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NATIONAL RADIO ASTRONOMY OBSERVATORY

QUARTERLY REPORT

April 1, 1996 - June 30, 1996

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A. TELESCOPE USAGE

The following telescopes have been scheduled for research and maintenance in the following manner during the second quarter of 1996.

	140 Foot	12 Meter	VLA	VLBA
Scheduled Observing (hrs)	1728.75	1751.25	1685.5	1012
Scheduled Maintenance and Equipment Changes	169.50	64.75	239.5	379
Scheduled Tests and Calibration	263.75	335.25	291.0	412
Time Lost	39.50	87.00	48.9	50
Actual Observing	1689.25	1664.25	1636.6	962

B. 140 FOOT OBSERVING PROGRAMS

The following continuum programs were conducted during this quarter.

No.	Observer(s)	Program
D191	de Pater, I. (Calif., Berkeley) Heiles, C. (Calif., Berkeley) Maddalena, R. Millan, R. (Calif., Berkeley) Wong, M. (Michigan)	Observations of the aftermath of the comet Shoemaker-Levy with Jupiter crash.

The following line programs were conducted during this quarter.

No.	Observer(s)	Program
B654	Barnbaum, C. Morris, M. (UCLA) Omont, A. (IAP, Paris)	Observations of OH masers associated with the extraordinary star, U Equ.
B657	Balser, D. Lockman, F. J.	Observations of ionized helium in diffuse HII regions.
B659	Burton, W. B. (Leiden)	21 cm measurements toward weak shoulders on HI spectra observed near b = 0.
B663	Brown, R. Wiseman, J. Schulman, E. Cox, C. (Virginia)	Observations at 1.7 and 3 GHz for detections of HI fine structure emission at high redshift.
C305	Carilli, C. Menten, K. (CFA) Reid, M. (CFA) Rupen, M. Stocke, J. (Colorado/JILA)	Redshifted HI 21 cm line observations of red quasars and red gravitational lenses.

No.	Observer(s)	Program
D190	Dickey, J. (Minnesota) Elliot, E. (Minnesota)	A search for OH emission at 18 cm from diffuse molecular clouds.
H304	Haynes, M. (Cornell) Giovanelli, R. (Cornell)	21 cm spectra of redshift independent distances to spiral galaxies.
L320	Lockman, F. J. Murphy, E. (Virginia)	21 cm HI observing and data reduction procedures testing.
M385	Murphy, E. (Virginia) Lockman, F. J.	The magnetic field in galactic HI.
T348	Thuan, T. (Virginia) Martin, J-M. (Meudon) Karachentseva, V. (Kiev)	21 cm observations of the influence of local environment on the physical properties of dwarf galaxies.

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)	Bi-monthly timing of 63 pulsars at 550, 800, 1420, and 1660 MHz.
A128	Arzoumanian, Z. (Cornell) Cordes, J. (Cornell) Gregg, M. (LLNL) Becker, R. (Calif., Davis) Nice, D. Sayer, R. (Princeton)	A 1.4 GHz directed search for radio pulsars in the first maps of the NRAO VLA sky survey.
A132	Arzoumanian, Z. (Cornell) Nice, D.	Monitoring at 575 MHz of the evolution of the PSR B1957+20 eclipsing binary system.
B617	Backer, D. (Calif., Berkeley) Sallmen, S. (Calif., Berkeley) Foster, R. (NRL) Matsakis, D. (NRL)	Pulsar timing array observations at 800 and 1395 MHz.
F132	Foster, R. (NRL) Wolszczan, A. (Penn State) Cadwell, B. (Penn State) Anderson, S. (Penn State)	Timing measurements of two new millisecond pulsars found in the Arecibo high latitude survey.
F133	Fruchter, A. (STScI) Eder, J. (NAIC)	Timing observations of a new, bright, fast pulsar.

No.	Observer(s)	Program
L317	Lundgren, S. (NRL) Cordes, J. (Cornell) Arzoumanian, Z. (Cornell) Hankins, T. (NMIMT) Moffett, D. (NMIMT) Finley, J. (Purdue)	Joint radio and x-ray observations of the fluctuations of the Crab pulsar.
M386	McKinnon, M. Fisher, J. R.	A 1.3-1.8 GHz polarization model test and timing of young pulsar PSR B1823-13.
Z139	Zepka, A. (Calif., Berkeley) Backer, D. (Calif., Berkeley) Nice, D.	A 1.4 GHz search for the radio pulsars associated with SNR G78.2+2.1.

The following very long baseline programs were conducted with Green Bank telescopes this quarter.

No.	Observer(s)	Program
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.
VT002	Okayasu, R. (ISAS, Japan)	VSOP scheduling test.

C. 12 METER TELESCOPE OBSERVING PROGRAMS

The following line programs were conducted during this quarter.

No.	Observer(s)	Program
B653	Butner, H. (DTM/Carnegie) Charnley, S. (NASA/Ames) Lada, E. (Maryland)	Tracing interstellar deuterium fractionation pathways.
B657	Boselli, A. (Paris Obs) Gavazzi, G. (Brera Obs) Lequeux, J. (Paris Obs) Buat, V. (Marseille) Donas, J. (Marseille) Casoli, F. (Paris Obs)	CO (1-0) in a complete sample of spiral galaxies in the Coma supercluster.
C296	Clancy, R. T. (Colorado/JILA) Sandor, B. (Colorado/JILA)	Mars dust storm observations.
C300	Combes, F. (Paris Obs) Wiklind, T. (Chalmers, Onsala)	A search for O_2 at $z = 0.685$ at 70 GHz.

No.	Observer(s)	Program
C303	Caselli, P. (CFA) Chen, H. (CFA) Myers, P. (CFA)	Search for quiescent massive molecular dense cores in Orion B.
CB05	Bower, G. (Calif., Berkeley) Backer, D. (Calif., Berkeley) Wright, M. (Calif., Berkeley)	Study of a dramatic flare in the extremely flat-spectrum QSO NRAO 530.
CD03	Doeleman, S. (Haystack)	Imaging and evolution of radio galaxy 3C 111.
CD04	Doeleman, S. (Haystack) Rogers, A. (Haystack) Bower, G. (Calif., Berkeley) Backer, D. (Calif., Berkeley) Wright, M. (Calif., Berkeley)	3 mm VLBI observations of the galactic center.
CL02	Lonsdale, C. (Haystack) Doeleman, S. (Haystack) Phillips, R. (Haystack)	A large-scale 3 mm VLBI survey.
F134	Frayer, D. (Toronto) Thuan, T. (Virginia) Seaquist, E. (Toronto)	Study of molecular gas in chemically young IRAS galaxies.
G350G	Gensheimer, P. (MPIR, Bonn)	Observations of HCO^+ toward CIT 6.
G351	Gensheimer, P. (MPIR, Bonn) Henkel, C. (MPIR, Bonn)	Study of H_2O toward NGC 7027.
H317	Helfer, T. (Maryland) Blitz, L. (Maryland)	On-the-fly CO mapping of NGC 3628, NGC 4826, and M83.
H318	Holdaway, M.	Verification of 3 mm continuum fluxes of bright quasars.
I18	Irwin, J. (Virginia) Frayer, D. (Toronto) Sarazin, C. (Virginia)	Search for CO in the HI cloud between NGC 4472 and UGC 7636.
K353	Kutner, M. (unaffiliated) Schombert, J. (NASA/GSFC) Pildas, R. (CFA)	Study of the molecular content of dwarf spirals.
L316	Liszt, H.	Study of $C^{18}O$ emission around rho Ophiuchus.
L321	Liszt, H. Lucas, R. (IRAM)	Study of galactic CO toward extragalactic sources.
M398	Mauersberger, R. (Arizona) Henkel, C. (MPIR, Bonn) Chin, Y. (Bonn U.)	Study of interstellar sulfur isotopes and oxygen burning in stars.

No.	Observer(s)	Program
M400	Mauersberger, R. (Arizona) Havenith, M. (IAP, Bonn) Wilson, T. (MPIR, Bonn)	A search for interstellar Van der Waals complexes.
P170	Pound, M. (Calif., Berkeley) Lada, E. (Maryland) Mundy, L. (Maryland) Gruendl, R. (Maryland)	An investigation of cluster formation in Orion.
P180	Papadopoulos, P. (Toronto)	Study of CO (2-1) in Markarian 10.
R265	Robinson, B. (Northwestern) Yusef-Zadeh, F. (Northwestern)	Search for high density molecular gas at -5 km/s toward OH masers surrounding the galactic center SNR G359.1-0.5.
S404	Sandor, B. (Colorado/JILA) Clancy, T. (Colorado/JILA)	Microwave spectroscopy of earth's atmosphere.
S409	Smith, B. (IPAC) Madden, S. (NASA/Ames)	CO (1-0) observations of low-luminosity Virgo spiral galaxies.
T362	Turner, B.	How big can interstellar molecules get in translucent clouds?
V86	van Dishoeck, E. (Leiden) Mundy, L. (Maryland) McMullin, J. (Arizona) Blake, G. (Caltech) Evans, N. (Texas) Mattingly, B. (Texas)	Studying the youngest stellar regions: The evolution of chemical morphologies.
V87	Yun, M. (CFA) Verdes-Montenegro, L. (IAA, Andalucia) Perea, J. (IAA, Andalucia) del Olmo, A. (IAA, Andalucia)	Study of the molecular component of Hickson groups.
W351	Wootten, H. A. Mangum, J. Wilking, B. (Missouri)	Study of origin of broad formaldehyde line emission in millimeter-bright, low-mass, star-forming regions.
W353	Williams, J. (Calif., Berkeley) Blitz, L. (Maryland)	Study of the clump structure in the Rosette molecular cloud.
W357	Womack, M. (Penn State) Stern, A. (SWRI)	Study of carbon chemistry in Kuiper disk comets.
W367	Wyckoff, S. (Arizona State) Ziurys, L. (Arizona State) Kleine, M. (Arizona State) Wehinger, P. (Arizona State)	A 2 mm spectral-line survey of Comet Hale-Bopp (150-170 GHz).
W370	Wyckoff, S. (Arizona State) Kleine, M. (Arizona State) Ziurys, L. (Arizona State) Wehinger, P. (Arizona State)	$^{12}C/^{13}C$ ratios in molecular clouds from CN: chemical processing in the pre-solar nebula.

No.	Observer(s)	Program
W371	Williams, J. (Calif., Berkeley) Myers, P. (CFA)	A search for gravitational infall toward young stellar clusters.
W372	Williams, J. (Berkeley) Myers, P. (CFA) Caselli, P. (CFA)	Comparison of the electron abundance in star-forming and starless cores.
W373	Woodney, L. (Maryland) A'Hearn, M. (Maryland) Samarasinha, N. (KPNO) McMullin, J. (Arizona) Mundy, L. (Maryland)	Monitoring the activity of Comet Hale-Bopp (c/1995 O1).
W374	Womack, M. (Penn State) Stern, A. (SWRI) Festou, M. (Midi-Pyrenees)	CO, H_2O, and CH_3OH in Comet Hale-Bopp: primordial ices?
W375	Womack, M. (Penn State) Stern, A. (SWRI) Festou, M. (Midi-Pyrenees)	Study of parent molecules in the newly discovered comet C/Hyakutake (c/1996 B2).
W377	Womack, M. (Penn. State) Stern, A. (SWRI) Festou, M. (Midi-Pyrenees)	Study of pre- and post-abundances of parent molecules in Comet C/Hyakutake.
W378	Woodney, L. (Maryland) A'Hearn, M. (Maryland) McMullin, J. (Arizona)	Study of parent molecules in Comet Hyakutake (c/1996 B2).
Y16	Yu, T. (Calif., Berkeley) Chernin, L. (Calif., Berkeley) Welch, W. J. (Calif., Berkeley)	A search for shock emission tracers in the VLA 1623 outflow.
Y17	Yu, T. (Calif., Berkeley)	Observations of OPH B1 in the $J = 1-0$ ^{12}CO line.
Z132	Ziurys, L. (Arizona State) Apponi, A. (Arizona State)	A search for interstellar/circumstellar FeCl.
Z134	Zhou, S. (Illinois) Choi, M. (Texas) Evans, N. (Texas)	A $C^{18}O$ $J = 2-1$ survey of selected regions in Taurus.
Z135	Ziurys, L. (Arizona State) Apponi, A. (Arizona State)	A search for vibrationally excited MgNC.
Z136	Ziurys, L. (Arizona State) Apponi, A. (Arizona State) Wyckoff, S. (Arizona State) Wehinger, P. (Arizona State) Kleine, M. (Arizona State)	Study of HCN and CN in Comet Hale-Bopp.

No.	Observer(s)	Program
Z137	Ziurys, L. (Arizona State) Wyckoff, S. (Arizona State) Wehinger, P. (Arizona State) Apponi, A. (Arizona State) Kleine, M. (Arizona State)	Study of HCN and CN in Comet Hyakutake.

D. VERY LARGE ARRAY OBSERVING PROGRAMS

The Second Quarter, 1996 was spent in the following configurations: C configuration from April 1 to April 30; DnC configuration from April 30 to June 27; D configuration from June 27 to June 30.

No.	Observer(s)	Program
AA196	Goss, W. M. Anantharamaiah, K. (Raman Institute) Pedlar, A. (Manchester)	H168 recombination lines from the galactic center. 20 cm line
AA197	Aschwanden, M. (Maryland) Gary, D. (Caltech) Bastian, T.	Gyroresonance stereoscopy. 2, 3.6, 6 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
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 cm
AB774	Beck, R. (MPIR, Bonn) Hoernes, P. (MPIR, Bonn)	Magnetic arms in NGC 6946. 20 cm
AB775	Beck, R. (MPIR, Bonn) Shoutenkov, V. (Lebedev) Shukurov, A. (Moscow/SSAI) Sokoloff, D. (Moscow/SSAI)	Magnetic fields in barred galaxies. 3.6, 6 cm
AB781	Bock, D. (Sydney) Frail, D. Green, A. (Sydney)	The Vela X region. 20 cm HTRP
AB783	Barvainis, R. (Haystack) Lonsdale, C. (Haystack)	Radio spectra of broad absorption line quasars. 0.7, 1.3, 2, 3.6, 6 cm

No.	Program	Program
AB784	Barvainis, R. (Haystack) Antonucci, R. (Calif., Santa Barbara)	Ultra-high redshift CO search. 2, 3.6 cm line
AB786	Beck, R. (MPIR, Bonn) Ehle, M. (CSIRO) Ye, T. (Sydney)	Search for magnetic arms in NGC 2997. 3.6, 6 cm
AB792	Brown, A. (Colorado/JILA) Ambruster, C. (Villanova) Jeffries, R. (Birmingham) Bromage, G. (Lancashire)	Correlation between stellar radio emission and rotation. 2, 3.6, 6, 20 cm
AB797	Brogan, C. (Kentucky) Troland, T. (Kentucky) Roberts, D. (Illinois) Crutcher, R. (Illinois)	HI and OH Zeeman observations toward M17. 20 cm line
AB799	Brinks, E. (Guanajuato U.) Duc, P. (Guanajuato U.)	HI in NGC 6845. 20 cm line
AC308	Condon, J. Cotton, W. Perley, R.	All sky survey. 20 cm
AC449	Cordes, J. (Cornell) Arzoumanian, Z. (Cornell) Hankins, T. (NMIMT) Moffett, D. (NMIMT) Lundgren, S. (NRL) Finley, J. (Purdue) Jahoda, K. (NASA/GSFC) Rots, A. (NASA/GSFC) Ulmer, M. (Northwestern)	Radio and x-ray fluctuations of the crab pulsar. 3.6, 6, 20 cm HTRP
AC458	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 coma cluster. 20 cm line
AC459	Cepa, J. (Laguna) del Rio, S. (Laguna) Vila, B. (Nobeyama Obs) Kawabe, R. (Nobeyama Obs) Brinks, E. (Guanajuato U.)	Atomic gas in early-type galaxies. 20 cm line
AD374	Duncan, A. (Queensland) Haynes, R. (CSIRO) Stewart, R. (CSIRO) Goss, W. M. Holdaway, M.	SNR candidates from the Parkes 2.4 GHz galactic plane survey. 20 cm

No.	Observer(s)	Program
AD375	Dickey, J. (Minnesota)	21 cm study of the BS12B supercluster. 20 cm line
AD379	Dwarakanath, K. (Raman Institute) Mitra, D. (Raman Institute)	Steep spectrum sources selected at 34 MHz. 20, 90 cm
AE106	Edge, A. (Cambridge) Grainge, K. (Cambridge) Jones, M. (Cambridge) Saunders, R. (Cambridge)	Extreme gigahertz peaked sources. 0.7, 1.3, 2, 3.6, 6 cm
AF300	Fey, A. (USNO) Gaume, R. (USNO) Claussen, M.	Does dense gas confine G29.96-0.02? 1.3 cm line
AF302	Frail, D. Goss, W. M.	Confirmation of supernova remnant/molecular cloud interactions. 20 cm line
AF305	Fomalont, E. Kellermann, K. Richards, E. (Virginia) Partridge, R. B. (Haverford College) Windhorst, R. (Arizona State)	The Hubble deep field; sensitive 8.4 GHz observations. 3.6 cm
AF306	Frail, D.	Monitoring GRO J1744-28 candidate source.
AG432	van Gorkom, J. (Columbia) Dwarakanath, K. (Raman Institute) Guhathakurra, P. (Calif., Santa Cruz)	HI imaging of cluster Abell 2670. 20 cm line
AG448	Greenhill, L. (CFA) Henkel, C. (MPIR, Bonn)	Monitoring the acceleration of water megamaser features in NGC 4258. 1.3 cm line
AG472	Gaensler, B. (Sydney) Frail, D. Manchester, R. (CSIRO) Green, A. (Sydney)	Two unusual barrel supernova remnants. 20, 90 cm
AG473	Gibb, A. (Kent) Little, L. (Kent) Phillips, R. (Kent)	Compact radio sources as evidence for embedded young stellar objects. 3.6 cm
AG477	van Gorkom, J. (Columbia) Yun, M. Bahcall, J. (Princeton)	PKS 2349-014, possible link between mergers and AGNs. 20 cm line
AG479	Gopalswamy, N. (Maryland) Kundu, M. (Maryland) Nitta, N. (Lockheed)	Nonthermal emission and plasma flow during bright point flares. 2, 3.6, 6 cm

