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NATIONAL RADIO ASTRONOMY OBSERVATORY

QUARTERLY REPORT

October 1, 1995 - December 31, 1995

PROPERTY OF THE U. S. GOVERNMENT
RADIO ASTRONOMY OBSERVATORY
CHARLOTTESVILLE, VA.
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A. TELESCOPE USAGE

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

	140 Foot	12 Meter	VLA	VLBA
Scheduled observing	1712.25	1747.50	1603.2	919.6
Scheduled maintenance and equipment changes	177.75	39.25	232.6	242.3
Scheduled tests and calibrations	194.00	337.75	317.2	431.8
Time lost	154.50	85.75	59.3	40.3
Actual observing	1557.75	1661.75	1543.9	879.3

B. 140 FOOT TELESCOPE OBSERVING PROGRAMS

The following continuum program was conducted during this quarter.

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

The following line programs were conducted during this quarter.

No.	Observer(s)	Program
B638	Bell, M. (NRC, Herzberg) Feldman, P. (NRC, Herzberg) Kolbuszewski, M. (Steacie, NRC)	Observations to determine if there is a chemical link between C_3H_2 and the carriers of the diffuse interstellar bands.
B639	Balser, D. Lockman, F. J. McKinnon, M.	Observations of helium, hydrogen, and carbon radio recombination lines toward pulsars.
B642	Balser, D. Rood, R. (Virginia) Bania, T. (Boston)	Ionized helium measurements in galactic HII regions.
B643	Braatz, J. (Maryland) Wilson, A. (Maryland)	Monitoring of H_2O megamasers in active galaxies.

No.	Observer(s)	Program
B646	Breen, J. (Virginia) Murphy, E. (Virginia)	Measuring accurate N_H column densities toward clusters of galaxies observed with the ROSAT PSPC.
B655	Bates, N. (Franklin WV High School)	High velocity resolution HI spectra of several face-on galaxies.
F124	Frayer, D. (Toronto) Brown, R. Vanden Bout, P.	A 12-20 GHz survey of molecular oxygen at high redshift.
H293	Haynes, M. (Cornell) Hogg, D. Maddalena, R. Roberts, M.	Evaluating galactic HI envelopes and a search for faint companions.
L273	Lockman, F. J.	HI mapping of Ursa Major.
L308	Liszt, H. Lucas, R. (IRAM)	Observations of CH emission toward extragalactic continuum sources previously studied in OH.
M385	Murphy, E. (Virginia) Lockman, F. J.	The magnetic field in galactic HI.
T348	Thuan, T. (Virginia) Martin, J-F. (Meudon)	21 cm observations of the influence of local environment on the physical properties of dwarf galaxies.
T349	Taylor, G. (Caltech) Conway, J. (Onsala) Readhead, A. (Caltech)	Search for HI absorption in radio galaxies with compact symmetric structure on the pc-scale.
V083	van Zee, L. (Cornell) Haynes, M. (Cornell) Maddalena, R.	HI observations of galaxies with extended hydrogen envelopes.
W280	Wootten, H. A.	H_2O monitoring in star-forming cores in Rho Oph.

The following pulsar programs were conducted during this quarter.

No.	Observer(s)	Program
A118	Arzoumanian, Z. (Cornell) Nice, D. Taylor, J. (Princeton) Taylor, H. (Princeton)	Bimonthly timing of 63 pulsars at 550, 810, and 1420 MHz.

No.	Observer(s)	Program
B617	Backer, D. (Calif., Berkeley) Sallmen, S. (Calif., Berkeley) Foster, R. (NRL) Matsakis, D. (NRL)	Pulsar timing array observations at 800 and 1395 MHz.
B644	Backer, D. (Calif., Berkeley) Zepka, A. (Calif., Berkeley) Sallmen, S. (Calif., Berkeley)	Pulsar flux density and pulse morphology observations at 3 GHz.
M386	McKinnon, M. Fisher, J. R.	A 1.3-1.8 GHz polarization model test and timing of young pulsar PSR B1823-13.

The following very long baseline programs were conducted.

No.	Observer(s)	Program
A120	Altunin, V. (JPL/Caltech) Migenes, V. (CSIRO) Slysh, V. (Lebedev)	OH masers VLBI survey.
BL022	Langston, G.	High resolution imaging of Einstein Ring MG1654+1346. 90 cm.
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-m Green Bank geodetic ties.

C. 12 METER TELESCOPE OBSERVING PROGRAMS

The following line programs were conducted during this quarter.

No.	Observer(s)	Program
A129	Apponi, A. (Arizona State) Ziurys, L. (Arizona State)	Evaluating the nitrogen/oxygen chemical network: additional mapping of NO and N_2O in Sgr B2.
A130	Apponi, A. (Arizona State) Ziurys, L. (Arizona State)	Re-evaluating the interstellar $[HCO^+]/[HOC^+]$ abundance ratio.

No.	Observer(s)	Program
C296	Clancy, R. T. (Colorado) Sandor, B. (Colorado)	Mars dust storm observations.
C297	Cappa de Nico, C. (IAR) Carey, S. (Hanscom/AFGL) Kutner, M. Mead, K.	CO observations around NGC 6888.
D187	Dayal, A. (Arizona) Bieging, J. (Arizona)	CO observations of young planetary and proto-planetary nebulae.
E61	Evans, A. (Hawaii), Sanders, D. (Hawaii) Mazzarella, J. (Caltech)	CO (1→0) observations of powerful radio galaxies detected by IRAS.
G345	Gensheimer, P. (MPIR, Bonn)	Search for vibrationally excited SiC_2.
G346	Gensheimer, P. (MPIR, Bonn)	Search for the HCCNC isomer of HC_3N toward IRC+10216.
G347	Glenn, J. (Arizona) Walker, C. K. (Arizona)	Continuum polarimetry of protostellar dust cores.
G348	Guélin, M. (IRAM) Ziurys, L. (Arizona State) Apponi, A. (Arizona State)	Confirmation of circumstellar ^{26}AlF: testing nucleosynthesis in AGB stars.
H313	Hogg, D. Roberts, M. Bregman, J. (Michigan)	Study of the CO distribution in the Sa galaxy NGC 3623.
H314	Hogg, D.	A search for CO associated with stellar wind bubbles.
H315	Ho, P. (CFA) Martin, R. (Arizona) Turner, J. (UCLA) Yun, S. (CFA)	A big CO map of NGC 253.
H316	Hurt, R. (Calif., Riverside) Turner, J. (UCLA) Martin, R. (Arizona)	OTF mapping of the molecular gas in the starburst galaxy Maffei 2.
I16	Irvine, W. (Massachusetts) Ohishi, M. (Nobeyama) Hjalmarson, A. (Chalmers, Onsala) Dickens, J. (Massachusetts)	Study of the hydrogenation of interstellar molecules.

No.	Observer(s)	Program
I17	Irvine, W. (Massachusetts) Dickens, J. (Massachusetts) Ohishi, M. (Nobeyama) Ziurys, L. (Arizona State) Amano, T. (NRC, Herzberg)	Confirmation of interstellar H_2COH.
J129	Jewell, P. Walker, C. (Arizona)	A study of SiO masers in evolved stars — polarization properties.
K352	Kurtz, S. (Mexico/UNAM) Lizano, S. (Mexico/UNAM)	Study of molecular flows in high mass star-forming regions.
L302	Lo, K-Y. (Illinois) Ho, P. (CFA) Steidel, C. (MIT)	Study of the molecular gas content of z ~ 0.1 to 0.3 IRAS galaxies.
L313	Latter, W. (NASA/Ames) Charnley, S. (NASA/Ames)	Study of methanol in IRC+10216.
M395	Mangum, J. (Arizona) Latter, W. (NASA/Ames) McMullin, J. (Arizona)	A derivation of the physical conditions in the Serpens molecular cloud.
M397	Mangum, J. (Arizona) Emerson, D. Emerson, C. (Cambridge) Emerson, N. (Catalina Foothills HS)	Study of CO in the Pleides.
P175	Paglione, T. (Boston) Jackson, J. (Boston) Bolatto, A. (Boston)	Study of the dense gas in the galactic center.
P178	Phillips, R. (Haystack) Beasley, A. Dhawan, V. Bower, G. (Calif., Berkeley) Backer, D. (Calif., Berkeley) Wright, M. (Calif., Berkeley) Baath, L. (Chalmers, Onsala) Booth, R. (Chalmers, Onsala) Conway, J. (Chalmers, Onsala) Rantakyro, F. (Chalmers, Onsala) Wikland, T. (Chalmers, Onsala) Perlman, E. (NASA/GSFC) Carilli, C. (CFA) Doeleman, S. (Haystack)	Millimeter VLB network studies.

No.	Observer(s)	Program
	(continued)	
	Rogers, A. (Haystack) Junor, W. (New Mexico) Biretta, J. (STScI) Krichbaum, T. (MPIR, Bonn) Witzel, A. (MPIR, Bonn) Graham, D. (MPIR, Bonn) Zensus, J. A. Grewing, M. (IRAM) Lonsdale, C. J. (Haystack) Wardle, J. (Brandeis) Roberts, D. (Brandeis)	
R262	Richter, M. (Calif., Berkeley) Graham, J. (Calif., Berkeley) Tauber, J. (ESTEC)	Comparing HCO^+ and H_2 in molecular shocks.
R263	Roberts, M. Hogg, D.	Study of the distribution of the cool interstellar gas in asymmetric isolated galaxies.
S404	Sandor, B. (Colorado) Clancy, R. T. (Colorado)	Microwave spectroscopy of Earth's atmosphere.
S405	Shen, J. (Illinois) Lo, K-Y. (Illinois) Yun, M. (CFA) Turner, J. (UCLA) Ho, P. (CFA)	CO, HCN, and HCO^+ observations of M82 and NGC 2146.
T355	Turner, B.	The sulfur chemistry of translucent molecular clouds: a proposed search for H_2S.
T357	Turner, B.	A confirmation of silanone (H_2SiO).
T358	Tielens, A. (NASA/Ames) Irvine, W. (Massachusetts) Ohishi, M. (Nobeyama) Hjalmarson, A. (Chalmers, Onsala) Dickens, J. (Massachusetts)	Study of physical conditions and carbon budget around YSOs with ice bands.
V86	van Dishoeck, E. (Leiden) Mundy, L. (Maryland) McMullin, J. (Arizona) Blake, G. (Caltech) Evans, N. (Texas)	The youngest stellar regions: the evolution of chemical morphologies.

