NATIONAL RADIO ASTRONOMY OBSERVATORY

QUARTERLY REPORT

April 1 – June 30, 1998

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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 1998.

	140 Foot	12 Meter	VLA	VLBA
Scheduled Observing (hrs)	1853.75	1912.25	1720.20	1333.00
Scheduled Maintenance and Equipment Changes	152.00	108.25	217.40	311.00
Scheduled Tests and Calibration	74.25	159.25	251.50	273.00
Time Lost	41.00	115.25	63.65	40.00
Actual Observing	1812.75	1797.00	1656.55	1293.00

B. 140 FOOT OBSERVING PROGRAMS

The following line programs were conducted during this quarter.

No.	Observer(s)	Program
B654	Barnbaum, C. (STScI) Morris, M. (UCLA) Omont, A. (IAP, Paris)	Monitoring OH associated with the extraordinary star, U Equ.
B662	Balser, D. (Boston) Bania, T. (Boston) Huang, M. (Boston) Shah, R. (Virginia) Rood, R. (Virginia) Jackson, J. (Boston)	Measurements of ionized carbon in the Milky Way.
B677	Balser, D. Lockman, F. J.	S-band observations of diffuse low surface brightness HII regions.
B680	Bourke, T. (CfA) Myers, P. (CfA) Robinson, G. (New South Wales) Hyland, H. (Southern Cross University)	OH Zeeman observations of northern molecular clouds.
L319	Lockman, F. J. Murphy, E. (Johns Hopkins)	21 cm HI mapping of the galactic plane.
L332	Langston, G. Brown, R.	Search for H_2O, HCN, and CO high redshift absorption lines.

No.	Observer(s)	Program
M411	Murphy, E. (Johns Hopkins) Sembach, K. (Johns Hopkins) Benjamin, R. (Minnesota)	A 21 cm deep map of high velocity cloud complex M.
M416	Mauersberger, R. (Arizona) Rollig, M. (Frankfurt) Kegel, W. (Frankfurt)	A search for a new, strong A-type methanol maser.
SETI	Tarter, J. (SETI)	Project Phoenix.
T370	Turner, B.	A search for OH in the Polaris flare.
W398	Wootten, H. A. Claussen, M. Wilking, B. (Missouri)	Water maser monitoring of low-luminosity young stellar objects.
Y021	Young, L. (New Mexico State) Gallagher, J. (Wisconsin) Bomans, D. (Illinois) Smecker-Hane, T. (UC, Irvine) Homeir, N. (Wisconsin)	A search for HI in and around four dwarf spheroidal galaxies.

The following pulsar programs were conducted during this quarter.

No.	Observer(s)	Program
A118	Arzoumanian, Z. (Cornell) Taylor, J. (Princeton) Nice, D. (Princeton)	Bimonthly timing of 63 pulsars at 500 and 800 MHz.
A132	Arzoumanian, Z. (Cornell) Nice, D. (Princeton)	Monitoring at 575 MHz of the evolution of the PSR B1957+20 eclipsing binary system.
A133	Arzoumanian, Z. (Cornell)	Measuring relativistic effects in binary pulsar systems.
B687	Backer, D. (UC, Berkeley) Somer, A. (UC, Berkeley) Sallmen, S. (UC, Berkeley) Foster, R. (NRL)	A pulsar timing array.
N018	Nice, D. (Princeton) Thorsett, S. (Princeton)	Monitoring the irregularities in the rotation and orbital motion of an eclipsing binary pulsar, B1744-24A.
N019	Nice, D. (Princeton)	Mass and proper motion measurements of three binary pulsars at 350-370 MHz.

The following very long baseline programs were conducted this quarter.

No.	Observer(s)	Program
BC066	Claussen, M., *et al.*	Water masers in elliptical galaxy NGC 1052.
BS061	Satoh, S., *et al.*	HI and OH absorption toward the nucleus region of NGC 3079.
V030	Preston, R. (JPL), *et al.*	The Pearson-Readhead survey from space.
V090	Kus, A. (Copernicus/Torun)	CSS source 3C 309.1. 6 cm
V123	Kameno, S. (NAO, Japan)	Cygnus A.
V327	Werhle, A. (Caltech)	VSOP observations of J1602+33.
VS04 VS06	Hirabayshi, H. (ISAS, Japan)	VSOP survey.

C. 12 METER TELESCOPE OBSERVING PROGRAMS

The following line programs were conducted during this quarter.

No.	Observer(s)	Program
B688	Butner, H. (Arizona) Charnley, S. (NASA/Ames)	Study of deuterium chemistry in Class O sources.
C316	Clancy, R. T. (SSI, Boulder) Sandor, B. (JPL)	Mars climate studies and spacecraft support.
C318	Crosthwaite, L. (UCLA) Turner, J. (UCLA) Martin, R. (Arizona) Ho, P. (CfA)	Large scale CO mapping of M83.
C319	Carey, S. (Hanscom/AFGL) Egan, M. (Hanscom/AFGL) Shipman, R. (Hanscom/AFGL) Clark, F. (Hanscom/AFGL)	Study of physical properties of MSX dark clouds.
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) Zenzus, J. A.	Do EGRET blazars differ from other flat-spectrum radio sources?
CB13	Boboltz, D. (Haystack) Diamond, P.	Observations of the 86 GHz SiO maser emission in the circumstellar envelopes of two symbiotic Miras.

No.	Observer(s)	Program
CD07	Doeleman, S. (Haystack) Lonsdale, C. (Haystack) Greenhill, L. (CfA) Kemball, A. Diamond, P.	86 GHz imaging of the SiO masers in VX Sgr.
CJ03	Junor, W. (New Mexico) Biretta, J. (STScI)	Close to the edge: within $30r_g$ of the supermassive core of M87.
CK05	Krichbaum, T. (MPIR, Bonn) Graham, D. (MPIR, Bonn) Alef, W. (MPIR, Bonn) Witzel, A. (MPIR, Bonn) Greve, A. (IRAM) Grewing, M. (IRAM) Wardle, J. (Brandeis) Roberts, D. (Brandeis) Brown, L. (Connecticut) Holdaway, M. Zenzus, J. A.	Polarization imaging of 3C454.3 and 3C279 at 86 GHz.
CK06	Krichbaum, T. (MPIR, Bonn) Graham, D. (MPIR, Bonn) Kraus, A. (MPIR, Bonn) Witzel, A. (MPIR, Bonn) Greve, A. (IRAM) Ungerechts, H. (IRAM) Grewing, M. (IRAM) Phillips, R. (Haystack)	86 GHz VLBI monitoring of BL Lac after a major optical outburst.
CK07	Krichbaum, T. (MPIR, Bonn) Britzen, S. (MPIR, Bonn) Bower, G. (MPIR, Bonn) Witzel, A. (MPIR, Bonn) Zenzus, J. A.	Broad-band variability and jet-bending in PK 0528+134.
CR05	Rantakyrö, F. (Bologna) Bååth, L. (Halmstad U.)	Investigation of the rapid structural variability in CTA 102.
CR06	Rantakyrö, F. (Bologna) Conway, J. (Chalmers, Onsala) Bååth, L. (Halmstad U.) Booth, R. (Chalmers, Onsala)	Continuing millimeter VLBI plus VSOP monitoring of 3C273 and 3C279.
CW2	Wiik, J. (ESTEC)	Target of opportunity 0235+164.

No.	Observer(s)	Program
D196	Dickens, J. (Massachusetts) Irvine, W. (Massachusetts) Ohishi, M. (Nobeyama Obs.) Ikeda, M. (Tokyo U.) Hjalmarson, A. (Chalmers, Onsala) Nummelin, A. (Chalmers, Onsala)	The c-C_2H_4O/CH_3CHO abundance ratio in molecular cloud cores.
G366	Gensheimer, P. (MPIR, Bonn) Ziurys, L. (Arizona) Wilson, T. (MPIR, Bonn)	Search for SiC_2 in Sgr B2.
G369	Gruendl, R. (Illinois) Gao, Y. (Illinois) Lo, K.Y. (Illinois) Hwang, C-Y. (SA/IAA, Taiwan)	Full synthesis imaging of CO (1-0) emission in ARP 244.
G371	Gruendl, R. (Illinois)	Study of CO (1-0) in NGC 2359.
H326	Hunter, T. (CfA) Sridharan, T. (CfA) Cesaroni, R. (Arcetri) Palla, F. (Arcetri) Zhang, Q. (CfA) Brand, J. (Bologna) Molinari, S. (Bologna)	Search for outflows from high-mass protostellar candidates.
H327	Hunter, D. (Lowell Obs.) Walker, C. E. (Arizona)	Study to determine the extent of molecular gas around the irregular galaxy NGC 4449.
H329	Helfer, T. Thornley, M. (MPIfEP, Garching) Regan, M. (DTM/Carnegie) Sheth, K. (Maryland) Vogel, S. (Maryland) Wong, T. (UC, Berkeley) Blitz, L. (UC, Berkeley)	Zero-spacing data for BIMA observations of nearby galaxies.
I20	Ikeda, M. (Tokyo U.) Hiroto, T. (Tokyo U.) Yamamoto, S. (Tokyo U.)	Study of variation of isotope abundances in local cloud complexes.
K359	Kuan, Y.J. (SA/IAA, Taiwan) Wilson, T. (MPIR, Bonn) Charnley, S. (NASA/Ames) Ohishi, M. (Nobeyama Obs.) Snyder, L. (Illinois)	Gas-grain and alcohol chemistry (II): search for interstellar complex organic molecules.

No.	Observer(s)	Program
K360	Krichbaum, T. (MPIR, Bonn) Graham, D. (MPIR, Bonn) Doeleman, S. (Haystack) Marvel, K. (Caltech) Wright, M. (UC, Berkeley) Greve, A. (IRAM) Grewing, M. (IRAM) Emerson, D. Freund, R.	1.3 mm and 2 mm VLBI: Sgr A* and bright AGN.
L333	Lee, C. (CfA) Myers, P. (CfA)	An unbiased survey for infall motions in starless cores.
L334	Larsen, F. (Stockholm Obs.) Olofsson, H. (Stockholm Obs.) Eriksson, K. (Uppsala Obs.) Gustafsson, B. (Uppsala Obs.)	The circumstellar envelopes of carbon stars: mass-loss rates and molecular abundances.
M415	Mangum, J. Bontemps, (Stockholm Obs.) André, P. (CEA/DSM, France)	A survey of outflows in protostars.
M418	Mauersberger, R. (Arizona) Henkel, C. (MPIR, Bonn) Langer, N. (MPIfEP, Garching) Chin, Y. (SA/IAA, Taiwan)	Study of interstellar ^{36}S: a probe of the s-process in C-stars.
M419	Minter, A. McMullin, J.	Detecting the Jean's length in the mass-size relationship.
R272	Reynoso, E. (IAFE) Mangum, J. Zhang, Q. (CfA)	A study of molecular clouds near supernova remnants.
S426	Sandor, B. (JPL) Clancy, R. T. (SSI, Boulder)	Earth atmosphere studies.
S429	Strelnitski, V. (Maria Mitchell Obs.) Benson, P. (Wellesley College) Gordon, M. Holder, B. (Wesleyan U.) Jorgenson, R. (Puget Sound U.)	Simultaneous monitoring of MWC 349 in millimeter hydrogen recombination lines and in optical domain.
S432	Smith, B. (IPAC) Struck, C. (Iowa State)	Study of molecular gas in bridge/ring galaxy pairs.
S435	Sahu, K. (STScI) Sridharan, T. (CfA) Zhang, Q. (CfA)	CO(4-3) and CI(1-0) observations of the gamma ray burster GRB 970508.

No.	Observer(s)	Program
T372	Turner, B.	A search for NH_3D^+.
T374	Turner, B.	How big can molecules get in translucent clouds? More data needed to refine chemical models.
W409	Wootten, H. A. Shah, R. (Virginia)	Study of hot core chemistry in low-mass protostars.
W410	Welch, W. J. (UC, Berkeley) Helfer, T.	Zero spacing ^{13}CO observations of HL Tau.
Y22	Yun, M. Shukla, H. (Caltech)	Hydrogen recombination line observations of Sgr A^*.
Z157	Ziurys, L. (Arizona) Apponi, A. (Arizona) Brewster, M. (Arizona)	Abundance of heavier elements II: searches for KCCH and KCH.
Z158	Ziurys, L. (Arizona) Apponi, A. (Arizona)	Searches for interstellar/circumstellar NaC and KC.

D. VERY LARGE ARRAY OBSERVING PROGRAMS

Second quarter, 1998, was spent in the following configurations: A configuration from April 1 to June 1; BnA configuration from June 1 to June 29; B configuration from June 29 to June 30.