No.	Observer(s)	Program
AG485	Galama, T. (Amsterdam) deBruyn, A. (NFRA) van Paradijs, J. (Amsterdam) Hanlon, L. (Dublin)	Candidate counterparts to GRB 940301. 3.6, 6, 20, 90 cm
AG490	Gray, R. (Gray Data)	The Ohio State University "WOW" signal. 6, 20 cm line
AG492	Goss, W. M. Cappa, C. (IAR)	HI associated with planetary nebula NGC 2359. 20 cm line
AH569	Hufnagel, B. (Michigan State) Marvel, K. (New Mexico State)	Search for masers in the AGB stars of the open cluster NGC 7419. 0.7, 1.3, 20 cm line
AH572	Hjellming, R. Rupen, M.	Radio and x-ray activity in the galactic black hole candidate J1719-24. 2, 3.6, 6, 20 cm
AH573	Hjellming, R. Rupen, M.	Radio and x-ray activity in the galatic black hole binary GRO J1655-40. 2, 3.6, 6, 20 cm
AH576	Habbal, S. (CFA) Gonzales, R. (CFA)	Coordinated ground and space based observations of macrospicules. 3.6, 6 cm
AH578	Hailey, C. (Columbia) Craig, W. (Columbia)	New pulsar in a new supernova remnant. 20, 90 cm
AH582	Hibbard, J. (Hawaii) Rich, R. (Columbia) Barnes, J. (Hawaii) van der Hulst, T. (Groningen/Kapteyn)	Dwarf formation in the tidal tail of the antennae. 20 cm line
AI062	Indrani, C. (Raman Institute) Jahan, M. (Raman Institute)	Search for pulsar companions to single line spectroscopic binaries. 20 cm
AJ253	Jorsater, S. (Stockholm Obs) Kristen, H. (Stockholm Obs) van Moorsel, G. Lindblad, P. (Stockholm Obs) Broeils, A. (Stockholm Obs)	HI observations of the bright barred spiral galaxies. 20 cm line
AK376	Kulkarni, S. (Caltech) Frail, D.	Search for the radio counterparts of gamma ray bursters.
AK414	Kronberg, P. (Toronto) Allen, M. (Toronto)	High resolution radio spectral index studies of the nucleus of M82. 3.6 cm
AK420	Kollgaard, R. (Penn State) Ghisellini, G. (Torino) Maraschi, L. (Genova U.) Pesce, J. (STScI) Sambruna, R. (STScI) Urry, C. M. (STScI)	Multifrequency monitoring of blazars. 1.3, 2, 3.6, 6, 20 cm

No.	Observer(s)	Program
AK421	Kobulnicky, C. H. (Minnesota) Skillman, E. (Minnesota)	HI mapping of the nearby peculiar starburst galaxy NGC 5253. 20 cm line
AK425	Kollgaard, R. (Penn State) Ghisellini, G. (Torino) Maraschi, L. (Genova U.) Pesce, J. (STScI) Sambruna, R. (STScI) Urry, C. M. (STScI)	Multifrequency monitoring of blazars. 1.3, 2, 3.6, 6, 20 cm
AK426	Kraemer, K. (Boston) Jackson, J. (Boston)	Continuum from NGC 6334 V. 3.6 cm
AK428	Kurtz, S. (Mexico/UNAM)	Ionized outflows from massive stars. 3.6 cm line
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
AL371	Leto, G. (Bologna) Pagano, I. (Catania) Umana, G. (Bologna) Trigilio, C. (Bologna) Rodono, M. (Catania)	High frequency part of dMe stars' radio spectra. 0.7, 1.3, 2, 3.6, 6 cm
AL374	Lanzetta, K. (SUNY) Briggs, F. (Groningen/Kapteyn) Zwaan, M. (Groningen/Kapteyn) Webb, J. (New South Wales) Barcons, X. (Cantabria)	Galaxies responsible for low-redshift Lyman alpha forest absorbers. 20 cm line
AL376	Lo, K. (Illinois) Tolstoy, E. (STScI)	HI distribution in the transition dwarf galaxy Phoenix. 20 cm line
AL377	Lu, N. (IPAC) Lord, S. (IPAC) Helou, G. (IPAC) Lo, K. (Illinois) Malhotra, S. (IPAC)	Galaxies of the ISO key project on normal disk galaxies. 20 cm
AL388	Lim, J. (SA/IAA, Taiwan) White, S. (Maryland) Drake, S. (NASA/GSFC) Phillips, R. (Haystack)	Radio spectrum of radio bright magnetic Bp stars. 0.7, 1.3, 2, 3.6, 6 cm
AL389	Alberto-Lopez, J. (Mexico/UNAM) Vasquez, R. (IAA, Andalucia) Gomez, Y. (Mexico/UNAM) Rodriguez, L. (Mexico/UNAM)	Kinematics of the peculiar BRET NGC 2440. 3.6 cm line

No.	Observer(s)	Program
AM479	Morrison, G. (New Mexico) Owen, F.	20 cm imaging of very rich Abell clusters. 20 cm
AM512	Mirabel, I. F. (CNRS, France) Rodriguez, L. (Mexico/UNAM)	Large scale radio lobes in GRS 1915+105. 6 cm
AM513	Marti, J. (Barcelona) Mirabel, I. F. (CNRS, France) Rodriguez, L. (Mexico/UNAM)	Search for radio jets in Cygnus X-1. 6 cm
AM516	Mandolesi, N. (TESRE, Bologna) Franceschini, A. (Padova) Desert, X. (CNRS, France) Cesarsky, C. (CEA, France) Zamorani, G. (Bologna)	An ISO survey area in the Lockman hole. 6 cm
AM518	McMahon, R. (Cambridge) Miley, G. (Leiden)	VLA survey of ISO survey regions. 20 cm
AM522	McMullin, J. (Arizona) Blake, G. (Caltech) Mundy, L. (Maryland) White, S. (Maryland)	Stellar radio population of Lynds 1641. 1.3, 2, 6 cm
AM523	Mundell, C. (Manchester) Pedlar, A. (Manchester) Thean, A. (Manchester) Shone, D. (Manchester) Done, C. (Durham) Brinks, E. (Guanajuato U.)	Observations of neutral hydrogen in Seyfert galaxies: NGC 4939. 20 cm line
AM532	Moore, E. (Rutgers)	HI observations of two early-type barred spiral galaxies. 20 cm line
AN068	Neilsen Jr., E. (Johns Hopkins) Tsvetanov, Z. (Johns Hopkins) Petrosian, A. (ARI, Heidelberg) Ford, H. (Johns Hopkins)	HI mapping of blue compact dwarf galaxies. 20 cm line
AN072	Navarro, J. Stappers, B. (Mt. Stromlo) Bailes, M. (CSIRO)	Continuum eclipses of PSR J2051-0827. 90 cm HTRP
AO122	Owen, F. Perley, R. Cotton, W. Postman, M. (STScI) Condon, J.	Deep A-array survey near 1015+51. 20 cm

No.	Observer(s)	Program
AP328	Prada, F. (Laguna) Torrelles, J. (IAA, Andalucia) Gomez, J. (IAA, Andalucia) Perez, E. (IAA, Andalucia) McKeith, C. (Queens U, Belfast)	M82: on the wavelength dependent kinematics of edge on dusty spirals. 3.6 cm line
AP332	de Pater, I. (Calif., Berkeley)	Jupiter Patrol: aftermath of Comet-Jupiter crash. 20, 90 cm
AP336	Palmer, P. (Chicago) de Pater, I. (Calif., Berkeley) Snyder, L. (Illinois)	OH in comet Hyakutake. 20 cm line
AQ011	Quillen, A. (Ohio State) Yun, M. Kenney, J. (Yale) Pogge, R. (Ohio State)	Barred spirals NGC 2903 and NGC 3351. 2, 6, 20 cm line
AR350	Reipurth, B. (ESO) Rodriguez, L. (Mexico/UNAM)	Thermal jets in selected Class 0 sources. 3.6 cm
AR353	Rajagopal, J. (Raman Institute) Srinivasan, G. (Raman Institute) Dwarakanath, K. (Raman Institute)	HI studies of interstellar clouds identified through Ca^+ and Na absorption lines. 20 cm line
AR357	Raulin, J. (Maryland) Gopalswamy, N. (Maryland) Kundu, M. (Maryland) Lara, A. (Maryland) Gurman, J. (NASA/GSFC)	Search for cool material in solar active regions. 6, 20, 90 cm
AR358	Robinson, B. (Northwestern) Yusef-Zadeh, F. (Northwestern) Roberts, D. (Illinois)	Radio continuum observations of G359.1-0.5 and the Snake. 3.6, 6 cm
AS568	Sramek, R. Weiler, K. (NRL) VanDyk, S. (Calif., Berkeley) Panagia, N. (STScI)	Properties of radio supernovae. 1.3, 2, 3.6, 6, 20 cm
AS578	Suleiman, S. (Georgia Tech) Kolodner, M. (Georgia Tech) Butler, B. Steffes, P. (Georgia Tech)	Mapping SO_2 and H_2SO_4 variations on Venus. 1.3, 2 cm
AS585	Simon, T. (Hawaii) Bastian, T. Hawley, S. (Michigan State) Fisher, G. (Calif., Berkeley)	Joint EUV, soft x-ray, radio, and optical observations of flares. 2, 3.6 cm

No.	Observer(s)	Program
AS589	Serabyn, G. (Caltech) Morris, M. (UCLA) Pauls, T. (NRL)	The galactic center arc filaments. 1.3 cm
AS590	Schiminovich, D. (Columbia) van Gorkom, J. (Columbia) van der Hulst, J. (Groningen/Kapteyn) Wilkinson, A. (Manchester)	HI imaging of shell galaxies. 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
AT196	Takano, S. (Cologne) Nakai, N. (NAO, Japan) Kawaguchi, K. (NAO, Japan) Winnewisser, G. (Cologne)	Observation of NH_3 in NGC 253. 1.3 cm line
AT197	Troland, T. (Kentucky) Crutcher, R. (Illinois) Roberts, D. (Illinois) Goss, W. M.	OH Zeeman observations toward Orion A. 20 cm line
AU067	Umana, G. (Bologna) Leone, F. (Catania) Trigilio, C. (Bologna)	Radio spectrum of B Lyrae. 0.7, 1.3, 2, 3.6, 6 cm
AV223	Vasquez, R. (IAA, Andalucia) Torrelles, J. (IAA, Andalucia) Lopez, J. (Mexico/UNAM) Miranda, L. (Madrid Obs)	Search for BRETs in planetary nebulae. 3.6 cm line
AV224	Vermeulen, R. (Caltech) Taylor, G.	Search for HI absorption at z = 3.4 in the damped LyA system in 1239+376. 90 cm line
AV226	van Gorkom, J. (Columbia) Carilli, C. Stocke, J. (Colorado/JILA) Shull, J. (Colorado/JILA)	HI environment of nearby Ly A clouds. 20 cm line
AW362	White, S. (Maryland)	The stellar activity cycle on active stars. 3.6, 6, 20 cm
AW425	Whiteoak, J. (MPIR, Bonn) Reich, W. (MPIR, Bonn) Wielebinski, R. (MPIR, Bonn) Megeath, S. (Haystack) Uchida, K. (MPIR, Bonn)	Clumped regions and star formation in S296. 6, 20 cm