No.	Observer(s)	Program
V87	Verdes-Montenegro, L. (IAA, Spain) Yun, M. (CFA) Perea, J. (IAA, Spain) del Olmo, A. (IAA, Spain)	Study of the molecular component of Hickson groups.
W351	Wootten, H. A. Mangum, J. (Arizona)	Study of the origin of broad formaldehyde line emission in millimeter-bright low mass star-forming regions.
W357	Womack, M. (Penn State) Stern, A. (SW Research Inst., Texas)	Study of carbon chemistry in Kuiper disk comets.
W368	Woodney, L. (Maryland) A'Hearn, M. (Maryland) Samarasinha, N. (KPNO-NOAO) McMullin, J. (Arizona) Mundy, L. (Maryland)	Observations of comet C/1995 01 (Hale-Bopp).
Y17	Yu, T. (Calif., Berkeley)	Observations of OPHB1 in the J=1-0 ^{12}CO line.
Z128	Zhao, J.-H. (SA/IAA, Taiwan) Zhou, S. (Illinois) Ho, P. (CFA) Xia, X-Y. (Tianjing U.) Deng, Z. (Beijing Obs.)	Confirmation of CO detection at z = 0.58.
Z129	Zhou, S. (Illinois) Choi, M. (Texas) Evans, N. (Texas)	A $C^{18}O$ J = 2→1 survey of selected regions in Taurus.
Z130	Ziurys, L. (Arizona State) Apponi, A. (Arizona State) Allen, M. (Arizona State)	A search for FeF in IRC+10216.
Z131	Ziurys, L. (Arizona State) Apponi, A. (Arizona State)	A search for circumstellar $MgCH_3$: constraining Mg chemistry.

D. VERY LARGE ARRAY OBSERVING PROGRAMS

Fourth Quarter, 1995 was spent in the following configurations: BnA, October 1 to October 2; B, October 2 to December 31.

No.	Observer(s)	Program
AA181	Alexander, P. (Cambridge) Green, D. (Cambridge) Clemens, M. (Cambridge)	Star-formation history in interacting galaxies NGC 4490/ NGC 4485. 3.6 cm line
AA192	Abada-Simon, M. (Utrecht) Lasota, L. (Paris Obs) Chanmugam, G. (LSU) Frank, F. (LSU)	Search for radio emission from magnetic catacysmic variable RXJ051541+01. 6 cm
AA193	Anantharamaiah, K. (Raman Institute) Roy, A. (Raman Institute) Goss, W. M. Zhao, J.-H. (SA/IAA, Taiwan)	Recombination lines from external galaxies. 20 cm line
AA194	Antonucci, R. (Calif., Santa Barbara) Barvainis, R. (Haystack) Geller, R. (Calif., Santa Barbara)	Nature of the optical/ultraviolet emission in AGN. 1.3 cm
AB628	Becker, R. (Calif., Davis) Helfand, D. (Columbia) White, R. (STScI) Perley, R.	Survey of the north galactic cap. 20 cm
AB705	Burke, B. (MIT) Becker, D. (MIT) Lehar, J. (CFA) Hewitt, J. (MIT) Roberts, D. (Brandeis)	Time delay of the gravitational lens 0957+561. 3.6, 6 cm
AB740	Baum, S. (STScI) Colbert, E. (Maryland) O'Dea, C. (STScI) Pedlar, A. (Manchester)	Three archetypical Seyferts: MKN 6, NGC 3079, MKN 231. 6 cm
AB759	Browne, I. (Manchester) Wilkinson, P. (Manchester) Sykes, C.(Manchester)	Ring and halo in the gravitational lens B0218+357. 20 cm

No.	Observer(s)	Program
AB760	Browne, I. (Manchester) Wilkinson, P. (Manchester) Sykes, C. (Manchester) Muxlow, T. (Manchester) Jackson, N. (Manchester) Myers, S. (Caltech) Fassnacht, C. (Caltech) Readhead, A. (Caltech) Pearson, T. (Caltech) de Bruyn, A. (NFRA) Snellen, I. (Leiden)	Deep imaging of the new quadruple lensed system 1608+656. 1.3, 2, 3.6, 6, 20 cm
AB764	Bujarrabal, V. (Yebes Obs) Alcolea, J. (Yebes Obs)	Radio continuum observations of M1-92, the Minkowski's Footprint. 3.6, 6, 20 cm
AB766	Blundell, K. (Oxford) Rawlings, S. (Oxford) Lacy, M. (Oxford) Littlewood, C. (Oxford) Willott, C. (Oxford) Serjeant, S. (Oxford)	The evolution of radio quasars and their environments from z = 0.5-3. 3.6, 6, 20 cm
AB767	Bloemhof, E. (Arizona) Gwinn, C. (Calif., Santa Barbara) Danen, R. (Calif., Santa Barbara)	High spatial resolution observations of the LkH 101 wind. 1.3 cm
AC420	Carilli, C. (CFA) Rottgering, H. (Cambridge) Best, P. (Cambridge) Owen, F.	Two classic "alignment effect" high-z radio galaxies. 3.6, 6, 20 cm
AC429	Cowan, J. (Oklahoma) Branch, D. (Oklahoma)	Search for extragalactic intermediate age supernovae. 6 cm
AC437	Curiel, S. (CFA) Eiroa, C. (Madrid Obs) Canto, J. (Mexico/UNAM)	Circumstellar disk structures around very young stellar objects. 0.7, 1.3, 3.6 cm
AC441	Cotton, W. Swain, M. (Rochester) Bridle, A. Kassim, N. (NRL)	J2146+82 – large radio galaxy with misaligned outbursts? 90 cm

No.	Observer(s)	Program
AC442	Conner, S. (MIT) Garnavich, P. (CFA) Turner, E. (Princeton) Schechter, P. (CFA) Burke, B. (MIT)	New gravitational lens candidates from the MIT-Green Bank-VLA survey. 2 cm
AC443	Chernin, L. (Calif., Berkeley)	Water masers in protostellar outflows. 1.3 cm line
AC445	Clarke, T. (Toronto) Kronberg, P. (Toronto) Bohringer, H. (MPIfEP, Garching)	Polarization observations of radio sources through Abell clusters. 3.6, 20 cm
AC446	Chandler, C. Koerner, D. (JPL) Sargent, A. (Caltech)	Resolving disk structure in HH 24MMS. 0.7 cm
AC451	Carilli, C. (CFA) Womble, D. (San Diego State) Sargent, W. (Caltech)	HI 21 cm absorption towards 0959+682 by tidal debris in the M81 group. 20 cm line
AC452	Chen, H. (CFA) Zhao, J.-H. (SA/IAA, Taiwan)	Direct imaging of circumstellar disk around L1641N. 0.7, 1.3 cm
AD365	Duric, N. (New Mexico) Perley, R. Kassim, N. (NRL)	75 MHz observations of galactic supernova remnant W49B. 90 cm
AD369	Danner, R. (Caltech) Kulkarni, S. (Caltech)	Soft X-ray sources in high galactic latitude clouds. 6, 20 cm
AD370	Dallacasa, D. (NFRA) Feretti, L. (Bologna) Giovannini, G. (Bologna) Klein, U. (Bonn U.)	Probing the cluster magnetic field in Abell 119. 3.6, 6, 20 cm
AD372	DePree, C. (North Carolina)	Unusual source in NGC 6951. 2 cm
AE097	Eilek, J. (NMIMT) Loken, C. (New Mexico State) Owen, F.	The ends of type I radio tails. 90 cm
AF294	Frail, D. Kulkarni, S. (Caltech) Vasisht, G. (Caltech)	High resolution imaging of the soft gamma ray repeater SGR 1806-02: the second epoch. 6, 3.6 cm

No.	Observer(s)	Program
AF296	Fiebig, D. (Heidelberg Obs) Papkalla, R. (Heidelberg Obs)	Search for H_20 maser emission from protostellar disks. 1.3 cm line
AF297	Fey, A. (USNO) Kassim, N. (NRL)	Low frequency observations of the Cygnus region. 90 cm
AG448	Greenhill, L. (CFA) Henkel, C. (MPIR, Bonn)	Monitoring the acceleration of water megamaser features in NGC 4258. 1.3 cm line
AG449	Gizani, N. (Manchester) Leahy, J.P. (Manchester) Garrington, S. (Manchester) Perley, R.	Faraday rotation in Hercules A. 3.6, 20 cm
AG450	Green, D. (Cambridge) Cowan, J. (Oklahoma)	Search for young galactic SNRs: a follow up. 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
AH551	Ho, L. (Calif., Berkeley) Van Dyk, S. (Calif., Berkeley)	Survey of nearby galactic nuclei. 3.6, 6 cm
AH556	Han, J. (Beijing Obs) Beck, R. (MPIR, Bonn) Berkhuijsen, E. (MPIR, Bonn)	Halo of M31. 20 cm
AH559	Ho, L. (Calif., Berkeley) Van Dyk, S. (Calif., Berkeley)	The nature of low luminosity active galactic nuclei. 3.6 cm
AH560	Hankins, T. (NMIMT) Moffett, D. (NMIMT) Shrauner, J. (Princeton) Taylor, J. (Princeton) Thorsett, S. (Princeton)	Search for strong pulses from PSR B1937+214. 6, 20, 90 cm
AH561	Henkel, C. (MPIR, Bonn) Gaume, R. (USNO) Fey, A. (USNO) Braatz, J. (Maryland) Wilson, A. (STScI)	Study of the H_20 masers in IC 1481. 1.3 cm line

No.	Observer(s)	Program
AH565	Herrnstein, J. (CFA) Blackman, E. (CFA) Moran, J. (CFA) Greenhill, L. (CFA) Diamond, P.	Polarmetric observations of the masing molecular disk in NGC 4258. 1.3 cm line
AH566	Ho, P. (CFA) Lo, K.-Y. (Illinois)	High velocity H_2O masers toward the galactic center. 1.3 cm line
AH567	Ho, P. (CFA) Wilner, D. (CFA)	Continuum mapping of HL Tau. 0.7 cm
AH568	Harvanek, M. (Colorado/JILA) Stocke, J. (Colorado/JILA)	Distant 3CR radio galaxies at z = 0.15-0.65. 20 cm
AJ250	Jackson, N. (Manchester) Bremer, M. (Leiden) Roland, J. (IAP, Paris)	Completion of an unbiased sample of radio sources. 6 cm
AK368	Kaufman, M. (Ohio State) Brinks, E. Elmegreen, B. (IBM) Elmegreen, D. (Vassar College) Struck-Marcell, C. (Iowa State)	Radio continuum observations of ocular and caustic galaxies. 20 cm
AK376	Kulkarni, S. (Caltech) Frail, D.	Search for the radio counterparts of gamma ray bursters.
AK403	deKoff, S. (STScI) Biretta, J. (STScI) Baum, S. (STScI) Sparks, W. (STScI) Miley, G. (Leiden) Macchetto, D. (STScI)	HST/VLA snap-shot survey of 3CR radio galaxies. 2, 3.6 cm
AK410	Knopp, G. (Hawaii) Chambers, K. (Hawaii)	High redshift radio galaxies – morphology and polarization. 6 cm
AK413	Kassim, N. (NRL) Perley, R. Erickson, W. (Maryland)	74 MHz observations of strong sources – large angular size objects. 90 cm
AK414	Kronberg, P. (Toronto) Allen, M. (Toronto)	High resolution radio spectral index studies of the nucleus of M82. 3.6 cm

No.	Observer(s)	Program
AK416	Keane, M. (KPNO-NOAO)	Deep, multi-frequency imaging of PKS 2349-014. 2, 3.6, 6, 20 cm
AK417	Koerner, D. (JPL) Chandler, C. Sargent, A. (Caltech)	Radial structure and dust properties of circumstellar disks. 0.7, 1.3, 3.6 cm
AK418	Koerner, D. (JPL) Jensen, E. (Wisconsin) Mathieu, R. (Wisconsin)	Circumstellar disks in the pre-main sequence binary environment. 0.7, 1.3, 3.6 cm
AK419	Keane, M. (KPNO-NOAO)	A new sample of southern compact groups. 20 cm
AK420	Kollgaard, R. (Penn State) Ghisellini, G. (Torino) Maraschi, M. (Genova U.) Pesce, J. (STScI) Sambruna, R. (STScI) Urry, C. (STScI)	Multifrequency monitoring of blazars. 1.3, 2, 3.6, 6, 20 cm
AL353	Ludke, E. (UFSM, Brazil)	Faraday effect in CSS sources. 1.3 cm
AL364	Leitch, E. (Caltech) Myers, S. (Caltech) Readhead, A. (Caltech)	Point source contaminants in the OVRO microwave background fields. 0.7, 1.3, 2, 3.6 cm
AL366	Lacy, M. (Oxford) Blundell, K. (Oxford)	A search for remnant hotspots in radio-quiet quasar E1821+643. 90 cm
AL367	Lehnert, M. (LLNL) Gregg, M. (LLNL)	High resolution observations of many highly polarized sources. 6 cm
AL368	Lara, L. (Bologna) Cotton, W. Feretti, L. (Bologna) Giovannini, G. (Bologna) Marcaide, J. (Valencia) Venturi, T. (Bologna)	Large angular size radio sources from the NRAO VLA Sky Survey. 6, 20 cm
AL369	Lopez, J. (Mexico/UNAM) Vazquez, R. (Mexico/UNAM) Rodriguez, L. (Mexico/UNAM)	Imaging of the remarkable planetary nebula KjPn 8. 3.6, 6 cm
AL381	Lundgren, S. (NRL)	Candidate for EGRET source 2EG0431+2910. 6 cm
AL382	Lestrade, J.-F. (Meudon)	Search for emission from 51 Peg. 3.6 cm

No.	Observer(s)	Program
AM490	Muxlow, T. (Manchester) Pedlar, A. (Manchester) Wilkinson, P. (Manchester) Axon, D. (STScI)	Combined 5 GHz VLA-MERLIN image of starburst activity in M82. 6 cm
AM499	Morrison, G. (New Mexico) Owen, F.	Imaging the two most extreme Butcher-Oemler clusters. 20 cm
AM500	Marti, J. (Barcelona) Paredes, J. (Barcelona) Peracaula, M. (Barcelona)	The Cygnus X-3 extended radio emission. 3.6, 6 cm
AM502	Muhleman, D. (Caltech) Grossman, A. (Maryland) Slade, M. (JPL) Butler, B.	Titan polarization and mapping radar measurements. 3.6 cm line
AM503	Moffett, D. (NMIMT) Hankins, T. (NMIMT)	Crab pulsar polarization at high radio frequencies. 3.6, 6, 20 cm
AM504	McHardy, I. (Southampton) Lehto, H. (Turku) Newsam, A. (Southampton)	Cosmic soft X-ray background and sub-millijansky radio sources: are they the same? 20 cm
AM505	Molnar, L. (Iowa) Fix, J. (Iowa) Dunn, D. (Iowa)	Thermal emission of Saturn's rings at Saturn equinox. 0.7, 2 cm
AM507	Mundell, C. (Manchester) Pedlar, A. (Manchester) Meaburn, J. (Manchester) Kukula, M. (Liverpool JMU) Axon, D. (STScI)	B Configuration observations of HI in NGC 3227. 20 cm line
AO123	O'Donaghue, A. (St. Lawrence U.) Eilek, J. (NMIMT) Owen, F.	Examining the morphological and dynamical basis for FRI/FRII boundary. 6 cm
AP296	Preston, R. (JPL) Folkner, W. (JPL)	Earth based observation of Galileo probe for Jupiter wind estimation. 3.6 cm
AP302	Pooley, G. (Cambridge) Hardcastle, M. (Cambridge) Alexander, P. (Cambridge) Riley, J. (Cambridge)	Jets in nearby FRI radio galaxies. 3.6, 20 cm

No.	Observer(s)	Program
AP325	Prins, S. (Amsterdam) Magnier, E. (Amsterdam) Fox, D. (MIT) Lewin, W. (MIT) van Paradijs, J. (Amsterdam)	Observations of SNRs in M31. 90 cm
AP326	Perley, R. Kronberg, P. (Toronto) Reid, R. (Toronto) Dyer, C. (Toronto) Roser, H.-J. (MPIA, Heidelberg)	Southern candidates for gravitational lensing of radio jets. 3.6 cm
AP327	de Pater, I. (Calif., Berkeley) Grossman, A. (Maryland)	Jupiter at the time of the Galileo probe entry. 2, 3.6, 6, 20 cm
AR334	Roser, H.-J. (MPIA, Heidelberg) Perley, R. Meisenheimer, K. (Royal Obs)	High frequency mapping of the jet of 3C 273. 0.7, 1.3, 2, 3.6, 6 cm
AR335	Rawlings, S. (Oxford) Lacy, M. (Oxford) Blundell, K. (Oxford) Serjeant, S. (Oxford)	An HST sample of quasars at $0.5 < z < 0.7$. 3.6, 6, 20 cm
AS516	Shaver, P. (ESO) Wall, J. (RGO) Kellermann, K.	Accurate positions of unidentified flat-spectrum Parkes sources. 3.6 cm
AS561	Stockton, A. (Hawaii) Ridgeway, S. (Hawaii)	Radio-optical survey of a complete z ~1 3CR sample of galaxies. 6 cm
AS566	Saripalli, L. (NAO, Japan) Patnaik, A. (MPIR, Bonn)	Study of a sample of flat-spectrum radio galaxies. 20 cm
AS568	Sramek, R. Weiler, K. (NRL) Van Dyk, S. (Calif., Berkeley) Panagia, N. (STScI)	Properties of radio supernovae. 1.3, 2, 3.6, 6, 20 cm
AS569	Skinner, S. (Colorado/JILA) Nagase, F. (ISAS, Japan) Itoh, M. (ISAS, Japan)	The unusual Wolf-Rayet star WR 147. 1.3, 2, 3.6, 6, 20 cm
AS571	Strelnitski, V. (NMIMT) Goss, W. M. DePree, C. (North Carolina)	High resolution imaging of G34.26+0.15 in H52α. 0.7, 1.3 cm line

No.	Observer(s)	Program
AS572	Saikia, D. (NCRA, India)	Mildly active galaxies with nuclear radio rings and spirals. 2, 3.6 cm
AS573	Saikia, D. (NCRA, India) Jeyakumar, S. (NCRA, India) Thomasson, P. (Manchester)	Three highly distorted compact steep-spectrum radio galaxies. 2, 3.6 cm
AS574	Seaquist, E. (Toronto)	A possible protogalaxy. 3.6 cm
AS575	Simon, L. (Iowa) Higdon, J. (CSIRO)	Ring galaxy Arp 141. 20 cm line
AT184	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
AT185	Thornley, M. (Maryland) Mundy, L. (Maryland)	Cold gas on sub-kiloparsec scales in nearby flocculent galaxies. 20 cm line
AV219	Vine, S. (Cambridge) Thomson, R. (Cambridge) Gilmore, G. (Cambridge) Lewis, J. (RGO) Wyse, R. (Johns Hopkins) Higdon, J. (CSIRO)	HI velocity field mapping of bulgeless, edge-on disk galaxies. 20 cm line
AW404	Wilcots, E. (Wisconsin) Hodge, P. (Washington)	HI study of nearby irregular IC 1613. 20 cm line
AW417	Willner, S. (CFA)	Structure of HII regions in M33. 6 cm
AW419	Watson, A. (Lowell Obs) Cox, A. (Wisconsin) Wilcots, E. (Wisconsin)	Sub-arcsecond imaging of nuclear starbursts. 2, 6 cm
AW420	Wannier, P. (JPL) Stapelfeldt, K. (JPL) Sahai, R. (JPL) Koerner, D. (JPL) Werner, M. (JPL) Trauger, J. (JPL)	Protostellar disks in bright HII regions. 3.6 cm
AW421	Wallin, J. (George Mason) Higdon, J. (CSIRO)	HI observations of two interacting ring galaxies. 20 cm line

No.	Observer(s)	Program
AW422	Wilner, D. (CFA) Dickel, H. (Illinois) Welch, W. J. (Calif., Berkeley)	Line and continuum mapping of W49A North. 0.7 cm line
AW423	Willson, R. (Tufts) Lang, K. (Tufts) Kile, J. (Tufts) Gelfreikh, G. (Pulkovo Obs) Bogod, V. (Pulkovo Obs)	Collaborative VLA observations of the sun. 6, 20, 90 cm
AY072	Young, L. (Illinois) Lo, K.-Y. (Illinois),	HI in the dwarf irregular galaxy Leo A. 20 cm line
AZ074	van Zee, L. (Cornell) Haynes, M. (Cornell) Salzer, J. (Wesleyan U.) Westpfahl, D. (NMIMT)	HI in the star forming regions in IZw18. 20 cm line
AZ075	Zhang, Q. (CFA) Ho, P. (CFA)	Contracting molecular cloud cores. 1.3 cm line

E. VERY LONG BASELINE ARRAY OBSERVING PROGRAMS

No.	Observer(s)	Program
BA011	Alberdi, A. (ESA, Spain) Lara, L. (Bologna) Marcaide, J. (Valencia) Kemball, A. Patnaik, A. (MPIR, Bonn) Porcas, R. (MPIR, Bonn) Pauliny-Toth, I. (MPIR, Bonn)	Polarization sensitive VLBI measurements of 3C 454.3 and 3C 395. 2, 3.6 cm
BA012	Alberdi, A. (ESA, Spain) Marcaide, J. (Valencia) Marscher, A. (Boston) Gomez, J. (Boston) Kemball, A.	Dual polarization observations of the superluminal 4C 29.25. 1.3, 2 cm
BA014	Aaron, S. (Brandeis) Wardle, J. (Brandeis) Roberts, D. (Brandeis)	Polarization and spectral index mapping of the CSS quasar 3C 309.1. 2, 3.6 cm

No.	Observer(s)	Program
BB043	Beasley, A. Bastian, T. Niell, A. (Haystack)	High-frequency VLBA observations of AE Aqr. 1.3 cm with phased VLA
BB045	Benz, A. (SFIT, ETH) Conway, J. (Chalmers, Onsala) Alef, W. (MPIR, Bonn) Gudel, M. (SFIT, ETH)	VLBA observations of nearby dMe stars. 3.6 cm with phased VLA
BB048	Bondi, M. (Manchester) Dallacasa, D. (NFRA) Marcha, M. (Lisbon) Stanghellini, C. (CNR/IRA-Frascati)	Flat spectrum radio galaxies. 6 cm
BB049	Beasley, A. Bastian, T.	Orbital monitoring of HR 1099 and UX ARi. 3.6 cm
BB052	Bartel, N. (York U.) Sorathia, B. (York U.) Bietenholz, M. (York U.) Carilli, C. (CFA) Diamond, P.	Nuclear jet and counterjet in Cygnus A. 1.3, 6 cm
BB054	Bower, G. (Calif., Berkeley) Backer, D. (Calif., Berkeley)	Multi-frequency polarimetry of 3C 454.3. 1.3, 3.6 cm
BC046	Claussen, M. Braatz, J. (Maryland) Diamond, P. Wilson, A. (STScI) Henkel, C. (MPIR, Bonn)	Water masers in the elliptical galaxy NGC 1052. 1.3 cm with phased VLA
BC047	Coles, B. (Calif., San Diego) Grall, R. (Calif., San Diego) Klinglesmith, M. (Calif., San Diego)	Interplanetary scintillation measurements of the solar wind speed. 2, 3.6 cm

No.	Observer(s)	Program
BC048	Clark, T. (NASA/GSFC) Ryan, J. (NASA/GSFC) Ma, C. (NASA/GSFC) Vandenberg, N. (Interferometrics) Gipson, J. (Interferometrics) Himwich, W. (Interferometrics) MacMillan, D. (Interferometrics) Potash, R. (Interferometrics) Gordon, D. (NASA/GSFC) Neill, A. (Haystack) Corey, B. (Haystack) Rogers, A. (Haystack) Eubanks, T. (USNO) Fomalont, E. Walker, R.C.	Revised:NASA space geodesy program observations for June-December, 1995. 3.6 cm
BC051	Cotton, W. Feretti, L. (Bologna) Giovannini, G. (Bologna) Lara, L. (Bologna) Ventura, T. (Bologna) Marcaide, J. (Valencia)	VLBA polarization observations of NGC 315. 6 cm with phased VLA
BD023	Denn, G. (Iowa) Mutel, R. (Iowa)	Monitoring BL Lac, with polarization. 1.3, 2, 3.6 cm
BD027	Diamond, P. Kemball, A.	Multi-epoch observations of stellar SiO masers. 0.7 cm with single VLA antenna
BE006	Eubanks, T. (USNO) Archinal, B. (USNO) Beasley, A. Fomalont, E. Walker, R. C. Napier, P.	Two centimeter astrometric survey; proof of concept. 3.6 cm
BF012	Fey, A. (USNO) Johnston, K. (USNO) Fomalont, E. Eubanks, M. (USNO)	Astrometric observations for the radio reference frame. 3.6 cm
BF016	Frail, D. van Langevelde, H. (NFRA)	Extragalactic scattering in galaxy/quasar pairs. 18, 90 cm

No.	Observer(s)	Program
BG015	Greenhill, L. (CFA) Diamond, P. Gwinn, C. (Calif., Santa Barbara) Moran, J. (CFA)	Tracing the dynamics of a protoplanetary disk. 1.3 cm
BG041	Geldzahler, B. (George Mason) Kafatos, B. (George Mason) Hollis, J.M. (NASA/GSFC) Bradshaw, C. (George Mason) Pedelty, J. (NASA/GSFC)	High resolution observations of the symbiotic star R Aqr. 6 cm with phased VLA
BG045	Greenhill, L. (CFA) Moran, J. (CFA) Danchi, W. (Calif., Berkeley) Bester, M. (Calif., Berkeley)	Snapshot survey of SiO maser stars at maximum and minimum luminosity. 0.7 cm with singleVLA antenna
BG046	Greenhill, L. (CFA) Braatz, J. (Maryland) Wilson, A. (STScI) Moran, J. (CFA) Herrnstein, J. (CFA) Claussen, M.	The water maser in the Seyfert NGC 1386. 1.3 cm with phased VLA
BG047	Greenhill, L. (CFA) Koekemoer, A. (Mt. Stromlo) Gwinn, C. (Calif., Santa Barbara) Moran, J. (CFA) Herrnstein, J. (CFA) Henkel, C. (MPIR, Bonn) van Breugel, W. (LLNL) Dey, A. (LLNL)	Ultraluminous water maser emission in an early-type galaxy at 100 Mpc. 1.3 cm with phased VLA
BH010	Hewitt, J. (MIT) Haarsma, D. (MIT) Katz, C. (MIT) Moore, C. (MIT) Trotter, C. (MIT)	Gravitational lens monitoring with the VLBA. 3.6, 18 cm
BH012	Hough, D. (Trinity U.) Zensus, J. A. Porcas, R. (MPIR, Bonn)	The lobe-dominated superluminal 3C 263. 2, 3.6, 6 cm
BJ020	Junor, B. (New Mexico) Biretta, J. (STScI) Wardle, J. (Brandeis)	VLBA 6, 4 cm polarimetry of Vir A.

No.	Observer(s)	Program
BK034	Krichbaum, T. (MPIR, Bonn) Britzen, S. (MPIR, Bonn) Witzel, A. (MPIR, Bonn) Zensus, J. A.	Monitoring of 0528+134 after a millimeter outburst. 1.3 cm
BK036	Kemball, A.	Polarization survey. 0.7 cm
BK037	Kellermann, K. Zensus, J. A. Cohen, M. (Caltech) Vermeulen, R. (Caltech)	Monitoring superluminal sources. 2 cm
BL020	Ludke, E. (UFSM, Brazil) Sanghera, H. (NFRA) Cotton, W.	Resolving Faraday effects in CSS jets. 6 cm
BL022	Langston, G.	High resolution imaging of Einstein Ring MG1654+1346. 90 cm with Green Bank
BL024	Lazio, T. (Cornell) Cordes, J. (Cornell)	Search for angular broadening in the galactic anticenter. 90 cm with phased VLA
BL026	Lobanov, A. (Lebedev) Zensus, J. A.	Relativistic shocks and transition zones in 3C 273. 1.3, 2, 3.6, 6 cm
BL030	Lonsdale, C. (Haystack) Barthel, P. (Groningen/Kapteyn)	Resolving the interaction edge of 3C 205 south. 6 cm with phased VLA
BM047	Marscher, A. (Boston) Gomez, J. (Boston) Wehrle, A. (JPL) Georganopoulos, M. (Boston)	Coordinated multi-band observations of blazars. 1.3 cm
BP026	Phillips, R. (Haystack) Deeney, B. (Colorado/JILA) Lestrade, J.-F. (Paris Obs)	WTT star polarization synthesis. 3.6, 6 cm with phased VLA
BR035	Rioja, M. (NFRA) Porcas, R. (MPIR, Bonn)	VLBA astrometry on the quasar pair 1038+528 A and B. 3.6 cm
BS019	Sjouwerman, L. (Chalmers, Onsala) Diamond, P. van Langevelde, H. (NFRA) Winnberg, A. (Chalmers, Onsala) Habing, H. (Leiden) Lindqvist, M. (Leiden)	Stellar proper motions in galactic center from SiO and H_20 masers. 1.3 cm with phased VLA

No.	Observer(s)	Program
BT018	Thakkar, D. (Caltech) Vermeulen, R. (Caltech) Pearson, T. (Caltech) Readhead, A. (Caltech)	Morphology and proper motions of the radio cores in FR I galaxies. 6 cm with phased VLA
BT019	Tingay, S. (Mt. Stromlo) Jauncey, D. (CSIRO) Reynolds, J. (CSIRO) Tzioumis, A. (CSIRO) Preston, R. (JPL) Jones, D. (JPL) Murphy, D. (JPL) Meier, D. (JPL) Lovell, J. (Tasmania) McCulloch, P. (Tasmania) Costa, M. (West Australia)	Sub-parsec scale structure of Centaurus A at the SVLBI frequency. 1.3 cm
BU006	Ulvestad, J. (JPL) Wrobel, J.	Continuum imaging of the Seyfert 1/Starburst Galaxy Mrk 231. 6, 18 cm
BV014	Vermeulen, R. (Caltech)	Nature of the low-frequency compact emission from 3C 84. 18, 90 cm
BV016	Vermeulen, R. (Caltech) Readhead, A. (Caltech) Walker, R. C. Romney, J. Kellermann, K. Dhawan, V. Benson, J. Backer, D. (Calif., Berkeley) Alef, W. (MPIR, Bonn)	Probing the accretion region in 3C 84. 1.3, 2, 3.6, 6 cm with single VLA antenna
BV017	Venturi, T. (Bologna) Cotton, W. Feretti, L. (Bologna) Giovannini, G. (Bologna) Lara, L. (Bologna) Marcaide, J. (Valencia)	Proper motion monitoring in two FRI radio galaxies. 3.6 6, 18 cm with single VLA antenna
BW019	Wilkinson, P. (Manchester) Browne, I. (Manchester) Jackson, N. (Manchester) Myers, S. (Caltech) Readhead, T. (Caltech) de Bruyn, G. (NFRA)	Testing CLASS gravitational lens candidates with the VLBA. 3.6, 6, 18 cm

