NATIONAL RADIO ASTRONOMY OBSERVATORY

QUARTERLY REPORT

April 1, 1997 - June 30, 1997

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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 1997.

	140 Foot	12 Meter	VLA	VLBA
Scheduled Observing (hrs)	1891.75	1889.75	1663.40	862.20
Scheduled Maintenance and Equipment Changes	178.50	19.00	210.70	395.00
Scheduled Tests and Calibration	113.75	271.25	314.90	313.50
Time Lost	40.75	123.50	71.53	23.30
Actual Observing	1851.00	1766.25	1591.87	838.90

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)	Observations of OH and H_2O masers associated with the extraordinary star, U Equ.
B660	Bania, T. (Boston) Rood, R. (Virginia) Balser, D. Wilson, T. (MPIR, Bonn)	Measurements of the cosmic abundance of ^{3}He.
B676	Braatz, J. (Maryland) Wilson, A. (Maryland)	H_2O maser monitoring and accretion disk dynamics in AGN.
K356	Koo, B-C. (Seoul National U.) Kim, K-T. (Seoul National U.)	He76α observations of the extended envelopes surrounding 17 ultracompact HII regions.
L323	Lo, K-Y. (Illinois) Chin, Y-N. (Taipei) Zhao, J-H. (CFA) Ho, P. (CFA) Ho, L. (CFA) Braatz, J. (Maryland) Wilson, A. (Maryland) Wilson, T. (MPIR, Bonn) Henkel, C. (MPIR, Bonn)	A 22 GHz survey of a complete sample of nearby active galaxies for water vapor megamasers.
M407	Murphy, E. (Johns Hopkins) Sembach, K. (Johns Hopkins) Friedman, S. (Johns Hopkins)	21 cm measurements of galactic HI column densities toward UV bright quasars and AGN.

No.	Observer(s)	Program
S415	Schloerb, F. P. (Massachusetts) Lovell, A. (Massachusetts) De Vries, C. (Massachusetts) Senay, M. (Massachusetts) Irvine, W. (Massachusetts) Wootten, H. A.	OH radio observations of comets Hale-Bopp and Wirtanen.
SETI	Tarter, J. (SETI Institute)	Project Phoenix.
T336	Tifft, W. (Arizona)	Terminal 140 Foot standard 21 cm observations.
W280	Wootten, H. A.	H_2O monitoring in star forming cores in Rho Oph.
W340	Wootten, H. A. Mangum, J.	A survey of H_2CO in protostellar clumps.
W397	Wootten, H. A.	Measurements of NH_3 in C/1995 01(Hale-Bopp).

The following pulsar programs were conducted during this quarter.

No.	Observer(s)	Program
A118	Arzoumanian, Z. (Cornell) Nice, D. (Princeton) Taylor, J. (Princeton) McLaughlin, M. (Cornell)	Bi-monthly timing of 63 pulsars at 575 and 800 MHz.
B617	Backer, D. (UC, Berkeley) Sallmen, S. (UC, Berkeley) Foster, R. (NRL) Matsakis, D. (NRL)	Pulsar timing array observations at 800 and 1395 MHz.
N018	Nice, D. (Princeton) Thorsett, S. (Princeton)	Monitoring the irregularities in the rotation and orbital motion of an eclipsing binary pulsar, B1744-24A.
Z143	Zepka, A. (UC, Berkeley) Backer, D. (UC, Berkeley) De Breuck, C. (LLNL) Becker, R. (LLNL)	A 1.4 GHz pulsar search targeted towards variable radio sources.

The following very long baseline programs were conducted this quarter.

BH025	Herrnstein, J., *et al.*	Nuclear continuum source in NGC 4258.
GR015	Rupen, M., *et al.*	VLBI imaging of supernova 1993J in M81.

C. 12 METER OBSERVING PROGRAMS

The following line programs were conducted during this quarter.

No.	Observer(s)	Programs
B681	Balser, D.	Study of CO isotopomers in planetary nebulae.
C307	Clancy, R. T. (SSI, Boulder) Sandor, B. (JPL)	Mars/Earth studies.
C309	Crosthwaite, L. (UCLA) Turner, J. (UCLA)	Large scale CO mapping of spiral galaxies.
CB07	Bower, G. (UC, Berkeley) Backer, D. (UC, Berkeley) Wright, M. (UC, Berkeley)	Study of the anatomy of a millimeter-wave flare.
CB09	Brown, L. (Connecticut College) Wardle, J. (Brandeis) Roberts, D. (Brandeis) Phillips, R. (Haystack) Doeleman, S. (Haystack) Holdaway, M.	3 mm linear polarization studies of bright extragalactic sources.
CD04	Doeleman, S. (Haystack) Rogers, A. (Haystack) Bower, G. (UC, Berkeley) Backer, D. (UC, Berkeley) Wright, M. (UC, Berkeley)	3 mm VLBI observations of the galactic center.
CD05	Doeleman, S. (Haystack)	Evolution of a new radio flare in N-Galaxy 3C111.
CK01	Kemball, A. Diamond, P.	Polarization VLBI at 86 GHz.
CK03	Krichbaum, T. (IRAM) Witzel, A. (MPIR, Bonn) Graham, D. (MPIR, Bonn) Grewing, M. (IRAM) Greve, A. (IRAM) Zensus, J. A.	Evolution of sub-parsec scale jets in highly active blazars.
CZ01	Zensus, J. A.	Physics of the jet in quasar 3C345 at sub-parsec resolution.
E63	Evans, A. (Caltech) Sanders, D. (Hawaii) Mazzarella, J. (Caltech)	CO (1–0) observations of powerful radio galaxies detected by IRAS.
G341	Gao, Y. (Illinois) Solomon, P. (SUNY)	An HCN survey in CO and IR bright/luminous galaxies.

No.	Observer(s)	Program
G362	Gensheimer, P. (MPIR, Bonn) Ziurys, L. (Arizona) Wilson, T. (MPIR, Bonn)	Search for interstellar FeCO.
G364	Gao, Y. (Illinois) Lo, K-Y. (Illinois) Gruendl, R. (Illinois) Hwang, C. (SA/IAA, Taiwan)	HCN observations of luminous IR galaxies in a merger sequence.
G366	Gensheimer, P. (MPIR, Bonn) Ziurys, L. (Arizona) Wilson, T. (MPIR, Bonn)	Search for SiC_2 in Sgr B2.
H324	Helfer, T. (UC, Berkeley)	CS J = 3–2 observations in the Milky Way Plane.
H325	Holdaway, M.	VLBI polarization bootstrap.
I19	Ikeda, M. (Tokyo U.) Yamamoto, S. (Tokyo U.)	Search for SiO emission lines toward low mass star forming region IRAS 04361+2547.
K355	Koo, B-C. (Seoul National U.)	CO J = 2–1 line observations of the shocked molecular gas in the W51 SNR.
K357	Kim, K-T. (Seoul National U.) Koo, B-C. (Seoul National U.)	^{13}CO J = 1–0 line observations of the surrounding area of 16 UC HII regions with extended envelopes.
L326	Liseau, R. (Stockholm Obs.) Larsson, B. (Stockholm Obs.) Odin Scientific Consortium (Canada, Finland, France, & Sweden)	CS (3–2) observations of dense low-mass cores.
M395	Mangum, J. Latter, W. (NASA/Ames) McMullin, J.	Study of the derivation of the physical conditions in the Serpens molecular cloud.
M401	Mangum, J. Wootten, H. A. Butler, B. Bockelée-Morvan, D. (Paris Obs.)	Study of the thermal evolution of Comet C/1995 01 (Hale-Bopp).
M402	Mangum, J. Emerson, D. Emerson, C. (Cambridge) Branch, C. (Michigan)	The Pleiades molecular cloud: a unique case of cluster-cloud interaction.
M409	Meixner, M. (Illinois) Fong, D. (Illinois)	Imaging the history of mass loss of evolved stars using the ^{12}CO J = 1–0 line.
M410	Mangum, J. Martin, R. (Arizona)	Study of kinematic temperature in galactic nuclei.

No.	Observer(s)	Program
S416	Slysh, V. (Lebedev) Kalenskii, S. (Lebedev) Val'tts, I. (Lebedev) Mead, K.	Search for new methanol masers at 166 GHz.
S417	Smith, B. (IPAC) Madden, S. (CNRS, France)	CO (1–0) observations of low luminosity Virgo spiral galaxies.
S418	Smith, B. (IPAC)	Study of molecular gas in star forming tidal bridges.
S422	Strelnitski, V. (Maria Mitchell Obs.) Gordon, M. Benson, P. (Wellesley) Jorgenson, R. (U. Puget Sound)	Study of hydrogen recombination lines in MWC 349A.
S423	Sage, L. (St. Mary's U.) Welch, G. (St. Mary's U.) Mitchell, G. (St. Mary's U.)	Study of CO in M32.
T367	Turner, B.	Continuation of CH_3OH studies in translucent clouds.
T368	Turner, B.	A study of C_2H in translucent clouds.
W390	Womack, M. (Penn State) Festou, M. (Midi-Pyrenees Obs.) Mangum, J. Stern, S. A. (SWRI)	Study of CO, H_2CO, CH_3OH, and HCN in Comet C/1995 01 (Hale-Bopp).
W391	Wolf-Chase, G. (UC, Riverside) Barsony, M. (UC, Riverside)	Outflow observations of a new protostar in L1448.
W392	Woodney, L. (Maryland) A'Hearn, M. (Maryland) McMullin, J. Samarasinha, N. (NOAO)	Study of sulfur chemistry in Comet Hale-Bopp (C/1995 01).
W393	Womack, M. (Penn State) Festou, M. (Midi-Pyrenees Obs.) Mangum, J. Stern, S. A. (SWRI)	Study of the carbon chemistry in Comet C/1995 01 (Hale-Bopp).
W395	Welch, G. (St. Mary's U.) Sage, L. (St. Mary's U.) Mitchell, G. (St. Mary's U.)	Kinematics and distribution of molecular gas in NGC 205.
W396	Williams, J. (CFA) Myers, P. (CFA)	CS (5–4) observations of two Class O sources in Serpens.

No.	Observer(s)	Program
W399	Wong, T. (UC, Berkeley) Helfer, T. (UC, Berkeley) Blitz, L. (UC, Berkeley)	Study of the origin of the molecular gas ring in NGC 4736.
Z148	Ziurys, L. (Arizona) Apponi, A. (Arizona State) Pesch, T. (Arizona State)	A search for interstellar/circumstellar NaS.
Z149	Ziurys, L. (Arizona) Apponi, A. (Arizona State) Pesch, T. (Arizona State) Robinson, J. (Arizona State)	A search for circumstellar/interstellar AlNC.

D. VERY LARGE ARRAY OBSERVING PROGRAMS

Second quarter, 1997 was spent in the following configurations: B configuration from April 1 to May 27; CnB configuration from May 27 to June 24; and C configuration from June 24 to June 30.

The following 124 research programs were conducted with the VLA during this quarter:

No.	Observer(s)	Program
AB628	Becker, R. (UC, Davis) Helfand, D. (Columbia) White, R. (STScI) Perley, R.	Survey of the north galactic cap. 20 cm
AB780	Bridle, A. Perley, R. Swain, M. (Cornell)	Fully-sampled imaging of the lobes of 3C219. 3.6 cm
AB805	Biretta, J. (STScI) Owen, F. Zhou, F. (STScI)	VLA monitoring of the M87 jet. 0.7, 1.3 cm
AB816	Braatz, J. (Maryland) Wilson, A. (Maryland)	Continuum emission from H_20 megamaser galaxies. 6, 20 cm
AB818	Butler, B. Clancy, R. T. (SSI, Boulder)	Observations of water vapor in the atmosphere of Mars. 1.3 cm line
AB821	Bolton, S. (JPL) Waite, J. (SWRI) Dulk, G. (Paris Obs.) Leblanc, Y. (Paris Obs.) Sault, R. (CSIRO)	Jupiter in conjunction with Galileo, HST, and ROSat. 6, 20 cm

No.	Observer(s)	Program
AB826	Baker, J. (Cambridge) Hunstead, R. (Sydney) Dennett-Thorpe, J. (Cambridge) Saunders, R. (Cambridge)	A low-redshift quasar with an optical arc. 6 cm
AB827	Brogan, C. (Kentucky) Troland, T. (Kentucky) Roberts, D. (Illinois) Crutcher, R. (Illinois)	High angular resolution HI Zeeman observations toward M17. 20 cm line
AB828	Brogan, C. (Kentucky) Troland, T. (Kentucky) Roberts, D. (Illinois) Crutcher, R. (Illinois)	OH Zeeman observations toward M17. 20 cm line
AB829	Beck, R. (MPIR, Bonn) Shoutenkov, V. (Lebedev) Shukurov, A. (Newcastle) Sokoloff, D. (Moscow/SSAI)	Polarization in barred galaxies. 20 cm
AB835	Brown, A. (Colorado/JILA) Harper, G. (Colorado/JILA)	Mass loss from evolved K and M stars: the K supergiant Lambda Vel. 3.6 cm
AC480	Carilli, C.	Detailed imaging of the molecular absorption system at z = 0.88582 towards PKS 1830-211. 7 cm
AC486	Carilli, C. Menten, K. (MPIR, Bonn) Reid, M. (CFA) Rupen, M.	Deuterium abundance in a molecular cloud at z = 0.9. 0.7 cm line
AC490	Cotton, W. Bridle, A. Palma, C. (Virginia)	Search for the jet(s) in the giant radio galaxy 2146+82. 20 cm
AD401	Dahlem, M. (ESTEC)	High level star formation in NGC 4666. 20 cm line
AE111	Edge, A. (Cambridge) Bremer, M. (IAP, Paris) Rengelink, R. (Leiden) Rottgering, H. (Leiden) van Haarlem, M. (NFRA)	Radio sources in distant x-ray selected clusters. 3.5, 20 cm
AE113	Eyres, S. (Keele) Bode, M. (Liverpool JMU) Davis, R. (Manchester) Evans, A. (Keele) Geballe, T. (Hawaii) Pollacco, D. (RGO) Salama, A. (ESA)	Sakurai's Object. 6 cm

No.	Observer(s)	Program
AF310	Fassnacht, C. (Caltech) Pearson, T. (Caltech) Readhead, A. (Caltech) Myers, S. (Pennsylvania) Browne, I. (Manchester) Wilkinson, P. (Manchester)	VLA monitoring of the gravitational lens system 1608+656. 3.6 cm
AF318	Florkowski, D. (USNO)	Monitoring the radio emission from the Wolf-Rayet Binary HD 192641. 0.7, 2, 6, 20 cm
AF319	Frail, D. Kulkarni, S. (Caltech) Greiner, J. (MPIfEP, Garching)	New search for radio counterpart to SGR 1900+14. 6, 20, 90 cm
AF321	Frail, D. Goss, W. M.	Identifying new pulsar wind nebulae. 3.6, 6, 20 cm
AF323	Florkowski, D. (USNO)	The radio emission from the Wolf-Rayet binary HD 192641. 0.7, 2, 3.6, 6 cm
AF324	Frail, D. Vasisht, G. (Caltech) Kulkarni, S. (Caltech)	Further monitoring of the soft gamma repeater SGR 1806-20. 3.6 cm
AF326	Frail, D. Kulkarni, S. (Caltech)	Search for radio counterparts of gamma ray bursters with BeppoSAX. 20 cm
AG485	Galama, T. (Amsterdam) de Bruyn, A. G. (NFRA) van Paradijs, J. (Amsterdam) Hanlon, L. (Dublin)	Candidate counterparts to GRB 940301. 3.6, 6, 20, 90 cm
AG508	Garcia-Barreto, J. (Mexico/UNAM) Franco, J. (Mexico/UNAM) Martos, M. (Mexico/UNAM) Carrillo, R. (Mexico/UNAM)	Polarization of the continuum emission of the barred spiral NGC 3367. 20 cm
AG510	Gunn, A. (Manchester) Spencer, R. (Manchester) Migenes, V. (NAO, Japan) Umana, G. (Bologna) Trigilio, C. (Bologna) Budding, E. (Carter Obs.)	Microwave survey of northern algol systems. 6 cm
AG511	Gregory, P. (British Columbia) Poller, B. (British Columbia) Scott, W. (British Columbia)	VLA study of new sample of short term highly variable radio sources. 1.3, 3.6, 20 cm
AG514	Graham, J. (UC, Berkeley) Liu, M. (UC, Berkeley)	Is the hyperluminous IRAS galaxy FSC 15307+3252 a gravitational lens? 3.6 cm

No.	Observer(s)	Program
AG516	Gao, Y. (Illinois) Lo, K-Y. (Illinois) Gruendl, R. (Illinois) Hwang, C. (SA/IAA, Taiwan)	Luminous IR galaxies in a merger sequence. 20 cm
AG518	Garcia-Sanchez, J. (Barcelona) Paredes, J. (Barcelona) Preston, R. (JPL) Jones, D. (JPL)	Multi-frequency observations of selected RS CVn binaries. 2, 3.6, 6, 20 cm
AH582	Hibbard, J. (Hawaii) Rich, R. (Columbia) Barnes, J. (Hawaii) van der Hulst, J. (Groningen/Kapteyn)	Dwarf formation in the tidal tail of "the antennae." 20 cm line
AH592	Hjellming, R. Rupen, M.	Monitoring galactic black hole x-ray transients. 2, 3.6, 6, 20 cm
AH593	Hewitt, J. (MIT) Moore, C. (Groningen/Kapteyn) Haarsma, D. (MIT)	Gravitational lens time delays. 2, 3.6 cm
AH597	Hoare, M. (Leeds U.)	Deep imaging of GL 490. 3.6 cm
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
AH604	Haarsma, D. (MIT) Hewitt, J. (MIT) Lehar, J. (CFA) Burke, B. (MIT)	Monitoring gravitational lens 0957+561. 3.6, 6 cm
AH611	Higdon, J. (CSIRO)	Radio continuum study of the Cartwheel ring galaxy. 20 cm
AH615	Ho, P. (CFA) Rengarajan, T. (TIFR)	Search for synchrotron radio emission from the Far-IR Source W33A. 6, 20 cm
AH617	Ho, P. (CFA) Rengarajan, T. (TIFR) Jackson, J. (Boston)	Ionized outflow from deeply embedded luminous infrared sources. 0.7, 1.3 cm
AH619	Hofner, P. (NAIC) Baan, W. (NAIC) Takano, S. (Cologne)	The H_2O masers in NGC 253. 1.3 cm line

No.	Observer(s)	Program
AJ257	Junor, W. (New Mexico) Salter, C. (NAIC) Bignell, R. C.	Proper motion in the planetary nebula NGC 7009. 3.6 cm
AJ258	Jensen, E. (Arizona State) Koerner, D. (JPL) Mathieu, R. (Wisconsin)	Circumstellar disks in pre-main sequence binary environment. 0.7, 1.3, 3.6 cm
AK397	Frail, D. Kulkarni, S. (Caltech)	Search for radio counterparts of gamma ray bursters - SAX follow-up. 20 cm
AK425	Kollgaard, R. (Fermi Lab) Ghisellini, G. (Torino) Maraschi, L. (Genova U.) Pesce, J. (STScI) Sambruna, R. (STScI) Urry, C. M. (STScI)	Multi-frequency monitoring of blazars. 1.3, 2, 3.6, 6, 20 cm
AK431	Kovo, O. (Tel-Aviv U.) Turner, J. (UCLA) Beck, S. (Tel-Aviv U.)	Multi-frequency continuum maps of Wolf-Rayet dwarf galaxies. 3.6, 6 cm
AK437	Karovska, M. (CFA) Mattei, J. (AAVSO) Carilli, C.	Possible jet formation in the CH Cyg symbiotic system. 2, 3.6, 20 cm
AK440	Kurtz, S. (Mexico/UNAM) Carral, P. (Guanajuato U.) Rodriguez, L. (Mexico/UNAM) Hofner, P. (NAIC) De Pree, C. (Agnes Scott College)	Exciting sources of water masers near cometary HII regions. 0.7, 6 cm
AK441	Kundu, M. (Maryland) Nitta, N. (Lockheed) White, S. (Maryland)	Coronal x-ray jets. 6, 20, 90 cm
AK442	Kulkarni, S. (Caltech) Danner, R. (Caltech) Frail, D. Gotthelf, E. (NASA/GSFC)	Mysterious nebula in the globular cluster M28. 6 cm
AK444	Krishna, G. (TIFR) Bhatnagar, S. (TIFR) Wisotzki, L. (Hamburg U.)	Search for radio continuum from QSOs in the Hamburg ESO Survey. 6 cm
AL383	Lisenfeld, U. (Arcetri) Alexander, P. (Cambridge) Pooley, G. (Cambridge)	Cosmic ray propagation and the star formation history of galaxies. 20 cm

No.	Observer(s)	Program
AL401	Lacy, M. (Oxford) Ridgway, S. (Oxford) Rawlings, S. (Oxford) King, L. (Oxford)	Rotation measures of z~1 radio sources. 3.6, 6, 20 cm
AL403	Leitch, E. (Caltech) Pearson, T. (Caltech) Readhead, A. (Caltech)	Monitoring of point sources in the OVRO microwave background fields. 1.3, 2, 3.6 cm
AL407	Lefloch, B. (IRAM) Lazareff, B. (IRAM) Eisloffel, J. (Hawaii)	The Cep E protostellar core. 3.6 cm
AL408	Lovell, J. (Tasmania) Reynolds, J. (CSIRO) Jauncey, D. (CSIRO)	Locating the z = 0.19 lensing galaxy in PKS 1830-211. 1.3 cm
AL410	Lehar, J. (CFA) Falcke, H. (Maryland) Barvainis, R. (Haystack) Menten, K. (MPIR, Bonn) Birkinshaw, M. (Bristol, UK) Elvis, M. (CFA) Blundell, K. (Oxford)	Variability of radio quiet quasars. 3.6 cm
AL412	Lara, L. (IAA, Andalucia) Cotton, W. Feretti, L. (Bologna) Giovannini, G. (Bologna) Marcaide, J. (Valencia) Venturi, T. (Bologna)	Large angular size radio sources from the NRAO VLA Sky Survey. 6, 20 cm
AL418	Lehar, J. (CFA) Falcke, H. (Maryland) Barvainis, R. (Haystack) Menten, K. (MPIR, Bonn) Birkinshaw, M. (Bristol, UK) Elvis, M. (CFA) Blundell, K. (Oxford)	Variability of radio quiet quasars. 3.6 cm
AL424	Lestrade, J-F. (Paris Obs.)	HR 5968 - G star with planet. 3.6 cm
AM547	Mirabel, I. F. (CNRS, France) Rodriguez, L. (Mexico/UNAM)	Large scale radio lobes in GRS 1915+105. 20 cm

No.	Observer(s)	Program
AM550	Marti, J. (CNRS, France) Mirabel, I. F. (CNRS, France) Rodriguez, L. (Mexico/UNAM) Mereghetti, S. (Milano Obs.) Treves, A. (Trieste Obs.) Chiappetti, L. (Milano Obs.)	Coordinated SAX and VLA Observations of black hole candidate 1758-258. 3.6, 6 cm
AM551	Marti, J. (CNRS, France) Paredes, J. (Barcelona) Peracaula, M. (Barcelona)	Arcsecond radio jets in Cygnus X-3. 6 cm
AM558	Marti, J. (CNRS, France) Mirabel, I. F. (CNRS, France) Rodriguez, L. (Mexico/UNAM) Chaty, S. (CNRS, France)	New radio counterparts of GRANAT sources in galactic bulge. 3.6, 6 cm
AM562	Marlow, D. (Manchester) Browne, I. (Manchester) Helbig, P. (Manchester) Wilkinson, P. (Manchester)	Search for gravitational lenses with component separation 10" to 60". 2, 20 cm
AM567	Machalski, J. (Jagellonian)	Nucleus of an extended double.
AN074	Neff, S. (NASA/GSFC) Ulvestad, J. Smith, D. (NASA/GSFC) Fanelli, M. (NASA/GSFC)	HII regions and SNR in NGC 4038/9 ("the antennae"). 3.6, 6 cm
AO132	O'Dea, C. (STScI) Elvis, M. (CFA)	High-redshift quasars with large x-ray absorbing columns. 0.7, 1.3, 2, 3.6, 6, 20, 90 cm
AP331	Pooley, G. (Cambridge) Hardcastle, M. (Cambridge) Riley, J. (Cambridge) Alexander, P. (Cambridge)	Constraining the luminosity function of jets in FRII radio galaxies. 3.6, 6 cm
AP343	Pentericci, L. (Leiden) Carilli, C. Miley, G. (Leiden) Rottgering, H. (Leiden)	Radio continuum imaging of high redshift radio galaxies. 3.6, 6 cm
AP348	de Pater, I. (UC, Berkeley) Palmer, P. (Chicago) Snyder, L. (Illinois) