NATIONAL RADIO ASTRONOMY OBSERVATORY

QUARTERLY REPORT

April 1 – June 30, 1999

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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 1999.

	140 Foot	12 Meter	VLA	VLBA
Scheduled Observing (hrs)	2013.50	1720.25	2189.10	1404.00
Scheduled Maintenance and Equipment Changes	170.50	150.75	218.80	199.00
Scheduled Tests and Calibration	35.00	308.50	342.90	170.00
Time Lost	90.75	125.75	561.60	53.00
Actual Observing	1922.75	1594.50	1627.50	1351.00

B. 140 FOOT OBSERVING PROGRAMS

The following continuum programs were conducted during this quarter.

No.	Observer(s)	Programs
F138	Finkbeiner, D. (UC, Berkeley) Curtis, F. (UC, Berkeley) Heiles, C. (UC, Berkeley) Schlegel, D. (Princeton) Davis, M. (UC, Berkeley)	A search for dust-correlated emission at 8 and 10 GHz.
D195	de Pater, I. (UC, Berkeley) Millan, R. (UC, Berkeley) Maddalena, R.	Jupiter's radio spectrum from 74 MHz up to 8000 MHz.

The following line programs were conducted during this quarter.

No.	Observer(s)	Programs
B695	Braatz, J. Wilson, A. (UMD) Henkel, C.(MPIR, Bonn)	Water maser monitoring and accretion disk dynamics in AGN.
B696	Bania, T. (Boston) Rood, R. (Virginia) Balser, D. Lockman, F. J.	A search for ^{3}He in the diffuse interstellar medium.
H335	Heiles, C. (UC, Berkeley) Young, L. (New Mexico State) Normandeau, M. (UC, Berkeley)	HI emission and Zeeman splitting in the spider's legs.
L339	Lockman, F. J. Murphy, E. (Johns Hopkins)	Extension of the 140 Foot Galactic Plane HI survey.

No.	Observer(s)	Programs
L340	Li, D. (Cornell) Goldsmith, P. (NAIC, Cornell)	Study of massive star formation: Probing cold cores in GMCs.
M428	Minter, A. Balser, D. Wiersgala, N.	Is the turbulence in HII regions inherited or generated?
R270	Rood, R. (Virginia) Balser, D. Bania, T. (Boston)	^{3}He abundances in galactic neutral hydrogen clouds.
R275	Roberts, M. Hogg, D.	A study of HI asymmetry in isolated galaxies, Part II.
R276	Rood, R. (Virginia) Balser, D. Bania, T. (Boston)	^{3}He abundances in galactic HII regions.
T378	Turner, B. Heiles, C. (UC, Berkeley) Fisher, R.	The C^{4}H Zeeman effect as a probe of magnetic fields in dense molecular clouds, and as a test case for polarimetric observations on the GBT.
T381	Turner, B. Lubowig, D. (AIR)	A search for atomic Na and 25 Mg^+.
W398	Wootten, H. A. Claussen, M. Wilking, B. (Missouri)	Water maser monitoring of low -luminosity young stellar objects.
W411	Wootten, H. A.	Water in comets.

The following pulsar programs were conducted during this quarter.

No.	Observer(s)	Programs
B687	Backer, D.(UC, Berkeley) Somner, A. (UC, Berkeley) Sallmen, S. (UC, Berkeley) Foster, R. (NRL)	Pulsar timing array.
N018	Nice, D. (Princeton) Thorsett, S. (Princeton)	Monitoring the irregularities in the rotation and orbital motion of a binary pulsar B1744-24A.

The following very long baseline programs were conducted during this quarter.

No.	Observer(s)	Programs
GF07	Fomalont, E., *et al.*	VLBA continuum observation of source 1504-166.
VS02 VS04 VS07	Hirabayshi, H. (ISAS, Japan)	VSOP survey.
W012	Ulvestad, J.	VSOP observation of J0919+33, J0949+29, J1001+29, and J1044+29 at 5 GHz.
W018	Snellen, I. (Cambridge)	VSOP observation of J1335+45 at 1.6 GHz.
W027	Murphy, D., *et al.* (JPL)	VSOP observation of J1927+73 at 1.6 GHz
W035	Gurvits, L. (NFRA)	VSOP observation of J1746+62 at 1.6 GHz.
W056	Bartel, N., *et al.* (York U)	VSOP observation of M81 at 5 GHz.
W112	Ulvestad, J.	VSOP observation of J1134+29, J1205+30, and J1228+31 at 5 GHz.

C. 12 METER OBSERVING PROGRAMS

No.	Observers	Programs
A142	Apponi, A. (CfA) McCarthy, M. (CfA) Thaddeus, P. (CfA)	Study of rhombic SiC_3 in IRC+10216.
C323	Clancy, R. T. (SSI, Boulder) Sandor, B. (High Altitude Obs.)	Mars and Venus temperature and water studies.
C325	Charnley, S. (NASA/Ames) Egan, M. (Hanscom /AFGL) Carey, S. (Boston College)	Study of molecular depletion in the ultradense MSX IRDCs.
CB11	Bower, G. (MPIR, Bonn) Backer, D. (UC, Berkeley) Wright, M. (UC, Berkeley)	Continued monitoring and polarimetric imaging of NRAO 530: a decelerating, subluminal gamma-ray blazar?
CB12	Bower, G. (MPIR, Bonn) Krichbaum, T. (MPIR, Bonn) Zensus, J. A. (MPIR, Bonn)	Do EGRET blazars differ from other flat-spectrum radio sources?

No.	Observer(s)	Programs
CC09	Colomer, F. (Yebes Obs) Cernicharo, J. (IEM-CSIC, Spain) Desmurs, J. (Yebes Obs) Baudry, A. (Bordeaux)	Study of high-velocity SiO maser emission from evolved stars.
CD13	Doeleman, S. (Haystack) Boboltz, D. (Haystack) Lonsdale, C. (Haystack)	Imaging the v=1, J= 2→1 86 GHz SiO masers toward χ Cygni.
CD14	Doeleman, S. (Haystack) Rogers, A. (Haystack) Bower, G. (MPIR, Bonn) Backer, D. (UC, Berkeley) Wright, M. (UC, Berkely)	Determining the structure of Sgr A* with 3 mm λ-VLBI.
CK08	Kardashev, N. V (ASC, Moscow) Kovalev, Y. (ASC, Moscow) Gabuzda, D. (ASC, Moscow)	3 mm VLBI monitoring of the BL Lacertae object 0235+164 after an optical and radio outburst.
CL05	Lonsdale, C. (Haystack) Boboltz, D. (Haystack) Doeleman, S. (Haystack)	The statistical properties of 86 GHz SiO masers around evolved stars.
CL06	Lo, K. Y. (SA/IAA, Taiwan) Zhao, J. (CfA) Ho, P. (CfA) Shen, Z. (SA/IAA, Taiwan)	Mapping the intrinsic source structure of Sgr A* at 86 GHz.
CP05	Phillips, R. (Haystack) Boboltz, D. (Haystack) Marvel, K. (Caltech)	Observations of the 86 GHz SiO maser emission towards Mira.
CR08	Rantakyrö, F. (Bologna) Conway, J. (Chalmers, Onsala) Wehrle, A. (IPAC) Bååth, L. (Halmstad U.) Booth, R. (Chalmers, Onsala)	Continuing millimeter-VLBI monitoring of 3C273 and 3C279.
G368	Gao, Y. (Toronto) Gruendl, R. (Illinois) Lo, K. Y. (SA/IAA, Taiwan) Hwang, C-Y. (SA/IAA, Taiwan)	Study of the widely-separated ultraluminous infrared galaxies.
G369	Gruendl, R. (Illlinois) Gao, Y. (Toronto) Lo, K. Y. (SA/IAA, Taiwan) Hwang, C-Y. (SA/IAA, Taiwan)	Full synthesis imaging of CO (1–0) emission in Arp 244.

No.	Observer(s)	Programs
H339	Helfer, T. Thornley, M. Regan, M. (DTM/Carnegie) Sheth, K. (Maryland) Vogel, S. (Maryland) Harris, A. (Maryland) Wong, T. (UC, Berkeley) Blitz, L. (UC, Berkeley) Bock, D. (UC, Berkeley)	Continuing program: zero-spacing data for BIMA SONG.
K361	Kuan, Y-J. (ASIAA, Taiwan) Snyder, L. (Illinois) Charnley, S. (NASA/Ames) Wilson, T. (MPIR, Bonn) Lovas, F. (JILA)	Study of interstellar glycine.
K364	Koo, B-C. (Seoul National U.) Rho, J. (IPAC) Reach, W. (IPAC)	CO observations of the shocked molecular gas in supernova remnants.
L342	Liszt, H. Lucas, R. (IRAM)	Study of ^{13}CO and SiO in W49.
M429	Moore, T. (Liverpool JMU) Ridge, N. (Liverpool JMU) Chandler, C. (Cambridge) Collins, C. (Liverpool JMU)	Study of the luminosity correlation for high-mass molecular outflows.
M430	Magnani, L. (Georgia) LaRosa, T. (Kennesaw State) Shore, S. (Indiana)	CO (1–0) observations of MBM40.
M431	Moore, T. (Liverpool JMU) Ridge, N. (Liverpool JMU) Chandler, C. (Cambridge)	Study of the Ophiuchus dwarf protostars outflows.
M432	Muders, D. (Arizona) Uchida, K. (Ohio State)	Study of the ionization of molecular clouds.
M433	Matthews, L. Gao, Y. (Toronto) van Driel, W. (Paris Obs)	CO observations of low surface brightness.
P181	Pankonin, V. (NSF) Bieging, J. (Arizona) Churchwell, E. (Wisconsin)	Study of C^{18}O in hot cores.
R273	Reynoso, E. (IAFE) Mangum, J.	Imaging the CO emission around the supernova remnants CTA1 and CTB1.

No.	Observer(s)	Programs
S436	Sandor, B. (High Altitude Obs) Clancy, R. T. (SSI, Boulder)	Earth atmosphere studies.
S442	Strelnitski, V. (Maria Mitchell Obs) Gordon, M. Moringello, S-A. (Vassar College)	Monitoring of MWC 349 in H30α and H35α recombination lines.
S443	Shah, R. (Virginia) Wootten, H. A.	Study of deuteration in galactic protostellar cores.
S445	Saito, M. (CfA) Kamazaki, T. (Tokyo U.) Takakuwa, S. (Tokyo U.)	Density and velocity distribution of stellar cores in Taurus: a new method to investigate the evolution of low-mass protostars.
T296	Turner, B.	A 2 mm spectral survey of Orion, SgrB2, W51M, and IRC+10216.
T380	Turner, B.	Study of deuterium in translucent clouds.
V90	Verheijen, M. Rhee, M-H. (CSA, Yonsei U., Korea) Yun, M. Byun, Y-I. (CSA, Yonsei U., Korea) Chung, A. (CSA, Yonsei U., Korea)	CO observations of spiral galaxies in the Ursa Major cluster.
W360	Wolf-Chase, G. (Chicago) Davidson, J. (NASA/Ames)	CO J=2–1observations of outflows in the Mon OB1 dark cloud.
W416	Williams, J.	Study of the dense gas dynamics in a filament of Class 0 sources along the Orion ridge.
W418	Williams, J. Bergin, T. (CfA)	Study of the ionization fraction in high-density molecular gas.
W419	Williams, J.	Study of CO and $C^{18}O$ in NGC 1333.
Z147	Zhu, M. (Toronto) Bushouse, H. (STScI) Frayer, D. (Toronto) Seaquist, E. (Toronto)	Study of molecular gas in strongly interacting galaxies.
Z161	Ziurys, L. (Arizona) Savage, C. (Arizona) Apponi, A. (CfA)	Is IRC+10216 unique? Searches for metal-bearing species towards other AGB stars.
Z165	Ziurys, L. (Arizona) Apponi, A. (CfA) Savage, C. (Arizona) Thompsen, J. (Arizona)	Chemistry in photon-dominated regions III: searches for interstellar NO^+.

No.	Observer(s)	Programs
Z166	Ziurys, L. (Arizona) Savage, C. (Arizona) Thompsen, J. (Arizona) Scheu, E. (Arizona)	Is IRC+10216 unique? Continued searches for metal-bearing species towards other objects.

D. THE VERY LARGE ARRAY OBSERVING PROGRAMS

No.	Observer(s)	Program
AA240	Anantharamaiah, K. (Raman Institute) Goss, W. M.	Orthogonal rotating gaseous disks in NGC 253. 3.6 cm line
AB881	Brunetti, G. (Bologna) Bondi, M. (Bologna) Dallacasa, D. (Bologna) Fanti, R. (Bologna) Feretti, L. (Bologna)	FR II radio galaxy 3C219. 6 cm
AB896	Beck, R. (MPIR, Bonn) Dumke, M. (IRAM) Golla, G. (Bochum)	Magnetic fields in the halo of NGC 4631. 6 cm
AB897	Bhatnagar, S. (NCRA, India) Rao, A. (NCRA, India)	Galactic SNR at low frequencies. 90 cm
AB898	Beck, R. (MPIR, Bonn) Shoutenkov, V. (Lebedev) Shukurov, A. (Lebedev) Sokoloff, D. (Moscow/SSAI)	Magnetic fields in barred galaxies. 3.6, 6 cm
AB899	Bregman, J. (Michigan) Wakkar, B. (Wisconsin) Miller, E. (Michigan)	High velocity cloud complexes in Milky Way type galaxies. 20 cm line
AB903	Brosius, J. (NASA/GSFC) White, S. (Maryland) Thompson, B. (NASA/GSFC)	Coronal magnetography using radio and EUV data. 2, 3.6, 6, 20 cm
AB908	Brogan, C. (Kentucky) Frail, D. Goss, W. M. Troland, T. (Kentucky)	Zeeman measurements of 1720 MHz OH masers in supernova remnants. 20 cm line
AB910	Bower, G. Falcke, H. (MPIR, Bonn) Backer, D. (UC, Berkeley)	Spectrum of circular polarization in Sagittarius A. 2, 3.6, 6, 20 cm

No.	Observer(s)	Programs
AB911	Brisken, W. (Princeton) Fruchter, A. (STScI) Goss, W. M. McGary, R. (Harvard) Thorsett, S. (Princeton)	Improper motions: a study of pulsar velocities. 20 cm
AB912	Browne, I. (Manchester) Jackson, N. (Manchester) Wilkinson, P. (Manchester) Phillips, P. (Manchester) Marlow, D. (Pennsylvania) Rusin, D. (Pennsylvania)	Possible lenses from JVAS/CLASS with separations greater than 6". 2, 20 cm
AB915	Butler, B. Slade, M. (JPL) Haldemann, A. (Caltech) Muhleman, D. (Caltech)	Goldstone/VLA radar observations of Mars. 3.6 cm line
AB916	Biretta, J. (STScI) Perley, R.	Search for kiloparsec-scale motion in 3C 273 and 3C 279. 2, 6 cm
AB921	Bregman, J. (Michigan)	Galactic hydrogen in front of the Perseus cluster line.
AB922	Browne, I. (Manchester) Marlow, D. (Pennsylvania) Myers, S. (Pennsylvania) Wilkinson, P. (Manchester) Fassnacht, C. (Caltech) Readhead, A. (Caltech) Xanthopoulos, E. (Manchester) Rusin, D. (Pennsylvania) Biggs, A. (Manchester) Blandford, R. (Caltech) de Bruyn, A. G. (NFRA) Jackson, N. (Manchester) Koopmans, L. (Groningen/Kapteyn) Norbury, M. (Manchester) Pearson, T. (Caltech)	Gravitational lens monitoring combined program. 3.6, 6, 10 cm
AC308	Condon, J. Cotton, W. Perley, R.	All sky survey. 20 cm
AC522	Clarke, T. (Toronto) Ensslin, T. (MPIR, Bonn) Thierbach, M. (MPIR, Bonn) Deiss, B. (Cologne) Klein, U. (Bonn U.) Kronberg, P. (Toronto)	Merging cluster Abell 2256. 6, 20 cm

No.	Observer(s)	Programs
AC527	Contreras, M. (/Mexico/UNAM) Rodriguez, L. F. (Mexico/UNAM)	Time variations in the binary system WR 147. 3.6 cm
AC533	Curiel, S. (Mexico/UNAM) Trinidad, M. (Mexico/UNAM) Torrelles, J. (IAA, Andalucia) Canto, J. (Mexico/UNAM) Rodriguez, L. (Mexico/UNAM) Gomez, J-L. (ESA, Spain) Ho, P. (CfA)	Radio jet/H_2O maser systems around young stellar objects. 1.3 cm line
AD421	Dahlem, M. (ESTEC) Ehle, M. (MPIfEP, Garching) Haynes, R. (CSIRO) English, J. (STScI) Lisenfeld, U. (IRAM)	Search for radio halos in late-type spiral galaxies. 20 cm
AD422	Dickey, J. (Minnesota) McClure-Griffiths, N. (Minnesota)	Absorption of linear polarization of the galactic background. 20 cm line
AD423	DiFrancesco, J. (CfA) Myers, P. (CfA) Lee, C. (CfA) Wilner, D. (CfA) Williams, J. (CfA)	A short VLA search for youngest protostellar sources. 3.6 cm
AD428	Dallacasa, D. (Bologna) Stanghellini, C. (Bologna) Fanti, R. (Bologna) Centonza, M. (Bologna)	High frequency peakers. 1.3, 2, 3.6, 6, 20 cm
AE124	Eyres, S. (Liverpool JMU) Evans, A. (Keele) Bode, M. (Liverpool JMU) O'Brien, T. (Liverpool JMU) Davis, R. (Manchester) Ivison, R. (U. College London)	Recurrent nova U Sco. 1.3, 2, 3.6, 6, 20 cm
AE130	Edge, A. (Durham) Carilli, C. Crawford, C. (Cambridge) Fabian, A. (Cambridge) Allen, S. (Cambridge) Augusto, P. (Portugal)	Survey of HI in cooling flow clusters. 20 cm line
AF349	Feretti, L. (Bologna) Giovannini, G. (Bologna) Tordi, M. (Bologna)	Observations of new radio halos and relics from NVSS. 20 cm

No.	Observer(s)	Programs
AF350	Falcke, H. (MPIR, Bonn) Lobanov, A. (MPIR, Bonn) Wright, M. (UC, Berkeley) Bower, G. Aller, M. (Michigan) Terasranta, H. (Helsinki) Patnaik, A. (MPIR, Bonn)	Monitoring extremely variable spiral III Zw 2. 1.3, 2, 3.6, 6, 20, 90 cm
AF356	Frail, D. Kulkarni, S. (Caltech)	Search for faint nebulae powered by magnetars. 20 cm
AF359	Fassnacht, C. Blandford, R. (Caltech) Browne, I. (Manchester) Myers, S. (Pennsylvania) Pearson, T. (Caltech) Readhead, A. (Caltech) Wilkinson, P. (Manchester)	VLA monitoring of the gravitational lens 1608+656. 3.5 cm
AF363	Farrell, W. (NASA/GSFC) Desch, M. (NASA/GSFC) Kassim, N. (NRL) Zarka, P. (Paris Obs) LeBlanc, Y. (Paris Obs) Dulk, G. (Paris Obs) Bastian, T.	Search for extrasolar planet emission at 74 MHz.
AG552	Gomez, Y. (Mexico/UNAM) Rodriguez, L. (Mexico/UNAM) Marti, J. (U. Jaen)	Ammonia emission toward the exciting source of HH80-81. 1.3 cm
AG558	Gudel, M. (SFIT, ETH) Audard, M. (SFIT, ETH) Guinan, E. (Villanova)	High-frequency spectra of two active dMe flare stars. 0.7, 2, 3.6, 6 cm
AG559	Green, D. (Cambridge) Thomas, H. (Cambridge) Alexander, P. (Cambridge) Eales, S. (Wales)	HI observations of galaxies in the JCMT/SCUBA galaxy survey. 20 cm line
AG563	Gibb, A. (U. Leeds) Hoare, M. (U. Leeds)	SiO imaging of three outflow sources. 0.7, 1.3 cm
AG564	Gottesman, S. (Florida) Malphrus, B. (Morehead State) Simpson, C. (NAO, Japan) Laine, S. (Hertfordshire)	A sample of interacting galaxies. 20 cm

No.	Observer(s)	Programs
AG567	Giovannini, G. (Bologna) Treves, A. (Milano Obs) Falomo, R. (Padova) Govani, F. (Padova) Scarpa, R. (STScI) Urry, C. M. (STScI)	Two new gravitational lens candidates. 0.7, 1.3, 2, 3.6, 6 cm
AG574	Gregg, M. (UC, Davis) Becker, R. (UC, Davis) Laurent-Muehleisen, S. (LLNL) White, R. (STScI)	Bright quasar lensing search. 3.6 cm
AG577	Gower, A. (Victoria) Patton, D. (Victoria)	Radio galaxies identified in CNOC2 field galaxy redshift survey. 3.6, 20 cm
AH662	Hunter, T. (CfA) Zhang, Q. (CfA) Churchwell, E. (Wisconsin)	Formaldehyde absorption in massive submillimeter protostar G12.20-0.12. 6 cm line
AH666	Hoffman, G. (Lafayette College) Brosch, N. (Tel-Aviv U.) Salpeter, E. (Cornell)	Neutral hydrogen envelopes of Virgo cluster BCDs. 20 cm line
AH669	Hjellming, R. Rupen, M. Mioduszewski, A.	Galactic black hole x-ray transients. 1.3, 2, 3.6, 6, 20 cm
AH670	Heiles, C. (UC, Berkeley) Young, L. (New Mexico State) Normandeau, M. (UC, Berkeley)	HI emission and Zeeman splitting in one of the Spider's legs. 20 cm line
AH672	Harris, D. (CfA) Walker, R. C. Leeuw, L. (Hawaii)	25" knot in the radio jet of 3C 120. 0.7, 2 cm
AH673	Helbig, P. (Manchester) Browne, I. (Manchester) Jackson, N. (Manchester) Wilkinson, P. (Manchester) Xanthopoulos, E. (Manchester) Blandford, R. (Caltech) Fassnacht, C. (Caltech) de Bruyn, A. G. (NFRA) Koopmans, L. (Groningen/Kapteyn) Marlow, D. (Pennsylvania) Myers, S. (Pennsylvania) Rusin, D. (Pennsylvania)	Study of the source population that forms CLASS gravitational lenses. 6 cm

No.	Observer(s)	Programs
AH674	Herrnstein, J. Wrobel, J. Mahadevan, R. (Cambridge)	Nearby quiescent ellipticals. 3.6 cm
AH676	Hameed, S. (New Mexico State) Young, L. (New Mexico State)	HI imaging of six early-type spirals with active star formation. 20 cm line
AH684	Helbig, P. (Manchester) Browne, I. (Manchester) Jackson, N. (Manchester) Wilkinson, P. (Manchester) Xanthopoulos, E. (Manchester) Blandford, R. (Caltech) Fassnacht, C. (Caltech) de Bruyn, A. G. (NFRA) Koopmans, L. (Groningen/Kapteyn) Marlow, D. (Pennsylvania) Myers, S. (Pennsylvania) Rusin, D. (Pennsylvania)	Sample of weak flat-spectrum radio sources. 3.6 cm
AH685	Haarsma, D. (Haverford College) Hewitt, J. (MIT) Langston, G. Moore, C. (Groningen/Kapteyn)	Time-delay monitoring of gravitational lens 2016+112. 3.6, 6 cm
AI063	Ivison, R. (Royal Observatory) Seaquist, E. (U. Toronto)	Third epoch imaging of RX Puppis during a phase of low excitation. 3.6 cm
AI076	Irwin, J. (Queens) Saikia, D. (NCRA, India) English, J. (STScI)	HI observations of 11 edge-on spiral galaxies. 20 cm line
AK453	Kassim, N. (NRL) Lazio, T.J.W. (NRL) Anantharamaiah, K. (Raman Institute) Goss, W. M. Falcke, H. (MPIR, Bonn)	74 MHz imaging of the Galactic center. 90 cm
AK456	Kulkarni, S. (Caltech) Bloom, J. (Caltech) Djorgovski, S. (Caltech) Frail, D. Vakil, D. (Caltech)	Radio afterglows of gamma-ray bursters. 2, 3.5, 6, 20 cm

No.	Observer(s)	Programs
AK462	Kronberg, P. (Toronto) Biermann, P. (MPIR, Bonn) Ensslin, T. (MPIR, Bonn) Feretti, L. (CNR) Giovannini, G. (CNR) Hanisch, B. (STScI) Perley, R.	Mapping the Coma Cluster and its environs at 74 MHz with subarcminute resolution. 90, 400 cm
AK483	Kawabe, R. (NAO, Japan) Ohta, K. (Kyoto) Yamada, T. (Tohoku) Kohno, K. (NAO, Japan) Tutui, Y. (Tokyo U.) Carilli, C.	CO imaging of third highest redshift quasar BR 1202-0725. 0.7 cm line
AK485	Kulkarni, S. (Caltech) Frail, D. Bloom, J. (Caltech) Djorgovski, S. (Caltech) Harrison, F. (Caltech)	Radio afterglows of gamma-ray bursts. 2, 3.6, 6, 20 cm
AK487	Kundu, M. (Maryland) Nindos, A. (Maryland) White, S. (Maryland)	Mapping of flaring loops on the sun. 2, 3.6, 6, 20 cm
AK489	Kotaro, K. (NAO, Japan) Ryohei, K. (NAO, Japan) Yoshinori, T. (Tokyo U.) Kouji, O. (Kyoto) Toru, Y. (Tohoku U.) Carilli, C.	Continuum emission from forming galaxy 1202-0725. 6, 20 cm
AK494	Kurtz, S. (Mexico/UNAM) Hofner, P. (NAIC)	Water masers at molecular cloud velocity in HH80-81. 1.3 cm line
AL379	Lara, L. (CNR) Cotton, W. Fereti, L. (CNR) Giovannini, G. (CNR) Marcaide, J. (Valencia) Venturi, T. (CNR)	Large angular size radio sources from NRAO VLA Sky Survey. 6, 20 cm
AL418	Lehar, J. (CfA) Falcke, H. (MPIR, Bonn) Barvainis, R. (Haystack) Menten, K. (MPIR, Bonn) Birkinshaw, M. (Bristol, UK) Elvis, M. (CfA) Blundell, K. (Oxford)	Variability of radio quiet quasars. 3.6 cm

No.	Observer(s)	Programs
AL451	Laine, S. (Hertfordshire) Gottesman, S. (Florida)	Anomalous radio continuum in NGC 7479. 2 cm
AL457	Lebron, M. (Mexico/UNAM) Rodriguez, LF. (Mexico/UNAM) Lizano, S. (Mexico/UNAM)	Kinematical study of compact HII region G111.61+0.37. 1.3 cm
AL476	Lopez, J. (Mexico/UNAM) Rodriguez, L. F. (Mexico/UNAM) Gomez, Y. (Mexico/UNAM)	Search for atomic hydrogen in the remarkable planetary nebula KjPn 8. 20 cm line
AL477	Lara, L. (IAA, Andalucia) Mack, K. (Bologna) Alberdi, A. (IAA, Andalucia) Feretti, L. (Bologna) Klein, U. (Bonn U.) Rioja, M. (Yebes Obs)	Lobes of the giant radio galaxy 3C 326. 3.6, 6, 20 cm
AL480	Lang, C. (Cornell) Yusef-Zadeh, F. (Northwestern) Goss, W. M.	Kinematics of the Quintuplet/Pistol/Sickle Complex. 3.6 cm line
AL483	Looney, L. (Maryland) Mundy, L. (Maryland) Welch, W. (UC, Berkeley) Volgenau, N. (Maryland)	Separating the envelope and disk in embedded stellar systems. 0.7 cm
AL484	Ledlow, M. (New Mexico) Owen, F.	1 Mpc scale FRI radio galaxy B2 1108+27. 20, 90 cm
AL485	Laurent-Muehleisen, S. (LLNL) Becker, R. (UC, Davis) Brotherton, M. (LLNL) Gregg, M. (UC, Davis)	Radio spectral indices of a complete sample of radio-selected quasars. 3.6 cm
AL494	Lang, C. (Cornell) Goss, W. M. Rodriguez, L. (Mexico/UNAM)	Massive stars in the Arches cluster. 0.7, 3.6 cm
AL505	Leighly, K. (Columbia) Laurent-Mueleisen, S. (LLNL)	A possible radio bright Seyfert. 6 cm
AM599	Miller, N. (New Mexico State) Owen, F.	Large scale surveys of Abell 2255 and 2256. 20 cm
AM602	Mirabel, I. F. (Saclay) Dhawan, V. Rodriguez, L. F. (Mexico/UNAM)	Coordinated radio, infrared, and x-ray observations of microquasar GRS1915+105. 2, 3.5, 6 cm

No.	Observer(s)	Programs
AM610	Molinari, S. (IPAC) Rodriguez, L. (Mexico/UNAM) Zhang, Q. (CfA)	Continuum survey in massive protostars. 2, 3.6 cm
AM611	Molinari, S. (IPAC) Rodriguez, L. F. (Mexico/UNAM) Testi, L. (Caltech)	Continuum from massive protostar candidate IRAS 23385+6053. 0.7, 3.6 cm
AM614	Niruj Mohan, R. (Raman Institute) Anantharamaiah, K. (Raman Institute) Goss, W. M.	Radio recombination lines towards the starburst galaxies IC 694. 2 cm line
AM621	Mioduszewski, A. Rupen, M. Hjellming, R.	X-ray nova CI Cam. 2, 3.6 cm
AM624	Miller, N. (New Mexico State) Owen, F.	High resolution imaging of starburst/AGN transition sources in A1367. 3.6 cm
AM625	Mirabel, I. F. (CNRS, France) Ogley, R. (CNRS, France)	XTE J1723-376.
AN081	Mohan, R.N. (Raman Institute) Anantharamaiah, K. (Raman Institute) Goss, W. M.	Radio recombination lines from starburst galaxies. 3.6 cm line
AO135	Osorio, M. (/Mexico/UNAM) Lizano, S. (Mexico/UNAM) Kurtz, S. (Mexico/UNAM) Rodriguez, L. F. (Mexico/UNAM) Carral, P. (Guanajuato U.)	Millimeter continuum search for new galactic hot cores. 0.7, 1.3 cm
AO136	Owen, F.	330 MHz observations of M87. 90 cm
AP378	Pooley, G. (MRAO) Bell Burnell, J. (Amsterdam) Fender, R. (Open University)	Simultaneous observations of GRS1915+105 at centimeter, millimeter, and IR wavelengths. 1.3, 2 cm
AP379	Pisano, D. (Wisconsin) Wilcots, E. (Wisconsin)	Extended HI and the formation of isolated galaxies. 20 cm
AR402	Rudnick, L. (Minnesota) Treichel, K. (Minnesota) Katz-Stone, D. (USNA) Giovannini, G. (Bologna)	Non-relativistic sheaths around extragalactic jets. 3.6, 6, 20 cm

No.	Observer(s)	Programs
AR405	Rawlings, S. (Oxford) Croft, S. (Oxford) Peacock, J. (Edinburgh) Meisenheimer, K. (MPIA, Heidelberg)	Search for CO from protogalaxies at z=13. 3.6 cm line
AR408	Richards, E. (Virginia)	50 UGC galaxies: the local 8 and 15 GHz luminosity function. 2, 3.6 cm
AR409	Rottgering, H. (Leiden) Cimatti, A. (Arcetri) Andreani, P. (Padova) Eisenhardt, P. (JPL) Stanford, A. (LLNL) Elston, R. (Florida)	Ultrared galaxies. 3.6 cm
AR416	Rusin, D. (Pennsylvania) Myers, S. (Pennsylvania) Marlow, D. (Pennsylvania) Browne, I. (Manchester) Jackson, N. (Manchester) Wilkinson, P. (Manchester) Norbury, M. (Manchester) Readhead, A. (Caltech) Fassnacht, C. (Caltech) Koopmans, L. (Groningen/Kapteyn) de Bruyn, A. G. (NFRA)	Searching for variability in new CLASS lens systems. 3.6 cm
AS568	Sramek, R. Weiler, K. (NRL) Van Dyk, S. (UCLA) Panagia, N. (STScI)	Properties of radio supernovae. 1.3, 2, 3.6, 6, 20 cm
AS632	Sahu, K. (STScI) Baum, S. (STScI) Kaiser, M. (Johns Hopkins) O'Dea, C. (STScI) Shaw, R. (STScI)	The most luminous x-ray cluster RXJ 1247.5-1145. 6 cm
AS644	Scuderi, S. (Bologna) Stanghellini, C. (Bologna) Panagia, N. (STScI)	Survey of radio emission from O and B supergiants. 2, 3.6, 6 cm
AS652	Sjouwerman, L. (NFRA) Lindqvist, M. (Chalmers, Onsala) van Langevelde, H. (NFRA) Diamond, P. (Manchester) Winnberg, A. (Chalmers, Onsala)	SiO masers in Galactic Center OH/IR stars. 0.7 cm

No.	Observer(s)	Programs
AS668	Straus, M. (Princeton) Carilli, C. Fan, M. (Princeton) Rupen, M. Schneider, D. (Penn State)	Two high redshift quasars from the SDSS. 6 cm
AT220	Thornley, M. (MPIfEP, Garching)	Weak spiral density waves in flocculent spiral NGC 7331. 20 cm line
AT224	Tahmoush, D. (MIT) Hewitt, J. (MIT)	Survey of 21 gravitational lenses at high frequencies. 0.7, 2, 3.6 cm
AU078	Urbanik, M. (Jagellonian) Chyzy, K. (Jagellonian) Soida, M. (Jagellonian)	Magnetic fields in perturbed galaxies: NGC 4254. 6 cm
AV237	Verheijen, M. Tully, B. (Hawaii) Trentham, N. (Cambridge) Zwaan, M. (Groningen/Kapteyn)	The HI mass function in Ursa Major. 20 cm
AW362	White, S. (Maryland)	The stellar activity cycle on active stars. 3.6, 6, 20 cm
AW505	Wrobel, J. Taylor, G. Gregory, P. (British Columbia)	Search for phase calibration sources at low galactic latitudes. 3.6 cm
AW506	Wilcots, E. (Wisconsin) Armandroff, T. (KPNO-NOAO) Caldwell, N. (CfA)	HI in F8D1, a low surface brightness galaxy in the M81 group. 20 cm line
AW507	Welch, G. (St. Mary's College) Sage, L. (Maryland)	Search for HI in SO galaxies. 20 cm line
AW508	Welch, G. (St. Mary's College) Sage, L. (Maryland)	Search for HI in M32. 20 cm line
AW510	Watt, S. (Maryland) Mundy, L. (Maryland)	Ammonia (3,3) toward ultra-compact HII regions and their precursors. 1.3 cm line
AW511	White, S. (Maryland) Lee, J. (NJIT) Mikic, Z. (SAIC)	Coronal currents, magnetic fields, and heating in the solar corona. 2, 3.6, 6, 20 cm
AW512	Wiseman, J. (Johns Hopkins) Fuller, G. (Manchester) Wootten, H.A.	Ammonia gas in HH 111 and H211. 1.3 cm line

No.	Observer(s)	Programs
AW515	Williams, P. (Royal Obs) Dougherty, S. (DRAO)	Imaging non-thermal emission in O-star systems. 1.3, 2, 3.6, 6 cm
AW516	Winn, J. (MIT) Hewitt, J. (MIT) Schecter, P. (MIT)	MIT-VLA-Magellan southern gravitational lens survey. 1.3, 2, 3.6 cm
AW520	Willson, R. (Tufts) Lang, K. (Tufts)	Metric and decimetric observations of nonthermal solar radio processes. 90, 400 cm
AY101	Yusef-Zadeh, F. (Northwestern) Anantharamaiah, K. (Raman Institute) Melia, F. (Arizona)	Search for positronium line toward Sgr A east arc. 20 cm line
AY102	Yun, M. Hibbard, J.	Giant radio plumes around IR luminous galaxies. 6 cm
AZ111	Zwaan, M. (Kapteyn) Briggs, F. (Kapteyn) Franx, M. (Leiden) van Kokkum, P. (Leiden) Verheijen, M.	HI imaging of galaxy cluster Abell 1689 at z=0.181. 20 cm
AZ113	Zhang, Q. (CfA) Hunter, T. (CfA) Sridharan, T. (CfA)	Ammonia in high mass protostar IRAS 20126+4104. 1.3 cm line
AZ116	van Zee, L.	HI in interacting dwarf galaxies UGC 5205 and CGCG 007-025. 20 cm line
AZ117	Zhang, J. (Maryland) White, S. (Maryland) Kundu, M. (Maryland)	Large scale features of the solar atmosphere. 2, 3.6, 6, 20 cm
AZ118	Zabludoff, A. (UC, Santa Cruz) Mulchaey, J. (Mt. Wilson) Wilcots, E. (Wisconsin) Williams, B. (Delaware) van Gorkom, J. (Columbia)	The HI content of loose groups of galaxies. 20 cm line
BC098	Claussen, M. Marvel, K. (AAS) Wilking, B. (Univ. Missouri) Wootten, H. A.	Magnetic fields in YSO jets.
BU012	Ulvestad, J. Vestrand, W. (New Hampshire) Stacy, J. (New Hampshire) Biretta, J. (STScI)	Flaring CGRO Blazar 2255-282. 0.7, 1.3, 2 cm

No.	Observer(s)	Programs
GM033	Marcaide, J. (Valencia) Guirado, J. (Valencia) Perez-Torres, M. (Valencia) Ros, E. (MPIR, Bonn) Alberdi, A. (IAA, Andalucia) Diamond, P. (Manchester) van Dyk, S. (UCLA) Weiler, K. (NRL)	Young radio remnant of SN 1979C. 20 cm with phased array
W079	Meier, D. (JPL) Tingay, S. (JPL) Preston, R. (JPL) Murphy, D. (JPL) Jones, D. (JPL) Fujisawa, K. (NAO, Japan) Hirabayashi, H. (ISAS, Japan) Kobayashi, H. (ISAS, Japan) Edwards, P. (ISAS, Japan)	Centaurus A. 6 cm with phased array VLBI

E. VERY LONG BASELINE ARRAY OBSERVING PROGRAMS

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

Project	Observer(s)	Title
BA036	Augusto, P. (Madeira) Browne, I. (Manchester) Wilkinson, P. (Manchester)	B2114+022, a gravitational lensing candidate. 90 cm
BB010	Beasley, A. Herrnstein, J.	Target of opportunity observations of WR140 (HD 193793). 4, 20 cm
BB106	Brisken, W. (Princeton) Fomalont, E. Goss, W. M.	VLBA Pulsar Astronomy. 20 cm
BC090	Carilli, C. Taylor, G. Wrobel, J. Ulvestad, J.	Ultra-luminous infrared galaxies. 18, 90 cm with phased array

No.	Observer(s)	Programs
BC091	Clark, T. (NASA/GSFC) Ma, C. (NASA/GSFC) Johnston, K. (USNO) Fey, A. (USNO) Gaume, R. (USNO) Eubanks, T. M. (USNO) Gordon, D. (NASA/GSFC) Vandenberg, N. (Interferometrics) Himwich, E. (Interferometrics) Shaffer, D. (Radioferometrics) Boboltz, D. (USNO) Kingham, K. (USNO) Fomalont, E. Walker, R. C.	Geodesy/astrometry observations for 1999. 3.6 cm
BD057	Diamond, P. (Manchester) Kemball, A.	Continuation of the monitoring of SiO masers around TX Cam. 0.7 cm
BD058	Dhawan, V. Mirabel, I. F. (Saclay, France) Rodriguez, L. (Mexico/UNAM)	GRS 1915 Jet evolution on AU scales. 2, 4, 13 cm
BD059	Desai, K. Brisken, W. (Princeton) Chatterjee, S. (Princeton) Fey, A. (USNO) Lazio, T. (NRL) Lestrade, J-F. (Meudon)	Serendipitious observations of an extreme scattering event towards PSR J1643-12. 20 cm
BD060	Dhawan, V. Kellermann, K. Romney, J.	Monitoring the accelerating, bent jet in 3C84. 2, 4, 13 cm
BF043	Fey, A. (USNO) Gaume, R. (USNO) Eubanks, T. M. (USNO) Johnston, K. (USNO) Ma, C. (NASA/GSFC)	Southern hemisphere astrometry for the celestial reference frame. 3.6 cm
BF050	Fanti, C. (IRA, Noto) Cotton, W. Fanti, R. (IRA, Noto) Mantovani, F. (IRA, Noto)	Search for CSS and GPS candidates. 6, 20 cm
BF051	Falcke, H. (MPIR, Bonn) Nagar, N. (Maryland) Ulvestad, J. Wilson, A. (Maryland)	Properties of parsec-scale radio cores in a distance and radio flux limited sample of low luminosity AGN. 6 cm

No.	Observer(s)	Programs
BF052	Faison, M. Goss, W. M. Marscher, A. (Boston)	Imaging small-scale structure in galactic molecular gas. 6 cm
BF053	Fomalont, E. Brisken, W. (Princeton) Chatterjee, S. (Cornell) Cordes, J. (Cornell) Goss, W. M. Kaplan, D. (Cornell)	Search of pulsar fields for inbeam calibrators. 20 cm
BF054	Furuya, R. (Graduate Univ.) Claussen, M. Kawabe, R. (Nobeyama) Kitamura, Y. (ISAS) Wootten, H. A.	Study of evolution of protostellar jets. 1 cm
BG087	Gaume, R. (USNO) Boboltz, D. (USNO) Fey, A. (USNO) Johnston, K. (USNO) Hajian, A. (USNO)	Astrometric observations of two radio stars. 3.6 cm
BG088	Britton, M. (UC, Santa Barbara) Gwinn, C. (UC, Santa Barbara) Hirano, C. (UC, Santa Barbara)	Angular broadening of a nearby pulsar. 90 cm
BG089	Gregory, P. (British Columbia) Capak, P. (British Columbia) Wrobel, J.	Probable new galactic jet source. 4, 20 cm
BG091	Gabuzda, D. (JIVE) Cawthorne, T. (Central Lancashire) Pushkarev, A. (Astro Space Center)	Finishing multi-frequency observations of complete sample of 1 Jy BL Lac objects. 2, 4, 6 cm
BH042	Herrnstein, J. Moran, J. (CfA) Greenhill, L. (CfA)	Are quasars being ejected from the nucleus of NGC 4258? 18 cm
BH056	Ho, P. (CfA) Torrelles, J. (IAA, Granada) Anglada, G. (Mexico/UNAM) Curiel, S. (Mexico/UNAM) Gomez, J-L. (IAA, Granada) Patel, N. (CfA) Rodriguez, L. (Mexico/UNAM) Torrelles, J. (IAA, Granada)	Proper motion studies of circumstellar water masers in NGC 2071 and W75N(B). 1 cm

No.	Observer(s)	Programs
BI012	Iguchi, S. (NAO, Japan) Fujisawa, K. (NAO, Japan) Hirotani, K. (NAO, Japan) Kameno, S. (NAO, Japan)	VLBA and VSOP monitorings of extremely high speed jet source. 2, 4, 7 cm
BI013	Imai, M. (NAO, Japan) Inoue, M. (NAO, Japan) Kameno, S. (NAO, Japan) Kanno, T. (Ibaraki Univ.) Oono, T. (Ibaraki Univ.) Tuboi, M. (Ibaraki Univ.) Venturi, T. (CNR, Noto)	VLBI mapping of double nuclei of 3C75. 4 cm
BJ029	Justtanont, K. (Stockholm) Claussen, M. Kerschbaum, F. (Vienna) Yates, J. (Hertfordshire)	High angular resolution observations of SiO maser in AGB stars. 7 cm
BK066	Koratkar, A. (STScI) Antonucci, R. (UC, San Diego) Gallimore, J. (UC, San Diego)	Testing the accretion disk model: radio jets in UV polarized QSOs. 4, 13 cm
BK068	Kellermann, K. Cohen, M. (Caltech) Vermeulen, R. (NFRA) Zensus, J. A. (MPIR, Bonn)	Kinematics of quasars and AGN. 2 cm
BL058	Lonsdale, C. (Haystack) Diamond, P.J. (Manchester) Smith, H. (UC, San Diego) Lonsdale, C. (Caltech)	Radio supernovae in OH mega maser galaxy Arp220. 3.6, 6, 18 cm
BL070	Lo, K. (Taipei) Ho, P. (CfA) Shen, Z. (Taiwan) Zhao, J-H. (CfA)	VLBA observations of intrinsic source structure of Sgr A*. 7 cm
BL077	Lister, M. (JPL) Preston, R. (JPL) Tingay, S. (JPL) Piner, B. (JPL)	Pearson-Readhead sources at 43 GHz. 7 cm
BL078	Lobanov, A. (MPIR, Bonn) Ros, E. (MPIR, Bonn) Zensus, J. A. (MPIR, Bonn)	New flare in 3C345. 1.3, 2, 7 cm
BM106	Mutel, R. (Iowa) Molnar, L. (Iowa)	Astrometric mapping of HR 1099: test of polar emission model. 3.6 cm

No.	Observer(s)	Programs
BM110	Mutel, R. (Iowa) Denn, G. (Iowa)	Monitoring BL Lac. 1.3, 2, 7 cm
BM112	Moran, J. (CfA) Greenhill, L. (CfA) Herrnstein, J. Diamond, P. (Manchester) Bragg, A. (CfA) Trotter, A. (CfA) Henkel, C. (MPIR, Bonn)	Next generation study of NGC 4258 accretion disk physics. 1.3 cm with phased VLA
BM114	Marcaide, J. (Valencia) Guirado, J. (Valencia) Perez-Torres, M. (Valencia) Ros, E. (MPIR, Bonn)	Absolute kinematics of radio source components in complete S5 polar cap sample. 4 cm
BM115	Morris, M. (UCLA) Reid, M. (CfA)	Nature of an unusual point source near the Galactic center. 4 cm
BM116	Marscher, A. (Boston) Cawthorne, T. (Lancashire) Gear, W. (Cambridge) Stevens, J. (Cambridge) Marchenko, S. (Boston) Lister, M. (JPL) Gabuzda, D. (Lebedev) Yurchenko, A. (St. Petersburg) Forster, J. (UC, Berkeley)	Monitoring millimeter-bright AGN. 0.7 cm
BM117	Mioduszewski, A. Rupen, M. Hjellming, R.	High resolution observations of the quiescent black hole candidate V404 Cyg. 2 cm
BN009	Norbury, M. (Manchester) Blandford, R. (Caltech) Browne, I. (Manchester) Jackson, N. (Manchester) Koopmans, L. (Groningen/Kapteyn) Marlow, D. (Pennsylvania) Myers, S. (Pennsylvania) Pearson, T. (Caltech) Readhead, T. (Caltech) Rusin, D. (Pennsylvania) Wilkinson, P. (Manchester)	Long-track observation of top CLASS lens candidates. 20 cm
BP051	Paredes, J. (Barcelona) Massi, M. (MPIR, Bonn) Marti, J. (U. Jaen) Ribo, M. (Barcelona)	X-ray binary LS 5039. 6 cm with phased VLA

No.	Observer(s)	Programs
BR057	Roberts, D. (Brandeis) Moellenbrock, G. (ISAS, Japan) Wardle, J. (Brandeis) Gabuzda, D. (Lebedev) Brown, L. (Connecticut)	Four 3C quasars with VSOP observations. 0.7, 1.3, 2, 3.6 cm
BR059	Reid, M. (CfA) Wilner, D. (CfA) Menten, K. (MPIR, Bonn)	Synchrotron jet in the star forming region W3OH. 18 cm with phased VLA
BR060	Rector, T. (NOAO) Gabuzda, D. (ASC, Russia) Stocke, J. (CASA)	Second-epoch observations of x-ray loud BL Lacs. 6 cm
BR063	Ratner, M. (CfA) Bartel, N. (York U.) Bietenholz, M. (York U.) Lebach, D. (CfA) Lestrade, J-F. (Paris Obs) Ranson, R. (York U.) Shapiro, I. (CfA)	Astrometry of HR 8703 in 1999 for the gravity probe B mission. 3.6, 6 cm with phased VLA
BR064	Roy, A. (MPIR, Bonn) Colbert, E. (GSFC) Mundell, C. (Maryland) Ulvestad, J. Wilson, A. (STScI)	Component motions in NGC 1068. 6, 20 cm
BT038	Tingay, S. (JPL) Jauncey, D. (ATNF) Jones, D. (JPL) Meier, D. (JPL) Murphy, D. (JPL) Preston, R. (JPL) Reynolds, J. (ATNF) Tzioumis, A. (ATNF)	Continued 8.4 GHz monitoring of Centaurus A. 4 cm
BT041	Tingay, S. (JPL) Jauncey, D. (ATNF) Jones, D. (JPL) Meier, D. (JPL) Murphy, D. (JPL) Preston, R. (JPL) Tzioumis, A. (ATNF)	Near-simultaneous observations of Centaurus A at 2.3, 4.8, and 8.4 GHz. 13 cm
BT045	Thorsett, S. (Princeton) Dewey, R. (Princeton) Brisken, W. (Princeton)	Orbital phase-resolved measurement of PSR B1534+12. 90 cm with phased VLA

No.	Observer(s)	Programs
BU012	Ulvestad, J. Vestrand, W. (New Hampshire) Stacy, J. (New Hampshire) Biretta, J. (STScI)	Flaring CGRO Blazar 2255-282. 0.7, 1.3, 2 cm
BY009	Yates, J. (Hertfordshire) Claussen, M. Justtanont, K. (Stockholm) Kerschbaum, F. (Vienna) Olofsson, H. (Stockholm)	H_2O maser proper motion study of mass-loss from two Mira variables. 1 cm
GB033	Bartel, N. (York U.) Rupen, M. Bietenholz, M. (York U.) Beasley, A. Conway, J. (Chalmers, Onsala) Altunin, V. (JPL) Graham, D. (MPIR, Bonn) Venturi, T. (Bologna) Umana, G. (Bologna)	VLBI imaging of supernova 1993J in M81. 6, 18 cm
GF007	Fomalont, E. Bradshaw, C. (George Mason) Geldzahler, B. (George Mason) Waltman, E. (NRL)	Formation and rapid variability of hot spots in Sco X-1. 6, 18 cm
GG040	Garrington, S. (Manchester) Garrett, M. (NFRA) Polatidis, A. (NFRA)	Faint GPS sources selected from a VLBI + MERLIN survey. 6 cm
GK019	Koopmans, L. (Groningen/Kapteyn) de Bruyn, A. G. (NFRA) Marlow, D. (Pennsylvania) Wilkinson, P. (Manchester) Browne, I. (Manchester) Jackson, N. (Manchester) Fassnacht, C.	Multi-frequency observations of a "dark" lens or binary quasar. 18 cm

No.	Observer(s)	Programs
GM035	Marcaide, J. (Valencia) Perez-Torres, M. (Valencia) Guirado, J. (Valencia) Alberdi, A. (IAA, Andalucia) Ros, E. (MPIR, Bonn) Diamond, P.J. (Manchester) Shapiro, I. (CfA) Preston, R. (JPL) Schilizzi, R. (NFRA) Mantovani, F. (Bologna) Trigilio, C. (Bologna) Van Dyk, S. (UCLA) Weiler, K. (NRL) Sramek, R. Whitney, A. (Haystack)	Monitoring of the expansion of SN 1993J. 6 cm
GR016	Ros, E. (MPIR, Bonn) Marcaide, J. (Valencia) Guirado, J. (Valencia) Perez-Torres, M. (Valencia) Lara, L. (IAA, Andalucia) Alberdi, A. (IAA, Andalucia)	Proper motions in quad gravitational lenses. 3.6 cm
V022	Wilkinson, P. (Manchester)	Investigation of three gravitational millilens candidates. 6 cm
V030	Preston, R. (JPL)	Pearson-Readhead survey from space. 6 cm
V050	Kollgaard, R. (FERMI)	Subparsec scale structure of x-ray selected BL Lac objects. 6 cm
V057	Gabuzda, D. (Lebedev)	VSOP polarization monitoring of four lacertae objects.
W006	Yakimov, V. (Lebedev) Gabuzda, D. (Lebedev) Vetukhnovskaya, Y. (Lebedev)	Polarization of 1055+018. 6, 18 cm
W008	Ulvestad, J. Wrobel, J. Carilli, C.	Seyfert galaxy Mrk 231. 6 cm with phased VLA
W022	Reid, M. (CfA) Greenhill, L. (CfA) Argon, A. (CfA) Moran, J. (CfA)	Nuclear jet in M87. 18 cm
W023	Jones, D. (JPL) Wehrle, A. (JPL)	NGC 4261. 6, 18 cm

No.	Observer(s)	Programs
W025	Tingay, S. (JPL) Tornikoski, M. (Helsinki) Muecke, A. (Adelaide) Bignall, H. (Adelaide) Clay, R. (Adelaide) Tzioumis, A. (CSIRO) King, E. (CSIRO) Lovell, J. (ISAS, Japan)	The bursting gamma-ray source, PKS 2255-282. 6 cm
W027	Murphy, D. (JPL) Conway, J. (Chalmers, Onsala) Polatidis, A. (NFRA) Preston, R. (JPL) Tingay, S. (JPL) Jones, D. (JPL) Meier, D. (JPL) Hirabayashi, H. (ISAS, Japan) Kobayashi, H. (ISAS, Japan)	Monitoring of 1928+738. 18 cm
W030	Tingay, S. (JPL) Jauncey, D. (CSIRO) Reynolds, J. (CSIRO) Tzioumis, A. (CSIRO) King, E. (CSIRO) Edwards, P. (ISAS, Japan) Lovell, J. (ISAS, Japan) Hirabayashi, H. (ISAS, Japan) McCulloch, P. (Tasmania)	Gamma-ray loud and quiet AGN. 6 cm
W039	Guirado, J. (Valencia) Preston, R. (JPL) Jones, D. (JPL) Marcaide, J. (Valencia) Perez, M. (NRC/Herzberg) Lestrade, J-F. (Paris Obs)	Proper motion in a closely spaced quasar pair: 1342+662/1342+663. 6 cm
W040	Junor, B. (New Mexico) Biretta, J. (STScI)	Proper motion in the Vir A jet. 6 cm
W051	Porcas, R. (MPIR, Bonn) Xanthopoulos, E. (Manchester) Browne, I. (Manchester) Wilkinson, P. (Manchester) Patnaik, A. (MPIR, Bonn)	Gravitational lens system 1030+074. 6, 18 cm

No.	Observer(s)	Programs
W053	Rioja, M. (Yebes Obs) Porcas, R. (MPIR, Bonn) Hirabayashi, H. (ISAS, Japan) Asaki, Y. (NAO, Japan) Machalski, J. (Jagellonian)	Astrometry on the pair 1308+326,8. 6, 18 cm
W056	Bartel, N. (York U.) Bietenholz, M. (York U.)	Structural variability in the core-jet of the galaxy M81. 6 cm
W059	Kedziora-Chudczer, L. (Sydney) Jauncey, D. (CSIRO) Reynolds, J. (CSIRO) Tzioumis, A. (CSIRO) Wieringa, M. (CSIRO) Nicolson, G. (HartRAO) Quick, J. (HartRAO) Walker, M. (Sydney) McCulloch, P. (Tasmania)	Complete sample of intra-day variables. 6 cm
W066	Lobanov, A. (MPIR, Bonn) Krichbaum, T. (MPIR, Bonn) Kraus, A. (MPIR, Bonn) Witzel, A. (MPIR, Bonn) Zensus, J. (MPIR, Bonn)	0836+710 jet kinematics. 6, 18 cm
W068	Zensus, J. (MPIR, Bonn) Carrara, E. (Sao Paulo) Abraham, Z. (Sao Paulo) Lobanov, A. (MPIR, Bonn) Unwin, S. (JPL)	Quasar 3C 273. 6 cm
W071	Kameno, S. (NAO, Japan) Wajima, K. (Ibaraki U.) Imai, M. (NAO, Japan) Inoue, M. (NAO, Japan) Satoh, S. (NAO, Japan)	Survey for GPS Sources. 18 cm
W088	Roberts, D. (Illinois) Moellenbrock, G. (ISAS, Japan) Wardle, J. (Brandeis) Gabuzda, D. (Lebedev) Brown, L. (Connecticut)	Polarization monitoring of four bright quasars at 5 and 1.6 GHz. 18 cm

No.	Observer(s)	Programs
W094	Hirabayashi, H. (ISAS, Japan) Wehrle, A. (JPL) Unwin, S. (JPL) Makino, F. (ISAS, Japan) Kii, T. (ISAS, Japan) Kobayashi, H. (ISAS, Japan) Edwards, P. (ISAS, Japan) Okayasu, R. (ISAS, Japan) Valtaoja, E. (Turku)	3C279. 6 cm

F. SCIENCE HIGHLIGHTS

Socorro

VLBA Sets New Standard for Accurate Cosmic Distance Measurement - The VLBA has been used to make the most precise, absolute extragalactic distance measurement ever made. Proper motions of water maser spots in a circumnuclear disk of the galaxy NGC 4258 were measured with the VLBA. The proper-motion measurements in a disk previously shown to be in Keplerian rotation around a supermassive object at the galaxy's center allowed a direct geometric determination of the distance to the galaxy. This distance measurement, 7.2± 0.3 Mpc, provides a valuable calibration for the extragalactic distance scale and thus will likely play a major part in calibrating the age and size of the universe.

Investigators: J. Herrnstein; J. Moran and L. Greenhill (CfA); P. Diamond, (MERLIN and U. Manchester); M. Inoue and N. Nakai (Nobeyama); M. Miyoshi (NAO Japan); C. Henkel (MPIfR); and A. Riess (Berkeley).

VLBA Detects Earth's Motion Around the Milky Way's Center - Observing subtle shifts in the apparent position of Sagittarius A*, at the center of the Milky way, compared to background quasars, the VLBA can detect Earth's motion around the Galactic center in ten days' time. The observations constrain peculiar motions of Sgr A* and thus also strengthen the case for a black hole at the Galactic center. The new data indicate a minimum mass for Sgr A* of 1,000 solar masses, which rules out a multiple-star system and strengthens the case for a black hole.

Investigators: M. Reid (CfA); A. Readhead and R. Vermulen (Caltech); and R. Treuhaft (JPL).

Green Bank

^{3}He Abundance in Galactic HII Regions Observations of the light element ^{3}He in several diffuse, low emission measure galactic HII regions will be the last scheduled observing project on the 140 Foot Telescope before it closes as a user facility in July 1999. The ^{3}He experiment using the 140 Foot spans about 15 years. These observations serve both as a probe of cosmology and stellar and galactic evolution. The goal has been to measure ^{3}He in enough objects located throughout the galaxy to disentangle the cosmological and stellar components. The advantage of diffuse HII regions is that they tend to be *simple*, i.e., they have a relatively simple structure which allows the ^{3}He+ spectral line parameters to be converted into a ^{3}He/H abundance. Eight new, distant, diffuse HII regions have been detected in ^{3}He+ to make a total of about 30 objects. Preliminary results indicate that there is no detectable ^{3}He gradient in the Galactic disk which may imply that these measurements are primordial.

Investigators: R. Rood (UVA); T. Bania (Boston University); and D. Balser.

Tucson

Tentative Detections of Two New Interstellar Big Molecules $CH_3OC_2H_5$ and $(C_2H_5)_2O$ - Recent modeling of gas-grain chemistry has demonstrated that many of the organic species in the interstellar medium are not the products of grain-surface reactions. These organic species must in fact be synthesized in the warm gas from simpler species produced on grains. To test this gas-grain chemistry scenario, in particular, alcohol chemistry, a search for $(C_2H_5)_2O$ (Diethyl Ether) and $CH_3OC_2H_5$ (methyl Ethyl Ether) has been made toward the giant molecular cloud cores Sgr B_2(N), W51 e1/e2, and Orion-KL. These three molecular cores are good candidates for regions where alcohols have been evaporated from ice mantles.

The preliminary 12 Meter Telescope results indicate clean detections of various line transitions of the two molecular species in the 1 mm, 2 mm and 3 mm regimes in all three molecular cloud cores. Furthermore, BIMA maps show a clear concentration of CH_3OH toward Sgr B_2(N), the Large Molecule Heimat. BIMA detections of $CH_3OC_2H_5$ and $(C_2H_5)_2O$ toward Sgr B_2(N), instead of the more evolved Sgr B_2(M), are also observed unambiguously as predicted by alcohol chemistry. These detections of the two complex molecules not only further confirm the gas-grain chemistry but also require specifically that Methanol (CH_3OH) and Ethanol (C_2H_5OH) be formed in grain mantles. Methyl Ethyl Ether ($(C_2H_5)_2O$) is the largest molecule ever discovered in the interstellar medium.

Investigators: *Y-J. Kuan (ASIAA); S. Charnley (NASA/Ames); T. Wilson (SMTO); M. Ohishi (NAO Japan); H-C. Huang (Taiwan Univ.); L. Snyder (UIUC).*

Deuterium in Translucent Molecular Clouds - The subject of deuterium in interstellar molecules is important for many reasons: as a diagnostic of ion-molecule chemistry in cold clouds, of grain processes in warm star-forming regions, as a probe of the ionized fraction in molecular clouds, and perhaps as a means to derive D/H itself, of importance to cosmology and to the nucleosynthesis history of the Galaxy. Previous efforts along these lines have been hampered by limited knowledge of physical conditions in the clouds, hence by potentially unreliable abundance ratios XD/XH. This situation has been improved using translucent clouds, whose physical conditions are much better known. We have detected at least two transitions each of DCO^+, N_2D^+, CCD, DCN, DNC, HDCO, NH_2D, and CH_3OD in three translucent clouds (CB_{17}, CB_{24}, CB_{228}) with surprisingly strong line intensities. Our detailed chemical modeling of translucent clouds indicates that all of these species form in the gas phase except CH_3OH, which will allow us to distinguish deuteration processes in the two regimes. With more reliable abundances than usual, we may even get an estimate of D/H.

Investigator: *B. Turner*

G. PUBLICATIONS

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

H. CHARLOTTESVILLE ELECTRONICS

Amplifier Development, Design, and Production

Two additional W-band amplifiers for the MAP project were delivered during May. These two amplifiers were to replace a complex gain matched pair, one of which failed during testing. Two high frequency tuned W-band amplifiers have been completed for use in a MMA antenna evaluation receiver to be built in Tucson. One Q-band and one C-band amplifier were also sent to Tucson in late May for use in evaluation receivers.

Eight additional Q-band amplifiers were produced during the quarter. Six of these were delivered to Socorro, with two going to Green Bank for initial assembly and development of the GBT Multibeam Receiver. Six K-band amplifiers were produced and delivered to Socorro in ongoing support of the VLA K-Band upgrade project.

Prototype design and mechanical drafting of a 4-12 GHz InP amplifier design were completed. Work on this initial prototype development will continue as machine shop scheduling permits production of the mechanical components.

A new amplifier assembly technician was hired this quarter.

Superconducting (SIS) Millimeter-Wave Mixer Development

SIS Mixers - We have completed the design of the first SIS mixers for fabrication at SUNY/Stony Brook, and await delivery of the first devices for testing any day.

A broadband waveguide quadrature hybrid has been designed using the EM simulator QuickWave, and the design verified using a WR-10 model. With appropriate frequency scaling, this design should be practical for operation to over 700 GHz, thereby allowing the fabrication of simple balanced mixers at that frequency.

Work continues on the automation of the SIS mixer testing procedure. This is crucial to production of SIS mixers at the rate demanded by the MMA.

During this quarter we have assembled and tested seven SIS mixers.

Vacuum Window Development - Work continues on the development of low-loss, low-leakage, quasi-optical vacuum windows for the MMA and the 12 Meter Telescope. After a delay due to the loss of the technician doing this work, we have resumed work on the laminated five-layer quartz/plastic design. It appears that with five layers it should be possible to obtain less than 0.08 dB loss over a full waveguide band at ~100 GHz. The design should be scalable for use at all higher bands on the MMA.

New Hires

Considerable time was spent this quarter with recruiting new engineering staff. Two new engineers and a summer student have been hired, and an additional engineer and technician will join us early next quarter.

Meetings

Two CDL engineers attended the IEEE International Microwave Symposium and Microwave Trade Show in Anaheim, CA.

Electromagnetic Support

GBT - The S-band feed (1.73-2.60 GHz) has an input converter section made from machined aluminum parts. The rest of the feed is fabricated by welding together sheet metal rings and bands. It is proposed that the outside of this feed be encased in fiberglass wrapping. The input return loss of the feed was measured at different elevations to determine if there was any gravity-induced deformation. Return loss is better than 29 dB over the entire band at all elevations. Above 2 GHz, return loss is better than 40 dB at 90° elevation but gets worse by 3 dB at other elevations, indicating that the feed deforms at lower elevations. Fiberglass wrap would help to stiffen the feed.

VLA - It has been proposed to build secondary focus receivers with octave bandwidths for the VLA Expansion project. Octave bandwidth feeds are large in wavelenghts. Hence, it was critical to study the trade-offs between the physical size of the feed and its performance at the low end of the band. Based on a comparison study of different size feeds for L-band (1–2 GHz), a profile horn 186" long with 76" aperture diameter has been chosen. Aperture efficiency and system temperature were calculated for this feed from 800 MHz to 2.0 GHz. Gain/system temperature (G/T_{sys}) falls sharply below 1.1 GHz. G/T_{sys} was also calculated for a prime focus feed from 700 MHz to 1.2 GHz. G/T_{sys} peaks at 1.0 GHz and rolls off at 1.05 GHz because of phase errors introduced by the shaped main reflector. The switchover from prime focus to secondary focus can occur between 1 and 1.1 GHz.

Spectrometers/Correlators

During the last quarter, preliminary designs for both the filter card and the memory card were completed for the MMA correlator. PCB layouts for both designs have been started using the Orcad layout program. Parts for a prototype filter card were ordered and all parts except for the Xilinx FPGAs have been received.

Three Xilinx FPGA designs for the MMA filter card were completed but now need modification because of minor changes occurring in the filter design over the last two months.

A program to simulate the MMA filter card using the current design precision values (10-bit fixed point arithmetic) has been written and is currently being tested.

Work is under way on the definition of the MMA correlator chip and back-end.

Card and system testing of the MMA test correlator (GBT clone) was begun during this quarter. Almost all the cards and samplers have now been tested and the system has been powered up with a few cards plugged in.

A small amount of time was spent in support of the GBT and Tucson spectrometers.

MMA Frequency Multipliers

Initial tests performed on the 110/220 GHz doubler indicated the need for smaller varactor diode structures. A contract with the University of Virginia was established for the fabrication of Schottky varactor diodes for use below 250 GHz. This contract will also support development of quartz-semiconductor integration. An 85/255 GHz tripler, currently being designed at NRAO, will take advantage of this integration technique.

I. GREEN BANK ELECTRONICS

GBT Spectrometer

Good progress was made on programming the Spectrometer.

The cooling problem is still being addressed, with the addition of an additional cooling stage in the supplied air. It is anticipated that a further 10 degrees C will be gained by pre-cooling the air. This modification was installed and testing is underway. We are still unable to run all four quadrants without overheating the correlator chips.

GBT Fiber IF System

The additional seven channels of the Fiber IF system are being manufactured. These should be finished in August.

GBT Servo System

The subreflector actuators were sent back to the manufacturer to replace a bad bearing that had shown a tendency to fail in the field. At the same time, the grease in the actuators was replaced by a grease formulated to perform in a wide temperature range. This appears to have solved most of the cold-weather operations problems, except on one actuator, which was designed with insufficient overload capacity to handle the cold-weather operation.

NRAO Electronics personnel calibrated the sensors in the actuators when they were returned and reassembled.

A meeting is held regularly between NRAO, COMSAT, and RSi/PCD to address the current Servo issues.

GBT Active Surface

All of the cables have been cut and dressed in preparation for testing.

Much progress is being made on the active surface software. One engineer is working full-time on this system.

An apparent bug has been found in the intelligent I/O Processors used to communicate with the actuators. The vendor is working on isolating the problem.

GBT Mockup

The Mockup has been used over the past quarter to help integrate the electronics for the GBT with the M&C software. This testbed has proven to be very beneficial. A stable version of the M&C software is available for system tests, and a test version of the software is available for the M&C group to test new software features.

Quadrant Detector

Work on linearity improvements continues. The signal level on the detector is critical for linearity. Improvements in the optics and mounting details are being worked out.

Holography System

Further tests of the GBT holography system is planned for the second quarter of 1999 at the 140 Foot Telescope. A preliminary testuncovered some problems in the hardware and the software that will be fixed before the astronomical holography tests in July.

Equipment Room

A replacement for an unreliable IEEE-488 interface card is being evaluated. Changes are being planned to accommodate the Spectral Processor after it is moved from the 140 Foot in September.

GBT Receiver Systems

Prime Focus Receiver - It was decided to repackage Band 5 of the prime focus receiver into its own front-end box. The new receiver will be completed once the original four bands are working properly, and money is available.

C-Band Receiver - The receiver was taken down from the 140 Foot for the last time this quarter. It will be refurbished with new IF components and readied for installation on the GBT.

Q-Band Receiver - The tests for the initial beam of the Q band receiver were completed, and construction of an additional beam is underway.

S-Band Receiver - The receiver is nearly complete. All electronic parts are in hand, and all but some gold plated brackets is ready for final assembly and test. The feed and the OMT were tested as a unit in the indoor-outdoor range.

GBT Cryogenics

The previously installed cryogenic tubing on the GBT has all been replaced with the fully-welded runs of tubing. About 26% of the tubing installation is complete.

Site Operations

OVLBI - Overall, the station is in good shape. Work is underway to replace the antenna control system with modern, reliable components. An intercom system is being designed to allow the operators to monitor noises generated by the station from the Jansky Lab control room.

Interference Protection Group - Electronics is an integral part of the Interference Protection Group. Four engineers and a technician work part-time on this program, along with staff scientists. Over the past quarter we have tested and re-tested many subsystems, identifying sources of RFI in each subsystem. Work was completed on a data acquisition system for the anechoic chamber. Work has begun on an interference monitoring station for the GB site. An enclosure for a microwave oven was designed and is being procured.

Telescope Support - Work to move the interferometer control system to the Jansky Lab was begun. A new control computer was purchased, and plans are being made to use the old Digital Delay Rack with the new control computer.

A significant amount of cryogenics work is being done to improve the reliability of our cooled receiver systems. Inspections by people from other sites have identified deficiencies in our procedures and equipment, and those are being rectified. This work will continue throughout the next two years, causing a significant drain on resources in the Electronics Division.

Maintenance, repair, and installation support was supplied to the 140 Foot, USNO 20 Meter, and the OVLBI earth-station telescopes. This includes electronic maintenance, electronic design projects to assist users for special projects, and cryogenic support for all cooled receivers in Green Bank. Normal day-to-day support of UNIX workstations, weather stations, time systems, and local area networks is also provided.

J. TUCSON ELECTRONICS

1mm Array, 220-250 GHz Receiver

This receiver is now in routine use. Several early operational problems have been identified and solved. We have identified two faults in this system which may be the source of the problems with baseline stability which sometimes affects wide-bandwidth

measurements. 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 1mm Array 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. A prototype 2-channel system is currently being tested.

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, and has been given lower priority than the multibeam systems mentioned above.

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, tested, and installed a digital phase-lock system into our 2/3 mm receiver that combines both frequency and phase control and provides faster, reliable switching over a broader frequency range. We can now routinely switch by as much as ±35 MHz, making frequency switching useable for a wide variety of research projects. We are currently producing digital phase-lock systems for all of our receivers.

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.

Receiver Component Servo Systems

Given the importance of the accuracy and reliability of the servo drivers for the components of the 12 Meter receivers, we have investigated these aspects on our 1 mm array system. By implementing a periodic test and maintenance procedure for all of the mechanical systems in these servo drivers, we have dramatically improved the accuracy, reliability, and repeatability of these systems. This will have direct impact on our ability to quickly and automatically tune all of the 12 Meter receivers.

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. All four of these units have been fabricated, tested and installed on the telescope.

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.

New Digital Spectrometer

A new digital spectrometer, called the Millimeter Auto Correlator (MAC), has been in routine use at the 12 Meter Telescope for the past nine months. The MAC, which is a GBT correlator clone, has twice the instantaneous bandwidth currently available for our multibeam systems, and uses a single wideband sampler for each IF channel. This new design avoids the persistent platforming problems experienced with our now decommissioned hybrid correlator spectrometer. The MAC supports the existing 1.3 mm and 3 mm, and any future, multi-beam systems on the telescope.

Software

Continuum On-The-Fly Analysis - Eric Greisen has added tasks to the AIPS package which allow the analysis of continuum On-The-Fly (OTF) data. By employing the Emerson, Klein, Haslam deconvolution algorithm, these analysis tasks add greatly to our complement of OTF analysis software. This development has also expanded the scientific capabilities of the 12 Meter by adding continuum OTF to its complement of observing modes.

ALMA - Many Tucson staff are delighted to be more involved in ALMA activities, but this has an inevitable impact on 12 Meter act ivies. The ALMA receiver system development, laser local oscillator and cryogenics, and antenna design are all based in Tucson. The current site testing activities and logistics support are managed out of Tucson. It is important to put effort into these activities, but until ALMA resources become available the staff involved are shared between ALMA development and 12 Meter support. This has been a major factor in delays with the new 8-feed 3-mm receiver, for example. All Tucson staff look forward to increasing ALMA development, and will do everything possible to avoid too large an impact on 12 Meter operations.

K. SOCORRO ELECTRONICS

VLA-Pie Town Link

During May, measurement of round-trip phase characteristics (VLA/PT/VLA) over 208 km of fiber was performed using 1200 MHz. A monotonically increasing seasonal drift rate (transmission line expansion) of 1 millidegree /sec was measured and agrees closely with analytic approximations. This is about .01 of the differential Maser effects (200millidegree/sec) of Dec 98.

June 1 saw the final installation of all 224 modified delay cards (eight test cards included). This part of the project has gone very smoothly and ahead of schedule.

A number of module failures, power supply problems and difficulties in establishing a reliable VLA to Pie Town (PT) digital communications path and synchronization of the VLA waveguide cycle at the PT site via the PT L8 hampered any fringe gathering in the second quarter. After relocating all the link hardware back at the AOC, rigorous tests revealed the "second order" bidirectional optical mechanisms responsible for the problem(s).

Work is currently underway and components ordered for new digital transceiver cards and upgrading the PT hardware for 4 IF conversion.

Much of the low level software for driving the 4 IF hardware for fringes is completed. The much more complex task of packaging a single fully integrated user friendly VLBA/VLA PT/VLA specific Windows interface is under construction.

The 1550 nm high-power, solid-state laser forming the hub of the high dynamic range RF transmission is no longer manufactured or supported. Fortunately, the availability of 1550 nm band telecommunication components is improving and a suitable DFB laser candidate is on order.

It is now anticipated that a working 4 IF system will be in place by late July, working on two fibers. A single fiber system will be available in September 1999.

The digital optical transmitter has been proposed to utilize a higher power transmitter unit. A new design and PCB should be completed in the third quarter.

VLA K-Band Front End

Components for eight more K-Band Front Ends have been received. Fabrication of these new front ends #5 to #8 has started. Front Ends #5, 6, and 7 have been lab tested and installed on antennas.

Q-Band Front Ends

Components for three new Q-Band dewars were fabricated in the VLA machine shop. Assembly of these new front ends has started and is expected to be completed early in the third quarter.

VLBA 3-mm Front-Ends

The four front ends have been returned to the AOC lab to be upgraded with the new LNAs from the CDL during the third quarter. This will depend on the delivery schedule from the CDL. All FE receivers will be returned to the array by 15 September.

VLA Water Radiometer

The Water Vapor Radiometer sub-system is undergoing further testing. The shielding and layout of the RF components for the radiometer has been improved. Oscillations due to feedback of RF leakage seem to be eliminated. One sub-system has been installed on an antenna. A two microsecond buffer zone was decided upon in order to remove the effect of the cal on/off switching noise. A prototype design was tested and will be tried on the water vapor radiometer test antennas.

Two F1s were built and tested this quarter. An additional four units will be assembled and tested at a rate of two per quarter. As each antenna rotates through the AAB, the F-rack will be wired to accept the units. Production of eight cardcages and cards has been completed They will be used for upcoming receivers.

VLBA FRM Rotation Improvements

The control system for the VLBA FRM is being studied in order to improve the response for the rotation axis. The current effort is focused upon a firmware, rather than hardware solution. The VLBA Hancock site was chosen for testing purposes. Work on this project will continue into the third quarter. Early results indicate that accuracy and consistent positioning will be traded-off for time. The current software can position itself very well; however, to do so can take minutes. Work will continue in order to shorten this as much as possible.

HTRP Fast A/D Card

A system prototyping phase has been entered. Tests of the complete path from data gathering to the computer is nearly complete. Once this has been done and tested, the next stage of producing a printed circuit board will begin.

Interference Protection

The RF-Environmental Monitoring System (RF-EMS) at the VLA was put on-line and on the Internet during the spring. Receiver control was made possible over the Internet through the efforts of Zach Barnes, an NRAO part-time employee from NMT, who also developed the original receiver control software. Frequency, span, and IF bandwidth changes may now be made remotely using a net

browser, with the display showing a spectral plot reflecting the changes made. Although there have been some problems with the FE amps, military surplus receivers, and electrical power to the RFI monitoring shelter, all the hardware and software components are now in place for a wideband, remotely controlled, spectral logging station.

A cost and effort analysis has been completed for building a low-cost, satellite tracking station at the VLA, using the military surplus 3 m dish and mount acquired from NRAO Tucson last year. This system should allow IPG monitoring of the power levels and spectral characteristics of emissions from the IRIDIUM, GLONASS, and other planned P-through U-band satellite systems.

Electromagnetic compatibility (EMC) tests of two new, 2-way radios for use at the site were performed. Spurious emissions were detected from P through L band. The power levels were similar to those of other 2-way radios currently used at the VLA.

Frequency coordination efforts worked on during the first part of this quarter included a technical review of the long planned upgrade to the MOU between NRAO/NSF and the US Air Force on the Tethered Aerostat Radar Systems (TARS). The new MOU should be signed this summer. Discussions continued with NM and TX spectrum users in the vicinity of the VLA or VLBA sites. A detailed test procedure was executed at the VLBA Fort Davis site, which demonstrated the compatibility of a new NASA, X-band radar and our VLBA receivers. Talks continued with the BLM, NM-ARES, and the USFS on the addition or modification of electronic sites near the VLA. Detailed calculations were made in order to justify our estimates of the damage a new 50 cm DTV assignment for Mesa, Arizona, would have on VLBA Kitt Peak observing. Recurring notifications and coordination efforts with seven US Air Force Frequency Coordinators continued, as well as special coordination with the US Space Command for GPS tests.

Amplitude Equalizers for the VLA

The average passband for the VLA antennas has a large slope across the 50 MHz bandwidth. This affects the observing center frequency during continuum observations. We plan to implement a simple equalizer circuit to correct bandpass shapes after the bandwidth has been expanded.

Increasing the VLA Continuum Bandwidth

Work on increasing the VLA continuum bandwidth on all four IFs continues. The 70 MHz low-pass filters in the screen room have all been tested and retuned as necessary to match group delay. The T3 modules are having several new filters installed. The mixers are being biased and retuned to lower secondary mixer products. Approximately 50 percent of the T3s are complete.

VLA Final LO Replacement

We have been informed that Fluke will no longer support the 6061 Fluke Synthesizers by the year 2000. These synthesizers are used as the final LO in the back-end at the VLA. We are currently working on plans to do an in-house design to replace these synthesizers. Preliminary design studies are ongoing.

Wye-Com Phone Replacement

When the Wye-Monitor system was installed a couple of years ago, this freed up enough pairs on the wye-com cable to allow installation of regular telephones in the antennas. We are currently testing the spare pairs to see if telephones can be viably installed. We have been able to talk over the lines as far as A7 without the use of extenders.

Analog Sum Fiber Link

Efforts are under way to study the feasibility of linking the analog sum outputs of the correlator with the VLA VLBI equipment. This link would be an effort to eliminate 60 Hz components caused by ground loops between the correlator screen room and the VLBI equipment. These 60 Hz components are most prevalent in the pulsar observations.

GPS Receivers

The remaining Truetime GPS receivers for the VLBA stations have been received. Installation of these receivers at the VLBA sites will be complete in July. A dual-frequency GPS receiver has been installed at the AOC for testing. This receiver will be moved to the VLA and will be used for ionospheric monitoring.

VLBA Masers

Maser #11 continues to have problems with IF degradation and is still under investigation. Maser #4 is at the factory for repairs.

VLBA Recorders

NRAO has tested two "square groove" triple cap headstacks from Spin Physics. These headstacks are now in use on playback drives at the VLBA correlator. Performance is satisfactory, and it is expected that the "square groove" headstacks will be acquired in future headstack purchases.

Continuation of the formatter expansion project has been delayed until late 1999 or early 2000. Four stations have been outfitted so far.

It is planned to continue outfitting ten more VLBA tape drives with dry air kits, to increase headstack life. Currently, eight drives have been outfitted.

L. COMPUTING AND AIPS

Observatory-wide Computing

Real-Time - The workshop for programmers and engineers involved in real-time computing at NRAO was held in Socorro in April as planned. There are several major projects in this area underway around the Observatory (VLA real-time system upgrade, MMA design, GBT development, etc.), with staff involved at all four main sites and considerable overlap in many of the issues they must deal with. Most of the attendees gave presentations, which provided an opportunity to exchange information and solutions with others who are working on similar tasks and face similar problems. The meeting was considered highly successful by everyone involved.

Security - Computer and network security continues to be a major concern at the Observatory. The NRAO computer security practices must balance the need for reasonable access by users to our computing services from outside the Observatory, with the need to protect those services from willful damage by unauthorized users. In recent months, we have seen a considerable increase in the "probing" of computers and networks from outside the NRAO. These probes are often used to detect vulnerabilities in our systems' configuration. There have also been a few break-ins, either minor or limited to a single system, which briefly disrupted some of the services we provide to non-NRAO sites and had the potential for greater damage.

The Computing Council, with the assistance of a group of NRAO technical staff, is studying ways to improve the security of our computers and networking without compromising services that are fundamental to our role as a user facility. It is likely that some changes may be required in the ways that users at other locations connect to NRAO systems. Because many network services contain security holes which cannot always be easily fixed, any to which access from outside of the NRAO is not essential, may in future be blocked to reduce our vulnerability. The impact of new security measures on our users will be identified before changes are implemented.

To reduce the risks associated with remote access, the NRAO has strongly recommended, and may eventually require, the use of the secure shell ("ssh") package for login connections between NRAO sites and our users' home systems. *ssh* encrypts the transmitted data, including passwords, and thus hides account information from "sniffer" programs. *ssh*, which is available for both UNIX and Windows in free and commercial versions, is supported at all NRAO sites, and we are urging NRAO's user community to install *ssh* on the computers that they will use to connect to our systems.

Hardware - Budget limitations have severely reduced the number of workstation upgrades that can be done this year, affecting both staff desktops and facilities for visiting observers. In total, less than 20 systems—most of which will be not be the best available in the desktop class—will be upgraded this year. This is in sharp contrast to the more than 50 done in 1998, which is approximately the number of upgrades we must do every year to sustain our goal of a five-year lifetime for UNIX workstations. Five years is the maximum period of time that a system can be considered useful, due to a combination of vendor support restrictions and the steady increase in resources required by operating systems and applications.

Equipment and development tools required to begin the VLA real-time system upgrade, as well as critical improvements of data storage capabilities at the 12 Meter Telescope, were given high priority.

The NRAO recently received an NSF grant which will allow us to implement a number of network-related enhancements, including improvements in network access to support remote real-time observing at the 12 Meter, establishing such a capability for the GBT, and supporting video- and data-conferencing connections both within the NRAO and to external sites which have the necessary equipment. This will also improve Green Bank's link to the Internet in anticipation of the increase in traffic associated with bringing the GBT on-line. Significant increases in the bandwidth of our internal network will be required. These enhancements are now being specified, and are expected to be in place by the fall. In addition, several scientific and technical staff members have been involved in evaluations of videoconferencing equipment and expect to make a decision during the summer.

AIPS

Versions - The current TST version of AIPS (15OCT99) is distributed nightly to all NRAO sites and to seven non-NRAO sites in the US, Europe and Japan. Full support for SVLBI processing has been available since 15APR98.

The 15OCT98 version of AIPS has been distributed to over 302 sites, running Solaris, Linux, DEC Alpha, HP and SGI versions. The overall number of AIPS installations has continued to grow over the last two years.

The majority (75%) of AIPS distributions are now received via ftp, although the CD-ROM distribution is still in strong demand.

General Issues -

- Raised the number of sub fields available in IMAGR to 512. This change has been made to support low-frequency observing on the VLA. Also changed coordinate handling to allow very large offset angles and the special coordinates used by East-West interferometers.
- Changed all tasks which use Clean components as the data model to support the large number of fields, to handle the new coordinates, and to offer a user-set flux limit for the components used in the model.
- Added option to do Steer-Dewdney-Ito Clean as well as Clark Clean in IMAGR. Also added option to remove weak, isolated Clean components from the Clean model.
- LWPLA has been changed to produce multi-page plot files.
- The ability to specify which antennas to use for gain normalization when running amplitude self-cal in CALIB has been added.
- FITLD now writes data weights that reflect the integration time of the sample.
- The VLBA phase-cal task PCCOR now allows IF selection for the case when two bands are observed simultaneously, for example S/X observations typically used in astrometry/geodesy.
- CL2HF - Dave Gordon at GSFC has supplied a new version of CL2HF that is reported by R. Gaume at USNO to produce acceptable results on one of the RDV experiments.
- Added support for Solaris on PCs; this allows large (>2GB) files on PCs. Full support for large files in Linux is expected late 1999.

Bugs -

- The 15APR99 release corrected a wide variety of bugs in the calibration application and imaging software. Bugs in bandpass calibration, 3D gridding of data during imaging, handling of source-table frequency offsets, and SPLIT were corrected in the last few weeks preceding the release.
- Patches have been issued for problems affecting little-endian computers' handling of the TV image catalog, dispersive delays in TECOR and APGPS, buffer handling in RESEQ, and compressed data in CLIP, DTCHK, and RESEQ.

Green Bank Computing

Primarily for reasons of increased security, we have decided to remove all Unix login accounts in Green Bank that have not been used recently. Unused but active accounts are a security risk—there can be unwanted intrusion into the computer systems without the account owner being aware of anything amiss. Most of the dormant accounts belong to visiting observers. Many of these visitors' accounts have home directories on an old Sun to support observations on the 140 Foot Telescope. With the impending demise of the 140 Foot, the home directories will have to be moved and the Unix environments will also need to be completely reconfigured for eventual use with the GBT. We expect that most observers will find it convenient to have a new account with a completely fresh environment when they are allocated observing time on the GBT.

Unfortunately, progress on planned Unix upgrades and installations has not proceeded as fast as was hoped. This was due to the temporary lack of a Unix system administrator. Fortunately, a new administrator has started, and has begun the process of catching up.

Several changes have been made to increase security (with new versions of sendmail, ftp, etc.). E-mail addresses with the Green Bank domain (person@gb.nrao.edu) are now recognized.

Observatory wide, funds in the computer budgets are tight this year. However, we have sufficient resources to upgrade the main Unix server (arcturus). In addition, we will be able to replace five of the older public Suns with PCs running Linux.

Last year, we embarked on a massive program to upgrade PCs used as personal workstations. One of the primary reasons for this was to give everyone a computer that would ride through the millennium change. As a result, no one has a personal workstation that has less performance than a Pentium 100MHz. We have now completed the installation of the upgrades.

To minimize interference on the main Green Bank local area network, we have moved the computers used for the education and outreach programs onto their own local area network.

The projection system in the new Green Bank auditorium is a very flexible one based on NTSC. For use with today's computer graphics, however, it does not have sufficient resolution, as was clear during two GBT meetings last year. We have purchased a dedicated projector with improved resolution and brightness to use for computer-based presentations.

M. AIPS++

This quarter, AIPS++ has focused almost exclusively on preparing the first release. This included testing the system, fixing defects, and preparing and testing the actual CDROM release.

Other than testing and fixing defects, little new work has been performed. Most of the new work has been in the application areas of Single Dish, synthesis, and visualization.

In Single Dish support, Jim Braatz joined the Single Dish group in AIPS++ in April. He will be working out of Green Bank, replacing Joe McMullin who is now based in Charlottesville. Garwood, McMullin, and Braatz continue to be involved in supporting the GBT. This includes regular visits by Garwood and McMullin to Green Bank and by Braatz to Charlottesville.

The revised GBT filler was used in a planned test of the GBT holography back-end in April. The test went well, exposing one bug and several shortcomings of the filler. The filler is being revised in time for another planned holography back-end test in late July. This revision will include the necessary framework to handle on-line data.

Much of the additional GBT support was focused on transferring knowledge and responsibility of the GBT commissioning support, tipper support, and other routine Green Bank support tasks from McMullin to Braatz. This has been mostly completed.

Much of the non-GBT focus during this quarter was on finding and fixing bugs in the Single Dish software. The Dish internal rewrite was postponed in order that Dish be ready and debugged in time for the upcoming release. The Dish plotter continues to be improved. A command-line Gaussian component fitting operation was added to Dish using available tools. A plug-in for the Dish plotter was written to use the JPL line list for quick line identifications. The documentation for Dish was also improved.

Work was begun this quarter on a suite of Single Dish imaging tools to be used in the Dish environment. Three tools have been developed so far. Lookmap reads a Dish data set and plots the spatial locations for all of the data in the set relative to a selected scan. Spectramap reads a Dish data set and plots the spectra at their relative spatial locations. Contourmap reads a Dish data set and plots contours of integrated intensity. These tools will be improved upon and used in conjunction with a Single Dish on-the-fly imaging tool to be developed next quarter.

In Synthesis support, in keeping with the rest of the package, a significant focus in Synthesis this quarter has been the stabilization of current capabilities in preparation for the release. This has included extensive testing to isolate defects, and their subsequent correction. This has been a necessary and beneficial process in preparation for wider deployment of the system in the scientific community.

The context of the development that has taken place, however, remains the same as in previous quarters. The strategy remains that of developing advanced Synthesis capabilities in key areas to test design completeness and sufficiency, while also developing a "thin-path" reduction sequence for connected-element interferometry. As previously noted, the resources for thin-path development have primarily been assigned at the expense of some VLBI development. This is expected to be reversed after the first release, in preparation for the second release which will contain greater VLBI support.

High-level Synthesis development efforts have been concentrated primarily in the area of wide-field imaging (T. Cornwell), and in mosaicing, primary beam effects, and general deconvolution (M. Holdaway and T. Cornwell). Kumar Golap, who arrived as a Visiting Scientist at the NRAO during this quarter, has provided significant testing of the wide-field imaging capability on a multi-processor SGI system in Socorro, in preparation for his future planned work in parallelization of these algorithms. This has included testing against simulated wide-field data, and the development of basic automated scripts to extract and test derived image component positions. He has also written a cookbook chapter on how to use wide-field imaging capabilities in AIPS++. The wide-field development work has included an application, called Dragon, to replace and extend the capabilities previously available in SDE under

this name. The NRL wide-field imaging group have agreed to assist in testing the new features using 74 MHz VLA data. The mosaicing and deconvolution work has included improved primary beam weighting, the migration of multi-resolution CLEAN deconvolution to the imager tool, and the implementation of a multi-field Hogbom CLEAN for comparison against the existing Clark CLEAN implementation. Various other changes and defect corrections of benefit to mosaicing have also been implemented. Time has also been spent on preparations for the Mosaicing Techniques meeting, planned for mid-July in Socorro, which is being arranged by M. Holdaway and M. Rupen, and is a collaborative effort between AIPS++ and the MMA project.

General defect correction and testing has continued for the imager and calibrator tools (T. Cornwell and A. Kemball), including some new features designed to improve ease of use. Synthesis has also benefitted overall from the improved capabilities and features in the graphical user interface. The MS v2.0 definition has been stable in this quarter, and M. Wieringa has continued the propagation of changes required for this format revision throughout the affected classes in the library. It is planned to adopt the new format, which will allow new single-dish and synthesis reduction approaches, after the first release. User impact will be minimized in this process. There has been a significant contribution to the format specification from across the project as a whole, and we have benefitted greatly from the diverse instrumental experience and opinions brought to bear in the discussion of this matter.

NFRA synthesis development has been focused on utilities required to support the commissioning of TMS at WSRT (J. Noordam and G. van Diepen). Development for WSRT will expand in the future with the hiring of new scientific staff to assist work in this area.

Thin-path development has continued during this quarter. R. Marson has further refined the VLA data filler, and expanded the supported scientific capabilities. It has been tested in the supported modes and is being compared to existing data fillers for the VLA. P. Barnes has continued work on uv-data visualization in the framework of the Display Library, in collaboration with D. Barnes, N. Killeen and A. Kemball. A basic pgplotter implementation for some of these capabilities has been completed in the interim.

The parallelization effort forms an important part of synthesis development, to address the largest, most computationally demanding applications. Work on a test mosaic dataset taken on M33 at the VLA have continued, as we build parallelized capabilities in this area.

Specialized design work in this quarter has included a holography requirements document (A. Kemball), which was submitted and accepted as part of the ALMA holography design review. Work on integrating single-dish and synthesis reduction in a common design framework has continued in the framework discussed in previous quarters, but at a slower pace this quarter.

In Glish, garbage collection was added as an optional feature to Glish. This collector cleans up memory which reference counting fails to delete. Typically this memory is allocated as part of records which are self-referencing through functions and other records.

In addition to bug fixes, some clean-up work was also done with Glish shared library creation to attach version numbers to the libraries.

In Parallelization, Roberts has been working most of the second quarter with the Pablo group at UIUC CS department to identify the IO bottlenecks in large image runs. We found a few files that did not have the proper instrumentation. Also in order to trace where IO was being carried out some event tracing needed to be introduced into the imager and pimager applications. The trace calls (IO and event) are checked into the code and can be turned on by an makedefs variable (PABLO_IO). We now have a stable version of pimager which we have been using for testing. We have been carrying out tests on dedicated machines and intend to work on a single machine for a long test in late July.

In Measures, no substantial changes were made.

In AIPS++ Infrastructure, little has happened beyond bug fixes and some minor integration improvements.

In Image Analysis, we added various new convolution capabilities, improved the interfaces for various parts of the image tool, and improved the performance of the image fitter.

In Documentation, we finished the revision of *Getting Started in AIPS++*, started on a cookbook, and implemented a FAQ.

In Management, we made demonstrations and presentations at the Chicago AAS, and at the Tucson meeting on Sub-Millimeter Imaging. We held discussions with the JCMT/ACSIS group on their requests for assistance. This amounts to six to seven weeks of time spread over about nine months.

In System, we directed nearly all of our effort to production of the initial CDROM. Some planning for the post-release phase has been completed. We expect to move towards using CVS for code management and distribution.

In June, our server tarzan was the subject of a breakin. This led to the machine being out of commission for about six days, during which code development at the sites was hindered. Following this attack, we have made a number of changes designed to improve the security of tarzan. The principal ones are that remote NFS is no longer permitted, and the secure shell must be used to connect to tarzan. The resulting changes in working habits for remote sites are acceptably small.

In the Quality Assurance Group, we embarked on a review of the compliance with various rules, resulting in, for example, closer adherence to our guidelines for writing Graphical User Interfaces.

N. GREEN BANK TELESCOPE PROJECT

Backup Structure

The rework of the permanent supports for the backup structure was completed when the last weld was made in mid-May. The final welding inspection has been made and all welds passed.

Transferral of the load of the reflector backup structure (BUS) from the temporary supports to its permanent supports has been a long process. The contractor, unfortunately, prolonged the operation when, in an effort to save time, decided to remove the temporary supports, out of the prescribed sequence. This caused an unanticipated redistribution of loads, causing some back chord members to bend and causing one to buckle. The contractor restored the BUS to its original configuration and performed an engineering analysis to determine why the failures occurred, and developed a procedure/method for transferring the loads, which was then successfully accomplished.

The shape of the structure was checked after the temporary supports were removed, and the weight of the BUS was carried by the permanents. The position of the actuators was found to vary a small amount from the dimensions measured when supported by the temporaries.

Installation of the Vertical Feed Arm & the Upper Feed Arm

Since the last quarter, the members of the Vertical Feed Arm (VFA) module M were bolted to the Upper Feed Arm, and the Upper Feed Arm was trail assembled to the structure made up of modules K and L, on the ground. This trial went well, and preparations for the lift of K and L were completed. Lifting of modules was delayed while their alignment was checked and confirmed, but on June 2 the modules were raised into place. Placement of the fill-in members which create the bridging module J is complete and their welding is in process. The telescope is shown in the figures (as of June 10). It is now planned to raise the Feed/Receiver Room late in June. Beginning in mid-July, the Upper Feed Arm will be raised and connected into place.

Servo

The structure was rotated in elevation for the first time on May 19, 1999, when it was moved 12 degrees to position it for the installation of the middle portion of the Vertical Feed Arm. This important test was carried out using the portable maintenance unit (PMU) to control the elevation motion. Both motor current and voltage were monitored, and all movement of the structure was smooth, silent, and without vibration. All Eight-Forty Horsepower Elevation Motors were used. Motor currents were predicted accurately by the analysis of counterweight out-of-balance and motion was readily controlled to 1/50 of an inch.

The Surface Panels

Measurement of GBT panels is continuing at the RSI facility in Sterling, VA. NRAO inspections are of two types. In type one, surface accuracy of the unpainted panels is analyzed on the basis of measurements provided by the manufacturer, and a number of panels selected by NRAO from the tier under review are measured again, with NRAO witnessing the measurements. If it is determined that the measurements agree with those provided by the manufacturer, and if the table of measurements for the tier shows that the entire tier is within the accuracy specified in the contract, then the panels of a tier accepted. By May 25, 1188 panels (59% of the total of 2004) from 22 tiers passed this requirement. The second type of inspection involves painted panels. As before, selected panels of a given tier are inspected, and all panels must pass scrutiny for the tier to be accepted. For the sample selected, the paint thickness is measured at many positions using a gauge provided by NRAO.

GBT Software

Most people involved in the GBT software effort attended the NRAO Real-Time Programmers Meeting on April 12-14 in Socorro. In all, a total of eleven papers describing GBT work or by people involved in the GBT project were presented. Most of these talks have also been presented in Green Bank so that our local colleagues can also benefit from the material prepared.

The GBT project management has produced a new project timeline, which includes a completely revised schedule for the software deliverables. The weekly mailing to the software developers has been altered to reflect the new target dates.

The software development manpower has received two welcome additions. First, the scientist who will be responsible for the support of VLBI on the GBT has generously agreed to help with the software development for the spectrometer. Second, we welcome a new Unix system administrator to the Green Bank staff. Although he will not be working directly on the GBT, he will enable the other members of the M&C group to devote more of their time to the GBT software effort.

Monitor and Control

In order to facilitate the use of the M&C libraries for the new Green Bank Interferometer (GBI) control system, we have divided the M&C libraries into two. The first part, which contains all the generic software, can be used by both the GBT and the GBI. The second part comprises only the software specific to the GBT devices. This separation should also speed GBT development since it makes it much easier to set up individual development environments.

Finally, we have installed the most recent version of the M&C system on the machines that control the weather stations and the site timing. This leaves the spectral processor as the only device in Green Bank that is not using the current software. The plans are to update the software for this during the summer.

The preliminary tests of the holography systems on the 140 Foot Telescope were successful, but they unfortunately exposed a design flaw in the control software. This will have to be re-written before the formal tests in July. The priority to fix this, plus the manpower needed to cover for the lack of a Unix system administrator, has meant that progress on the spectrometer has not been as fast as hoped. Nevertheless, significant advances have been made. The control interface for the spectrometer plus the scan initialization and sequencing are all substantially complete. We have a draft document describing the contents of the FITS files that will be written by the spectrometer and the other back-ends. A skeleton FITS file written from the back-end tasks of the spectrometer has been successfully read into AIPS++.

Operators' and Engineers' displays

We continue to make good progress on the engineers' displays. The library of tcl/tk functions is much richer; in particular, there is a generic library to interface to the M&C device managers. Screens to monitor many more devices have been added, including the important displays for all of the main GBT antenna servos.

O. MILLIMETER ARRAY PROJECT

The major events for the Millimeter Array Project in the last quarter were the following:

- A Memorandum of Understanding (MOU) for the design and development phase of the Atacama Large Millimeter Array (ALMA) was signed by the NSF, representing the United States, and by a collaboration of five European institutions led by the European Southern Observatory and including also the Centre National de la Recherche Scientifique (CNRS, France), the Max-Planck-Gesellschaft (MPG, Germany), the Netherlands Foundation for Research in Astronomy and Nederlandse Onderzoekschool Voor Astronomie, and the United Kingdom Particle Physics and Astronomy Research Council. The ALMA Project initially will be an equal collaboration between the U.S. and Europe; it is expected that Japan will join as a third partner sometime later. The MMA Project will be subsumed by ALMA and the resources planned for the MMA by the NSF will become the U.S. contribution to ALMA. The text of the MOU can be found on the MMA web pages.
- The NSF Millimeter Array Oversight Committee (MMAOC) met May 12-14 at the MMA offices in Tucson. The report of that meeting is also available on the MMA web pages.
- Bid responses were received from four antenna contractors for design and fabrication of the U.S. prototype ALMA 12 meter antenna. The plan is that these responses will be evaluated over the next quarter in anticipation that a contract can be awarded in October of 1999. Delivery and erection of the prototype antenna at the VLA site is expected in the second half of 2001.
- The MMA Project prepared for a NSF *Lehman Audit* to be held in July 1999. The Project prepared a thorough bottom-up cost estimate and contingency analysis for the MMA U.S. Reference Project, an array of 36 10-m antennas, fully equipped to 700 GHz, and built in Chile.

The MMA D&D phase is a three-year design and prototyping project designed to position the project to begin construction in 2001. It has been funded by the NSF at $9M in FY1998, $9M in FY1999; a final $8M is expected in FY2000. At the end of the quarter $7.268M had been expended or committed, an amount that is 40.5 percent of the funds received to date. Spending is progressing at the rate expected with contingency funds held in anticipation of the major procurement of the D&D phase, the contract for the prototype antenna. Forty-four FTE employees at the NRAO are assigned to the MMA Project.

The transition from the U.S.-only MMA Project to the international ALMA Project is a transition that has to be made at every level from the management of the project, to the system description of the joint array, and to the tasks and schedules of each person working on it. Definition and coordination of this transition has become the focus of the MMA Project efforts in the last quarter. At a working level the transition has been aided by the opportunity afforded through the scheduled MMA Preliminary Design Reviews (PDRs). The MMA PDRs are being broadened to include participation by the involved European groups. Four scheduled MMA PDRs in the last quarter have benefitted by presentations made to the respective review boards by the European groups. These four were (1) the holography system design review; (2) the IF System PDR; (3) the Fiber Optics System PDR; and (4) the Phase Calibration System design review. In the next quarter the transition will be accelerated by involving the European groups not just in the reviews as presenters, but also by broadening the composition of the Review Boards to include both U.S.-based, and European-based, reviewers. Moreover, such Review Boards will be explicitly asked to review ALMA, not the MMA.

In the past quarter, three major Project decisions were made successfully as U.S.-European collaborations. First, the technical specifications for the prototype 12 m antennas—one to be procured by the U.S. and the other to be procured by the European collaboration under separate procurements—were negotiated and agreed. The technical requirements in the U.S. Request for Proposals was word-for-word identical to the technical requirements in the European Call for Tender. Second, the real-time operating system (RTOS) to be used for the software that controls hardware in the test interferometer was agreed by the U.S. and European groups to be VxWorks. In making this decision, the two groups specifically noted that the decision for the RTOS to be used for ALMA itself was still to be decided. Third, as a result of the IF PDR the two sides agreed that the 16 GHz wide IF for ALMA would be transmitted digitally, not as an analog signal. This decision has ramifications for many areas of the ALMA system and reinforces the conclusion that the U.S. and European groups will be able to work successfully on ALMA.

The MMA collaboration with the U.S. university groups, the Millimeter Array Development Consortium (MDC), also continues to provide a mutually beneficial forum for technical innovation. The design of a dual-load amplitude calibration system at U.C. Berkeley, done as a MMA-funded MDC project, has culminated in the installation of a prototype system on one antenna of the BIMA array. Design refinements are being made to eliminate problems experienced owing to solar heating. Another MDC project, design and fabrication of a 32-channel water vapor radiometer at the University of Maryland, has led to delivery of the first prototype to the OVRO array where it has been incorporated into the 22 GHz radiometer. Testing of the device will begin in the third quarter of 1999. Finally, university representatives of the MDC software group accompanied the MMA software team to ESO and other involved European institutes for discussions regarding use of the VLT common software for ALMA and to review common ideas for development of the ALMA software environment.

Involvement of the U.S. community in the ALMA project has occurred in several ways in addition to participation in the Millimeter Array Advisory Committee (the MAC). The MMA science working group prepared a new brochure for the MMA that was distributed at the May 1999 meeting of the American Astronomical Society. The brochure is available on the web. This same group is involved in planning for the October 1999 science workshop entitled *Science with the Atacama Large Millimeter Array*. The workshop will be held October 6-8 at the Carnegie Institution in Washington D.C. and will include presentations made by scientists from the U.S., Europe, and Japan. The workshop will provide a forum for enhancing the visibility of the ALMA Project among government officials in both Executive and Legislative agencies.

P. PERSONNEL

New Hires

Ediss, G.	Electronics Engineer I	6/07/99
Bania, T.	Visiting Scientist	6/11/99
Barnbaum, C.	Visiting Assistant Scientist	6/01/99
Golap, K.	Visiting Scientist	4/05/99
Koller, D.	Electronics Engineer I	5/03/99
Johnson, R.	Public Education Officer	6/28/99
Ray, J.	Junior Engineering Associate	5/12/99
Sumner, M.	Junior Engineering Associate	5/12/99
Poindexter, A.	Systems Analyst	5/03/99
Van Tilburg, C.	Senior Systems Analyst	5/03/99

Terminations

Altamirano, P.	Junior Engineering Associate	6/30/99
Chatterjee, S.	Junior Research Associate	5/07/99
Lugten, J.	Electronics Engineer I	6/07/99
Richards, E.	Junior Research Associate	6/30/99

Promotions

Braatz, J.	to Assistant Scientist -Research Support	4/06/99

Other

Carilli, C.	to Leave of Absence	6/01/99

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ATTRIDGE, J.M.; ROBERTS, D.H.; WARDLE, J.F.C. Radio Jet-Ambient Medium Interactions on Parsec Scales in the Blazar 1055+018.

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CARILLI, C.L.; HOLDAWAY, M.A. Tropospheric Phase Calibration in Millimeter Interferometry.

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CLAUSSEN, M.J.; GOSS, W.M.; FRAIL, D.A.; DESAI. K. The Sizes of 1720 MHz OH Masers: VLBA and MERLIN Observations of the Supernova Remnants W 44 and W 28.

CONDON, J.J. Very Large Radio Surveys of the Sky.

COTTON, W.D.; CONDON, J.J.; ARBIZZANI, E. Arcsecond Positions of UGC Galaxies.

DEUTSCH, E.W.; MARGON, B.; ANDERSON, S.F.; WACHTER, S.; GOSS, W.M. Infrared Candidates for the Intense Galactic X-ray Source GX17+2.

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HO, L.C.; VAN DYK, S.D.; POOLEY, G.G.; SRAMEK, R.A.; WEILER, K.W. Discovery of Radio Outbursts in the Active Nucleus of M81.

HUNTER, T.R.; TESTI, L.; ZHANG, Q.; SRIDHARAN, T.K. Molecular Jets and H2O Masers in the AFGL 5142 Hot Core.

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