVLBI earth-station and the new USNO 20-meter antenna. The fiber system is now in use for delivery of LO reference signals from the maser at the Interferometer control building to the OVLBI earth-station and the 20-meter (with round-trip delay measurement) and for control and IF signals between the control building and the 20-meter. GBT M/C software was completed, allowing logging of measurement data for the 1PPS measurements, the round-trip delay measurements, and for monitoring of the maser and of the GPS receiver.

Maintenance, repair, and installation support was supplied to the 140 Foot, Interferometer, and site computer facilities. Twenty-five receiver installations and feed changes were completed at the 140 Foot. Significant maintenance problems were encountered with the VLBA DAS tape drive at the Interferometer and with the H-316 computer system at the 140 Foot.

J. TUCSON ELECTRONICS

Status of Development Projects for the 12 Meter Telescope

8-Beam, 1.3 mm SIS Receiver. This project is nearing completion. The receiver will be tested on the telescope this spring and is expected to be available to observers on a regular basis beginning in the fall of 1995. Observing proposals for this receiver are being accepted now. The receiver consists of a 2x4 array with a beam separation of about 87". The array can be rotated to an arbitrary orientation angle and can track parallactic angle. We expect the receiver to tune from at least 215 to 245 GHz.

4-Beam, Dual-Polarization, 3 mm Receiver. We are beginning development of a 90-116 GHz, 8-channel SIS receiver. The array configuration will be a four-point cross with dual polarization channels at each point. The orientation and separation of one arm of the cross will correspond to the beam throw of the subreflector so that dual-polarization, double-Dicke switching can be employed for point sources, using four of the eight receivers. Other improvements in receiver optics and LO injection should lower the noise temperatures compared to the present generation of receiver. Thus, we expect this receiver to be a significant improvement for both point source and wide-field imaging work. We are just beginning this project; completion is anticipated in 1.5 years.

On-the-Fly Observing Enhancements. OTF spectral line observing should be available with the hybrid spectrometer by the fall 1995. Heretofore, spectral line OTF was available only with the filter banks. The hybrid spectrometer is an autocorrelation device. The FFT's will be done in real-time, ten per second, using a digital signal processing card. This project is well along toward completion. Other on-the-fly upgrades are planned, including more sophisticated scanning modes.

K. SOCORRO ELECTRONICS

VLA 1.3 - 1.7 GHz Receiver Improvements

One of the two remaining spare front ends was completed and tested. The remaining spare will be used for cryogenic testing of resonance suppression in the orthomode transducer.

Prototypes of the new frequency converter F15 modules were installed on three antennas and tested. The design will be modified to reduce feed-through of interference in the 990 - 1060 MHz range. In the current system, out-of-band signals are imaged to appear in-band. 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. Additional parts were ordered to construct all 30 modules this year.

VLA 40 - 50 GHz Receivers

Most parts are on hand for three additional front ends. Assembly of the first began this quarter. All three should be assembled, tested, and installed in time for the 1995/1996 winter atmosphere.

New VLA Correlator Controller

A VME computer with custom cards will replace the old correlator controller which is nearing the end of its repairable life. A new project plan was developed, which has system tests with the correlator starting in early 1996. Work resumed in both hardware and software areas.

VLA Antenna B-Rack Shields and Optical Fibers

Twenty-two shields with optical fibers have been installed in antennas. We expect to complete all antenna B-racks by mid-1995.

VLA Visitor Center Radiometer

An L-band radiometer was installed as an interactive exhibit at the Visitor Center.

VLBA Maser Frequency Standard

In February two masers failed on consecutive days. The Oscilloquartz EFOS #2 maser at the VLA depleted its hydrogen source and Sigma Tau #11 developed a major vacuum leak. We returned maser #11 to Sigma Tau for repair. Sigma Tau replenished the EFOS hydrogen source. The EFOS operates again, but testing will continue into April. Sigma Tau maser #12 replaced the EFOS at the VLA.

VLBA Recorders and Playback Drives

The older VLA recorder was returned to the AOC for repairs and was returned to provide two-recorder operation at the VLA. Recent work toward improving reliability of playback drives at the correlator has focused on the vacuum loss problem, and some progress occurred. Efforts will continue. Work progresses on improving the tape container for better resistance to damage in shipment.

VLBA Samplers

Work continues to improve accuracy of sampling levels. A test unit for measuring two bit code level counts was built and testing continues.

Data Acquisition System for Green Bank

The Russian VLBA D-rack and recorder were returned to Socorro. Both the rack and recorder were refurbished to the current specifications. After checkout of the DAR and the recorder, the entire DAS was shipped to Green Bank in January.