No.	Observer(s)	Program
AW430	Wilcots, E. (Wisconsin) Elmegreen, B. (IBM) Gallagher, J. (Wisconsin)	HI observations of late type spiral galaxies. 20 cm line
AW441	Wilcots, E. (Wisconsin) Elmegreen, B. (IBM) Gallagher, J. (Wisconsin)	HI observations of NGC 925 and NGC 1744. 20 cm line
AW442	Willson, R. (Tufts) Lang, K. (Tufts) Kile, J. (Tufts) Rothberg, B. (Tufts)	Evolving solar noise storms. 20, 90 cm
AY073	Yun, J. (Lisbon) Moreira, M. (Lisbon) Torrelles, J. (IAA, Andalucia)	Radio continuum sources seen towards Bok globules. 2, 6 cm
AZ083	Zhao, J. (SA/IAA, Taiwan) Chen, H. (CFA)	L1641N: a newly discovered protobinary. 0.7, 3.6 cm
BD035	Doeleman, S. (Haystack) Claussen, M.	A new radio flare in N-Galaxy 3C 111. 0.7, 1.3, 2 cm
BR034	Roberts, D. (Brandeis) Wardle, J. (Brandeis) Ojha, R. (Brandeis) Homan, D. (Brandeis) Aller, H. (Michigan) Aller, M. (Michigan) Hughes, P. (Michigan)	Sources with rapidly varying polarization. 1.3, 2 cm

E. VERY LONG BASELINE ARRAY OBSERVING PROGRAMS

No.	Observer(s)	Program
BB023	Beasley, A. Conway, J. (Chalmers, Onsala) Dhawan, V. Walker, R. C. Wrobel, J. Patnaik, A. (MPIR, Bonn) Muxlow, T. (Manchester)	VLBA calibrator survey. 3.6 cm
BB056	Blundell, K. (Oxford) Lacy, M. (Oxford) Beasley, A. Walker, R. C.	Parsec-scale structure of radio quiet quasars. 3.6 cm

No.	Observer(s)	Program
BB057	Bujarrabal, V. (Yebes Obs) Colomer, F. (Yebes Obs) Alcolea, J. (Yebes Obs)	Spatial structure of the linearly polarized emission in SiO masers. 0.7 cm
BB066	Butler, B. Beasley, A. Wrobel, J.	Occultation of J0237+2848 by comet Hyakutake. 20 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
BC053	Clark, T. (NASA/GSFC) Ryan, J. (NASA/GSFC) Walker, R. C. Himwich, W. (Interferometrics) Ma, C. (NASA/GSFC) MacMillian, D. (Interferometrics) Vandenberg, N. (NASA/GSFC) Gipson, J. (NASA/GSFC) Gordon, D. (NASA/GSFC) Niell, A. (Haystack) Corey, B. (Haystack) Rogers, A. (Haystack) Eubanks, T. (USNO) Fomalont, E.	NASA Space Geodesy Program: geodetic observations for 1996 – scheduled as RD GEO2. 13, 3.6 cm with geodetic stations
BC054	Coles, W. (Calif., San Diego) Klingesmith, M. (Calif., San Diego) Rickett, B. (Calif., San Diego)	Measurement of solar wind speed near the sun using IPS. 2, 3.6 cm
BC055	Colbert, E. (STScI) Roy, A. Ulvestad, J. (JPL) Wilson, A. (Maryland) Norris, R. (CSIRO)	Radio structure of Seyfert nuclei on parsec scales. 2, 6, 18 cm
BC056	Carilli, C. Menten, K. (CFA) Claussen, M. Reid, M. (CFA) Rupen, M.	Imaging the Pc-scale structure in molecular clouds at z = 0.89. 3.6 cm
BC057	Carrara, E. Zensus, J. A. Abraham, Z. (Sao Paulo) Lobanov, A. (NMIMT)	Parsec scale structure of the 3C 273 jet: multi-frequency monitoring. 1.3, 3.6, 6 cm

No.	Observer(s)	Program
BD027	Diamond, P. Kemball, A.	Multi-epoch observations of stellar SiO masers. 0.7 cm with single VLA antenna
BD031	Diamond, P. Field, D. (Bristol, UK) Kemball, A. Gray, M. (Bristol, UK) Masheder, M. (Bristol, UK)	Polarization observations of OH masers in star forming regions. 18 cm
BD033	Dewey, R. (Princeton) Beasley, A.	VLBA observations of millisecond pulsars for frame-tie. 18 cm with 8 hours phased VLA
BD035	Doeleman, S. (Haystack) Claussen, M.	A new radio flare in N-galaxy 3C 111. 1.3, 2 cm
BE010	Eubanks, T. (USNO) Matsakis, D. (USNO) Fomalont, E. Beasley, A. Corey, B. (Haystack) Shapiro, I. (CFA)	GR light bending. 2, 4, 13 cm
BF013	Fomalont, E. Goss, W. M. Lyne, A. (Manchester) Manchester, R. (CSIRO)	Pulsar parallax and proper motions: second and third epochs. 18 cm
BF019	Fassnacht, C. (Caltech) Snellen, I. (Leiden) deBruyn, G. (NFRA) Schilizzi, R. (NFRA) Browne, I. (Manchester) Jackson, N. (Manchester) Wilkinson, P. (Manchester) Myers, S. (Pennsylvania) Pearson, T. (Caltech) Readhead, A. (Caltech)	VLBI imaging of the gravitational lens system 1608+656. 6, 18 cm
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 VLA single antenna
BG049	Gallimore, J. (MPIfEP, Garching) Baum, S. (STScI) O'Dea, C. (STScI)	VLBA mapping of thermal emission from the torus in NGC 1068. 3.6, 18 cm with phased VLA
BG050	Greenhill, L. (CFA) Chernin, L. (Calif., Berkeley)	Collimation and launch of protostellar outflows. 1.3 cm with VLA single antenna

No.	Observer(s)	Program
BG056	Garrett, M. (Manchester) Patnaik, A. (MPIR, Bonn) Nair, S. (Manchester) Porcas, R. (MPIR, Bonn)	VLBA 15 GHz and 43 GHz multi-epoch observations of 1830-211. 2 cm
BH017	Ho, P. (CFA) Patel, N. (CFA) Torrelles, J. (IAA, Andalucia) Gomez, J. (Boston) Rodriguez, L. (Mexico/UNAM) Curiel, S. (Mexico/UNAM)	Proper motions of circumstellar water masers in Cepheus A. 1.3 cm
BH019	Hirabayashi, H. (ISAS, Japan) Fomalont, E.	Pre-launch observations of the VSOP survey of bright AGN. 6 cm
BH021	Hough, D. (Trinity U.) Readhead, A. (Caltech)	Lobe-dominated superluminal quasar 3C 245. 2, 3.6, 6 cm
BH022	Hjellming, R. Dhawan, V. Rupen, M. Mirabel, I. F. (CNRS, France) Rodriguez, L. (Mexico/UNAM)	GRS 1739-279. 3.6, 13 cm
BJ024	Jauncey, D. (CSIRO)	VLA and VLBA target of opportunity observations of PKS 0405-385. 1.3, 3.6 cm
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
BK037	Kellermann, K. Zensus, J. A. Cohen, M. (Caltech) Vermeulen, R. (Caltech)	Monitoring superluminal sources. 2 cm
BK041	Kemball, A. Porcas, R. (MPIR, Bonn) Patnaik, A. (MPIR, Bonn)	VLBI polarimetry of the gravitational lens system 0218+357. 1.3, 2 cm
BK042	Kellermann, K. Zensus, J. A. Gurvits, L. (NFRA) Vermeulen, R. (Caltech)	Seven high-redshift quasars. 2 cm
BL033	Lundgren, S. (NRL) Foster, R. (NRL) Waltman, E. (NRL) Hummel, C. (USNO)	Mapping the new gamma ray blazar 2EG0432+2910. 1.3, 2, 3.6, 6 cm

No.	Observer(s)	Program
BL037	Lobanov, A. (NMIMT) Swain, M. (Rochester)	Compact emission in lobe dominated quasars. 18 cm
BM034	Dhawan, V.	GRS 1915. 3.6, 13 cm
BM051	Marr, J. (Union College) Crawford, F. (MIT) Strauss, M. (Princeton)	GPS sources 0108+388. 1.3, 3.6, 6, 18 cm
BM060	Menten, K. (CFA) Reid, M. (CFA)	Proper motions of SiO masers in the central parsec of the galaxy. 0.7 cm with VLA single antenna
BM063	Marscher, A. (Boston) Gomez, J. (Boston) Wehrle, A. (JPL) Xu, W. (JPL) Georganopoulos, M. (Boston)	Coordinated multiband observations of blazars. 1.3 cm
BM067	Mattox, J. (Maryland) Marscher, A. (Boston) Wagner, S. (Heidelberg Obs)	Gamma ray blazar 1622-297. 1.3, 2 cm
BP028	Patel, N. (CFA) Zhang, Q. (CFA) Herrnstein, J. (CFA) Ho, P. (CFA) Greenhill, L. (CFA) Moran, J. (CFA) Goldsmith, P. (NAIC)	Proper motion of water masers around IRAS 21391+5802. 1.3 cm
BR034	Roberts, D. (Brandeis) Wardle, J. (Brandeis) Ojha, R. (Brandeis) Homan, D. (Brandeis) Aller, H. (Michigan) Hughes, P. (Michigan)	Sources with rapidly varying polarization. 1.3, 2 cm
BR040	Ratner, M. (CFA) Bartel, N. (York U.) Lebach, D. (CFA) Lestrade, J-F. (Paris Obs) Shapiro, I. (CFA)	Astrometry of HR 1099 and IM Peg for the Gravity Probe-B mission. 3.6 cm with phased VLA, DSS14, DSS6.
BS034	Salter, C. (NAIC) Salgado, J. (Michigan) Ghosh, T. (NAIC) Manoharan, P. (TIFR) Junor, W. (New Mexico)	Scattering in the range l = 30 to l = 75. 18, 90 cm

No.	Observer(s)	Program
BS035	Simon, R. Beasley, A. Fomalont, E. Junor, W. (New Mexico)	VLBI survey. 90 cm
BS036	Stanghellini, C. (CNR/IRA-Frascati) O'Dea, C. (STScI) Baum, S. (STScI) Dallacasa, D. (Bologna) Fanti, R. (Bologna) de Vries, W. (Groningen/Kapteyn)	VLBA observations of gigahertz peaked-spectrum radio sources. 2, 18 cm
BS038	Snellen, I. (Leiden) Schilizzi, R. (NFRA) de Bruyn, A. (NFRA) Miley, G. (Leiden) van Langevelde, H.	Faint GPS sources. 2 cm
BS040	Sykes, C. (Manchester) Wilkinson, P. (Manchester) Browne, I. (Manchester) Jackson, N. (Manchester) Nair, S. (Manchester) Myers, S. (Pennsylvania) de Bruyn, G. (NFRA) Fassnacht, C. (Caltech) Readhead, A. (Caltech) Pearson, T. (Caltech) Koopmans, L. (Groningen/Kapteyn)	Gravitational lens J1934+504. 18 cm with VLA single antenna
BT021	Tingay, S. (Mt. Stromlo) Jauncey, D. (CSIRO) Reynolds, J. (CSIRO) Tzioumis, A. (CSIRO) Preston, R. (JPL) Meier, D. (JPL) Jones, D. (JPL) Murphy, D. (JPL) Lovell, J. (Tasmania) McCulloch, P. (Tasmania) Costa, M. (Tasmania)	Short time-scale monitoring of Centaurus A at 8.4 GHz. 3.6 cm
BT022	Taylor, G. Vermeulen, R. (Caltech)	Measuring absolute motions in the bi-directional jets of 1946+708. 2, 3.6 cm
BW026	Wehrle, A. (JPL) Unwin, S. (Caltech) Zook, A. (Pomona College) Xu, W. (JPL)	3C 279: coordinated multiwavelength observations and evolution. 1.3, 2 cm

No.	Observer(s)	Program
BZ017	Zensus, J. A. Lobanov, A. (NMIMT) Leppanen, K. (Helsinki)	Monitoring the parsec-scale jet structure of 3C 345. 1.3, 2, 3.6, 6 cm
CMVA2	Phillips, R. (Haystack)	3 mm VLBI observations (Kitt Peak and Owens Valley, recording systems only).
GM027	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)	Monitoring the expansion of SN 1993J. 6 cm
GM028	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)	Monitoring the expansion of SN 1993J. 13 cm
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

No.	Observer(s)	Program
VT002	Okayasu, R. (ISAS, Japan) Edwards, P. (ISAS, Japan)	Ground telescope test for VSOP observing. 1.3, 6 cm

F. SCIENCE HIGHLIGHTS

Socorro

Large-Scale Magnetic Field Surrounds Interacting Galaxies – Polarization maps made with the VLA show evidence for a large-scale, structured magnetic field surrounding a pair of colliding galaxies. The L-Band observations of 4C 35.3, a pair of interacting elliptical galaxies, show evidence for a magnetic field larger than the size of either galaxy. The magnetic field is within the halo surrounding the galaxies, with two magnetic loops, each centered on one of the jets emitted by the nucleus of the larger galaxy. This raises the possibility that the halo surrounding the interacting pair may be formed from material emitted by the jets.

Investigator: A. Minter

Galileo Probe Signal Detected in VLA Recordings – When the Galileo probe entered the Jovian atmosphere in December, 1995, the VLA was used to record the weak signal from the probe, whose antenna was aimed nearly 90 degrees from earth, toward the orbiter spacecraft. Extensive analysis of the recorded data has yielded a detection of the probe's signal. Extraction of the probe signal was made quite difficult by the low signal-to-noise ratio, uncertainty over the probe's transmitted frequency, and the dynamics and swinging of the probe under its parachute. Further analysis of the probe signal will improve greatly the accuracy of Jovian wind-speed determinations.

Investigators: W. Folkner, R. Preston, J. Border (JPL), J. Navarro (NRAO), M. Oestreich and W. Wilson (ATNF)

Tucson

Molecular Spectral Line Studies of Comets Hale-Bopp and Hyakutake – A number of experiments designed to measure the spectral line emission from comets Hale-Bopp and Hyakutake have been conducted at the 12 Meter Telescope during the past several months. A monitoring program to study the changes in the CO emission production rate toward Comet Hale-Bopp (1995 O1) found it to be an object similar to Chiron, yet is presently a long-period comet that has evolved from an Oort cloud quasi-parabolic trajectory. Carbon monoxide is thought to be the dominant out-gassing agent in this comet and CO has been observed via both the J = 1-0 and J = 2-1 transitions. A main goal of this proposal is to measure for the first time the evolution of the production rate of CO with heliocentric distance and to compare it to the rate of water.

The recent near-Earth passage of Comet Hyakutake (C/1996 B2) afforded a great opportunity to conduct detailed ground-based studies of a comet. A number of programs designed to measure the abundances of parent molecules in Hyakutake were conducted at the 12 Meter. Measurements of the CH_3OH, H_2CO, HCN, and CO emission toward the comet have been used to derive production rates for H_2CO, HCN, and CO, which indicate that the HCN production rate is similar to that measured for CN, suggesting a direct link between these two species. The CO and H_2CO production rates, on the other hand, indicate that H_2CO is not the main parent of the observed CO. This suggests that CO and H_2CO are parent species (species left-over from the formation of the comet), while HCN is not. Comparison to other CO measurements done previous to these March measurements indicates very rapid changes in the production rate over time scales of weeks.

Investigators: M. Womack, A. Stern, and M. Festou (Penn State)

The discovery of OCS emission through its J = 12-11 transition toward Comet Hyakutake has allowed a new insight into the sulfur chemistry in comets. The measured OCS production rate is similar to that predicted by theory (Q(OCS)/Q(OH) = 0.004), and indicates that OCS is a parent species within the comet.

Investigators: L. Woodney, J. McMullin, and M. A'Hearn (Maryland)

Studies of the Molecular Gas Content in Galaxies – A number of studies of the molecular gas content toward external galaxies have been conducted at the 12 Meter during the past several months.

A sample of metal-poor IRAS galaxies at low redshifts have been searched for CO 1-0 and 02 emission. The information obtained from this experiment will be used to study the O2/CO ratio dependence on the CO to IRAS flux correlation.

Investigators: D. Frayer (Toronto), T. Thuan (Virginia), and E. Seaquist (Toronto)

On-the-fly observing techniques have been used to measure the CO J = 1-0 emission toward the spiral galaxies NGC 3628, NGC 4826, and M83. These maps have been combined with BIMA array measurements of the CO emission toward these objects in order to produce fully sampled 5" resolution maps. This information is being used to study the HCN/CO ratio toward these galaxies in order to understand the variations in molecular gas pressure toward the star formation regions in these galaxies.

Investigators: T. Helfer and L. Blitz (Maryland)

Green Bank

Twenty-one centimeter neutral hydrogen absorption has been detected towards the red quasar 1504+377 at a redshift of 0.673 using the 140 Foot Telescope. The HI absorption is associated with a broad molecular absorption line cloud located within the dust lane of the AGN's edge-on spiral host galaxy. This system has the largest integrated optical depth of any redshifted 21 cm absorption line system, making it an ideal system in which to study the neutral and molecular ISM in a galaxy at substantial look-back times.

Investigators: C. Carilli (NRAO), K. Menten and M. Reid (CFA), and M. Rupen (NRAO)

G. PUBLICATIONS

Attached as Appendix A is a tabulation of all reprints 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

Frequencies Above 40 GHz – A prototype version of the 75-110 GHz amplifier has been completed and one more unit has been built. Both amplifiers have more than 25 dB of gain from 70-113 GHz at the ambient temperature of 26 K. The first unit was tested for noise in the 75-90 GHz band and exhibited an average noise temperature of about 80 K for the whole receiver. Testing both units in the 90-113 GHz range is under way.

Two Q-band (40-50 GHz) amplifiers have been built, tested, and delivered.

Frequencies Below 40 GHz

Frequency Band	Quantity	Status
290-395 MHz	6	Built and evaluated
385-520 MHz		Design nearly complete
1.2-1.8 GHz	2	Repaired and evaluated
1.73-2.70 GHz	1	Prototype built, evaluation pending
8-10 GHz	9	Built and evaluated
26-36 GHz		Design completed

The amplifier group performed the following work in addition to the amplifier work: the new wideband noise test setup was calibrated, a special 26-36 GHz noise test setup was reconstructed and calibrated, and the entire cryogenic system, which supports the four noise test dewars, was completely revamped.

Three amplifiers built with normal construction techniques were vibration tested by NASA in preparation for the MAP project. They survived and still perform correctly.

Superconducting (SIS) Millimeter-Wave Mixer Development

We have completed the design of a new tunerless SIS mixer for 200-300 GHz. This design requires no anodization, and is compatible with both the UVa and JPL SIS fabrication processes. It has low capacitance in the IF circuit to allow wide IF bandwidth, which is not the case with some present SIS mixer designs. The masks for this mixer are now being fabricated.

The design of a new 260-300 GHz SIS mixer has been completed, and the mask layout is now under way. This mixer will be made in both tunerless and tunable versions, the latter to allow receivers to be tuned for single-sideband operation.

The experimental single chip image-separating SIS mixer for 200-300 GHz is now being fabricated at JPL.

An experimental 250-350 GHz traveling-wave SIS mixer has been designed in collaboration with SAO and UVa. This uses the recently developed UVa edge-junction process to make a long, narrow, SIS junction down which the LO and RF signal propagate as on a lossy transmission line. As the input impedance is essentially real, resonant tuning circuits are not required. SAO experiments at higher frequencies have shown such mixers to be capable of excellent broadband performance.

As part of the MMA collaboration, John Lugten (Berkeley) visited the CDL for a week in June to study our methods for SIS mixer assembly prior to starting work on mixers for BIMA using devices made at UVa.

Work continues in the Ivy Road lab and shop on components for the new 8-channel, 3-mm SIS receiver being constructed in Tucson.

During this quarter we assembled and tested 17 SIS mixers, using chips from six UVa wafers and one Hypres wafer.

Electromagnetic Support

GBT - The final design for the spillover shield was completed. The shield will cover the feed arm structure around the subreflector up to 23 degrees from the secondary focus feed axis. The shield is trapezoidal in cross-section with sides 67" and 185" and height of 78". In order to minimize wind loading forces, perforated sheets are being considered. Two different hole patterns have been chosen based on transmission loss. These sheets will be tested for wind loading.

Design of the Q-band (40 to 52 GHz) feed was done and the manufacturing drawing has been sent to the Green Bank shop.

VLA - Design of feed and square/circular transition for the 18-26.5 GHz band has been completed, and manufacturing drawings are in the works.

GBT Spectrometer

During the last quarter, construction of the GBT spectrometer was completed and system testing begun. So far, the sampler rack has been populated with all thirty-two 100 MHz samplers, and system timing has been done on this rack.

Population of one bin in the digital rack was started, and so far about one-half of the cards in this bin have been installed and tested in the rack.

Testing of all circuit cards for the spectrometer is complete with the exception of the Long Term Accumulator. Testing of all 1.6 GHz and 100 MHz production samplers for the spectrometer is also complete.

Testing of the prototype Long Term Accumulator for the spectrometer is complete and all production cards have been wirewrapped. The only items lacking for the completion of the LTA card testing are the DRAM adapter cards and PLCC adapters.

I. GREEN BANK ELECTRONICS

GBT Spectrometer

The wideband filter modules (800 MHz and 200 MHz) are all constructed, with the exception of the output amp. At this time, no testing has been done on these modules. Most of the metal work for the narrowband modules (50 MHz and 12.5 MHz) is under construction in the machine shop. Most electronic components are on order. All the filters for these modules have been received. The rack for filter modules is wired and ready to go. Both the low and high speed samplers are constructed. The initial testing of the low speed samplers is complete. This testing gets the samplers to the point of being fully functional. Additional testing will be done in the system to check for potential subtle problems. Initial testing of the high speed samplers will be completed shortly. Tektronix will lend a high speed scope to check timing of the high speed samplers

GBT IF/Converter Racks

The testing of the 1.6 GHz sampler/filter modules is still on hold because of lack of personnel.

The testing of the 100 MHz converter/filter modules is also still on hold because of lack of personnel.

Sixteen 1-8 GHz converter modules have been assembled and are presently under test.

Extensive research has been done to determine how to fix the GBT IF fiber optic distribution system problems. We have ordered polarization maintaining fiber and will install it on the 140 Foot Telescope for tests. Ortel Corporation has promised to work with us and try to help us to find a solution. They are loaning us different fiber optic receivers for our 140 Foot tests in August. A GBT memo has been generated for those wishing to better understand the problem.

GBT Receivers

The L-Band feed modifications are about 95 percent complete. The L-Band feed will be tested on the antenna test range in August. The L-Band OMT modifications should be complete by the end of July.

The four-band prime focus receiver will be installed on the 140 Foot Telescope in August for preliminary tests at 800 MHz.

The design and fabrication drawings for the 910 MHz-1230 MHz prime focus receiver ortho-mode transducer (OMT) was completed in May. It will be fabricated after the GBT L-Band OMT is completed.

The C-Band short-term tests are complete. We are now running it for long-term tests to verify the cryogenics system.

The S-Band Receiver is on hold because of lack of personnel. The S-Band feed fabrication has slid also until later this summer. The S-Band OMT design has slid to late summer or early fall due to a lack of personnel.

GBT 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. Over the past quarter we have reviewed the servo operations and maintenance manual and the field test procedures for the Azimuth/Elevation and the Feedarm Servo systems. Reviewing these documents requires good knowledge of the AUI Specification, the Servo Statements of Work, and a working knowledge of the system.

Site Operations

As usual, 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. This includes electronic maintenance, electronic design projects to assist users for special projects, and cyrogenic support for virtually every receiver in Green Bank. In addition, we have been preparing for outfitting the new addition to the Jansky Lab.

Normal day to day support of UNIX workstations, weather station, time systems, and local area networks is on-going.

J. TUCSON ELECTRONICS

68-115 GHz Receiver

New mixers have been installed in the low frequency pair of this receiver, resulting in appreciably improved performance over the 68-90 GHz band.

8-Beam 220-250 GHz Receiver

This receiver is now in routine use. Several early operational problems have been identified and solved. This receiver is the ideal candidate for the development of automatic tuning of receivers, and the software to realize this has been developed and implemented. Although all of our receivers are tuned remotely over the computer network at the telescope site (or even tuned over the Internet from our downtown offices), the precise tuning still relies on the telescope operator closing the loop. The receiver characteristics are such that a simple lookup table of tuning parameters is not adequate to ensure optimum performance. With eight receivers to tune, this clearly puts considerable demand on the operator and can lead to inefficiency in the setup time needed for a new observer, even though the individual receiver channels are less complex to tune than our regular single-beam systems. We are currently using the experience gained with automating the 8-feed system to modify the tuning procedure for all receivers on the 12 Meter Telescope.

The 8-Channel, 4-Beam, 3-mm System

A commercially available frequency tripler for the LO has been tested and works well at 4 K. This validates the concept of using coaxial lines to input the LO to the dewar at one-third of the LO frequency. The dewar has been built and awaits testing. The design of the basic receiver insert has been completed, and fabrication has begun. A crossed-grid polarization diplexer designed to operate at 4 K has been constructed and tested. The complete receiver system will likely be tested later this year.

Planned Wideband Continuum Receiver.

The availability of HEMT amplifiers covering the frequency range from 70 - 90 GHz raises the possibility of building a continuum receiver with a sensitivity of around 50 mJy per root sec; the extraordinarily high sensitivity comes from the very wide bandwidths. The major problem to be overcome is the 1/f noise which has been reported from early experiments. Although not necessarily worse in this system than in other HEMT amplifiers, the extremely large (bandwidth times integration time) product means that much lower levels of 1/f gain modulation can dominate the residual noise in the detected output from the receiver. Progress with this project is dependent on available manpower.

New Phase Lock Control

One of the most efficient observing modes, generally applicable to relatively narrow bandwidth observations, is frequency switching. Unlike other switching schemes, in this observing mode the object of interest is in the telescope beam and in the spectrometer passband for 100 percent of the time. At present we are limited in our ability to frequency switch, in both switching rate and in total frequency throw, by the analog phase lock system. We have designed and tested a prototype digital phase lock system that combines both frequency and phase control and provides faster, reliable switching over a broader frequency range. Our initial tests with this prototype indicated that we could switch by as much as ± 40 MHz, making frequency switching useable for a wide variety of research projects.

Another capability which will become practical, thanks to the enhanced digital phase lock, is *sideband smear* operation. This is a powerful technique of reducing confusion in spectral line observations from features appearing in the unwanted sideband. The principles have been established during some *ad hoc* test observations performed at the 12 Meter Telescope, and have been described in conference proceedings. The practical implementation of a usable system at the 12 Meter has been hampered by the performance of the phase lock system; fast switching times over a relatively large bandwidth are required. The digital phase lock should solve these problems.

Cryogenics

All receivers on the 12 Meter Telescope rely heavily on reliable operation of cryogenic systems. A new cryogenic compressor system has been developed for our closed-cycle 4 K refrigerator. The individual compressor units for the Gifford-McMahon refrigerator and the Joule Thomson expansion valve have been combined into a single unit, resulting in a smaller installation with lower power consumption. One of these new units has been fabricated and tested, and three more are under construction.

Quadrant Detector and Thermal Sensors

One of the main contributions to pointing changes on the 12 Meter Telescope is lateral movement of the subreflector, with respect to the main telescope surface. This is caused by unbalanced thermal effects on the subreflector support structure. We have installed a system on the 12 Meter to sense these changes; we have a laser quadrant detector to measure the lateral motion of the subreflector mount, with respect to the telescope central hub structure, and we have thermistors continuously monitoring the temperature of the feed legs and other parts of the telescope structure. We are currently trying to build up statistics to enable us to understand the detailed relationship between the thermal distribution of the telescope and telescope pointing offsets. At a later date we hope to incorporate the thermal data into our telescope pointing model to give real time pointing corrections.

K. SOCORRO ELECTRONICS

VLA 200 MHz Phase Switch

Microstrip prototypes of the new Walsh function phase switching scheme in the 200 MHz output of the L2 first local oscillator did not remove all the out-of-band signals which are imaged to appear in-band; nor did it greatly reduce the 1400 MHz spurious signal in L-band. Investigations indicated isolation via amplifiers will be required to reduce the effect of load pulling on the phase accuracy. We expect to evaluate isolated prototypes on five antennas early next quarter. A number of F12, 12-15 GHz converters excessively leak the 1400 MHz harmonic of 200 MHz, so all modules will be retrofitted with new RFI suppressed phase detectors. All antennas should be outfitted in the first quarter of 1997.

VLA Upgrade Prototype: K-band Front End

Development work continued slowly on a front end with the full bandwidth of the waveguide in the frequency range of 18 GHz to 26.5 GHz. The Central Development Lab completed a prototype polarizer consisting of a waveguide phase shift section and an OMT section. The phase shifter will be improved. Most components for two front ends are on hand. Dewar design and fabrication will occur next quarter. Assembly will start late in the third quarter of 1996. One front end will include three sub-band total power system temperature monitors for estimating atmospheric phase variations.

VLA Upgrade Prototype: F14 Module

Three new F14 modules with front panel cyro controls and analog monitoring will be built for the K-band front end project. The target for completion is August 1996.

VLA Pulsar Improvements

A new Rack Mounted PC passive backplane with 14 ISA/PCI slots upgraded the High Time Resolution Processor (HTRP) for pulsar observing. A Pentium 133 MHz single-board computer was installed in this backplane as well as a PCI video card, a SCSI controller, and 4 DAC boards. The number of channels was doubled from 28 to 56 for measurements of the four Stokes polarization parameters. The system worked very well during an April experiment.

In time for a critical observing session in April, the 14 MKIII video converters were gain (total power) equalized to within 0.25 dB at the 2 MHz bandwidth setting.

VLA Correlator Controller

The project plan was revised again. Work in hardware continues, but software slowed because of little available programmer time. The optical fiber link and serial I/O subsystems will be tested next quarter.

VLA Antenna B-Rack Shields and Optical Fibers

Twenty-eight shields with optical fibers have been installed in antennas. However, tests indicated shielding effectiveness is about 15 dB at P-band instead of the expected 35 dB. A New Mexico Tech student is locating and correcting leakage paths in a spare shield.

VLA Virtual Instrument Recorder (VIR)

This system replaces the eight-channel Digital Data Tape which uses an eight-channel Analog Recorder. All hardware and software work to provide AOC access to on-line VLA site monitoring and data recording using a graphical interface was completed. The system provides simultaneous multichannel and multiuser capability. Software development for long term data logging continues.

Cryogenics

We have used a variable-speed motor controller to investigate the effects of reduced-speed operation on a CTI 350 refrigerator. The refrigerator operates smoothly to 25 Hz with the controller feeding a Scott T transformer arrangement. Tests of load capacity vs speed will be done.

GPS Receivers

The Radio Code (U.K.) GPS receiver distributed by Brandywine Communications, which is nearly compatible with the VLBA Odetics 325 receivers, was returned to Radio Code to repair an operational defect. The receiver should be returned and operational at the VLA VLBI system early next quarter.

VLBA Masers

All masers operate satisfactorily except #11, which is at the AOC lab. It has falling IF level which indicates either a physics package degradation or decreasing gain of the IF amplifier. Retuning the IF amplifier narrowband filters resulted in normal IF level. The maser will be monitored for level stability over the next month.

VLBA IF Equalizing Amplifiers

Early this year we discovered a fabrication defect in most of the IF gain equalizing amplifiers which degraded their gain compression level by about 5 dB. Seven of the VLBA sites were tested and corrected.

VLBA M105 D-Rack Interface Module

Testing of sixteen modules resulted in a modification. The first field installation occurred at Pie Town. The remaining antennas will be completed by August.

VLBA Correlator

No additional failures have occurred in the batch of 1000 new ASDICS installed in the FFT cards. Four additional old ASICs have failed in the second quarter (as of June 18). Modification of the FFT cards has been completed, resulting in the elimination of slight errors in the Fractional Sample Time Correction that previously were detected in system tests.

A problem in 64 point FFTs was found and a firmware fix is ready to be installed. The problem was introduced three years ago as part of firmware changes to support high delay rates in OVLBI. The microprocessor on the FFT Control Cards has been upgraded to provide a speedup factor of approximately three. This change will support faster model updates in OVLBI if required.

Checkout of the 89 Playback Interface Modes for bit-to-track modes 1-4, 1-2 and 1-1 has been completed.

VLBA Data Acquisition and Playback

The VLBA switched to high density recording on May 1, 1996. After some initial problems, data quality through the recording system is generally good. Work continues toward improving the data quality at high density on certain playback drives. We are attempting to identify and eliminate playback noise which seems to affect data quality more at high density than at low density. New recorder firmware at the VLBA sites has greatly reduced vacuum losses during observing. Work continues on methods to deliver air with lower relative humidity (RH) to the head stack area.

Interference Protection

Data from the low-sensitivity survey of the electromagnetic environment at the VLA, described in the previous Quarterly Report, were flawed by temperature variations in the monitor equipment and by coupling of RF from the monitor equipment into the spectrum analyzer. In response, the monitoring station has been moved into a military surplus shielded structure. An HVAC unit now maintains the test equipment temperature to within ± 5 degrees Fahrenheit which has stabilized the data. Shielding by the structure and use of a shielded personal computer (PC) have eliminated measurable local interference to the monitoring equipment. Prior measurements will be repeated.

The shielded PC mentioned in the previous paragraph is the product of a NM Tech Senior Design Project. Two Tech electrical engineering students, as part of their undergraduate curriculum, reduced the UHF emissions of an NRAO PC by as much as 50 dB, using shielding and filters. A report is available.

Representatives from Motorola Iridium visited the VLA site to better understand deployment of the RASE (Radio Astronomy Special Equipment) beacon at radio astronomy observatories. The RASE is intended to prevent mobile units from communicating with the Iridium constellation of Low Earth Orbit (LEO) satellites and thereby reduce satellite-traffic-induced RFI in the vicinity of the Observatory. However, there is much concern that operation of the RASE will in itself cause RFI by gain compressing the radio

astronomy receiver. Deployment of the Iridium communication satellites, which will use a band adjacent to the OH band of 1610.6 MHz - 1613.8 MHz, is scheduled to begin later this year.

The Front-end Group modified an L-band FET amplifier to contain only one stage of amplification, and a pair of low-loss cryogenic transmission lines in order to test a 1-stage amplifier/room temperature filter/cryo postamp configuration. This configuration will be installed on one VLA antenna for Iridium satellite tests. Normal cryo/ambient amplifier configuration will experience sufficient gain compression to impair satellite spurious emission measurements when the satellite is in the VLA main beam.

The online P and L band monitor at the VLA mentioned in a previous Quarterly Report was used to measure signal activity in L band (1155 - 1734 MHz). A frequent intermittent signal interfering with the VLA L band survey was found at ~1381 MHz, possibly related to GPS L3 operation; but the dominant impact of interference on the survey was activity in the 1350 - 1400 MHz range between the hours of 0700 - 2200 local. The frequency band 1350 - 1400 MHz is a military communication band; a large air defense exercise was being conducted at WSMR during the time when interference was strongest. The spectrum analyzer used for the monitor has been updated to a newer model that provides improved frequency identification and permits remote control, once software is completed.

The prototype auto-correlator described in the previous Quarterly Report was tested successfully at the VLA. Sensitivity is improved over a swept frequency analyzer by 13 dB, given equal spans, resolution bandwidths and real time averaging on both spectrometer and analyzer. A planned frequency downconverter will allow the auto-correlator to replace the spectrum analyzer in the P and L band online monitor.

L. COMPUTING AND AIPS

1996 RE Budget

Fifty thousand dollars has been allocated for computing RE. Rather than going towards true research equipment, it will be budgeted for one or two projects which aim to shore up NRAO's networking infrastructure between sites (see the section on the NRAO Intranet below) and inside the AOC.

With luck, there may be small amount of funds towards the end of the year to go towards true RE projects, such as investigating small, inexpensive multi-processor systems.

NRAO Intranet

We are pursuing the creation of a dedicated frame-relay network between the NRAO sites, including many of the VLBA stations. Such a dedicated network, or "Intranet," will provide guaranteed levels of service allowing critical functions to be reliably carried out. Currently, most intersite computer networking traffic relies on the Internet, which is unable to provide the levels of service required at reasonable cost. The benefits of the NRAO Intranet will be dramatically improved reliability and higher bandwidth to Green Bank, which currently has only a 56 kbit link to the Internet. NRAO will remain firmly connected to the Internet through one or two gateways, but intersite networking will no longer depend on the Internet. There will likely be some moderate startup costs associated with the Internet, but rough estimates are that the operations cost of the NRAO Intranet will be similar to our current Internet connections.

Strategic Partnership between NRAO and NCSA

Working under the aegis of our strategic partnership with the NCSA, NRAO has installed the latest release of AIPS at NCSA. The version is kept up to date via the AIPS midnight job. Testing and benchmarking are underway.

ADASS '96: Sixth Annual Conference on Astronomical Data Analysis Software and Systems

NRAO is the host institution for the Sixth Annual Conference on Astronomical Data Analysis Software and Systems (ADASS). The Conference will be held in Charlottesville, Virginia, at the Omni Charlottesville Hotel, 1996 September 22-25. ADASS is an international conference which provides a forum for scientists and programmers concerned with algorithms, software, and software systems employed in the reduction and analysis of astronomical data. Approximately 300 participants are expected.

The preliminary program for the Conference has been mailed to over 1100 potential attendees; it is available on the World Wide Web through the Conference home page at http://www.cv.nrao.edu/adass/.

VLA Computing Projects and Hardware

In the VLA re-archiving project, which reformats and copies all VLA data onto Exabyte tape, the 1988 data were completed. This leaves the data from 1984 through 1987; work on the 1984 data recently has started. At the current rate of progress, which is considerably slowed by the presence of poor quality tapes from the mid-eighties, we estimate that the project will take another 2 - 3 years to complete. These poor quality tapes are one more justification for the whole re-archiving effort, in a couple of more years, the data on these tapes might have become totally unrecoverable. Another, smaller, delay is caused by a bug in the rearchiving program which caused antenna files to be missing in data from the earlier years; we are planning to halt the regular rearchiving process for 2 - three months in order to recover those missing antenna files. The VLA archive database is accessible via the NRAO home page and contains full header information on all data except for the aforementioned period 1984 - 1987.

The almost five year old public IPX workstations Acoma and Isleta were replaced by Sparc Ultra I machines. The names of the machines remain the same, but visitors and staff alike will appreciate the factor of 5 - 6 increase in speed. These workstations will be primarily allocated to users with large VLBA or VLA data sets, and will be especially useful as soon as the first VSOP (orbiting VLBI) data are run through the correlator. We are experimenting successfully with the system of "primary" and "secondary" user on these machines, which allows in-house staff members to share the machine with a colleague. Since this latest purchase we have only three public machines (out of a total of 15) left with Sparc IPX-like performance.

AIPS Release Information

We introduced a more accurate system of counting shipped AIPS versions, in which a *source only* shipment combined with a *binaries* shipment is now counted as only one shipment. This reduces the previously published numbers: the total number of shipped versions of 15JUL95 AIPS is now 189, and the current number for 15JAN96 AIPS is 140 (the latter number is still rising). These numbers are still higher than that of any previous AIPS release. The percentage of shipments using anonymous ftp appears to have stabilized at 80 percent, and the percentage of shipments which include binaries at roughly 60 percent

Personnel

In March 1996, Ketan Desai joined the AIPS group to work on software to support the OVLBI project. In April 1996, Eric Greisen decided to leave the AIPS group, which is a loss to the AIPS project. The AIPS group currently consists of approximately 6 FTE's, who have to share the load of developing new software (primarily VLBA and OVLBI), maintaining existing software, supporting the world-wide community of users, and maintaining the AIPS installations at NRAO sites.

General Developments

New bandpass calibration modes were added, specifically bandpass interpolation, with correct treatment of flagged BP entries, and allowing weighted and unweighted two-point interpolation. A new task, ELINT, has been developed to allow elevation interpolation of calibration tables. Other new developments in the general area concentrated on increasing the overall robustness, and implementing changes and improvements as suggested by the AIPS user community.

VLBA Specific Developments

The objectives for VLBI-related work in AIPS remain the maintenance of existing support for VLBI data reduction and the development of new applications for the VLBA and Space VLBI. A number of general changes have been made in this area during the last quarter to improve the reliability and utility of the VLBI software. Specific new developments have included the addition of IF-selection to the VLBA data loading task FITLD, the development of software support for the new subarraying capability of the VLBA correlator and continued work to add orbiting VLBI capability to existing tasks. The testing of AIPS tasks using simulated data has continued in this quarter with specific enhancements in preparation for orbiting VLBI data. A new task to aid in space VLBI fringe-fitting has been substantially completed which allows the phasing up of the ground component array.

M. AIPS++

In the second quarter of 1996, we proceeded with work aimed towards a beta release of AIPS++ targeted for early 1997. We also worked towards supporting the use of AIPS++ for a number of applications: an HI survey using a multibeam system on the Parkes telescope, as the prime data reduction system for the GBT, and used as the prime on-line data inspection system for the new WSRT on-line system, TMS. We have continued development of the infrastructure needed to support these activities, in the Table system, in the User interface, in the Measures system, and in documentation. Work in all of these areas has proceeded reasonably well, although continuing problems with compilers have generally slowed the Project. The most significant obstacle has been continuing difficulties in some areas of design, most particularly the design of the single dish analysis package, this resulting in a delay of a few months in the first tests of a single dish package for the GBT. A cross comparison of synthesis processing by Newstar and AIPS++ has been performed and confirms that the AIPS++ synthesis package can reproduce the results from Newstar even at very high levels of precision. First tests of programming AIPS++ by non-expert programmers have also been encouraging, showing that the promises of object-oriented programming are to some extent being realized. Planning for the beta and full releases is continuing, and a detailed list of the targeted contents of the first beta release has been drawn up.

N. GREEN BANK TELESCOPE PROJECT

Antenna

Construction of the Green Bank Telescope has made significant progress over the last quarter. The antenna structure has grown with the regular addition of main members in the air, including eight of the ten trusses that make up the box structure.

In addition, much progress has been made on the ground with the erection of sub-assemblies which will be lifted onto the main structure at a later time. The backup structure (BUS) trial erection on the assembly pad is progressing nicely. Trusses are in place up to trusses R15L and R12R for hoops 15 to 33. For reference, there will be 57 ribs in the final structure (the center rib plus 28 right and left) extending from the apex at the base of the feed arm for 44 hoops to the outer edge of the dish. This is a major part of the current site work and will continue through the summer. Welding is complete through modules 2L and 2R.

The upper feed arm (the section of the feed arm which will be ultimately above the receiver room) has been completed on its trial erection foundation. It is completely welded and the access and stairways are near completion. The prime focus boom is also in place on the arm.

Trial erection of one cube section of the horizontal feed arm is complete and the second cube (out of five total) is underway.

The subreflector backup structure assembly is complete on a frame at the site. Panels will be shipped and installed later this summer so that the subreflector may be measured before its installation on the upper feed arm.

All of the servo system equipment has been delivered to the site. Testing will be conducted this summer. Many smaller items have been completed or are underway including installation of electrical lines, HVAC, control cables and cable trays, and painting.

Electronics

Work by the GBT Electronics group continues on several receiver front-ends, the GBT spectrometer, parts of the IF and LO systems, and several other vital parts of the GBT receiving electronics. The microwave design of the 1.15-1.73 GHz front-end has been complete for some time, and almost all of the construction components are in hand. A moding problem was encountered with the orthomode transducer for this front-end, and work is underway to correct the problem. Some design and fabrication of radiation shields has yet to be done. Once these problems are solved, assembly of the dewar will begin. A rigid-foam and epoxy-fiberglass coating has been applied to the 1.15-1.73 GHz Gregorian feed-horn. This coating greatly increases the rigidity of the ten-foot long horn, as well as providing thermal insulation. A microwave design for the 1.73-2.6 GHz front-end has been started, and a prototype 40-52 GHz single-beam assembly is well underway. Work on the spectrometer digital correlator preceded without serious obstacles, and despite manpower shortages progress was made on the spectrometer IF section.

A serious technical problem with the transmission of IF signals over optical fibers was recognized in December during tests of the GBT IF systems on the 140 Foot, and study of the causes, as well as investigation of solutions, have been a major focus. The problem involves a change in the polarization of the IF modulated laser light as the fiber is bent or twisted. Because the optical receivers used to demodulate the light are slightly sensitive to polarization, an apparent system gain change correlated with antenna motion was observed. Several solutions to this problem are being evaluated. One promising solution still under investigation is the use of a special type of polarization-maintaining fiber.

Monitor and Control

The development of Monitor and Control (M&C) software continues, with current emphasis on antenna control, local oscillator control, enhancements to the control screens, and the design of a system to manage the interconnections of front-ends, IF/LO, and back-ends. In January the M&C software interface to the contractor servo systems was tested in conjunction with factory acceptance tests of the feedarm servo systems. Additional testing with the actual feedarm mechanisms will occur following field tests by the contractor later this summer, where their servo system is for the first time connected to the actual mechanisms. Initial versions of the focus-tracking routines were completed. These routines describe how to control the prime focus or the subreflector as the structure deforms under gravity, and will be incorporated in the antenna controller. A simplistic version of the local-oscillator manager was used in integrated tests at the 140 Foot, in order to prove the design concept, doing simple frequency-switched observations on test tones. A production manager is now being developed, incorporating Doppler tracking. In addition to the software development underway, an internal review of the M&C hardware design was completed, and the results will be presented to other NRAO experts in late July.

Active Surface

The production of surface actuators and controllers for the Open-loop Active Surface is now complete. Until delivery of the antenna and installation of the surface control hardware begins, little more hardware work remains to be done. The major work yet to be completed for the active surface is software, both for the embedded software which controls the individual actuators and monitors the hardware's health, and for the higher-level software which determines to where the actuators should be set in order to achieve the desired surface. Work is now underway on both these tasks.

The Metrology group continues to develop and refine the laser rangefinders and associated systems. A problem was encountered with encoders used in the steerable mirror assembly. Correction of the problem necessitated replacement with a different encoder type and some redesign of the assembly. The retrofit delayed progress on our effort to demonstrate integrated operation of several rangefinders tracking a retroreflector mounted on the 140 Foot. However, that effort is again going forward, and we hope to report success later this summer. Four monuments with associated utilities and control hardware are now in place and preliminary versions of the tracking and control software have been tested. In addition to work on the rangefinders, parallel experimental work on a quadrant detector system is underway. It is expected that this system will provide data on feedarm motions in order to assist in our effort to characterize the antenna as well as achieve precision pointing.

O. PERSONNEL

New Hires

REU Students

Terminations

L. Macknik (RIF)	Deputy Assistant Director - Green Bank	04/05/96
A. O'Donoghue	Visiting Scientist	05/08/96
C. Smith	Librarian - Socorro	05/31/96
T. Roberts	Scientific Programmer	06/24/96
T. Bania	Visiting Scientist	06/28/96

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