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

No.	Observer(s)	Program
AA218	Anglada, G. (IAA, Andalucia) Rodriguez, L. (Mexico/UNAM) Torrelles, J. (IAA, Andalucia)	Variations in thermal radio jets in YSOs. 3.6 cm
AA220	Anantharamaiah, K. Mohan, R.N. (IIA, Bangalore) Goss, W. M.	Recombination lines from PKS 1830-211. 20 cm line
AA222	Arzoumanian, Z. (Cornell) Xilouris, K. (NAIC) Hankins, T. (NMIMT) McKinnon, M.	High precision polarimetry of relativistic binary pulsars. 20, 90 cm
AA226	Antonucci, R. (UC, Santa Barbara) Kinney, A. (STScI) Schmitt, H. (UFRGS, Brazil) Pringle, J. (Cambridge)	Properly matched Seyfert sample to test the unified model. 3.6 cm

No.	Observer(s)	Program
AA227	Acord, J. (Illinois) Churchwell, E. (Wisconsin)	Proper motions in two ultracompact HII regions. 3.6 cm
AA228	Appleton, P. (Iowa State) Norris, R. (CSIRO) Heisler, C. (Mt. Stromlo) Dopita, M. (Mt. Stromlo) Bransford, M. (Iowa State) Marston, A. (Drake U.)	Search for compact cores in low power AGNs. 3.6, 6 cm
AB808	Blundell, K. (Oxford) Rawlings, S. (Oxford)	Complete sample of $z > 2$ radio sources at high frequency and resolution. 1.3, 2, 3.5 cm
AB849	Bondi, M. (Bologna) Dallacasa, D. (Bologna) Marcha, M. (Lisbon) Polatidis, A. (Chalmers, Onsala) Conway, J. (Chalmers, Onsala) Stanghellini, C. (Bologna)	Search for HI absorption in flat spectrum FR I sources. 20 cm line
AB852	Butler, B. Stern, S. A. (SWRI)	Detecting OH in the Lunar atmosphere by radio occulation. 20 cm line
AB854	Brotherton, M. (LLNL) Smith, R. (AAO) van Breugel, W. (LLNL) Miller, L. (Oxford) Boyle, B. (AAO)	The NVSS/UVX quasar sample. 6, 20 cm
AB857	Backer, D. (UC, Berkeley) Sramek, R.	Proper motion of Sgr A*. 3.6, 6 cm
AB858	Browne, I. (Manchester) Jackson, N. (Manchester) Marlow, D. (Manchester) Wilkinson, P. (Manchester) Phillips, P. (Manchester)	Search for arcminute scale gravitational lenses. 6, 20 cm
AB859	Braatz, J. (CfA) Greenhill, L. (CfA) Moran, J. (CfA)	Continuum in maser line emitting AGNs. 1.3 cm line
AB862	Becker, R. (UC, Davis) White, R. (STScI) Laurent-Muehleisen, S. (LLNL)	24 radio selected BAL quasars. 3.6, 6, 20 cm
AB864	Black, G. (Cornell) Campbell, D. (Cornell) Nicholson, P. (Cornell)	Position and structure of Saturn radio occultation candidates. 3.6, 20 cm

No.	Observer(s)	Program
AB866	Best, P. (Leiden) Rottgering, H. (Leiden) Lehnert, M. (Leiden) Kurk, J. (Leiden)	Powerful southern radio sources. 6 cm
AB871	Barthel, P. (Groningen/Kapteyn) Hunstead, R. (Sydney) Schilizzi, R. (NFRA) Bland-Hawthorn, J. (AAO)	Radio morphologies of southern 3CR quasars and radio galaxies. 3.6 cm
AB875	Bennett, P. (Colorado/JILA) Harper, G. (Colorado/JILA) Brown, A. (Colorado/JILA) Bauer, W. (Wellesley College)	1997/98 Eclipse of VV Cephei. 1.3, 2, 3.6, 6 cm
AB878	Bauer, F. (Virginia) Condon, J. Thuan, T. (Virginia)	Energy sources and beaming in the brightest x-ray galaxies. 6 cm
AC467	Colina, L. (STScI) Alberdi, A. (ESA, Spain) Torrelles, J. (IAA, Andalucia) Panagia, N. (STScI) Wilson, A. (Maryland)	Search for radio supernovae in luminous Seyfert galaxies. 2, 3.6 cm
AC500	Cooray, A. (Chicago) Grego, L. (Chicago) Carlstrom, J. (Chicago) Joy, M. (NASA/MSFC) Holzapfel, W. (Chicago)	Radio source contamination in Sunyaev-Zeldovich effect observation. 2, 3.6, 6 cm
AC502	Curiel, S. (Mexico/UNAM) Rodriguez, L. (Mexico/UNAM) Pedlar, A. (Manchester) Canto, J. (Mexico/UNAM)	On the nature of double radio source associated with L1551 IRS5. 2, 3.6 cm
AC504	Curiel, S. (Mexico/UNAM) Rodriguez, L. (Mexico/UNAM) Moran, J. (CfA) Canto, J. (Mexico/UNAM)	Monitoring the Serpens radio jet. 2, 3.6, 6 cm
AC505	Chandler, C. (Cambridge) Herrnstein, J. Greenhill, L. (CfA)	Orion-IRc2 SiO masers. 0.7 cm line
AC513	Carilli, C. Verheijen, M. Yun, M. Menten, K. (MPIR, Bonn)	z = 0.19 absorption toward 1830-211. 20 cm line

No.	Observer(s)	Program
AD413	Dougherty, S. (DRAO) Moffat, A. (Montreal) Williams, P. (Royal Obs.)	Binarity and non-thermal emission in WR stars: WR 86. 1.3, 3.6, 6, 20 cm
AD414	De Pree, C. (Agnes Scott College) Gaume, R. (USNO) Goss, W. M.	Continuum observations of HII region W49A. 0.7 cm
AD415	Devereux, N. (New Mexico State) Hameed, S. (New Mexico State) Miller, N. (New Mexico State) Churchwell, E. (Wisconsin)	Infrared luminous early type spiral galaxies. 20 cm
AD417	Dallacasa, D. (Bologna) Tschager, W. (Leiden) Grueff, G. (Bologna) Mack, K-H. (Bologna)	New sample of GHz-peaked spectrum radio sources. 1.3, 2, 3.6, 6, 20, 90 cm
AE117	Edge, A. (Cambridge) Allen, S. (Cambridge) Crawford, C. (Cambridge) Fabian, A. (Cambridge) Taylor, G.	Radio sources in cooling flows. 3.5, 20 cm
AF308	Fiebig, D. (Heidelberg Obs.)	Maser background source in IRAS 00338+6312. 1.3 cm line
AF328	Feretti, L. (Bologna) Giovannini, G. (Bologna) Arnaud, M. (CNRS, France) Rusco-Femiano, R. (IAS, Frascati)	Cluster-wide radio halo in A2163. 20 cm
AF336	Fruchter, A. (STScI) Thorsett, S. (Princeton) Goss, W. M. McGary, R. (Furman University)	Pulsar velocities. 20 cm
AF337	Frail, D. Kulkarni, S. (Caltech) Vakil, D. (Caltech)	Late-time radio emission from well localized gamma ray bursts. 3.6, 6, 20 cm
AF338	Falcke, H. (MPIR, Bonn) Wilson, A. (Maryland) Axon, D. (STScI)	Radio outflows in Seyfert galaxies. 3.6 cm
AF339	Falcke, H. (MPIR, Bonn) Zensus, J. A. Ho, L. (CfA)	Compact radio cores in nearby galaxies. 2 cm

No.	Observer(s)	Program
AF340	Fassnacht, C. (Caltech) Pearson, T. (Caltech) Readhead, T. (Caltech) Browne, I. (Manchester) Wilkinson, P. (Manchester) Myers, S. (Pennsylvania)	VLA monitoring of gravitational lens 1608+656. 3.6 cm
AF341	Frail, D. Kulkarni, S. (Caltech)	Continued radio monitoring of the May 8, 1997 gamma ray burst. 6, 20, 90 cm
AF347	Florkowski, D. (USNO)	Monitoring the radio variations from Wolf-Rayet star HD 19264. 1.3, 2, 3.6, 6 cm
AG465	Dhawan, V. Frail, D. Goss, W. M. Rodriguez, L. (Mexico/UNAM)	Target of Opportunity: HI observations of future outburst in GRS1915+105. 20 cm
AG529	Gregory, P. (British Columbia) Poller, B. (CfA)	Possible new galactic jet source. 3.6, 6 cm
AG533	Garcia-Barreto, J. (Mexico/UNAM) Rudnick, L. (Minnesota)	A possible AGN in barred, Seyfert-like galaxy NGC 3367. 3.6, 20 cm
AG534	Greenhill, L. (CfA) Herrnstein, J. Reid, M. (CfA) Moran, J. (CfA) Argon, A. (CfA)	H_20 maser survey of spiral arms of M33. 1.3, 3.6, 6, 20 cm line
AG537	Garrington, S. (Manchester) Garrett, M. (Manchester) Polatidis, A. (Manchester)	VLBI survey of faint, compact radio sources. 20, 3.6 cm
AG538	Garay, G. (Chile) Rodriguez, L. (Mexico/UNAM) Mardones, D. (Chile)	Thermal jet within the S68N region. 1.3, 2, 3.6, 6 cm
AG541	Gabuzda, D. (Lebedev) Pushkarev, A. (Lebedev)	Rotation measure of BL Lacertae object 0119+115. 3.6, 6, 20 cm
AG543	van Gorkom, J. (Columbia) Valluri, M. (Rutgers) Duc, P. (ESO) Reichborn-Kjennerud, B. (Columbia) James, E. (Columbia)	An HI selected dwarf sample in Hydra. 20 cm line

No.	Observer(s)	Program
AH603	Harper, G. (Colorado/JILA) Brown, A. (Colorado/JILA) Bennett, P. (Colorado/JILA) Hummel, C. (USRA) Walder, R. (SFIT, ETH)	Radio modulation of Zeta Aur's orbitally varying HII region. 3.6, 6 cm
AH628	Hjellming, R. Mioduszewski, A. Rupen, M.	Radio and x-ray activity in galactic black holes. 2, 3.6, 6, 20 cm
AH637	Ho, L. (CfA) Ho, P. (CfA)	Very young "super star clusters" in starburst environments. 1.3, 2, 3.6, 6 cm
AH638	Harper, G. (Colorado/JILA) Brown, A. (Colorado/JILA) Baade, R. (Hamburg U.) Kirsch, T. (Hamburg U.) Reimers, D. (Hamburg U.)	Imaging the wind and ionization cavity of Antares. 1.3, 2, 3.6, 6, 20 cm
AH640	Hewitt, J. (MIT) Schechter, P. (MIT)	MIT-VLA-Magellan southern gravitational lens survey. 3.6 cm
AH641	Hjellming, R. Rupen, M. Narayan, R. (CfA)	Search for quiescent radio emission from black hole x-ray transients. 3.6 cm
AH642	Habbal, S. (CfA) Gonzalez, R. (NAIC) Woo, R. (JPL)	Coronal transient events and the solar wind. 6, 20, 90 cm
AH644	Hofner, P. (NAIC) Baan, W. (NAIC) Takano, S. (Cologne)	The water masers in NGC 253. 1.3 cm line
AH649	Harper, G. (Colorado/JILA) Brown, A. (Colorado/JILA) Bennett, P. (Colorado/JILA) Hummel, C. (USRA) Baade, R. (Hamburg U.) Kirsch, T. (Hamburg U.) Reimers, D. (Hamburg U.)	Monitoring the eclipse of Aurigae's B Star HII region. 2, 3.6, 6 cm
AH650	Hofner, P. (NAIC) Kurtz, S. (Mexico/UNAM) Watson, A. (Mexico/UNAM) Lizano, S. (Mexico/UNAM) Testi, L. (Caltech) Cesaroni, R. (Arcetri)	Ammonia (4,4) in hot molecular core G9.62+0.19-F. 1.3 cm line

No.	Observer(s)	Program
AH652	Higdon, J. (CSIRO) Londish, D. (Sydney)	Does the Cartwheel possess a radio jet? 20 cm
AI072	Ivison, R. (Edinburgh) Smail, I. (Durham) Blain, A. (Cambridge) Kneib, J. (Toulouse Obs.)	Distant, dusty galaxies from a submillimeter survey. 6, 20 cm
AI073	Irwin, J. (Queens) Saikia, D. (NCRA, India) English, J. (Queens)	Edge-on galaxies with possible outflow features. 3.6, 20 cm
AJ265	Jackson, N. (Manchester)	Complex FIRST source J0825+3147. 20 cm
AK456	Kulkarni, S. (Caltech) Bloom, J. (Caltech) Djorgovski, S. (Caltech) Vakil, D. (Caltech) Frail, D.	Radio afterglows of gamma ray bursters. 2, 3.6, 6, 20 cm
AK457	Koratkar, A. (STScI) Gallimore, J. (MPIfEP, Garching) Antonucci, R. (UC, Santa Barbara)	Radio jets in UV polarized QSOs. 3.6 cm
AK460	Kaplan, D. (Cornell) Cordes, J. (Cornell) Condon, J. Arzoumanian, Z. (Cornell) McLaughlin, M. (Cornell) Chatterjee, S. (Cornell)	Complete sample of sources with extremely steep spectra. 6, 20 cm
AK469	Kameno, S. (NAO, Japan) Hamaguchi, K. (Kyoto) Umemoto, T. (NAO, Japan) Tsuboi, Y. (Kyoto) Koyama, K. (Kyoto) Fomalont, E.	Jet ejection from protostar R1 in R CrA star forming region. 3.6 cm
AL430	Lucas, P. (Oxford) Blundell, K. (Oxford) Roche, P. (Oxford)	VLA and IR mapping of low mass young stellar objects. 2, 3.6 cm
AL434	Lehar, J. (CfA) Buchalter, A. (Columbia) McMahon, R. (Cambridge) Kochanek, C. (CfA)	Candidate gravitationally lensed radio lobes. 6 cm
AL436	Lim, J. (SA/IAA, Taiwan) Carilli, C. White, S. (Maryland)	Structure and evolution of Betelgeuse's atmosphere. 0.7, 1.3 cm

No.	Observer(s)	Program
AL439	Leahy, J. (Manchester) Spencer, R. (Manchester) Garrington, S. (Manchester)	Prototype classical double 3C 295. 0.7, 1.3 cm
AL441	Ludke, E. (UFSM, Brazil) Katz-Stone, D. (USNA)	Spectral analysis of CSS galaxies. 6 cm
AL445	Lacey, C. (Mexico/UNAM) Goss, W. M. Duric, N. (New Mexico) Pannuti, T. (New Mexico)	SNRs in nine nearby galaxies. 6, 20 cm
AL446	Ludke, E. (UFSM, Brazil) Pastoriza, M. (UFSM, Brazil) Adornes, R. (UFSM, Brazil)	Nature of stellar bars in mildly active galactic nuclei. 6, 20 cm line
AL458	Lewis, G. (Washington U.) Ibata, R. (ESO) Kuncic, Z. (Victoria) Irwin, M. (RGO)	APM 08279+5255 - an ultraluminous BAL quasar at z = 3.87. 3.6 cm
AM582	Miranda, L. (IAA, Andalucia) Torrelles, J. (IAA, Andalucia)	Changes in the variable, extremely young planetary IC 4997. 0.7, 3.6 cm
AM585	Marti, J. (CNRS, France) Mirabel, I. F. (CNRS, France) Rodriguez, L. (Mexico/UNAM) Chaty, S. (CNRS, France)	Monitoring the radio outbursts of GX 354-00. 3.6, 6 cm
AM587	Marti, J. (CNRS, France) Rodriguez, L. (Mexico/UNAM) Reipurth, B. (Grenoble) Torrelles, J. (IAA, Andalucia)	The HH 80-81 thermal radio jet. 1.3 cm line
AM588	Mirabel, I. F. (CNRS, France) Rodriguez, L. (Mexico/UNAM) Dhawan, V.	Monitoring of the microquasar GRS 1915+105. 3.6 cm
AM590	McLaughlin, M. (Cornell) Arzoumanian, Z. (Cornell) Cordes, J. (Cornell) Lazio, T. J. W. (NRL)	Search for radio counterparts to unidentified EGRET sources. 20, 90 cm
AM591	Mundell, C. (Maryland) Shone, D. (Manchester) Wilson, A. (Maryland) Brinks, E. (Guanajuato U.) Pedlar, A. (Manchester)	HI absorption in Seyferts. 20 cm line

No.	Observer(s)	Program
AM592	Menten, K. (MPIR, Bonn) Reid, M. (CfA)	Deep survey for stellar SiO and H_2O masers within 1 pc of Sgr A*. 0.7, 1.3 cm line
AM593	Myers, S. (Pennsylvania) Jackson, N. (Manchester) Fassnacht, C. (Caltech) Koopmans, L. (Groningen/Kapteyn) Marlow, D. (Manchester) Rusin, D. (Pennsylvania)	Continuation of the CLASS VLA search for gravitational lenses. 3.6 cm
AM597	Menten, K. (MPIR, Bonn) Greenhill, L. (CfA) Reid, M. (CfA)	Radio recombination lines from the BN object. 0.7 cm
AM598	Meier, D. (UCLA) van Dyk, S. (UCLA) Turner, J. (UCLA)	RSNe in M83 and NGC 4826? 2, 6, 20 cm
AM602	Mirabel, I. F. (CNRS, France) Dhawan, V. Rodriguez, L. (Mexico/UNAM)	Coordinated radio, infrared, and x-ray observations of microquasar GR 1915+105. 2, 3.5, 6 cm
AM605	Meehan, L. (Missouri) Wilking, B. (Missouri) Claussen, M. Wootten, H. A.	Water masers and collimated outflows. 1.3 cm line
AN076	Nath, B. (Raman Institute) Anantharamaiah, K. Srianand, R. (IUCAA)	Recombination lines from damped Lyman systems. 20 cm line
AN078	Neuhauser, R. (MPIfEP, Garching) Sterzik, M. (MPIfEP, Garching) Menten, K. (MPIR, Bonn)	X-ray emitting PMS stars. 3.6 cm
AO136	Owen, F.	330 MHz observations of M87. 90 cm
AO137	Dwarakanath, K. (Raman Institute) Owen, F. Ledlow, M. (New Mexico) Keel, B. (Alabama)	Deep 21 cm continuum image of A2125. 20 cm
AO138	Olmi, L. (Massachusetts) Cesaroni, R. (Arcetri) Walmsley, C. M. (Arcetri)	Search for nonthermal continuum towards H_20 masers: is W3 unique? 6, 20 cm
AP357	Paredes, J. (Barcelona) Marti, J. (CNRS, France)	New radio emitting x-ray binary from the NVSS survey. 1.3, 2, 3.6, 6, 20 cm

No.	Observer(s)	Program
AP361	Pooley, G. (Cambridge) Alexander, P. (Cambridge) Gilbert, G. (Cambridge) Hardcastle, M. (Bristol, UK) Riley, J. (Cambridge)	Properties of jets in FRII radio sources. 3.6 cm
AP366	Patnaik, A. (MPIR, Bonn) Porcas, R. (MPIR, Bonn) Menten, K. (MPIR, Bonn) Kemball, A.	Faraday rotation in gravitationally lensed images. 0.7, 1.3, 2, 3.6, 6 cm
AP367	Pedelty, J. (NASA/GSFC) Hollis, J. M. (NASA/GSFC)	The R Aquarii binary system: orbit and kinematics. 0.7, 3.6 cm
AP372	Peck, A. (NMIMT) Taylor, G.	Searching for HI gas in three new compact symmetric radio sources. 20 cm line
AR386	Rudnick, L. (Minnesota) Treichel, K. (Minnesota) Mack, K-H. (Bologna) Klein, U. (Bonn U.) Katz-Stone, D. (USNA)	Electron populations and ages in radio galaxies. 6, 20, 90 cm
AR391	Rudnick, L. (Minnesota) Dickel, J. (Illinois)	Asymmetric expansion of Kepler SNR shells. 20,6 cm
AR396	Rupen, M. Anantharamaiah, K.	Radio recombination lines and OH in NGC 1052. 3.6, 20 cm line
AR397	Rottgering, H. (Leiden) Best, P. (Leiden) da Costa, L. (ESO) Rengelink, R. (Leiden) Slijkhuis, R. (ESO) Wall, J. (RGO)	Radio sources in ESO survey area for 2df spectroscopy. 20 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
AS629	Smith, D. (MIT) Frail, D. Kulkarni, S. (Caltech)	Search for radio afterglows from gamma ray bursts. 6, 20 cm
AS632	Sahu, K. (STScI) Baum, S. (STScI) Kaiser, M. (NASA/GSFC) O'Dea, C. (STScI) Shaw, R. (STScI)	The most luminous x-ray cluster RXJ 1247.5-1145. 3.6, 20 cm

No.	Observer(s)	Program
AS633	Seaquist, E. (Toronto) Frayer, D. (Caltech) Frail, D.	OH satellite masers in Seyfert and related galaxies. 20 cm line
AS634	Sarma, A. (Kentucky) Troland, T. (Kentucky) Crutcher, R. (Illinois) Roberts, D. (Illinois)	Zeeman survey of 22 GHz H_20 masers. 1.3 cm line
AS638	Slysh, V. (Lebedev) Val'tts, I. (Lebedev) Kalensky, S. (Lebedev) Golubev, V. (Lebedev)	Methanol masers in star-forming regions. 0.7 cm line
AS640	Slee, O. (CSIRO) Roy, A. Andernach, H. (ESA, Spain) Reynolds, J. (CSIRO)	Structure in steep spectrum relics near cluster centers. 20 cm
AS641	Sterzik, M. (MPIfEP, Garching) Neuhauser, R. (MPIfEP, Garching) Menten, K. (MPIR, Bonn)	Nearby young cool stars with strong x-ray emission. 3.6 cm
AT210	Thorsett, S. (Princeton) Taylor, J. (Princeton) Nice, D. (Princeton) Briskin, W. (Princeton)	Timing fast pulsars at the VLA. 6, 20, 90 cm
AT211	Taylor, G. Fabian, A. (Cambridge)	X-ray to radio correlations in cooling flow clusters. 6, 20 cm
AT215	Turner, J. (UCLA) Ho, P. (CfA) Beck, S. (Tel-Aviv U.)	Compact radio source in NGC 5253: AGN or super star cluster? 1.3, 2 cm
AT217	Trigilio, C. (Bologna) Leto, P. (Bologna) Leone, F. (Catania) Umana, G. (Bologna) Buemi, C. (Catania)	Phase modulation of a CP star: HD 124224. 2, 3.6, 6, 20 cm
AT218	Thompson, M. (Kent) Gibb, A. (Leeds U.) Macdonald, G. (Kent)	$^{15}NH_3$ towards ultracompact HII regions. 1.3 cm line
AT219	Testi, L. (Caltech) Hofner, P. (NAIC) Kurtz, S. (Mexico/UNAM) Rupen, M.	Deep radio continuum imaging of G9.62+0.19 F hot core. 0.7, 1.3 cm

No.	Observer(s)	Program
AV231	Van Bemmel, I. (Groningen/Kapteyn) Barthel, P. (Groningen/Kapteyn) De Graauw, M. (Groningen/Kapteyn)	Core spectra of 3CR quasars. 0.7, 2, 6 cm
AV234	Venturi, T. (Bologna) Dallacasa, D. (Bologna) Bardelli, S. (Trieste Obs.)	J1332-3308 in the dominant galaxy of A3650. 6, 20 cm
AW362	White, S. (Maryland)	The stellar activity cycle on active stars. 3.6, 6, 20 cm
AW461	Winnberg, A. (Chalmers, Onsala) Engels, D. (Hamburg U.)	OH/IR star OH26.5+0.6.
AW482	Wills, B. (Texas) Brotherton, M. (LLNL) Dey, A. (KPNO-NOAO) Antonucci, R. (UC, Santa Barbara)	Free-free absorption in the core of quasar 3C 68.1. 1.3, 2, 3.6, 6, 20, 90 cm
AW485	Wrobel, J. Carilli, C.	Angular expansion of protoplanetary nebula CRL 618 . 0.7, 1.3, 2, 3.6, 6, 20 cm
AW486	Wilner, D. (CfA) Ho, P. (CfA) Rodriguez, L. (Mexico/UNAM)	Continuum studies of T Tauri disks. 0.7 cm
AW488	Waters, L. (Amsterdam) van der Ancker, M. (Amsterdam) Dougherty, S. (DRAO) Bouwman, J. (Amsterdam) de Koter, A. (Amsterdam)	Dust disk of Herbig Ae system HD 163296. 1.3, 3.6, 6, 20 cm
AW490	Willson, R. (Tufts) Lang, K. (Tufts)	Solar noise storms and decimetric bursts. 6, 20, 90 cm
AW491	Wang, J. (Maryland) Lazio, T. J. W. (NRL) Ray, P. (NRL) Cadwell, B. (NRL)	Search for slow pulsations from the isolated neutron star RX J0720. 20, 90 cm
AX004	Xanthopoulos, E. (Manchester) Browne, I. (Manchester) Wilkinson, P. (Manchester) Patnaik, A. (MPIR, Bonn) Porcas, R. (MPIR, Bonn) King, L. (Manchester)	Monitoring the CLASS gravitational lenses B1030+074 and B1933+503. 3.6 cm
AY092	Yun, M. Carilli, C.	Search for HI absorption in a z=3.5 radio galaxy. 90 cm line

No.	Observer(s)	Program
AY096	Yusef-Zadeh, F. (Northwestern) Roberts, D. (Illinois) Biretta, J. (STScI)	Proper motion study of ionized gas and stars at the galactic center. 0.7, 1.3, 2 cm
AY098	Yusef-Zadeh, F. (Northwestern) Shure, M. (Georgia State) Biretta, J. (STScI)	High resolution radio continuum observations of M20. 2, 6, 20 cm
AZ104	Zhao, J. (CfA) Goss, W. M.	Proper motions of ionized gas near Sgr A*. 1.3 cm
BG050	Greenhill, L. (CfA) Chernin, L. (UC, Berkeley)	Collimation and launch of protostellar outflows. 1.3 cm
GB029	Bartel, N. (York U.) Bietenholz, M. (York U.)	VLBI imaging of Supernova 1986J in NGC 891. 6 cm

E. VERY LONG BASELINE ARRAY OBSERVING PROGRAMS

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

No.	Observer(s)	Program
BA027	Alef, W. (MPIR, Bonn) Preuss, E. (MPIR, Bonn) Kellermann, K.	Polarimetric monitoring of the outburst in 3C111. 0.7 cm
BA029	Alberdi, A. (ESA, Spain) Gomez, J. (ESA, Spain) Marcaide, J. (Valencia) Perez-Torres, M. (Valencia) Marscher, A. (Boston)	Superluminal source 4C39.25. 0.7, 1.3, 2 cm
BA032	Aaron, S. (MPIR, Bonn) Lobanov, A. (MPIR, Bonn) Wardle, J. (Brandeis) Roberts, D. (Illinois)	Mrk 501. 1.3, 2, 3.6, 6, 18 cm
BB086	Bartel, N. (York U.) Sorathia, B. (York U.) Bietenholz, M. (York U.) Carilli, C.	Proper motion of the nuclear jet and counterjet in Cygnus A. 2, 3.6, 6 cm
BB088	Brisken, W. (Princeton) Dewey, R. (Princeton) Thorsett, S. (Princeton) Beasley, A. Benson, J.	Proper motions of pulsars in supernova remnants. 18 cm wth phased VLA