VLBA Correlator

Our custom integrated circuit chips in the VLBA correlator have been failing at a rate higher than expected. There is a definite correlation between elevated operating temperatures and increased failure rate. LSI Logic has subjected a total of ten failed VLBA1 chips to test vector evaluation and verified nine of the ten as failing. They have submitted six of the nine to their failure analysis lab.

An additional five VLBA1 chips have failed in the first 12 weeks of 1995, and one spare chip was found to be bad when it was installed in place of one of the failed chips.

Engineering and Services Division started installing dedicated cooling units to provide lower temperatures inside the correlator, which should reduce the chip failure rate.

VLBA Site Maintenance and Inspection Visits

A maintenance/inspection team of eight New Mexico based staff visited the St. Croix VLBA station during the week of 27 February. This team, representing mechanical, servo, HVAC, cryogenics, and electronics, spent seven days performing equipment upgrades, performance tests, preventive maintenance, and overall station inspections. In addition, they replaced the subreflector, 50/90 cm dipole feed, and elevation drive motor #1.

Interference Protection

Development of an on-line interference monitoring spectrum analyzer for the VLA continued. The first phase of development allows data retrieval and display at the AOC using the zia command ~vlarfi/if.monitor/bin/plotif MMDDhhmm.tYY, which transfers a postscript file to the user's directory, and on command will perform a screen plot via Tektronix graphic. 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. We also assisted in preparing formal comments by NRAO on the FCC proposed rule making to enhance protection of Channel 37 (611 MHz) from adjacent TV Channels 36 and 38.

L. OBSERVATORY COMPUTING AND AIPS

During the past quarter significant organizational changes were made in Computing at the Observatory. First, the AIPS++ project has been split out as a separate activity, with a new, full-time project manager at the Assistant Director level taking over. This change emphasizes the importance to the Observatory of AIPS++ and strengthens the project. Details on the AIPS++ project are discussed in a separate section. Second, computing activities at Charlottesville have been streamlined organizationally, partially in response to the changes in the AIPS++ project. The Observatory continues to support the AIPS package and the UniPOPS packages, although the latter is receiving limited support.

The stringent limitations on computing resources at the Observatory remain a concern, and will require careful planning during the coming months. The 1995 budget for computing RE is only sufficient to cover the most critical requirements.

NRAO will be the principal local host for the 1996 Astronomical Data Analysis Software and Systems conference, which will be held in Charlottesville in the fall of 1996. This is an international conference of software developers and users in the astronomical community. Initial planning is starting now.

By 21 March 1995, the 15JAN95 release of "Classic AIPS" had been shipped to 73 institutions, 34 by magnetic tape and 39 by electronic copies. With this release, we offer a full binary copy of AIPS on tape and over the Internet. The full binary version was shipped on 28 of the magnetic tapes and 14 of the electronic copies. The binary versions are currently available for SunOS, Solaris (Sun), AIX (IBM), OSF/1 (DEC Alpha), Linux (PCS), SGI, and Hewlett-Packard (HP-UX). At the end of this quarter, Phil Diamond left the AIPS group in Socorro to help manage the VLBA project. This leaves a serious hole in our manpower and expertise for developing VLBA-related software.

The re-write of the AIPS CookBook continued at a slower pace during the quarter. A new VLBI data reduction chapter was completed, and changes to the imaging and analysis chapters were begun. 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).

The most significant change in AIPS during the quarter was the release of the new imaging task IMAGR. Using the object-oriented software package in AIPS, this task implements a wide range of data weighting options including a "robust weighting" scheme to temper the effects of uniform weighting. IMAGR also uses improved gridding and gridded model subtraction routines and uses a new interactive TV display option. The latter is done with a menu approach allowing the user to view all fields being imaged with enhancements as needed and to reset the Clean boxes/circles of each field interactively. IMAGR implements all of the wide-field, wide-bandwidth options of WFCLN as well. It is intended to replace all previous imaging tasks except SCMAP (which will get many of these enhancements during the next quarter).

The package of VLB-related software also received numerous corrections and enhancements. A new task was written to use auto-correlation data to estimate corrections to cross-correlation spectra due to errors in sampler thresholds. Another new task was written to convert external amplitude calibration text files to entries in AIPS calibration tables. The VLBA-data reading task (FITLD) was given new powers to correct the data for a variety of "digital" correlator effects. The tasks to fit for multi-band delays and to convert to the Haystack fringe-fit format (allowing use of the Goddard CALC/SOLVE package) were improved.

In addition to the new OOP TV object, many of the display tasks were improved. In particular, the multi-panel contour task (KNTR) was given the ability to display a grey-scale image or cube as well. The polarization display task PCNTR was given the ability to convert Q and U polarizations on-the-fly and all display tasks now allow the user to control the type and degree of labeling. The difficulty of removing all bugs in code was illustrated by the discovery of a non-trivial bug in one of the oldest and most basic disk I/O routines. The bug was not stimulated by "normal" usage, but the needs of OOP code did bring it out. Basic bugs in the POPS compiler and in the VLA-data reading task were also repaired.

M. AIPS++

The AIPS++ Project is in the midst of large upheavals. Both NRAO and the AIPS++ consortium are strongly committed to the continuation of the AIPS++ Project. However, as was clear from the Project review conducted in December 1994, substantial changes in management are required. Within NRAO, the Project will be treated as a construction project with budget and manpower separate from other parts of the Observatory. Tim Cornwell was appointed AIPS++ Project Manager in mid-March. NRAO's partners in the AIPS++ consortium will continue to provide support for the development of AIPS++.

AIPS++ is an ambitious project, advancing on many different fronts at once: management of a large collaborative software project, adoption of object-oriented software methods, and a push to a new level of complexity in radio astronomical applications. In recognition of the difficulties that the project has encountered and can expect to encounter in the future, we have chosen to sharpen our focus to a few simple short-term goals. We will endeavor to test and validate the infrastructure library code by building two to three applications, one in single dish processing and one or two in interferometric imaging. These applications will be chosen to test a wide range of infrastructure capabilities. We hesitate to give time-scales at this early stage of the re-organization but this phase may be expected to last a year or more. Once the viability of the infrastructure library has been demonstrated in this way, other more complex applications will be added. The strategy is to first build unique applications and to then expand out to completeness.

Part of NRAO's work will shift to being located in Socorro, directed at the infrastructure code and applications for interferometric imaging. Development of single dish capabilities will continue in Charlottesville and Green Bank. In the short-term, there will be less emphasis on the utilization of manpower at the non-NRAO consortium sites.

N. SOCORRO COMPUTING

Because of changes in the administration of New Mexico's regional Internet provider, in mid-1995, the state of New Mexico's Internet connections will be taken over by various groups located in Albuquerque and Las Cruces. We anticipate the possibility of disruptions in service during the first six months of the year while the transition takes place. As part of the change, the primary gateway to and from New Mexico is now through ANSnet rather than the old NSFnet backbone.

On March 22, a Request For Quotation was issued for the purchase of twenty-eight high-speed SCSI disks for our high-end IBM RS/6000 systems, which are primarily used for reduction of large VLBA datasets. Bids are due April 6. Depending on delivery

schedules, the upgrade should be complete by summer. By retaining the current design of distributed independent disks, and simply replacing the existing disks with these high-speed models on Fast-Wide SCSI buses, we can obtain I/O throughput two to three times greater than what we now see. This should have a very favorable impact on I/O-bound AIPS tasks, and thus reduce the (currently lengthy) waiting period for time on these systems. The existing disks will be redistributed to a number of Sun workstations where more space is desperately needed.

During 1995, we plan to upgrade a number of our existing SPARCStations with the Weitek CPU chip, which provides up to twice the performance as compared to the native Sun processor. This will allow these workstations, most of which are at least three years old, to be useful for a longer time in the future. However, aside from a few reservable public systems, funding does not permit full-scale upgrades with newer, faster computers such as SPARCstation 20s. This is already a serious problem and will become even more serious in the future.

In mid-February our copy of Sun's Solaris 2.4 operating system arrived and is now being tested. The upgrade of all NRAO-NM SPARCstations requires that completely new installation/upgrade procedures be adopted, and development is proceeding in this area. We anticipate this will be ready to use on a large-scale basis by the end of April. Solaris 2.4 provides major improvements in performance over the previous release.

VLA Online

The necessary equipment was purchased to allow all of the online computers to be on the VLA ethernet. The same purchase has also allowed us to use generic SCSI discs to replace the aged disc drives currently used. Work continues to allow the operators easy access to the Modcomps through the network.

Support has been added for the final Q-band system. This includes both the mechanical aspect of making the array work at a new frequency and the invention of a new "referenced pointing" mode. This is needed to help correct for the poor (at 45 GHz) open loop pointing of the VLA antennas. Reference pointing can also be used to advantage for 1 cm observing. Much fine-tuning has been done and remains to be done in order to use VLA antennas to their full potential at Q-band.

Significant changes and additions were made to the online system to allow the 21 cm All Sky Survey. As a side effect, we now have an easily extendable mechanism to carry out mosaiced observations. A collection of phase centers may be successively observed without incurring the overhead of a source change for each pointing.

Design work has begun for the replacement of the correlator controller and associated array processor. It is anticipated that this will consume much of our effort for the next year.

We have been, with the help of the operators, assessing the needs and problems of operations staff. The result will appear in the short term in simple changes to make the operator's task smoother and more foolproof. In the long term, what we have learned will be applied to the design of the next generation of the VLA control system.

VLA Archive

The VLA archive database browser was officially released. The database contents can be inspected online through mosaic, and are accessible on the NRAO home page. It allows querying the VLA database using various user-supplied criteria. The program will display a full list of all observations satisfying the selection criteria. The user can click on an item in this list to obtain a more detailed view of the header information for that particular observation.

The database is a product of the tape archiving project, in which all VLA data are converted to the current data format and copied to high density Exabyte tape. To date, all observations from 1976 to 1983 and those from 1992 to present have been converted; therefore, the VLA archive database is complete for these years only. At the current rate it will take several more years before the whole history of VLA observing is available this way. Currently data from 1991 are being converted and their header information is being added to the VLA database. There is a feedback mechanism which automatically sends comments and suggestions to the responsible support staff.

O. VLBA OPERATIONAL STATUS

During the first quarter of 1995, a total of 58 projects was correlated (41 VLBA, 8 Tests and 9 Global). The current throughput is a little better than that achieved in the last quarter of 1994. The lack of a significant increase in throughput is caused by the range of problems encountered tackling the backlog of global projects. The need for clock searches, the different flavors of log files and sometimes the poor recording quality at some antennas make this labor intensive. These problems notwithstanding, we have now reached the oldest problem-free project dating from November 1992. The remaining 22 MkIII projects require correlator modes (such as sub-arraying, handling of short scans and handling Mode C logs) that are not yet implemented. There is essentially no backlog for VLBA (+VLA) only observations. Global projects recorded from January 1, 1995 are being treated in the same manner as VLBA only projects and are correlated in chronological order.

As the rewrite of the correlator software continues, we are seeing the effects of the freeze and less frequent updates in the form of a significant reduction in the rate of bugs in the code. Code updates are now performed under carefully controlled circumstances with heavily tested code and we are seeing a marked decrease in the number of projects that require recorrelation. The ultimate goals of the rewrite project (expected to be completed later this year) are both scientific, including support for narrowband (< 250 kHz) and sub-array observations, and technical, providing a more secure basis for the development of additional capabilities in future phases.

About 40 percent of the final shipment of thin tapes has been received, inspected, and transferred to self-packing reels. The remainder of the thin tapes will be received and transferred in the second quarter of this year. The VLBA was scheduled for 60 percent of the time during March. The amount of astronomical observing will be increased during the next quarter as both the suppluy of thin tapes increases and the efficiency of the VLBA correlator improves.

P. GREEN BANK TELESCOPE PROJECT

Antenna

At the GBT site, COMSAT/RSI's main thrust has been continued trial erection of the elevation box and shaft. Work was slowed recently due to a question which arose over the joint fabrication and welding. Following a thorough review and analysis, the problem is solved and work again is moving ahead. Preparations are being made to lift the elevation shaft onto the alidade in April. In the fabrication shop, CRSI has continued fabrication of the main reflector panels, frames, and details and has completed testing of the impact of using powder paint on the panel manufacturing accuracy. Fabrication has begun on the horizontal and upper vertical feed arm joints as well as the upper feed arm beams. Fabrication of the subreflector continues.

Open Loop Active Surface

Actuator assembly tests revealed that grease could migrate into the actuator motor. During this period, supplies and tools necessary to remove the excess grease from the motors were either purchased or fabricated. A production line to remove grease was set up, and to date all actuator assemblies received have been checked out and retrofitted as necessary.

A retrofitted actuator was tested to see if grease could still migrate to the motor. The motor was run at the worst case angle for six days, at 90 degrees Farenheit no grease migrated towards the motor. Based on this test a decision was made to replace the bearing in the motor with a sealed bearing only on those motors that have to be opened to be degreased.

The Actuator Room, which will house actuator controls on the GBT is now available to NRAO for installation of equipment. Plans are to install mechanical and electrical equipment while the building is on the ground, and wait until the building is on the telescope and properly climate-controlled before installation of electronics. This period, the control rack that is to be mounted in the room has been partially outfitted in the lab.

Closed Loop Active Surface

Site work has resumed on the 140 Foot Telescope ground based laser demonstration. Earthwork around the four GBT prototype monuments has been completed and the electronics equipment installation will be complete by mid-April. Monument leveling/location

calibration experiments have begun and are expected to continue to determine the long-term stability and characteristics of the prototype monument design. The in-house design of GBT shelters has proven to be more complicated than originally thought. As a result, in order to proceed with the 140 Foot Telescope demonstration, the decision has been made to improvise shelters for the demonstration.

Excellent progress has been made on the production of the mirror systems. The machine shop has completed seven units and a number of parts are complete on the remaining 13 units. The retro mounting brackets have been ordered and are expected to be complete by late second quarter. Experiments will be conducted with various retro mounting adhesives and production mounting/calibration is expected to begin early third quarter. Mounting design and location of the retrospheres has been delayed, but is expected to be complete and a purchase order issued by early third quarter. The laser diode specification has been settled and the full production of laser modulators is in the final stages of assembly and calibration. A prototype system for transmitting video from a remote frame grabber, e.g., to audit the environmental condition of the surface retroreflectors from the feed arm, has been demonstrated.

A series of optical experiments were conducted to investigate a discrepancy between the laser system and an interferometer. As a result, the optical system design has been delayed, but will take priority as the machine shop completes the mirrors and moves on to the optics stage of the system. Work is underway to develop proper calibration methods and standards for the new weather station instruments.

Servo

During this period weekly teleconferences were held to monitor the progress of the AZ/EL servo factory tests. A dry run of the tests by contractor personnel, was successful, except for a few minor problems which should be resolved shortly. The results of these tests have been reviewed. Factory testing of the AZ/EL servo software interface with NRAO and the system test took place during March.

Electronics

Possible techniques which can be used to stiffen the L-band feedhorn were considered. The best all-around technique appears to be one similar to that used in construction of the Australian Telescope and VLBA L-band feeds. That is, a sandwich consisting of rigid structural foam and a fiberglass skin epoxied to the outer surface of the horn. The details of this process are being developed.

Significant progress was made in construction of the first eight 1-8 GHz converter modules. The Converter Rack layout was finalized and assembly work began. Design of a X21 Multiplier chain for generation of the 10.5 GHz LO signal needed in the Converter Rack progressed. Work is also underway on construction of the LO Reference distribution system. Our goal is to complete the first of two Converter Racks in the second quarter for use in integration tests at the 140 Foot Telescope.

Work on the new GBT spectrometer continues. Parts for the correlator are being ordered, and selection of components for the 1.6 GHz filter modules is completed. Design work on the 100 MHz filter module is still underway.

Some stability problems in the 12-15.4 GHz front-end identified at the 140 Foot Telescope are being corrected, and installation and testing of a 25-35 GHz receiver channel in this front-end is being completed.

Design work continues on the LO Reference distribution system and the fixed 10.50 GHz LO3 source. All components for the first LO3 source have been ordered. Components for the LO Reference system are being ordered; some have been received and are being tested.

Monitor and Control

The monitor and control computers, programmers, and GBT antenna control software (the same that controls the 140 Foot Telescope) went to the contractor's facility this period to drive the GBT antenna motors through the contractor's software interfaces. On the whole the interface is sound. Modifications to the GBT software are planned to alter how some tasks are accomplished, but the basic design is acceptable.

Tests of GBT software controlling the Spectral Processor and 140 Foot Telescope antenna in conjunction for running scans continued this period.

Work continued on cleaning up, enhancing, and fully documenting the Control classes.

The Registry Manager was put in use for controlling the Timing center and weather Registries.

Work continues on the Spectral Processor and message system.

Data Analysis

During this period, maintenance and testing of the AIPS++ development installation in Green Bank continued. During 1995, GBT data analysis will depend on systems such as PV-WAVE and UniPops.

Work continued on the GBT monitor logging system with the addition of support for the timing center. Progress was made on the testing and debugging of the weather station logging. The new server and data analysis development workstation were upgraded to the Solaris 2.4 operating system.

Q. PERSONNEL

New Hires

J. Thunborg	Mechanical Engineer I	03/08/95

Terminations

W. Latter	Jansky Postdoctoral	01/19/95
D. Wood	Assoc. Scientist - Socorro Operations	03/31/95

Changes in Title

M. McKinnon	to Asst. Scientist - Green Bank Operations	01/01/95
N. Horner	to Electronics Engineer I	01/01/95
W. Schillue	to Electronics Engineer I	01/01/95
T. Folkers	to Sr. Scientific Programmer	01/01/95
R. Creager	to Sr. Scientific Programmer	01/01/95
C. Beverage	to Systems Analyst	01/01/95

Other

G. Langston	transfer Charlottesville to Green Bank	01/01/95
S. Prewitt	Leave of Absence	01/01/95
M. Balister	to Gradual Retirement (80%)	03/01/95

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