No.	Observer(s)	Program
BZ017	Zensus, J. A. Lobanov, A. (Lebedev) Leppanen, K. (Helsinki)	Monitoring the parsec-scale jet structure of 3C 345. 1.3, 2, 3.6, 6 cm
GM025	Marcaide, J. (Valencia) Ros, E. (Valencia) Alberdi, A. (ESA, Spain) Diamond, P. Shapiro, I. (CFA) Guirado, J. (JPL) Preston, R. (JPL) Jones, D. (JPL) Witzel, A. (MPIR, Bonn) Krichbaum, T. (MPIR, Bonn) Schilizzi, R. (NFRA) Mantovani, F. (Bologna) Trigilio, C. (Bologna) Whitney, A. (Haystack)	Radio-shell expansion in SN 1993J. 13, 18 cm with phased VLA
GR012	Rupen, M. Bartel, N. (York U.) Beasley, A. Conway, J. (Chalmers, Onsala) Bietenholz, M. (York U.) Sorathia, B. (York U.) Graham, D. (MPIR, Bonn) Venturi, T. (Bologna) Umana, G. (Bologna) Rius, A. (Barcelona) Altunin, V. (JPL) Jones, D. (JPL)	VLBI imaging of supernova 1993J in M81. 3.6, 6, 18 cm with phased VLA

F. SCIENCE HIGHLIGHTS

Green Bank

The evolved star, U Equ, has a very peculiar optical spectrum indicating an unusual circumstellar environment. It is known to have OH and H_2O maser emission with a profile structure that suggests an outflow velocity of only 2.5 km/s. Recent observations of OH and H_2O masers with the 140 Foot indicate that the emission has changed in intensity and character over the last ten years. The H_2O maser has developed an additional spectral feature and the OH profile exhibits changes on a time scale of months. The velocity spread of emission has increased. The characteristics of U Equ probably

result from the combination of a warm, evolved, star surrounded by a cold oxygen-rich shell with a disk/(bipolar) shell geometry. Regular monitoring of the star in the H_2O and OH lines is now underway at the 140 Foot to search for signs of acceleration in the cold shell.

Investigators: C. Barnbaum (NRAO), A. Omont (Institut d' Astrophysique de Paris), M. Morris (UCLA)

Socorro

Sequence of VLBI Images Shows Expansion of SN1993J – Using the VLA, the VLBA, and European telescopes, an international VLBI team has made a sequence of images of Supernova 1993J in M81. The high-resolution sequence shows the expansion over a one-year period. While the expansion is symmetrical, the radio emission is clearly stronger on one side of the shell. So far, no protrusions such as those seen resulting from instabilities in older supernova events have developed. The images also show that the debris shell has not begun decelerating due to interaction with circumstellar material. The angular expansion rate measured with the VLBI images, combined with expansion speed measured by optical spectroscopy, should provide a refined value for the distance to M81, about 11 million light-years away.

Investigators: J. Marcaide and E. Ros (U. Valencia, Spain): A. Alberdi (Special Laboratory for Astrophysics and Fundamental Physics of Madrid, and Institute of Astrophysics at Andalucia, Spain); P. Diamond (NRAO); I. Shapiro (CFA); J. Guirado, D. Jones and R. Preston (JPL); T. Krichbaum and A. Witzel (MPI R); F. Mantovani (Bologna); A. Rius (Special Laboratory for Astrophysics and Fundamental Physics, Madrid and the Center for Advanced Studies at Blanes, Spain); R. Schilizzi (Joint Institute for VLBI in Europe and Leiden); C. Trigilio (Noto); and A. Whitney (Haystack)

Observations Show Collapsing Envelope Around Protostar – The VLA and the DSN 70-meter telescope were used to make 22 GHz spectral-line maps of CCS toward the core of B335, a young protostellar region. The resulting high-resolution channel maps image the collapsing envelope around the protostar. The velocity structure supports the evidence for inside-out collapse and the high-velocity features are consistent with accretion onto a rotating central disk. The CCS emission is asymmetric and clumpy, implying that the physical conditions of the region are not spherically symmetric and that the infall of gas onto the circumstellar disk may be episodic.

Investigators: T. *Velusamy, T.B.H. Kuiper and W.D. Langer (JPL)*

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

A total of 18 amplifiers was delivered this quarter. Work on the 290-395 MHz amplifier prototype was completed Work has begun on the balanced version. The new PC-based HFET test station was completed.

A prototype of the 60-90 GHz amplifier has been developed. A laboratory receiver with this amplifier demonstrate noise temperature of less than 75 K from 60-89 GHz and less than 55 K from 78-86 GHz, which is about the same as th

best SIS mixer receivers in this frequency range. The prototype version will be further evaluated in the VLBA 80-90 GHz receiver. A production version of this amplifier with improved performance is under development.

Superconducting (SIS) Millimeter-Wave Mixer Development

For the new 8-channel 3-mm receiver, we have developed a new six-wire SIS bias-T with internal protective resistors for use with an L-band IF. In addition to protective series resistors, a 50-ohm resistor is connected across the SIS junction to ground. It is hoped that this bias-T will reduce the number of mixer failures due to static electricity.

Also for the 8-channel 3-mm receiver, six dual backshort drive mechanisms have been completed.

Work continues on a new tunerless SIS mixer design, initially for 200-300 GHz. This design will be compatible with both the UVa and JPL fabrication processes. If successful, this mixer design will be incorporated into the planned single-chip image separation mixer.

During this quarter we have assembled and tested, or repaired, 10 SIS mixers, and mounted and DC-tested 19 SIS chips from 7 UVa wafers.

Electromagnetic Support

The Central Development Laboratory is developing a circular polarizer for the new 18-26 GHz VLA receiver. This component consists of a broadband 90 degree differential phase shifter followed by an orthomode transition.

A prototype phase shifter has been fabricated and tested. The measured differential phase shift between 19 GHz and 25.6 GHz is $86.3 \pm 3.5°$. A slightly longer phase shifter to give a mean phase differential of 90 degrees is being fabricated.

A K-band orthomode junction to be used in conjunction with the wideband phase shifter is under development. Prototypes of the symmetric and antisymmetric ports and the associated test fixtures were fabricated to evaluate the junction performance. A return loss of 25 dB in both ports from 18 to 26.5 GHz was demonstrated. A production model of the full junction is currently undergoing fabrication at the Green Bank Shop.

GBT Spectrometer

During the last quarter, construction of the GBT spectrometer continued. The system is almost complete, with bins, power supplies, and cooling fans mounted in place. Bin backplanes have been wirewrapped, but some re-work is required because of physical obstruction between some of the wirewrap coax cables and signal cable connectors.

All control cards in the system except the Long Term Accumulator (LTA) have been wirewrapped and tested. More than one-half of the high-speed multi-layer cards have been tested and are awaiting installation. All parts for the construction of the system have been ordered and received with the exception of the LTA memory modules.

The design and construction of the LTA card test fixture was completed during the quarter, but the unit has not yet been tested.

Construction of a frame decoder for the Russian Radioastron OVLBI satellite was completed during this quarter. The unit has been tested and is now ready for shipment to Russia. The decoder is almost identical to that used in the NRAO Green Bank Earth Station and will be provided to the Russian Astro Space Center for testing of the Russian Radioastron ground support system.

Spectrum Management

During November 4-18, an NRAO staff member spent two weeks as an IUCAF representative at the World Radiocommunication Conference in Geneva. Although there is severe competition for spectrum in many areas, radio astronomers at the conference were successful in getting approval for a number of new footnotes to the radio regulations. These will increase the protection of radio astronomy, and include, for example, one urging administrations to take all practicable steps to protect observations of the recently discovered line of methanol in the 6650-6675.2 MHz band. Other activities in the general area of interference protection include discussions with Motorola engineers on tests of emission levels from satellites of the Iridium series in the 1610.6-1613.8 MHz OH-line band. The first of which will be launched in the latter half of 1996, and Motorola will cooperate with NRAO staff at Green Bank and Socorro in tests using NRAO telescopes.

I. GREEN BANK ELECTRONICS DIVISION

GBT Development

Servo System

We have been working closely with the Comsat/RSI servo division on the GBT Servo system. We are monitoring their progress, working out technical details, and reviewing their test procedures and documentation. The areas of focus this past quarter have been the Feed Arm Servo system and the Auto-Stow protocol/implementation for both the azimuth/elevation and the feed arm systems. The factory tests for both of these areas is scheduled to take place January 15-26, 1996.

Spectrometer

The latest wafer run is complete. 63.6 percent of the chips passed the wafer probe test. A few chips were tested to 160 MHz and passed. Some correlator and memory cards have been tested with good results. The LTA prototype is being wire-wrapped. We also received and have now tested all of the wire wrap control cards (with the exception of the LTA). More than half of the multi-layer correlator cards have been tested. Both spectrometer racks have been constructed, and back plane installation and power wiring should occur in the next month.

IF/Converter Racks

Construction and testing of the prototype 1.6 GHz filter module were completed, and construction of the remaining seven modules started. The construction of the 100 MHz filter module prototype has started. All MCB interface modules for the IF/converter racks have been built and partially tested.

Receivers

Construction is continuing on Prime Focus Receiver #1. Design work started on Prime Focus Receiver #2 earlier this quarter. Design and fabrication of the OMT for this receiver is scheduled to begin first quarter of 1996.

The X, Ku, and K-band receivers are actively being used on the 140 Foot Telescope. This is proving to be invaluable giving us opportunities to tune and refine these receivers to be world class.

Active Surface

A technical review of the Active Surface computer interface with proposed protocols took place this quarter. The software to control the actuators and interface with the Monitor and Control system is being designed and tested.

Site Operations

Routine maintenance, repair, and installation support was supplied to the 140 Foot, the 85-1/2/3, USNO 20 Meter, and the OVLBI earth-station telescopes.

J. TUCSON ELECTRONICS

Fiber Optic Link between VLBA Antenna and 12 Meter

During the past quarter, a fiber-optic link has been established between the VLBA antenna and the 12 Meter Telescope. The objective here is to facilitate the millimeter-wave VLBI observations that are now regularly scheduled. Reference and IF signals are exchanged between the two sites so making the set-up of VLBI experiments far easier than in the past.

8-Beam 1.3 mm SIS Receiver

Although this receiver is now complete and was tested on the telescope in December 1995, some unsolved problems remain. The most serious of these is that receiver noise temperatures are several K higher than expected. Tests continue in order to understand the reasons for this.

On the positive side, the eight-beams are well formed and the efficiency of the beams is correct. The rotator for tracking parallactic angle is now operational.

4-Beam Dual-Polarization 3 mm Receiver

Progress on this receiver has been slower than hoped for owing to the pressure of other work. A crossed grid polarization diplexer designed to work at 4 K has been built and has yet to be tested. A cooled tripler has been tested and has given good results over the frequency range of interest. The cryogenic enclosure has been fabricated, but has yet to be tested.

K. SOCORRO ELECTRONICS

VLA 1.3 - 1.7 GHz Receiver Improvements

Prototypes of a new Walsh-function phase switching scheme in the 200 MHz output of the F2 first local oscillator successfully removed the out-of-band signals which were imaged to appear in-band. The scheme also greatly reduces the 1400 MHz spurious signal in L-band. This method replaces the previously planned frequency converter F15 with a much less expensive system. We expect to complete all antennas next quarter.

VLA Upgrade Prototype Front End

Development work proceeds on a front end covering the full bandwidth of the waveguide in the frequency range of 18 GHz to 26.5 GHz. The design includes three sub-band system temperature monitors for estimating atmospheric phase variations. A polarizer consisting of a waveguide phase shift section and an OMT section are under development by the Central Development Lab. Other components have been selected and ordered. Assembly will start in the first quarter of 1996.

VLA 40 - 50 GHz Receivers

The last of the 13 front ends was installed on antenna 20 this quarter in time for the 1995/1996 winter atmosphere. This installation phase of the project is complete. The division system engineer is assisting scientific staff and the E&S Division with holographic and other measurements to improve aperture efficiency with surface adjustments and subreflector positioning.

New VLA Correlator Controller

A new project plan was developed. Work on hardware and software progresses. The optical fiber link and serial I/O Subsystems will be tested in April.

VLA Antenna B-Rack Shields and Optical Fibers

Shields with optical fibers have been installed in all 28 antennas. The project is complete. However, tests indicated shielding effectiveness is about 15 dB at P-band instead of the expected 35 dB. Leakage paths will be located and corrected.

VLA T4/T5 Baseband Filter/Driver Upgrade

Investigations of poor antenna passbands resulted in the discovery of T4 baseband filter problems. Over the last 17 years, carbon composition resistors within the T4s have changed resistance as much as 50 percent and have also become reactive. All of the 115 T4 modules have been tested and repaired within the past year. Most passbands now are within 0.25 dB of the average. Some T5 driver modules are being upgraded to achieve the overall 0.25 dB passband specification.

VLA Wye Cable

A section of wye multipair cable in the vicinity of the antenna assembly building was replaced to eliminate excessive noise and leakage which impaired reliable wireline monitor and control of antennas on the west arm.

VLA Virtual Instrument Recorder (VIR)

This system is being developed to replace the eight channel Digital Data Tap which uses an eight channel Analog Recorder. The Analog Recorder has reached the end of its repairable life. This older system required engineers or technicians to travel to the VLA Site to set-up and retrieve the data. We are in the process of implementing hardware and software to provide AOC access to on-line VLA site monitoring and data recording using a graphical interface. This system will provide simultaneous multichannel and multiuser capability. It was installed at the VLA for beta testing, and should be functional next quarter.

GPS Receivers

The effort to develop a universal interface to connect any brand/model GPS receiver to the VLBA station computer without software changes encountered unexpected setbacks. The VME computer requires faster response than the interface can provide, and the Trak GPS computes GPS-station clock time offsets in a manner incompatible with the Odetics receivers. Another manufacturer has not yet delivered a compatible receiver.

VLBA Correlator

Five ASIC chips have failed since the new cooling units came online May 16, which translates to about 0.7 chips per month, compared to a rate of 2 chips per month prior to the increased cooling.

We received 861 of the 1000 new ASICs being provided by LSI Logic. Approximately 800 of these have been installed in FFT cards since 14 December. One of the new chips has failed and it failed in the first 24 hours. The remaining 139 chips were received in late December.

Problems were found and fixed in the 2K FFT Trig Table and in the Pulsar Model Tracking Firmware.

Work continues on cleaning up the Fractional Sample Time Correction serial interface to eliminate slight occasional errors that show up in system tests.

VLBA Data Acquisition and Playback

Progress has been made with the "barrel roll" problem in the formatter. A firmware fix is in place which cleared the problem in tests. Work continues to identify and fix a related firmware problem. Tests are being carried out on samples of Ampex tape, to determine if it can be used with the VLBA recording system. Two headstacks have been ordered from Penny & Giles. These will be tested to determine if Penny & Giles could be a second source of headstacks. Tests will continue to determine the highest relative humidity (RH) which avoids excessive headstack wear. Design continues on methods to deliver lower RH air to the headstack area.

VLBA Weather Stations

Nearly all site weather stations have new power supplies to improve the reliability of the TSL dew point temperature sensors. The remaining sites will have new supplies installed in January.

Interference Protection

Tests of a cellular phone (domestic public cellular radio telecommunications service) showed emissions at the second harmonic to be 1 milliwatt, which exceeds standards given in 47CFR Paragraph 22.907. Since the harmonic is in the 1150-1750 MHz band used by the VLA and VLBA, there is concern about interference from the hand-held mobile cellular radios when used in close proximity to the radio telescopes. Additional information has been requested from the Equipment Authorization Division of the FCC. Further tests are planned.

A cable between pad W8 of the VLA and the control building has been installed to permit direct monitoring of interfering signals entering the P band and L band sidelobes (73-75 MHz, 300-345 MHz, and 1155-1734 MHz) of the antenna at W8. A test performed with a time domain reflectometer shows the cable has no discontinuities. A test of cable attenuation shows the cable losses are equal to or less than design calculations. The first interference data from this system are planned to be presented at the URSI National Radio Science Meeting in January.

Problems with the AIPS reduction of VLBA monitor data taken this past summer have slowed the presentation of interference information from the VLBA sites. A second test better suited for AIPS has been executed but not yet reduced.

The frequency calibration of X and P band interference information from the VLA was found to be skewed during AIPS reduction. The reduction routine now has been modified interference plots for P band, X band, and other VLA bands are expected to join L band interference plots on the Web during the next quarter.

Computer-controlled monitoring with a scanning radio receiver and a tape recorder may have identified a frequently strong intermittent interfering source in the band 1429 - 1435 MHz. Further tests are planned to verify the findings before mitigation negotiations begin. The scanning monitoring system, now that it is fully operational, is expected to help identify interfering signal sources in P and L bands.

L. COMPUTING AND AIPS

General

The long-term outlook for computing at NRAO remains similar to that described in previous quarterly reports, with our current data reduction facilities moving towards obsolescence more rapidly than they are being replaced.

Computing security issues were significant this quarter due to break-ins which occurred in Green Bank and Charlottesville. Thanks to the efforts of various staff members, both intrusions were detected relatively early (less than 48 hours after the weekend break-in Green Bank, and about 8 hours after the intrusion in Charlottesville). The root cause of the break-ins was almost certainly due to compromise of external users' passwords, by way of password "sniffers" running at non-NRAO sites. Other, more subtle methods were also used to compromise our systems and gain root access. The steps taken to deal with the break-ins and reduce our vulnerability caused more disruption than anyone would have liked (such as delaying NRAO outgoing e-mail for about two days), and other lingering effects (such as difficulties in some types of inter-site file transfers). We have taken steps to insure that known security holes have been closed (applying various software and hardware updates at all NRAO sites, and eliminating more subtle vulnerabilities due to various types of public accounts). We are also taking steps to review our overall security posture at NRAO. The challenge is to balance the need to provide convenient access to NRAO computing facilities to our many legitimate outside users while at the same time preventing unauthorized hackers from gaining access to our systems and potentially causing serious problems. As long as our systems are available for access through the Internet, we will remain vulnerable at some level. The goal is to minimize the number of break-ins and intrusions while still providing convenient access to our user community.

During December, the remainder of 1995 RE funds were combined with unused travel funds, and amounts from various other accounts to meet several critical needs in computing at NRAO. In Charlottesville, a large amount of additional disk storage (> 30 GBytes) was purchased, to meet the needs of visiting and staff scientists, as well as to provide additional storage for results from the VLA D-Array survey. In Green Bank, three new single-user workstations were purchased, to meet needs for additional workstations in Green Bank and also help upgrade obsolete workstations. In Socorro, two high-end workstations were purchased to augment the publicly available machines in Socorro. The new machines (Sun Sparc Ultra 1 model 170e's) have an AIPS benchmark well over 6.5, making those machines the fastest workstations at NRAO, with the exception of a DEC Alpha machine on loan from Digital Equipment Corp. (NRAO remains extremely grateful to DEC for that machine!) In Tucson, a small project was undertaken to provide high speed mass storage on removable magneto-optical drives to meet the needs of 12 Meter observers.

Increasing the network bandwidth to Green Bank remains an on-going issue. Initial cost estimates are rather high, but alternative solutions are being vigorously pursued. One promising possibility would allow us to create a dedicated network among NRAO sites, including high-speed links to all the major sites, with costs only slightly above current costs.

Negotiations with the National Center for Supercomputing Applications in Illinois (NCSA) are underway to try and develop a working partnership between NCSA and NRAO. This partnership will provide high-end computing facilities to NRAO users with scientific and technical problems which are beyond present or anticipated NRAO computing facilities. If the various problems that beset remote use of computing facilities can be resolved, the facilities at NCSA will provide our users (visitors and staff) with large improvements for some scientific problems. Initially, expected uses of NCSA will include installation of AIPS for tests on certain large problems, and use of the NCSA facilities for running various finite-element modeling for the Green Bank Telescope. To date, NCSA has been extremely cooperative and encouraging, which bodes well for this effort.

VLA Archiving

The VLA re-archiving project, which reformats and copies all VLA data onto Exabyte tape, made reasonable progress. Currently, all data from 1976 through 1983 and from 1990 to present have been re-archived. Work on the 1989 data is progressing reasonably well, but has met with some delay due to poor quality nine-track tapes. We are studying alternative methods which allow faster handling of the problematic tapes we are encountering. We have made promising tests using one of the old Telex tape drives connected to a PC. The new VLA database, which is being created automatically during the re-archiving, is directly accessible via the NRAO home page and offers standard search facilities.

Visitor Support

In order to facilitate planning for scientists visiting Socorro, we have created a "Socorro Visitor's Information Package" on the Socorro, VLA, and VLBA pages of the NRAO World Wide Web site. The first item concerns a list of public workstations at the AOC in Socorro and rules and guidelines by which they are assigned to visitors. The Visitor's Registration Form asks for all the information that is needed to book a stay in Socorro, including reserving a workstation. Coming soon will be a third item in the package which will allow a prospective visitor to look at current and future workstation bookings at the AOC.

VLA Online

With the availability of 7 mm receivers at the VLA, pointing has become an important issue. The current state of reference pointing is described in "Some Issues for Q Band Observing" which is available on the web. Some improvements planned for the near future include: (a) Remove the restriction which limits pointing offset analysis to one subarray at a time. This will simplify the scheduling of pointing scans when multiple subarrays are used and allow the operations group more freedom in scheduling pointing runs. (b) Allow "second order" reference pointing . This would remove residual inter-band pointing errors that remain after correcting for the pointing offset determined at longer wavelengths. It is not clear that the increased complexity of such a procedure is warranted except in the most demanding observations. We expect to have capabilities (a) and (b) available by April of 1996.

Maintenance Software

Now that lack of funding has prevented NRAO from purchasing a commercial maintenance software product, we have started to improve and enhance our current Ingres-based version of MAINT. This is done in close collaboration with frequent MAINT users, especially those at the VLA site.

The new AIPS programming position has been filled, and the new hire will start in March, in Charlottesville. The emphasis for this position will be to support the NASA-funded space VLBI related parts of AIPS. This is especially important with the launch of VSOP due in September of this year.

The first release of AIPS under a "GNU General Public License" rather than a "user agreement" took place on August 18. The source code and full binary forms for a variety of architectures are found through anonymous ftp in directory aips/15JUL95 (and below) on the computer known as baboon.cv.nrao.edu. Since then, 154 sites have copied some or all of AIPS to their machines. Tape copies of AIPS are also available, currently without a media charge. So far 51 copies have been shipped on tape to 32 sites. To provide more information on AIPS use, and to provide data which will allow us to set priorities, a registration system has been established. Although the AIPS code is now free and mostly anonymous, help with installation and use of AIPS requires a site "registration" which is also at no charge to institutions engaging in research in astronomy. To date, 70 of the 186 non-NRAO sites have registered the 15JUL95 release, indicating that they expect to run it on 485 computers. These include 163 Sun4, 167 Solaris, 47 PC (Linux), 39 DEC Alpha, 27 HP, 20 SGI, 13 IBM, 4 DEC Ultrix, 2 Sun3, 2 PC (Linux Elf), and 1 Convex systems.

The new edition of the CookBook neared completion during the quarter. Out-of-date chapters on analysis, advanced subjects (POPS, remote use, programming), exiting, and the handling of problems were revised to reflect modern conditions and capabilities. A brand new chapter on single-dish data in AIPS was written. The new index plus the table of contents and all references to these chapters were kept current. The only chapter that has not been modernized is the Glossary, which is rather dated but still very useful. 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). AIPS is at WWW URL http://www.cv.nrao.edu/aips/.

A number of changes of general interest were made. When users enter a gripe, the text is now sent by e-mail to a number of accounts. This makes the gripe system available to non-NRAO sites and should improve the reaction time to many of the gripes. The remote use of magnetic tapes and, particularly, pseudo-tape disk files caused a glaring hole in computer security which has been repaired at the cost of forcing remote sites to be registered with the site providing the remote "tape" service. Remote users of compute servers will soon be able to interact with their data using AIPS display tools running on their desktop computer using a new provision for "guest" display accounts. A "garbage collector" has been written for POPS, the user input language of AIPS. This has been needed for 25 years and not only reclaims wasted space but allows the user to pick up new system verbs, adverbs, and procedures while retaining all adverb values and procedures.

Of interest both to VLA and to VLBA, the new task CPASS determines the spectral bandpass calibration with polynomial fits rather than channel-by-channel averages. This should enhance the flexibility and signal-to-noise ratios in that calibration process. Fringe-rate imaging may now be applied to VLA data with FRMAP to find the areas of emission prior to using more standard imaging techniques. FITLD applies a correction for the correlator's saturation effect in VLBA self spectra. Serious errors in position angles plotted by PCNTR and fit by IMFIT, JMFIT, and SAD were corrected. The handling of noise and error estimates in the fitting routines was also improved.

Support for single-dish data reduction in AIPS was enhanced by a significant number of (individually) small corrections and improvements. The new task SDMOD may be used to generate model single-dish data or subtract a model from real data. OTFUV was corrected to read 12 Meter on-the-fly data on all computer architectures.

M. AIPS++

In Single Dish processing, the Charlottesville-based group continues to work closely with the GBT on providing AIPS++ software for single dish processing. The most important goal is to allow use of AIPS++ single dish data analysis

processing by a first user on the NRAO 140 Foot Telescope in June 1996. In addition, the ATNF has decided to use AIPS++ to support an HI survey using a 13-feed multi-beam system on the Parkes telescope, scheduled for August 1996.

We have developed an extension to Glish, called Glishtk, that allows construction of a Tk-widget based GUI from inside Glish. It gives the ability to design and implement a GUI from the Glish command line and has led to a design for the AIPS++ GUI. This design will be implemented over the next few months using Glishtk and the Tasking classes.

Excellent progress has been made on designing and implementing the Measures Classes. All of the system, apart from high-precision VLBI support, should be available by April 1996. Much of the coding has been done now, but a redesign of the interface is underway partly in response to comments by others and partly as a result of experience in implementing the classes.

A design and implementation for synthesis calibration and imaging based upon the Measurement Equation for a Generic Interferometer has been developed. Development is proceeding on various fronts. One important goal will be to allow support of the commissioning of the new WSRT on-line control system, TMS, expected to commence in August 1996. Another is an early test of the AIPS++ GUI mentioned above by implementing a general imaging and self-calibration task. This will be made available to users for testing and use.

In Visualization and Image Analysis, the NCSA group has worked on the graphics capabilities in AIPS++. Currently for the GBT tests, we use a Glish client, gplot1d, that calls a commercial widget, Xrt/Graph. A tentative plan was to replace this at some point with classes developed at Fermilab. A better option is to instead use a Motif-based widget for the Caltech PGPLOT library that is widely used in Astronomy.

In Infrastructure, the Table system continues to evolve and grow towards completion. A modification of the Table system was agreed to, designed, and implemented, all within a few weeks. Similar changes to the AIPS++ library are expected to occur repeatedly in the future as applications needs come to drive the Project.

In Documentation, we have resolved our staffing problem mentioned in the last Quarterly report, and a large number of changes are now in progress. AIPS++ has adopted the Free Software Foundation's gnats program to track bug reports and change requests.

In the System area, we have implemented automated testing whereby the entire test suite is run weekly and the results monitored. The goal is to catch problems with the Library early on. We are now working towards rectifying existing problems. We have also implemented registration of template specializations, and are in the process of implementing shared libraries, something that will be vital to reduce the typical size of executables.

In Management, a major push was made during the last quarter to formulate development plans for various key areas of the Project. A development plan is essentially a detailed time-line with deliverables, responsibilities and requirements on other parts of the Project all laid out clearly. This is a vital discipline for a project as diverse and complex as AIPS++, serving not only to aid in management but also in ensuring that all members of the Project are aware of goals and activities. We also implemented a formal scheme for managing substantial changes to the system, involving a proposal, request for comments, and decision date.

N. GREEN BANK TELESCOPE PROJECT

Antenna

Construction activity has moved ahead at the Green Bank Telescope site over the last quarter, although at a slightly slower pace owing to a couple of factors. First, the derrick crane went out of service in October due to a broken sheave (pulley wheel around which the cable is wrapped). This was not an easy fix for COMSAT RSI, which involved engineering design, special parts order and significant disassembly/installation/re-assembly effort over about two months. Fortunately, work was able to proceed using the traveling cranes on the ground. More recently, the second factor affecting progress has been the Green Bank winter weather.

In spite of these hindrances, obvious progress has been accomplished. On the structure, the elevation wheel has been completed and sixteen counterweight boxes (out of 22 total) have been installed on the wheel. The boxes are approximately 14 ft x 8 ft x 8 ft and weigh about 25,000 pounds each empty, so installation is not trivial. Ultimately, the boxes will be filled with concrete to counterbalance the structure with a weight of approximately 2 million pounds. Also, the front center truss of the rotating box has been put into place, following completion of the rotating box trial erection on the ground. All eight elevation gear reducers have been installed. All access lighting on the alidade is now in place and working. In addition, the lower elevation cable wrap junction box has been installed and the cables have been pulled from level one.

On the ground, work has continued on the back-up structure (BUS) trial erection. The R_0 truss (center truss) from hoop 15 to 33 is in place. The R_{1R} and R_{1L} (ribs 1 right and 1 left of center) trusses are in place from hoop 27 to 33, and R_{2R} and R_{2L} are in place from hoop 15 to 33. For reference, there are 57 ribs total (the center rib plus 28 right and left). This is a major part of the current site work and will continue into the summer. Disassembly of the BUS and installation on the structure is scheduled for next fall. And, eight concrete foundation pads have been built to support the trial erection of the upper feed arm scheduled for next quarter.

Fabrication and assembly of the subreflector (an ellipsoid 7.55 m x 7.95 m) is proceeding at COMSAT RSI's Sterling, Virginia plant. Twenty-eight of the 40 panels have been fabricated and measured and are being installed on the subreflector back-up structure. The assembled unit is scheduled to be shipped to Green Bank in February. In addition, fabrication, measuring and painting of the 2,000 main reflector panels continues at Sterling. At the Dallas plant, the GBT feed arm servo hardware is undergoing system integration. The system will be ready for in-house tests in late January and shipment to the site in February.

The next quarter promises to be exciting as the box structure and horizontal feed arm erection continues, the trial erection of the back-up structure progresses, and the marriage of the upper feed arm, subreflector and servo system occurs.

Open Loop Active Surface

Most of the software work this period centered around the Intelligent I/O Processors (IIOP's). A second IIOP interface has been added to the VME chassis. The software in the slave has been modified to work with an array of IIOP's. The detailed configuration of the system has been defined and programmed into the system. Several control modules were integrated into the system to test the IIOP code with real hardware. In addition, test code was enhanced to test these modifications. The enhancement is now fully tested.

Some timing tests of the enhanced slave code (handling 25 percent of the actuators) were done. The maximum time through 560 position loops is 5.2ms, or an average of 9.2μs per axis. The longest RPC service call takes almost 19ms.

Two printed circuit boards, power supply peak detector, and room temperature monitor have both been calibrated and installed in the control chassis.

NRAO has received the op-amps required for our LVDT temperature monitor circuit. A prototype has been built, and we are in the process of evaluating the circuit. The purpose of this circuit is to use the DC resistance of LVDT's as an indication of temperature.

Closed Loop Active Surface

140 Foot Telescope Demonstration

The first experiments using laser ZP10 (the best unit) on the 140 Foot Telescope monuments revealed a pointing problem. After checking the calibration procedures, data entries and calculations, and trying the system on various monuments, we went back to the calibration lab and started checking the mirror mechanics. Autocollimator measurements identified two errors in the mirror system. The encoders showed a maximum error of about 50 counts in 180 degrees. The forks on the elevation assembly of two units that were inspected showed them to be off axis by 45-60 seconds.

The laser mirror pointing problems have been traced to the encoders. ZP10 has been modified to use ROD 500 encoders, and this unit will be calibrated and tested during early December. Problems with the two axes not being orthogonal have been traced to the bearing retainer rings. This is a much simpler problem than errors in the milling of the fork as originally feared. A temporary cover has been placed over the four monuments in order to leave the instruments in place. The model of the 140 Foot Telescope motions will be a priority in December. Software development effort is being exclusively dedicated to a ZIY program for the 140 Foot Telescope demonstration.

Panel Setting Tool

The tool was demonstrated to COMSAT RSI. Modifications and suggestions are being incorporated into the software and hardware. Effort is underway to correct the distance readings for tilt on the dish and field calibration procedures. Measurements are being made to determine if the instrument can be used as a check on the tilt of the actuators.

Software

Problems with the Bancom IRIG interrupt service routine have been resolved. Version 1.41 of the ZY program was released and is being tested. This version includes a number of changes in the pointing calibration algorithms, IRIG time sync, moving target tracking, and sets a standard for device memory, I/O locations, interrupt levels, and DMA channels. A prototype ZIY program is being developed to run the 140 Foot Telescope experiment. Plans are also being developed to attempt to interface to the GBT weather station.

Servo

Presently, the feed arm servo hardware is undergoing system integration, and will be ready for in-house tests early in 1996. A revised Factory Test Procedure has been received and is being reviewed.

NRAO is defining several operational scenarios involving the servo and developing a best guess of the detailed procedure required to effect the scenario. Following contractor reviews, the procedures will then be run in conjunction with the factory test.

Work is also continuing on the interface between the NRAO monitor and control system and the servo system. Code is being developed in-house and tested against a simulator.

Electronics

Prime Focus Receiver

The design of Dewar #2 is in progress. A model of the dewar was placed in the FE Box to determine the size, spacing and mounting. The cryogenic refrigerator has been selected and ordered. Shop drawings for construction of the dewar are underway. Investigation into what components are required for Band #5 has been started. In addition, a study of what kind of IF cables are required for the prime focus IF cable started, as well as how cables from prime focus FX to the receiver room should be installed at the receiver room cable entrance panel.

Prime Focus Temperature Controllers

The control circuit for the GBT temperature controller was redesigned to eliminate the pulse transformers and the RCA zero-crossing semiconductor. Instead, a motorola zero-crossing SCR driver is used. This chip simplifies the design. Fabrication of two of these models will begin next month. The circuit board for the control circuit and the digital control was drawn on AUTOCAD and a negative is being made. The fabrication and testing of these circuits should be completed next summer.

Analog/Sampler/Filter Modules

The drawings for the driver board used in 1.6 GHz Sampler Filter and 100 MHz Converter/Filter modules were completed and are now being fabricated by an outside shop. Also, the drawings for the 100 MHz converter/filter module were completed and are now being fabricated in-house. The analog filter rack wiring diagrams were begun.

The SQL detector video amp and 4-way divider/amplifier modules for new Converter modules have been built. Also, fabrication of the semi-rigid cables for the new Converter modules have been started.

Construction of the MCB interface module for the Analog Rack is finished. Also, we tested the MCB interface modules for Converter Rack B, and Analog Rack and started construction of a third MCB interface module.

The 1.6 GHz Sampler Filter module prototypes units were constructed, tested and evaluated.

Converter Rack A for output spur tests using the 140 Foot Telescope spectral processor has been set up.

Switching Signals

We are in the process of entering the first logic card into Or Cad to control the data flow of the multiplexed digital signals.

Spectrometer

During the period the back planes for the digital rack were received from the wire wrap company. Some of the wire wrap work on these back planes was not acceptable and will require some re-work. The main problem was a failure to anticipate that the large number of wire wrap coax cables would cover up some of the connectors. NRAO has also received and tested all of the wire wrap control cards with the exception of the LTA.

More than half of the multi-layer correlators cards have been tested. All of the correlator chips received so far from the last wafer run have now been installed into these correlator cards. No correlator chip failures were encountered during the correlator card testing. Three memory cards have been tested so far. Both spectrometer racks have been constructed and back plane installation and power wiring was started.

LO Reference Distribution System

Additional rework of the new RTPM was necessary to make it electrically compatible with OVLBI's RTPM. The rework, testing, and installation was completed this quarter.

X-Band Receiver

The new refrigerator was installed and the system was cooled. The receiver's SIB failed on 11/14/95, possibly caused by a water leak. The SIB was replaced in late November, but the 15 K and the 50 K monitors are not reading correctly (30 K and 58 K, respectively). The voltages going into the MCB interface are acceptable. The investigation will continue until the problem is solved.

K-Band Receiver

The new cold cathode gauge tube remote monitor was wired into the MCB interface so that data can be logged. The software will be modified as needed to scale the data properly. Also, during the B638 observing program, an instability in the receiver hardware was identified. The 300 K receiver components were taken to the lab and the unstable behavior was duplicated. The problem appears to be due to broken coax cables (aluminum). This testing will continue until the issue is resolved.

Similar to the X-band MCB problem, the 15 K and 50 K monitors are reading 25 and 60 K. The voltages here also are acceptable as they enter the MCB box. A new LO scheme that will make the use of frequency switching more effective in removing receiver instabilities was developed.

S-Band Receiver

Electrical design of the S-band receiver began this period.

L-Band Receiver

Work on the L-Band receiver continued including revision of OMT drawings and mechanical drawings.

Cryogenic GBT Activities

K-band: A problem was discovered with the cold cathode tube not reading. The controller was tested and found broken. The replacement tested OK.

X-band: The refrigerator was removed while cold. The displacers were found frozen to the cylinder walls, indicating water vapor was present. The entire system was evacuated (compressor and helium lines) and recharged and the charcoal trap was replaced. Further, a leak in the compressor was found and fixed.

Monitor and Control

The end of this period saw the release of a new version of the GBT monitor and control software at the 140 Foot Telescope. Release 2.0 includes the registries which are used for logging monitor information and the spectral processor. This release has a number of characteristics about it that make it, for the first time, mature enough for release to outside users. First, it is the first release of the Spectral Processor with no interim code and the list of enhancements and bugs fixes is completed. Second, the release was linked to the latest versions of the libraries, so it has important functionality such as the use of the message system which provides the sending of all messages from all processes to one user window, independent files for representing each GUI window in the console, compatibility with Glish 2.5.0.6d, the first use of config files for storing equipment setup information between invocations, the ability to start or restart processes or computers in any order, and all Sun processes run on Solaris.

Concerning antenna control a general finite state machine library was implemented in order to emulate actual states of hardware devices associated with the GBT during simulation. This library was used to code multiple state machines with interdependencies in the A140 program. The A140 program serves two functions. First, it is a GBT-to-140 Honeywell-316 protocol converter for use on the 140 Foot Telescope, and second it is used as a testbed for M&C antenna development. Also, the depth of control of the antenna was expanded to include stow/unstow, receiver selection, and optics mode selection.

Work continued on the analysis of the Gregorian focus tracking algorithm, which combines the results from the structural model, best-fitting paraboloid and ellipsoid analyses to produce the required trajectory of the subreflector mounting as a function of elevation angle.

Work on the updates for the receiver software continues: the enhancement for switching signals is finished and work continues on the registries and porting the work done on the X-band receiver to K- and Ku-band receivers. Work on the console rewrite began again as the receivers neared completion.

Work was completed for allowing Glish scripts to access telescope monitor points, and work has started and is near completion for a new Spectral Processor data monitor based on PV-Wave for displaying intensity plots of pulsar data as they are generated.

Work continued on coordination of prime focus, subreflector, feed boom turret and main dish. A focus-tracking module was added, which is the beginnings of the actual focus tracking module (algorithms based on the structural model are not yet included, just the control architecture). In preparation for testing, a SCCU network interface manual is being prepared to document, in detail, the meaning of the status information reported by the SCCU.

Data Analysis

The AIPS++ single-dish data analysis development for the GBT continued. A draft of a "AIPS++ Single Dish Development Plan" document was completed and released to the AIPS++/GBT Working Group for comment. The plan includes target dates for development milestones spanning the next eight months. It also attempts to define a minimal requirement set for a functional single-dish analysis package that could be released for trial use to 140 Foot Telescope observers. This draft is under review.

A small prototype GUI interface to Glish is nearing release for trials. This utilizes a public domain library, Tk widgets, as building blocks for the GUI. A GUI for the "gbtlogfiller" is expected soon as a demonstration tool and for trials.

A proposal for a unified Help system for use in conjuction with Glish functions is being prepared.

O. PERSONNEL

New Hires

J. Wiseman	Research Associate	October 1, 1995
J. Ford	Electronic Engineer I	October 1, 1995
X. Yang	Assistant Scientist - Research Support	November 13, 1995
J. Mangum	Assistant Scientist - Tucson Operations	December 13, 1995

Terminations

J. Higdon	Research Associate	October 18, 1995
C. Chandler	Research Associate	November 16, 1995
G. Fuller	Research Associate	November 30, 1995
P. Jewell	Scientist - Tucson Operations	December 31, 1995

Change in Title

A. Beasley	to Assistant Scientist - Socorro Operations	October 1, 1995

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