No.	Observer(s)	Program
BB089	Barvainis, R. (Haystack) Lonsdale, C. (Haystack)	Extremely steep spectrum components in OW 637. 1.3, 2, 3.6, 6, 13 cm
BB092	Braatz, J. Greenhill, L. (CfA) Moran, J. (CfA) Herrnstein, J. Wilson, A. (Maryland)	Nearby Seyfert 2 galaxy NGC 1386. 6 cm
BB093	Baan, W. (NAIC) Hofner, P. (NAIC)	Emission structure of OH megamasers. 18 cm
BC066	Claussen, M. Diamond, P. Braatz, J. Wilson, A. (Maryland) Henkel, C. (MPIR, Bonn)	Water masers in elliptical galaxy NGC 1052. 1.3 cm wth phased VLA
BC070	Charlot, P. (Paris Obs.) Sol, H. (Paris Obs.) Vicente, L. (Paris Obs.)	Multi-frequency monitoring of BL Lac object OJ287. 1.3, 3.6, 6 cm
BC075	Combes, F. (Paris Obs.) Baudry, A. (Bordeaux) Wiklind, T. (Chalmers, Onsala) Desmurs, J. (Yebes Obs.)	Mapping C_3H_2 absorption toward the gravitational lens PKS 1830-211. 0.7, 1.3 cm
BC077	Charlot, P. (Paris Obs.) De Grange, B. (Ecole Polytech) Gabuzda, D. (Lebedev) Pare, E. (Ecole Polytech) Sol, H. (Paris Obs.)	Simultaneous VLBI polarization and TEV gamma ray observations. 1.3, 2, 3.6, 6 cm
BC079	Cotton, W. Owen, F.	Mapping the Faraday screen in M87. 18 cm with phased VLA
BD037	Denn, G. (Iowa) Mutel, R. (Iowa)	Polarized VLBA jet of BL Lac. 1.3, 2, 6 cm
BD045	Dhawan, V. Kellermann, K. Romney, J.	Monitoring the accelerating, bent jet in 3C84. 0.7 cm with VLA single antenna
BD046	Diamond, P. Kemball, A. Boboltz, D. (Haystack)	Monitoring SiO masers through a cycle of Mira TX Cam. 0.7 cm with VLA single antenna

No.	Observer(s)	Program
BD047	Doeleman, S. (Haystack) Lonsdale, C. (Haystack) Greenhill, L. (CfA) Kemball, A. Diamond, P.	SiO masers in VX Sgr. 0.7 cm with VLA single antenna
BD051	Dhawan, V. Mirabel, I. F. (CNRS, France) Rodriguez, L. (Mexico/UNAM)	GRS 1915+105 on AU scales: exploring the disk/jet connection, and monitoring the secular parallax. 7 cm
BE017	Engels, D. (Hamburg U.) Winnberg, A. (Chalmers, Onsala) Yie, J. (Chalmers, Onsala)	Structure of H_2O masers in OH/IR stars. 1.3 cm with VLA single antenna
BF028	Fey, A. (USNO) Gaume, R. (USNO) Eubanks, T. M. (USNO) Ma, C. (NASA/GSFC)	Southern hemisphere astrometry for the celestial reference frame. 3.6 cm
BF039	Falcke, H. (MPIR, Bonn) Bower, G. (MPIR, Bonn) Zensus, J. A. Aller, M. (Michigan) Aller, H. (Michigan) Terasranta, H. (Helsinki)	Extremely variable spiral galaxy III Zw 2. 0.7 cm
BF040	Fomalont, E. Beasley, A. Goss, W. M.	VLBA pulsar astrometry - pilot observations in 1998. 18 cm
BG059	Guirado, J. (Valencia) Gomez, J-L. (ESA, Spain) Marscher, A. (Boston) Alberdi, A. (ESA, Spain) Marcaide, J. (Valencia)	BL Lac object 0735+178. 0.7, 3.6 cm
BG073	Gomez, J-L. (ESA, Spain) Marscher, A. (Boston) Alberdi, A. (ESA, Spain)	3C 120 rapid variations. 0.7, 1.3 cm
BG077	Gurvits, L. (NFRA) Kellermann, K. Fomalont, E.	Resolution matching survey of VSOP survey sources. 2 cm
BG078	Greenhill, L. (CfA) Herrnstein, J. Reid, M. (CfA) Moran, J. (CfA) Argon, A. (CfA)	Measuring the rotation of the spiral arms of M33. 1.3 cm

No.	Observer(s)	Program
BG079	Gabuzda, D. (Lebedev) Kochenov, P. (Lebedev) Cawthorne, T. (Lancashire)	Polarization observations of extraordinary intraday variable 0716+714. 3.6, 6, 18 cm with phased VLA
BG082	Greenhill, L. (CfA) Herrnstein, J. Moran, J. (CfA) Henkel, C. (MPIR, Bonn)	Water maser in TXFS 2265-1826. 1.3 cm
BH047	Hagiwara, Y. (Nobeyama Obs.) Kawabe, R. (NAO, Japan) Diamond, P. Herrnstein, J. Kameno, S. (NAO, Japan) Nakai, N. (NAO, Japan)	H_20 megamaser in NGC 5793. 1.3 cm
BI008	Imai, H. (NAO, Japan) Shibata, K. (NAO, Japan) Migenes, V. (Guanajuato U.) Inoue, M. (NAO, Japan) Sasao, T. (NAO, Japan) Miyoshi, M. (NAO, Japan) Murata, Y. (ISAS, Japan) Marvel, K. (Caltech) Diamond, P.	Monitoring of stellar water maser RT Vir. 1.3 cm
BJ027	Johnston, K. (USNO) Fey, A. (USNO) Gaume, R. (USNO) Eubanks, T. M. (USNO) Kingham, K. (USNO) Clark, T. (NASA/GSFC) Ma, C. (NASA/GSFC) Ryan, J. (NASA/GSFC) Vandenberg, N. (Interferometrics) Himwich, E. (Interferometrics) Shaffer, D. (Radiometrics) Gordon, D. (NASA/GSFC) Fomalont, E. Walker, R. C.	VLBA geodesy/astrometry observations for 1998. 3.6 cm
BK053	Krichbaum, T. (MPIR, Bonn) Lobanov, A. (MPIR, Bonn) Britzen, S. (NFRA) Witzel, A. (MPIR, Bonn) Zensus, J. A.	Broad-band variability and jet bending in PKS 0528+134. 0.7, 1.3, 3.6 cm
BK055	Kollgaard, R. (Fermi) Gabuzda, D. (Lebedev) Laurent-Muehleisen, S. (LLNL)	Polarization study of ROSAT Green Bank BL Lacertae objects. 6 cm

No.	Observer(s)	Program
BL048	van Langevelde, H. (NFRA) Schilizzi, R. (NFRA) Diamond, P.	Parallax of nearby Miras. 18 cm
BL059	Ludke, E. (UFSM, Brazil) Cotton, W. Sanghera, H. (NFRA) Dallacasa, D. (Bologna)	Faraday rotation and depolarization in CSS jets. 3.6, 6 cm
BL060	Lara, L. (IAA, Andalucia) Alberdi, A. (ESA, Spain) Marcaide, J. (Valencia)	Polarimetric observations of 3C395. 1.3, 2 cm
BM080	Moellenbrock, G. (ISAS, Japan) Roberts, D. (Brandeis) Wardle, J. (Brandeis)	Polarization structure monitoring of gamma ray blazars. 0.7, 1.3, 2, 3.6 cm
BM095	Marscher, A. (Boston) Cawthorne, T. (Lancashire) Gear, W. (Cambridge) Stevens, J. (Cambridge) Marchenko, S. (St. Petersburg) Yurchenko, A. (St. Petersburg) Gabuzda, D. (Lebedev) Lister, M. (Boston) Forster, J. (UC, Berkeley)	Monitoring bright AGNs. 0.7 cm
BM102	Moore, C. (Groningen/Kapteyn) Briggs, F. (Groningen/Kapteyn) Vermeulen, R. (NFRA) de Bruyn, A. G., (NFRA) Carilli, C. Menten, K. (MPIR, Bonn) Conway, J. (Chalmers, Onsala) Kus, A. (Copernicus/Torun)	Sources with UHF spectral line absorption. 18, 50 cm
BM103	Mioduszewski, A.	X-ray burster. 6 cm
BP040	Polatidis, A. (Chalmers, Onsala) Wilkinson, P. (Manchester)	3C380. 0.7, 2, 3.6 cm
BP042	Paragi, Z. (FOMI) Fejes, I. (FOMI) Vermeulen, R. (NFRA) Schilizzi, R. (NFRA) Spencer, R. (Manchester) Stirling, A. (Manchester)	SS433. 1.3, 2, 3.6, 6 cm with VLA single antenna

No.	Observer(s)	Program
BP044	Palen, S. (Iowa) Fix, J. (Iowa) Claussen, M.	Main line OH emission in R Aql and WX Psc. 18 cm with VLA single antenna
BR043	Roy, A. Claussen, M. Diamond, P. Wrobel, J. De Pree, C. (Agnes Scott College) Greenhill, L. (CfA) Herrnstein, J. Moran, J. (CfA)	Nonthermal nucleus of NGC 4258. 2, 6 cm
BR054	Romney, J. Dhawan, V. Kellermann, K. Alef, W. (MPIR, Bonn)	Kinematics of the NGC 1275 nucleus. 2 cm with VLA single antenna
BR055	Rantakyro, F. (Bologna) Baath, L. (Halmstad U.) Valtaoja, E. (Turku) Tornikoski, M. (Helsinki) Wiik, K. (Helsinki)	Dual frequency studies of the core of CTA 102. 0.7, 1.3 cm
BR058	Rupen, M. Hjellming, R. Mioduszewski, A.	Target of Opportunity observations of CI Cam: radio afterglow. 2, 6, 20 cm
BS061	Satoh, S. (NAO, Japan) Inoue, M. (NAO, Japan) Nakai, N. (NAO, Japan) Shibata, K. (NAO, Japan) Kameno, S. (NAO, Japan) Migenes, V. (Guanajuato U.) Diamond, P.	HI and OH absorption towards the nuclear region of NGC 3079. 18 cm with phased VLA
BT028	Tingay, S. (JPL) Preston, R. (JPL) Jones, D. (JPL) Murphy, D. (JPL) Meier, D. (JPL) Jauncey, D. (CSIRO) Reynolds, J. (CSIRO) Tzioumis, A. (CSIRO) McCulloch, P. (Tasmania) Lovell, J. (ISAS, Japan) Costa, M. (Tasmania)	Monitoring of Centaurus A at 8.4 and 22 GHz. 1.3, 3.6 cm
BT034	Taylor, G.	Gamma ray bursters. 4 cm

No.	Observer(s)	Program
BT036	Taniguchi, Y. (Tohoku U.) Ohyama, Y. (Tohoku U.) Kaburaki, O. (Tohoku U.) Inoue, M. (NAO, Japan) Kameno, S. (NAO, Japan) Satoh, S. (NAO, Japan)	NGC 6251. 1.3, 6 cm
BT037	Tingay, S. (JPL)	Nearby gamma ray AGN, PKS 0521-365. 1.3, 3.6, 6 cm
BT040	Taylor, G. Silver, C. (Columbia) Giovannini, G. (Bologna)	Searching for milli-halos in active galactic nuclei. 90 cm
BW038	Wrobel, J. Conway, J. (Chalmers, Onsala) Terlevich, R. (RGO)	Testing the starburst model for NGC 5548's Seyfert 1 nucleus. 3.6 cm
BW039	Wilson, A. (Maryland) Ulvestad, J. Mundell, C. (Maryland) Roy, A.	Accretion disks in Seyfert galaxies. 3.6 cm
BW040	Wilson, A. (Maryland) Greenhill, L. (CfA) Mundell, C. (Maryland) Braatz, J. Herrnstein, J. Moran, J. (CfA)	Water masers in NGC 2639 and Mrk 1210. 1.3 cm
BW041	Wilson, A. (Maryland) Ulvestad, J. Mundell, C. (Maryland) Roy, A.	Free-free absorption in megamaser galaxies. 2, 6, 18 cm
BX003	Xanthopoulos, E. (Manchester) Browne, I. (Manchester) Porcas, R. (MPIR, Bonn) Patnaik, A. (MPIR, Bonn) Wilkinson, P. (Manchester)	Search for extended radio structure in the JVAS lens B1030+074. 2, 3.6, 18 cm
GB027	Bartel, N. (York U.) Rupen, M. Bietenholz, M. (York U.) Beasley, A. Conway, J. (OSO) Altunin, V. (JPL) Graham, D. (MPIfR) Venturi, T. (IRA, Bologna) Umana, G. (IRA, Noto)	Supernova 1993J in M81. 3.6, 6, 18, 90 cm

No.	Observer(s)	Program
GL034	van Langevelde, H. (NFRA) Phillips, C. (Tasmania) Garrett, M. (NFRA) Schilizzi, R. (NFRA)	3C 380 test observation for JIVE correlator. 6 cm
GM035	Marcaide, J. (Valencia) Perez-Torres, M. (Valencia) Guirado, J. (Valencia) Alberdi, A. (ESA, Spain) Ros, E. (MPIR, Bonn) Diamond, P. 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, 18 cm
GP017	Paragi, Z. (FOMI) Fejes, I. (FOMI) Vermeulen, R. (NFRA) Schilizzi, R. (NFRA) Spencer, R. (Manchester) Stirling, A. (Manchester)	SS 433. 18 cm

The following research programs were conducted with the VLBA, used in conjunction with the HALCA (VSOP) orbiting radio telescope.

No.	Observer(s)	Program
V008	Linfield, R. (JPL)	Brightness temperature of compact sources: 1519-273. 6, 18 cm
V010	Marscher, A. (Boston)	Relativistic jets: 1807+698. 6 cm
V012	Lara, L. (IAA, Andalucia)	Quasar 3C395. 6 cm
V015	Vestrand, W. T. (New Hampshire)	Variable CGRO blazars: 0208-512. 6 cm
V017	Giovannini, G. (Bologna)	BL-Lac type objects: Mrk 501. 18 cm
V019	Rantakyro, F. (Bologna)	Structural variability in quasar CTA 102. 6 cm
V022	Wilkinson, P. (Manchester)	Gravitational milli-lens candidates: 1809+568. 6 cm with phased VLA
V029	Gwinn, C. (UC, Santa Barbara)	Nanoarcsecond study of the Vela pulsar. 18 cm

No.	Observer(s)	Program
V030	Preston, R. (JPL) Pearson, T. (Caltech) Readhead, A. (Caltech) Murphy, D. (JPL) Meier, D. (JPL) Jones, D. (JPL) Hirabayshi, H. (ISAS, Japan) Kobayashi, H. (ISAS, Japan) Inoue, M. (NRO, Japan)	Pearson-Readhead Sources: 1637+524.
V032	Guirado, J. (Valencia)	Quasar phase-reference mapping and astrometry: 1342+662. 6 cm
V034	Murphy, D. (JPL)	Continuous monitoring of 1928+739. 6 cm
V047	Gurvits, L. (NFRA)	Structure of extremely high redshift quasars: 1937-101. 6, 18 cm
V049	Rioja, M. (NFRA)	"New" point source 1308+328 near 1308+326. 6 cm
V053	Witzel, A. (MPIR, Bonn)	Intraday variable sources: 2007+777. 6 cm
V054	Porcas, R. (MPIR, Bonn)	Cores of lobe-dominated quasars: 3C 263. 6 cm
V077	Booth, R. (Chalmers, Onsala)	OH masers - OH45.5+0. 18 cm
V080	Wehrle, A. (JPL)	Gamma ray blazars: 1739+522. 6 cm
V085	Schilizzi, R. (NFRA)	GPS galaxies and quasars: 1622+663. 6 cm
V090	Kus, A. (Copernicus/Torun)	CSS source 3C 309.1. 6 cm
V105	Taniguchi, Y. (Tohoku U.)	Radio cores: NGC 6251. 6 cm
V123	Kameno, S. (NAO, Japan)	Cygnus A. 6 cm with phased VLA
V130	Edwards, P. (ISAS, Japan)	TeV gamma ray emitting AGN: Mkn 501. 6 cm
V131	Edwards, P. (ISAS, Japan)	1928+293.
VT835 VT837	VSOP Group (ISAS, Japan)	HALCA In Orbit Checkout. 1.3 cm with phased VLA

F. SCIENCE HIGHLIGHTS

Socorro

Second GRB Radio Afterglow Supports "Hypernova" Model - Only one day after the gamma ray burst of March 29 (GRB 980329) a radio counterpart was observed with the VLA. Continued monitoring showed evidence of interstellar scintillation, indicating an angular diameter for the fireball of a few microarcseconds in the first two weeks after the burst. This GRB counterpart was much fainter at infrared and optical wavelengths than at radio wavelengths (in fact, optical observers found the counterpart only after they were provided with the position of the radio counterpart and re-examined their images). This suggests extinction by dust. If so, the GRB's occurrence in a dusty environment, probably a star-forming region, supports the "hypernova" model for GRBs and is harder to explain with the merging neutron-star model.

Investigators: G. Taylor and D. Frail; S. Kulkarni and D. Shepherd (Caltech); M. Feroci (Istituto de Astrofisica Spaciale, CNR, Rome); and F. Frontera (Istituto Tecn. Studie delle Rad. Extraterrestri, CNR, Bologna and Univ. Ferrara).

VLA Makes Probable Detection of Oldest Radio Supernova - Multi-epoch VLA observations have revealed radio emission probably from Supernova 1923A in M83. Two unresolved radio sources are coincident with the optical position of the supernova. Spectral indices indicate these sources are nonthermal, and they appear to be fading with time. If confirmed, this would be the oldest radio supernova (as opposed to a supernova remnant, presumed to form no sooner than 100 years after the explosion) yet detected.

Investigators: C. Eck (Oklahoma); D. Roberts (Illinois); J. Cowan and D. Branch (Oklahoma).

Green Bank

Small, "translucent" molecular clouds provide a definitive test of astrochemistry models. Their quiescent physical conditions are well characterized so they may be reliably modeled both physically and chemically. Observations of HC_3N, C_3H_2 and C_2S in almost 40 of these objects were made using the 140 Foot Telescope. These data, combined with observations at millimeter wavelengths, have been interpreted using a chain of 4,000 chemical reactions to show that the abundances are consistent with steady-state chemistry, not
early-time chemistry. Furthermore, although the current gas-phase ion-molecule reaction schemes fit the data quite well, neutral-neutral reactions are of fundamental importance in forming HC_3N.

Investigators: B. Turner; H-H. Lee and E. Herbst (Ohio State)

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

The MAP project continues to dominate amplifier production. All the MAP designs are proven, and 82 of 114 amplifiers have been completed. NASA raised some issues involving gold plating quality, and as a result we have extensively revised the gold plating procedures. This work is still continuing. We anticipate completing the last of the spare amplifiers for MAP in August.

Two new designs are under way. The first is a modification of the MAP Q-band design to cover the 40–52 GHz range needed by the GBT and the VLA, which has been undertaken by Ed Wollack. This design is nearly complete. The second is a new design for W-band which is optimized for the VLBA desired frequency range of 80–95 GHz. This will replace the prototype amplifiers now being used in the VLBA W-band receivers. Marian Pospieszalski is working on this design now.

Superconducting (SIS) Millimeter-Wave Mixer Development

To assist with the problem of flaking gold plating in feed horns, reported last quarter, John Lichtenberger of MetaPlate visited the Central Development Laboratory (CDL) for two days. He found that several inappropriate procedures were being used during mandrel cleaning and preparation for electroforming, and that the composition of some of the baths had drifted out of acceptable ranges. The quality of plating and electroforming was quickly restored. Recommendations for future plating procedure include weekly titration of all plating baths to verify their compositions. The improved preparation steps and more rigorous process control, combined with the vacuum solder-filling procedure described in the last quarterly report, are expected to solve the current problem and give us very high quality plating and electroforming for MMA development and production.

The CDL has now completed the ten SIS mixers for the new eight-channel, 3 mm receiver being developed in Tucson.

Two 2 mm mixers were completed and shipped to Princeton for cosmic background work.

The new EM simulation program, QuickWave, is now in use in the CDL. This finite-difference time-domain (FDTD) Maxwell equation solver is very much faster than HFSS (the "industry standard" finite-element frequency-domain from HP) and can handle much larger electrical structures. It has been used by S. Srikanth to design a full-waveguide-band circular polarizer in a square waveguide with 38 corrugations. Agreement with measured results is exceptionally good. We are now applying QuickWave to the problem of minimizing LO leakage under the substrate in our balanced and sideband-separating SIS mixers. Following the MTT Symposium in June, the authors of QuickWave, Wojciech Gwarek and Malgorzata Celuch-Marcysiak, visited the CDL for two days of technical discussion and training in the use of QuickWave.

Several CDL engineers and technicians attended the International Microwave Symposium and Microwave Trade Show in Baltimore. The following invited paper was presented at a workshop on cryogenic electronics by A. R. Kerr: "Suggestions for Revised Definitions of Noise Quantities, Including Quantum Effects."

During this quarter the CDL assembled and tested 12 SIS mixers for three frequency bands, all using Nb circuits fabricated at UVA.

Electromagnetic Support

GBT – Development work on a short-backfire antenna in the frequency band of 385–520 MHz was completed. This design will also be used for the prime focus feeds in the 290–395 MHz and 510–690 MHz bands. The calculated aperture efficiency of the GBT with this feed varies between 57 percent and 74 percent. The measured cross-polarization of the feed is better than -21 dB. The estimated spillover temperature is 9 K at the high end and 13 K at the lower end of the band.

General – A finite-difference time-domain based software was used to design a Ka-band (26.5-40 GHz) phase shifter. The more narrow corrugations on the new design are 0.010" wide. If the K-band phase shifter was scaled to this band, the width would be 0.007", making it difficult to machine the mandrel. The new design is also 12 percent shorter in length compared to a scaled version. The software used revealed the presence of higher order modes in the initial design. A Ka-band phase shifter has been fabricated and will be measured shortly.

GBT Spectrometer

During the last quarter, the Tucson 8-beam spectrometer was completed, tested, and shipped to Tucson. So far, tests of the system in Tucson have not indicated any problems.

Work has progressed on the MMA correlator design. Most of the work in this quarter has had to do with simulating a digital filter to be used on the system. This simulation has taken much longer to accomplish than initially anticipated and more work needs to be done.

Some beginning definition work was done on a possible application of the MMA correlator to the VLA upgrade. Meetings held in Socorro in June helped develop a set of initial specifications for the VLA upgrade correlator.

Frequency Coordination

In the area of frequency coordination, analysis of the tests of emissions of the IRIDIUM satellite system in the 1610.6–1613.8 MHz radio astronomy band, made during the previous quarter, was completed. A report on the results was prepared under the coordination of A. R. Thompson, and was issued on May 7. Except for the broadcast signal channels, which at Green Bank exceeded the levels agreed upon in the MOU between NRAO and Motorola, the emissions were within the predicted levels. Thompson also attended the annual meeting of CORF (the Committee on Radio Frequencies of the National Research Council) and reported on actions of ITU Working Party 7D and the IRIDIUM tests. Work is continuing through U.S. Working Party 7D in preparation for the World Radiocommunication Conference in 2000.

I. GREEN BANK ELECTRONICS

GBT IF System

Completed signal conditioning card/box for helium pressure sensors and ambient temperature sensors. This initial unit has prototype board with circuits for two pressure sensors and four temperature sensors. The unit was installed in the Mockup; awaiting M/C software to log readings. If circuits work OK, a PCB with full complement of 12 pressure circuits and eight temperature circuits will be made.

RF testing of the repackaged Optical Driver Module was completed successfully. Made swept gain, noise figure, and gain compression tests. Some problems with the layout were identified and corrected. All the bandpass filters required for eight IF channels have been received and tested successfully. The variable attenuators which were returned to the manufacturer for repair have been repaired and received back.

GBT Fiber IF System

We successfully closed the AGC loop on the optical fiber hardware. Tests were run and the system works perfectly. We have practically eliminated all measurable effects of signal gain problems when the fiber cable is disturbed.

GBT Servo System

Although a program to exercise all components of the Feed Arm Servo weekly was put into place, because of various mechanical problems, only the feed turret system can be moved at this time. It will probably be a few months before we can continue this testing.

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

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.

Quadrant Detector

Most of the work on the quadrant detector was involved in recording data over a long period of time. The reason for this was to get enough data so we can set a minimum signal level at which the quadrant detector data will be reliable. We also replaced the detector which was 2 mm square with one that is 4 mm square. The original detector would have been too small for the expected movement of the arm.

Holography

We began testing phase stability of the holography receiver system. The phase was very sensitive to the movement of helix cables. The problem was found to be a mismatch of the 10 MHz reference at the bias T. We changed the method of combining DC and reference through a coupler, which reduced cable sensitivity. Improvements to the test setup are necessary before accurate phase measurements can be completed.

Equipment Room

We have been looking into design of HVAC controllers in the Jansky Lab addition equipment rooms. We wish to improve the temperature control, to eliminate an observed 3C temperature cycle. A promising retrofit scheme has been developed; which, if it works, will cost less than $500 per room. This scheme was tested and the results were very promising.

GBT Receiver Systems

Prime Focus - We tested the 450MHz dipole feed with favorable results. We tested the 1070 MHz feed assembly VSWR with around 20 dB return loss throughout the band. We had vacuum problems on the low-band dewar, and problems with the window. These problems are now resolved. The IF conditioner is scheduled to be completed in mid-August.

K-Band - After running cold, continuously for 12.5 months, the refrigerator failed. It was replaced on April 15th. The receiver was cooled the same day. The 12.5 months of continuous operation is a record for this receiver.

C-Band - We spent a significant amount of time this quarter working on a Vac Ion controller replacement for the unit we bought from Varian. This unit will run off the receiver DC supply, have an LED display for Torr or pump current, and be controllable from an external TTL signal. A prototype should be ready for testing soon.

Q-Band - The mechanical design of the fixturing to test the prototype Q-band RF assembly in a lab test dewar is still in progress. Outfitting of the test dewar with electronics and cabling is underway. The mechanical drawings for the test dewar fixtures should be complete and in the shop by the end of July

Site Operations

Project Phoenix (SETI) - Project Phoenix has moved their electronics to Arecibo for observations there. We spent time testing their receiver and packing their system up for transport over this past quarter, of course with their funds.

OVLBI - Overall, the station is in good shape. Two Way Timing (TWT) Control problems appear to be solved, and phase noise in the two-way path residuals is lower than ever.

Interference Protection Group - Electronics is an integral part of the Interference Protection group. Over the past quarter we have tested and re-tested many subsystems, identifying sources of RFI in each subsystem.

As usual, maintenance, repair, and installation support was supplied to the 140 Foot Telescope, the 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 virtually every receiver in Green Bank. Normal day-to-day support of UNIX workstations, weather station, time systems, and local area networks.

J. TUCSON ELECTRONICS

1-mm 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 1-mm 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 Wide-band 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 multi-beam 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 gather 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

Work is complete on a new digital spectrometer for the 12 Meter Telescope copied from the GBT design. The new spectrometer has twice the instantaneous bandwidth currently available for our multi-beam systems, and uses a single wide-band sampler for each IF channel, so avoiding the persistent platforming problems experienced with our existing hybrid correlator spectrometer. This new correlator will support the existing 1.3 mm and 3 mm, and any future, multi-beam systems on the telescope. In anticipation of this development, the Tucson programming staff have been participating in the development of real time software for the GBT spectrometer. We anticipate installation of this new spectrometer during the 1998 summer shutdown period.

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.

K. SOCORRO ELECTRONICS

VLA K-Band Front-End

The components for the third and fourth front-ends have been received along with the CDL's cooled amplifiers. The VLA machine shop has fabricated the dewar components. Front-ends #3 and #4 are assembled including the H_2O radiometer sub-system. Front-end #3 receiver section has been tested with testing of the H_2O sub-system continuing. Testing of front-end #4 has just started. These front-ends will be installed on two antennas during the third quarter of 1998 as well as the three sub-band total power monitors for estimating atmospheric phase variations. Preliminary system tests of front-ends #1 and #2 indicate that with a zenith atmospheric temperature of 20K the total system temperature will be about 50K. This is about three times more sensitive than the present narrowband K-Band front-ends. A water radiometer digital interface design was implemented using a Xilinx Field Programmable Gate Array (FPGA). Six 24-bit counters, plus a VLA monitor interface, are contained within one Xilinx FPGA. Lab testing indicates a three count error at 5MHz. Final integration and system testing is slated to begin early 3QTR 1998.

VLBA 3-mm Receivers

The second 80–90 GHz receiver dewar was mostly assembled in Charlottesville with support by some of the unique capabilities of CDL in custom waveguide fabrication and electroforming techniques. The Socorro Front-End group completed assembly of Receiver 2. Two prototype MAP low noise amplifiers, which were returned from Princeton University, were installed in early January, 1997. Receiver 2 was installed at Los Alamos in April. Experience with dewars 1 and 2 indicated that disassembly of these dewars for component testing and troubleshooting was time consuming. A new dewar design has been started and will be completed next quarter. Most components are on hand for receivers 3 and 4. Construction, testing, and antenna installations will continue during 1998.

VLA Correlator Controller

Because of time constraints with online programming, this project has been delayed. The hardware for this phase of the project is almost complete. The spare VLA correlator controller backplane is being modified for testing at the AOC and eventual testing and installation at the VLA. Completion of this project has been turned over to the Online Computer group and a programmer has been assigned to this project.

Amplitude Equalizers for the VLA

The average passband for the VLA antennas has a large slope across the 50 MHz passband. This affects the observing center frequency during continuum observations at 50 MHz bandwidth. A simple R-L-C equalizer circuit to correct the bandpass slope has been tested using a spectrum analyzer in the laboratory. We plan to further investigate and implement the equalizer modification during the next quarter.

Increasing the VLA Continuum Bandwidth

Work on increasing the VLA continuum bandwidth on all four IFs continues. We plan to increase the bandwidth, initially, to 70 MHz/IF using existing electronics in the back-end. The IF filters needed in the F7 and F8 front-end modules have been fabricated in the VLA machine shop and tuned by the Front-End group. The cost of the modifications to increase the bandwidth to 70 MHz should be less than about $1k/antenna. The system has been installed in all four IFs, on three antennas, and testing has been completed. The results are an improvement in signal to noise ratio of 24 percent and phase closure error within 0.2 degrees. All testing done so far was limited to 70 MHz by the screen room filters. Some preliminary work in retuning these filters to 80 MHz bandwidth has been successful. This phase of this project is complete.

VLA - Pie Town Fiber Link

NSF Major Research Instrumentation (MRI) funding in September, 1997, triggered a detailed design effort to link the VLBA antenna at Pie Town (PT), NM, to the VLA via existing in-ground optical fiber. Project engineer Ron Beresford, visiting from ATNF, led the development of a detailed design which minimizes additional electronics without sacrificing performance while using the Pie Town antenna as the 27th antenna of the VLA. The design includes the proposed VLA bandwidth increase to 70 MHz. Implementation of the design prototypes has started and will continue into the third and fourth quarters. By including the PT antenna, we will double the resolution of the array at all common frequency bands.

A new module, M30 Relay Control Module, is being designed. The main circuitry also was implemented using a Xilinx FPGA. Module completion and testing is expected to be early 3QTR 1998. On another front, evaluations were made for the selection of the digital link technology that can provide VLA style Monitor and Control signals to be used at Pie Town. A Gigabit transmit/receive chip set made by Hewlett-Packard was selected. A PCB is being designed around this set for incorporation into another module M31 Digital Fiber Optic Interface. Completion is expected to be completed by the middle of the third quarter.

VLA AZ/EL Encoder Replacement

A lab prototype has been bench tested. The design will be refined and costs estimated. After this, a decision will be made on whether or not to proceed. If a positive decision is made, an antenna prototype attempt could possibly start in 1QTR 1999 for an antenna prototype attempt.

GPS Receivers

Two of the Truetime model XL-AK-600 GPS receivers that have been chosen to replace the Odetics 325 are in the field and working well. Five additional receivers have been purchased and are currently under test.

VLBA Masers

A maser IF module, modified with a hand-wound inductor in a tuned circuit, was installed in maser #1 at the Brewster site. The maser's IF level degradation rate has decreased as a result of this retrofit. The hydrogen bottle in maser #4 was re-filled at the VLA site. An excessively increasing palladium heater voltage, which controls hydrogen flow, is being investigated.

VLA Correlator

A new protocol for transferring delay values into the correlator was written and tested. Short test observations indicate that it is now working correctly. This supports the extended delay range required for the Pie Town to VLA connection. Simple testing with a few modified Delay Cards in the correlator should occur in the third quarter. Work continues on testing the new interface cards to be used in replacing the original Correlator System Controller. Power supplies have been received to use on the new analog sums, in order to reduce noise on the sums. They will be installed during the third quarter.

VLBA Correlator

The VLBA Technical Reports for the FFT sub-system and the Playback Interface sub-system are ready for formal release. The report covering the Digital Filter is close to completion. These are three in a series of five reports planned for the correlator. Several low level errors that were occasionally detected in system test have been identified and fixed.

VLBA Data Acquisition and Playback

The Formatter expansion has now been completed at Pie Town, Los Alamos, and Owens Valley. Outfitting is expected to continue at about the rate of one site per month. Testing of this new recording mode has begun. This expansion doubles the present recording bandwidth to 512 Mbps and requires recording on two tapes at the same time.

Two humidity reduction systems have been installed at the VLBA correlator. These have been in use for several weeks. The remaining eight systems will be installed soon. They will increase headstack lifetime by reducing the relative humidity in the tape contact area of the headstack.

NRAO and other members of the VLBI community are working toward a specification for headstacks which will include the stepped headstack, which has been used for years, as well as the triple-cap headstack. Progress has been made and the specification should be complete during the third quarter of 1998.

Performance of triple-cap headstacks is satisfactory at the VLBA correlator. We plan to purchase triple cap headstacks in the future, rather than the stepped headstacks, because the triple cap headstacks are expected to have a longer lifetime.

Interference Protection

The W8 monitor parameters were modified again this quarter in order to zoom-in on the 1600–1630 MHz GLONASS/IRIDIUM bands. Previously, the grayscale plotting program was modified to accept plot data based on 1 minute peak-hold increments, rather than the previous five minute increments. The standard full L-band plots, as well as the new 1600–1630 close-up plots are available on the Socorro IPG www site on a daily basis.

The ability to request and automatically generate L-band (W8) grayscale plots in real-time over the www is in the final stages of debugging. Unlike the current W8 plots, the new grayscale plots will allow the plotting of data covering day, week, or month time increments.

Data is being collected and plotted from the new RF Environmental Monitoring System (RF-EMS). The Socorro Interference Protection group now has full antenna direction and receiver frequency control from the AOC via PC over a modem link. Early plots showed problems with reflections when using the L-band, FE amplifiers. The reflections exhibit themselves as amplitude variations of from 2 to 5 dBm across a 15 to 10 MHz span, although external signals are being detected, logged, and plotted.

Additional studies will be done in order to find the source of the impedance mismatch(es). In the meantime, a new HELIX transmission line was installed to allow higher frequency operation. Receiver control software was rewritten during the past month in order to allow for a faster peak-hold type function for capturing intermittent signals. We are currently using the system to fill-in S-band and C-band holes from the 1994 and 1996 site survey. The data will be used for planning purposes during the VLA Upgrade

Review. Frequency coordination efforts continued between the Socorro IPG and military spectrum users from seven different military bases. In addition, RFI reduction technical communications continued between the Socorro IPG and the owners and engineering sub-contractors of a number of proposed and potentially damaging TV and communications transmitter facilities being constructed near the VLA and VLBA sites.

IRIDIUM Satellite Tests

The 1994 MOU between NRAO and Motorola Satellite Communications, Inc., requires cooperative work on a test program to determine the IRIDIUM satellite system signal levels at the observatory sites. Motorola intends not to exceed at all times a spectral power flux density (SPFD) of -223 dB($W/m^2/Hz$) at the VLA and -208 dB($W/m^2/Hz$) at all NRAO observatory sites. VLA test objectives are to measure A) the impact of IRIDIUM emissions on VLA observations of 1612 MHz OH, and B) the spectral power flux density (SPFD) of IRIDIUM emissions in the 1610.6–1613.8 MHz radio astronomy band.

On February 22 and 24, and March 3 through 7, the VLA test team of 14 individuals acquired data from the IRIDIUM test satellite emitting under three different operating scenarios. The data from the VLA, the 140 Foot, and a small tracking antenna at Tucson was released in an NRAO report on May 7, 1998. The report also included an overview and conclusions by NRAO and an extrapolation by Motorola to a 2000 second integration time from the IRIDIUM constellation of satellites.

NRAO concluded that a single IRIDIUM satellite, with the voice traffic and broadcast loading as tested, will not exceed the SPFD of the MOU at the VLA and VLBA sites.

L. COMPUTING AND AIPS

Hardware

The main hardware focus during this quarter has been on replacing old equipment. In particular, with the recent improvements on Intel processors running Linux, this has become a very attractive desktop platform from the perspectives of both price and performance. We also anticipate that it will remain competitive for this purpose for the long term. Accordingly, approximately three-quarters of the 50 UNIX workstation upgrades currently planned for this year will run Linux. The remainder are SPARC Ultra 10's, which were ordered in late June. Sun SPARC/Solaris continues to be the most popular environment in the AIPS community, and will still outnumber Linux systems within NRAO by a factor of three; thus there are no plans to reduce support for Suns in the foreseeable future.

There is a huge variety of hardware options available on Intel systems, resulting in an increase in the complexity of system configuration and maintenance. To minimize these difficulties, an effort is underway to establish observatory-wide standards for the peripheral hardware that will be formally supported.

Planning

In April, after receiving budget information, the Observatory-wide Computing Council assigned priorities to the various planned computing projects and allocated funds from the Observatory-wide budget to cover the most critical ones. A number of important projects, such as major local-area networking upgrades at Green Bank and Charlottesville, have had to be postponed.

Development on the long range computing plan continues, although at a reduced pace this past quarter due to conflicting time commitments for those involved. This effort will resume during the summer.

Software

AIPS - A new release of AIPS (15APR98) is now available, and a test version (15OCT98) is under development. Multiple TV screens can now be used on a single workstation/X-terminal. Support of DLT drives and code distribution on CD-ROMs are now available. Automatic transfer of calibration data for VLBA datasets is undergoing testing. Developments in the areas of millimeter VLBI support and imaging are underway.

Linux - With a significant increase in the number of Linux systems at the NRAO, it will be necessary to develop automated installation and support tools. System staff at all four main NRAO sites are now involved in a cooperative effort to do this; considerable groundwork has been done by the UNIX administrators at NRAO Charlottesville.

PCs - Work is underway to replace the Novell servers in Green Bank, Charlottesville, and Socorro—currently required for NRAO's payroll software and also used for general administrative computing in Socorro—with modern PC hardware running NT. We anticipate that the necessary payroll applications will be available under NT by late summer, and our goal is to have the new servers operational before the end of 1998.

General - After a formal proposal and evaluation process, a PC-based computerized maintenance management system has been purchased. This software is required to track repairs, schedule maintenance and engineering changes to instruments. It will replace the existing MAINT program used in Socorro, which was developed in-house several years ago, and it is likely that the same package will be adopted in Green Bank as well. We view this software as a long-term investment in the reliability of the VLA, the VLBA, and the GBT.

NCSA - Good progress is being made on the joint collaboration with NCSA to enhance AIPS++ to take advantage of high-performance parallel computing environments such as those available at NCSA. Preliminary parallelization of the AIPS++ Clark CLEAN algorithm, using 32 processors on a Silicon Graphics system, resulted in a factor of 22 improvement in speed. The code used for this testing will be integrated with mainstream AIPS++ code. Implementation efforts are progressing on several fronts, including spectral-line imaging, image mosaicing, and performance tuning using SGI libraries. After some unsuccessful efforts to use the University of Virginia vBNS connection to improve network access from NRAO to NCSA, we are now preparing instead to connect NCSA via a relatively low-speed (1Mbps) circuit directly to the NRAO Intranet. During the development phase of the project, this connectivity will be adequate; in the long term much higher bandwidth will probably be required.

VLA Archive Project

The VLA re-archiving project finished reformatting and re-archiving data from 1986, and has now progressed well into 1987, its last year. Another couple of months and we will have re-archived all previous VLA data from 1976 to present. Earlier, a bug in the conversion program had been discovered, which, for pre-1988 data, caused zero amplitudes and phases for certain observing parameters. In the meantime, we have a compiled a full list of affected observations. After finishing 1987, we will spend a number of months reformatting all observations in this list using the corrected conversion program. During this effort, it is likely that we will use this pass through the system to rectify a few bugs affecting the archive catalog, which is available to the outside world on the www.

VLA Networking

Good progress was made with the installation of fiber optic link at the VLA site. All the fiber is in place; we are currently busy with the precise and time-consuming task of terminating the fibers. The link connecting the VLA Control Building and the Technical Services Building is operational; connections to the other main buildings are planned in the near future. We expect to complete this project by the end of June.

AOC Software

After receiving bids from several vendors, and based on local demos of their products, we selected a commercial PC-based maintenance system to replace our locally developed product. Primary use is at the AOC, the VLA, and the VLBA sites, but it is not unlikely that other NRAO sites such as Green Bank will adopt this system as well. We expect the product and the dedicated server it will run on early this summer. We are currently developing an implementation plan in order to make the transition from the old to the new system as smoothly as possible.

AOC Hardware

No major purchases were made during this quarter. There have been lengthy discussions, though, of the yearly workstation upgrade. Currently, NRAO-NM is considering a shift from Sun workstation based computing to the PC/Intel architecture running the Linux operating system. These purchases are expected to take place during the fourth quarter of 1998, by which time we expect to have developed a system to support Linux installations centrally much in the same way we support Sun Solaris.

AOC Personnel

Ruth Milner, for many years Manager of Computer Systems, moved to a position related to NRAO Observatory-wide computing. Replacing her is James Robnett, who previously held a comparable position at the New Mexico Tech Computer Center. Vic Kiff, one of our system managers and network specialists left NRAO in May. We are currently in the process of finding a replacement. The heavy demand for computer personnel is making it increasingly difficult for NRAO-NM to find competent personnel willing to move to Socorro, and this vacancy was no exception in that we received very few applications. We managed to fill our third previously open position, that of online programmer. Rich Moeser accepted our employment offer and we expect him to come on board in the second half of July.

With Robnett already on board and the new system manager hopefully joining us soon, we hope to be in a good position to continue to support AOC and VLA computing and add central Linux support as discussed previously.

Green Bank Computing

The Suns at the Green Bank Interferometer are now all at revision 2.5 of Solaris. As part of the observatory-wide computer procurement, we have ordered an upgrade for our central server (sadira). This will be delivered in August with Solaris 2.6. The reconfiguration of the software served by sadira to accommodate the new revision is in progress. The major upgrade of the rest of the site will occur thereafter.

Work continues on the NRAO domain for Windows NT in collaboration with Charlottesville and Socorro. In Green Bank, the Windows NT file server is now fully operational with 25 clients. The server already serves the Corel suite to some users and provides nightly backup for personal disk areas.

We have a need to track the component maintenance history on the GBT, so we are actively tracking the progress of the purchase of the new product being acquired for this very purpose on the VLA and VLBA in New Mexico. A presentation of the proposed software product was given in Green Bank by the software engineer responsible for the final selection.

We have isolated the GBT network into its own "non-routable" domain. The GBT devices are now only accessible from specific machines in Green Bank itself, not from the rest of the Internet. We are in the process of putting the Macintosh computers onto their own subnet to reduce some of the traffic on the main Green Bank local area network. In order to prepare for the higher volume of network traffic when the GBT is in operation, we propose to replace the old (coaxial) Ethernet wiring in the Jansky Lab with fiber, which can support communication at 100 megabits/second.

The contract for the new PBX in Green Bank has been awarded. The machine should be delivered in July; the installation and cut over is presently planned for August. This will provide many modern features such as voice mail. We have also ordered a new terminal server to provide much enhanced modem dial-in and dial-out capabilities. The modems will support speeds up to the limit of the analog connections. The PBX procurement includes a remote expansion cabinet on the GBT to support digital phones providing hands-free operation and an intercom capability throughout the structure.

Year 2000 Issues

Y2K Inventory and Assessment - A comprehensive inventory of all NRAO date-aware hardware was completed in late 1997. This inventory is continuously updated as new hardware is acquired. Plans have been made to replace older hardware which performs critical functions that will be affected by the Y2K problem during 1998. Detailed testing of PCs, which have a great deal of variation in their degree of Y2K compliance depending on hardware and firmware revisions, is also underway.

Software - All NRAO software which understands the FITS (Flexible Image Transport System) data format has now been updated to begin using the new Y2K-compliant format for date-related keywords. This includes the UNIPOPS package as well as AIPS, AIPS++, and the software which records VLBA data in FITS format for distribution and archiving.

Except where described elsewhere in this report, none of the third-party commercial and public-domain application software (such
as spreadsheets and software development tools) in use at the NRAO is both date-aware and critical to fundamental Observatory operations. For the relatively few date-aware applications that are heavily relied upon, we are contacting authors/vendors to obtain information on their Y2K status and will do Y2K-specific testing. We do not plan specific Y2K remediation for these non-critical applications, but expect to handle minor Y2K deficiencies via normal upgrades.

Financial and Personnel Systems - NRAO's key financial management software and payroll systems are purchased from outside vendors with active or completed Y2K compliance efforts. In early 1998, upgrades were applied to the operating system and accounting
software on the primary in-house fiscal computing systems which ensures that these components are Y2K-compatible. A careful review of NRAO's customizations to this software has been completed, and no problems were found. Software being written in-house for use by the Personnel office is designed for Y2K compliance.

The primary remaining Y2K issue in this area is the application used for outsourcing NRAO's payroll. Currently we must run an old version of this software which requires Windows 3.11 and an old release of a special networking environment on the Fiscal PCs and their servers; none of these is Y2K-compliant. However, a new version of the payroll software is expected during summer 1998, and planning has already begun for the migration of payroll processing to Windows 95 using NT servers during the fall.

Telescope Operations - Significant progress has been made this quarter in testing telescope operations. The VLBA, including the correlator, has been tested as thoroughly as is possible at this time; only minor problems were found, which have been fixed. Full testing cannot be done until closer to the year 2000; when the date on the telescope systems is set forward, the current positions of radio sources are too far from where they will actually be on that date to evaluate the results. This is much more critical for the VLBA than for other NRAO telescopes because of its high angular resolution. The software is designed for Y2K compliance, and final tests will be scheduled during 1999. The monitoring software used in VLBA operations is scheduled for full testing in early 1999.

In Tucson, Y2K tests of the 12 Meter control system and on-the-fly data recording and analysis were carried out successfully in June. A few minor bugs were found; all have been fixed. At this time, we do not expect that the 140 Foot Telescope in Green Bank will be in operation beyond 1999. If this situation changes, any required modifications to the control software will be made promptly. The GBT control software is designed to be Y2K compliant; testing to the extent possible will be done ahead of telescope completion.

Communications and Networking - Only a few instances of non-compliance exist within NRAO's internal communications, telephone, and computer networks. The Green Bank telephone PBX is scheduled for replacement in mid-1998. The network server in Socorro, which is so obsolete that it cannot use a Y2K compliant operating system, will be replaced sometime during the second half of 1998. Some older routers are not guaranteed by the manufacturer to be fully Y2K compliant, but we believe that this will not interfere with correct operation.

M. AIPS++ PROJECT

In Single-dish Support, we added the following to the Dish program: an operation to save results back to disk, the ability to save the state of Dish and its plotter between executions of the program, and use of the same pgplotter widget in the dish plotter as used elsewhere in AIPS++. The full SDFITS convention is now supported in the fits2table application. At Green Bank, we added support for the Holography back-end to the existing fillers. The RFI data base developed last quarter is now in use in Green Bank and we are responding to the initial user feedback. We support GBT staff in on-going testing of GBT hardware and software. We have begun development of the continuum analysis tools necessary for GBT commissioning.

In Synthesis Support, we finalized the definition of the second version of the MeasurementSet format. This will be implemented following the third beta release. We developed a Glish-based visibility plotter using the ms module and the pgplotter interactive plotter. We expect that this will meet visibility examination needs for the short term but will have to be revised or replaced when the display library is available for application programmers. Only about a week's investment of time was needed for the development of a very functional initial version. The sky synthesis imaging application was subject to various testing and as a result a number of (mostly subtle) bugs were fixed. The corresponding cal synthesis calibration application is still under development and has not been placed in the system. Wim Brouw developed a very promising approach to wide-field imaging in which some of the most time-consuming operations (the image coordinate system conversions) are no longer required. The Measures system now supports this via the UVWMachine class, and we expect to implement the full algorithm in the next quarter.

In Glish, a number of important modifications were made:

- Basic file I/O was completed; this allows Glish users to access ASCII files line-by-line. The user can also get basic information about files (similar to what is returned by the Unix stat() function).
- printf(), sprintf(), and fprintf() were added to Glish as built-in functions. This addition was complicated by the fact that stdarg argument lists cannot be created dynamically at runtime. As a result, the (publicly available) source code for the shell version of printf() had to be used.

- A TCL/Tk based client was developed. This client can be used instead of the current version of the TCL/Tk widgets which is linked into the Glish interpreter. This client replaces the current widgets without any modification to existing scripts which the Tk widgets. This required additional classes built upon the Client class along with changes to the internals of the Glish interpreter. These changes make it easy for those developing Glish clients to have a client act as a repository for "proxy clients." These proxy clients are similar in functionality to the AIPS++ distributed objects (DOs).

In Measures, after ample discussions about the proper inheritance structure and format, we wrote (and got code-reviewed) QuantumHolder and MeasureHolder classes, which are generic holders of any Measure or Quantum, and aimed at providing a general interface to the Tasking system. We included the VLBI reference source list in the 'data' system, which is accessible from both the Glish (measures GUI) and C++ code. We wrote the MBaseline Measure (and its coordinating classes): no Earth tide or other secondary effects included as yet, Muvw Measure (and its coordinating classes), added an angular shift method (in both true and projected angles) to the MDirection Measure, added de-projection of an 'off-axis' field to UVWMachine, improved some of MDirections forward/backward conversion precisions, finished EarthMagnetic field Measure using the IGRF reference magnetic field, wrote a FieldMachine to easily calculate the magnetic field at a certain direction in e.g. the ionosphere, wrote a VelocityMachine to convert between velocities and frequencies in a simple manner, and added new ITRF and TOPO codes to MDirection. We also wrote an article for newsletter on measures GUI.

In AIPS++ Infrastructure, mostly minor changes were made, mostly in response to bugs. The table browser was improved significantly, adding user-controlled formatting, smart formatting of special column types such as time and direction, etc.. The catalog browser was substantially re-written in response to comments and bug reports from the alpha testers. Finally, we developed a prototype of a command-line parameter-setting shell, similar in principle and details to various systems now in use in astronomy (Standard commands package, AIPS, MIRIAD).

In Image Analysis, work has largely revolved around regions of interest, masks, the classes which hide the details of optimal iteration through images, and the integration of these things with our high level applications. Neil Killeen and Ger van Diepen made good progress in these directions, and now have in place:

- A wide range of C++ classes to handle lattice coordinate based regions and masks (for example, boxes, polygons, ellipsoids, extensions of these shapes along axes, unions of them, differences, intersections and so on).
- A much smaller set of C++ classes to handle world coordinate base regions. So far we just have a box and polygon. These class objects know how to convert themselves to the equivalent lattice coordinate based objects whereupon the union, complement, difference, etc., classes can be invoked
- The first steps towards improving the user interface from the simple lattice coordinate blc/trc regions has been taken. This was done by creating Glish functions which create GlishRecords defining the desired region definition. The Glish record is then passed to the image DO via an application where it is reconstituted into the C++ class object for use by the classes which access the lattice data in the image.

The image analysis applications already in place have been integrated with these new classes as much as is possible.

In Display work, David Barnes has joined the ATNF AIPS++ team and reinvigorated the Display Library (DL) work following Tom Oosterloo's departure last year; he is working closely with John Pixton of NCSA. David spent time familiarizing himself with the DL design and current implementation.

In the System area, the major change this quarter was the addition of a system to "bless" development updates as having met internally-defined criteria for stability and usability; this now enables AIPS++ sites that require stable installations to confidently track development progress between public releases. Other system changes include: continued incremental improvements to the code management, distribution, compilation, testing, and documentation systems; improved support for providing some of the third-party software packages required by AIPS++ to end-users, particularly those running Linux; and an investigation into building AIPS++ with the free Lesstif library suite, attempting to eliminate its dependence on the commercial Motif library suite.

In the area of Parallelization, work proceeded on a number of fronts. In April, Wes Young completed the parallelization of the spectral line Clark CLEAN application in AIPS++. Using the spectral line deconvolution, Doug Roberts has spent much of April benchmarking the task to measure the speed-up across processors on the NCSA SGI Origin 2000. The speed-up achieved is encouraging; the application executed 22 times faster than uniprocessor speed on 32 processors. An ideal speed-up on 32 processors would be 32. The results of the benchmarking were presented by Doug Roberts at the Alliance98 conference, held in Urbana at the end of April. Brian Glendenning and Ruth Milner from NRAO along with Dan Briggs, Dick Crutcher, and Doug Roberts from NCSA

attended the Alliance'98 conference. The on-line version of the Alliance'98 presentation is available at the URL: http://pacont.ncsa.uiuc.edu/A98/poster/roberts/

In Documentation, we continued with publication of the AIPS++ Newsletters (available via the AIPs++ Web page at http://aips2.nrao.edu/aips++/docs/html/navpages/learnmore/newsletters.html). We have installed a new system of Web pages that have improved layout and navigation aides. Our alpha testers (particularly Rupen and Anantharamaiah) have started re-writing the introductory documentation, with a view to making the concepts in the system comprehensible to astronomers, and to defining terminology to be used elsewhere in the documentation.

In Management, Brian Glendenning left his position as Deputy Project Manager to join the NRAO MMA Project. Athol Kemball will replace Brian as Deputy Project Manager, effective July 1. Ger van Diepen will replace Brian as Acting Technical Leader, effective September 1. Tim Cornwell and Brian Glendenning gave presentations to the NRAO Visiting and Users Committee Meetings and Tim Cornwell gave a presentation to the AUI Board of Trustees.

N. GREEN BANK TELESCOPE

Antenna

In late June the last of the twenty-two modules which comprise the backup structure of the GBT was raised into place. The figure shows the completed BUS mounted on the box structure. With this milestone achieved, one of the most complex and time-consuming portions of the construction program is nearly finished. There remains the completion of the welding of the beams joining the modules together. Approximately 97 percent of this "intermodule welding" is complete.

The primary effort now being expended at the site is aimed at correcting the poor quality welds discovered in the interior stiffeners in the permanent supports of the backup structure. The rework of the permanent supports and the connecting of the supports to the box will continue over the next several months. After the permanent supports are installed the load of the backup structure will be transferred to them, and the tipping structure can then be rotated.

Additional work on the structure includes the preparation for the installation of the surface actuator cables, the checking of the shape of the backup structure on the temporary supports, painting, and installation of electrical gear. The assembly on the ground of portions of the vertical feed arm has been completed, and it is planned to lift the first of the lower modules onto the structure in late summer.

GBT Servo

(Progress on the GBT Servo is addressed in the Green Bank Electronics section of this report.)

GBT Spectrometer

(Progress on the GBT Spectrometer is addressed in the Charlottesville Electronics section of this report.)

GBT Metrology

The final four actuator room cable bulkheads were installed. A design and work order was submitted to the shop for production of actuator room bulkhead covers.

Production - The University of Arizona completed the rework of the second and third spherical retroreflectors. One has been sent out for measurement on a coordinate measurement machine, and the other is in Green Bank for inspection.

Experimental Work - The Euler angles for all GBT monuments were measured again, using an autocollimation method to measure the azimuth angles. The coordinates were also surveyed again, now that the backup structure is clear and monument-to-monument sights are better. These refined numbers will be used to test the pointing ability of the ZP instruments in early July. The accelerometer experiments were turned over to operations to hammer out the bugs. Work has started on the automated hydrostatic level instrument that was prototyped earlier. The COMSAT 140 ton load link was repaired and inspected. We also assisted with the voltage readings and data analysis for the weight of module 8R. A report was issued (A0117) on the results. The 140 ton load link is out of specification and the four 25-ton dynamometers are not consistent (the moments on the spreader beams do not balance). A third method using a 100 ton dynamometer cannot be traced to a calibration and is 30 percent over the estimate. In

summary, the weight of module 8R (and the other modules) is unknown. The report on the measurement of the box offsets, and the measurement of the last receiver location is on hold pending an analysis on thermal distortions of the turret.

Software - The ZY manual draft is up-to-date and will be issued in July along with the release of the new version of the software. The new version contains bug fixes, calculation of the mirror center coordinates (from the monument survey data and ZP calibration data), manual adjustment of the monument Euler angles and coordinates, global initialization of the ZYs and ZIY software, extended memory management, Bancom IRIG generated interrupts, and a revision to the watchdog timer for the new 586 boards. This release will also include a formal procedure for handing off the software for testing.

Several memos are near completion on the metrology architecture, among them:

1. "Range Scan Program - Static Check Scan, Main Reflector Surface"
   This memo describes the procedures for checking the main reflector surface shape and pointing by scans to the surface from feed arm rangefinders, and ground-to-feed arm range measurements to locate the feed arm rangefinders. Algorithms are given for range reduction. Scan timing is discussed. Scan scenarios are discussed. Algorithms are given for computing a-priori approximate target locations as functions of telescope azimuth and elevation.

2. "Range Scan Program - Rangefinder Aiming"
   Algorithms are derived and presented for computing the rangefinder beam aiming angles for pairs of rangefinders and retroreflector targets on the GBT.

3. "Range Scan Program - Triplet Retroreflector Use"
   The procedures for calibrating and using the retro-reflector triplet assemblies on the main dish rim are discussed. Range reduction algorithms are given. Range and coordinate adjustments are discussed.

4. "Dynamical Rangefinder Measurements"
   The processes of range finding and measurement reduction and adjustment are discussed for ranging measurements taken while the telescope is moving. Dynamical range corrections are derived.

Telescope Operations

The documents "Operational Description of E-Stop/Movement Inhibit/Lockout," "Operational Description of the GBT Control (Servo) System," and "Operational Description of Auto Stow" have now been completed and are part of the Operations Documentation System. Additional documentation and manuals for the GBT generators, switch gear, and load bank have been collected and a draft of "Operational Description of the GBT Power Generation/Distribution System" has been started. Work has continued on the GBT "Glossary of Terms" and the "Basic Astronomy Primer."

Operator GUI Interface requirements have been submitted to the GBT Archive.

Templates and instructions for Spares documentation have been distributed to the Green Bank staff.

Operations now has the responsibility for monitoring the hardware and status of the accelerometers currently on the GBT and for coordinating the data collection.

Operations is currently determining NRAO cable requirements for the elevation cable wrap and coordinating with COMSAT to ensure that all cables, cryo lines, water and power will fit in the limited 20" x 70"area.

Four of the initial operator candidates have been interviewed. A few more will be interviewed in the middle of July before a decision is made.

GBT Systems

The locations of the elements of the quadrant detector are being pinpointed by the working group. Engineering is forwarding certain dimensions of the telescope structure that are needed to locate and size the small hole in the primary reflector that is required by the quadrant detector.

Scientific requirements for GBT metrology have been developed. The requirements and their implications were discussed in a meeting of scientists, metrologists, and software engineers. Action items were assigned to converge upon an appropriate strategy for integrating laser metrology into the monitor and control system for Phase III operations of the telescope.

A GBT coordination meeting was held on June 16, 1998. Issues raised by the User's Committee Meeting were discussed. The Users wanted to keep the 140 Foot Telescope open through mid-1999. They also wanted to see the results of Mockup testing posted in a public forum. RFI tests of the GBT receiver room were discussed. NRAO will perform much of the work required to prepare the room for the tests. Concern was expressed that the contractor has not purchased an RFI door for the room, but NRAO may be able to fabricate a temporary door for the tests. The agenda for the upcoming GBT Science Workshop was briefly reviewed. For one reason or another, it has been difficult to record accelerometer data at the GBT. The responsibility of coordinating data recording sessions in the future to avoid or minimize problems with the accelerometers was assigned.

Plans for RFI testing of the GBT Receiver room have been developed.

The objectives and specifications of the Q-band tertiary reflector which are contained in GBT Memo 141 were reviewed and endorsed by the Project Scientist.

Software General

We congratulate John Ford on his appointment to the Head of the Electronics Division and we wish him every success in his new job. His contributions to the Monitor and Control software effort have been outstanding, and his intimate involvement in the project will be missed.

The GBT network is now logically separate from the rest of Green Bank operations. The GBT network is "non-routable;" no address from the network can be accessed by a computer from anywhere else. The GBT devices are only accessible from specific machines in Green Bank itself, not from the rest of the Internet. Nic Benders has returned to West Virginia University after working as a co-op student with John Ford on the network re-configuration.

Monitor and Control

The GBT M&C group has completed a new software release (2.7). This release was complete essentially by the target date of the end of April. At the outset, we said "The primary goal for this release is to focus on the basic core capabilities for commissioning: to have all necessary software available for at least one receiver (Ku-band), the essential IF equipment, and the digital continuum receiver (DCR), holography, and spectral processor (SP) back-ends." In fact, we have all the necessary software for nine receivers (L-, C-, X-, Ku-, and K-bands plus the four receivers in the Prime Focus receiver package) and one more (S-band) is ready for testing when the hardware is ready. The software to control the essential LO and IF equipment plus the DCR and the holography back-ends is also included. The software for the SP was not completed, since the device has been required for observations on the 140 Foot, and has therefore not been available for testing. The antenna control software included in 2.7 contains full support for control and monitor of all axes of the GBT (i.e., main axes, subreflector, turret rotation, and boom extension). Most of this has been extensively tested; it has been used to control the devices on the ground at the GBT site. The control software for the main axes has been used to communicate with the antenna simulator in Texas. Also included is enhanced features to support the graphical user interface (GUI) for both the Operators and Observers. To improve testing capabilities, we have also installed a complete antenna simulator in the Mockup.

Several other significant changes have been made while preparing for 2.7. a) A redesigned monitor system includes a new data description library which provides a flexible description of the monitor points provided by devices in terms of data types, units, and FITS representation. It further enables encoding and decoding in an architecture-independent manner. b) A single set of FITS writing functions (based on the cfitsio library from NASA Goddard) is included in the release. The data associated parameters and the log files are now written using these procedures. c) Release 2.7 also includes a new interface between the command language (Glish) and the device controllers. This provides much easier access to the monitor and control functions of the individual devices from Glish. d) As a necessary preparatory step to the implementation of 2.7, several infrastructure changes were made at the outset - adopting a new C++ compiler, adopting an improved code management system, and the upgrade of the operating system on the single board computers.

The GBT Software Review Committee noted inconsistent documentation practices and the need to use modern software engineering tools. All software certified for inclusion in the 2.7 release had to pass a checklist of items which included documentation extraction using the tool (cxx2html) developed for AIPS++ and checking the code through Purify and Code Wizard to see that the modules have no memory leaks and comply to the coding standards.

Although release 2.7 was completed at the end of April, a substantial effort has been spent fixing bugs in support of engineering tests in the Mockup. Some other elements not bundled with 2.7 have now been added to the working system. These include support for the motor rack, the site timer, the LOs, and updates to the antenna control libraries. Also added is the archivist and the sampler

logger which take data associated parameters and monitor point samples respectively and write them into standard FITS files. One problem which has plagued us for a long time is the disconnection of the single board computers. When contact is lost and then re-established, data will now automatically resume flowing.

Operators' and Engineers' Displays

There were several presentations to demonstrate the achievements so far. The acceptance of the screens for use by the engineering staff has been positive. Screens to support many of the subsystems are now complete; these include the analog filter rack, the IF rack, the LO router, the Ku band receiver, the motor rack, and the switching signal selector.

The operations group has provided a list of requirements they have for the development of the primary operator's screen. A detailed analysis of these requirements has just been completed.

Observers' Displays

All GUIs have been updated to conform to version 2.7 except for the SP, which is still at version 2.6. Enhancements have been made to the simulators for the DCR and the SP. The first version of an antenna simulator is finished, and the antenna control GUI is also complete.

O. MILLIMETER ARRAY PROJECT

With the approval of the National Science Board, the three-year Design and Development phase of the Millimeter Array has begun. On June 1, 1998, much of the NRAO staff who are assigned to the MMA Project were transferred formally onto it so this provides an easily remembered start date for the formal project at the NRAO. We are enormously pleased and very grateful for the efforts of everyone at the NRAO and in the U.S. community who worked to bring this about.

The Design and Development phase of the MMA is meant to provide us with an opportunity to prototype representative modules of some of the technically most demanding instrumentation. A prototype antenna is the most visible example of the effort but many of the other prototyping efforts are equally challenging: these include prototyping SIS mixers that are in fact MMIC SIS circuits on a single chip that incorporate balanced image separation; 4K cryogenics that is reliable and economical even when running at an ambient pressure 70 percent of that at sea level; an optical fiber signal transmission system with 16 GHz bandwidth; and a computing environment that is designed from the outset to be developed, used, and maintained remotely. A primary goal of the MMA D&D effort is to allow us to establish a firm cost basis for the construction phase of the project.

Approximately 20 people at the NRAO are now working on the MMA project, about a third of these people are at each of the Tucson, Socorro, and Charlottesville sites. By the end of the year the number of staff should grow to more than 30 all together; their efforts will be augmented by the design and research efforts of another six people working at the OVRO and BIMA arrays. Advertisements for open positions with the MMA project can be found on the NRAO homepage http://www.nrao.edu.

Personnel assignments to the MMA project at the NRAO have brought about some changes that users of the Observatory will notice. In particular, Brian Glendenning has transferred to the MMA Project from AIPS++ where he worked for many years directing the technical work on that project; Brian is now the Division Head for all of MMA computing. Al Wootten has assumed the role of MMA Project Scientist replacing Frazer Owen. Frazer was the inspiration for much of what is now the MMA, and we are very grateful to him for his seminal insights and efforts.

The burden of organizing initial D&D work, assembling the staff and making the facilities ready for the staff to work effectively, has prevented much progress from being made with potential international partners in the MMA or in that larger, combined array that will subsume the MMA. However, in the weeks ahead discussions and negotiations on possible partnership arrangements will resume with a realistic expectation that a mutually satisfactory, and beneficial, international partnership can indeed be forged.

P. PERSONNEL

New Hires

Altamirano, P.	Junior Engineering Associate	05/27/98
Barnes, P.	Assistant Scientist-Research Support	05/26/98
Chatterjee, S.	Junior Research Associate	06/08/98

Hicks, S.	Junior Engineering Associate	05/18/98
Lang, C.	Junior Research Associate	06/15/98
Miller, N.	Junior Research Associate	06/01/98
Robnett, J.	Senior Systems Analyst	06/08/98
Terminations		
Benders, F.	Junior Research Associate	05/01/98
Kiff III, E.	Systems Analyst	04/30/98
Ray, J.	Junior Engineering Associate	05/22/98
Sumner, M.	Junior Engineering Associate	05/22/98
Change in Title		
Brundage, W.	to Electronics Engineer	05/01/98
Simon, R.	to Scientist (C) - MMA Project	05/01/98

PREPRINTS RECEIVED, APRIL - JUNE, 1998

ALLEN, M.L.; KRONBERG, P.P. Detailed Radio Spectra of Selected Compact Sources in the Nucleus of M82.

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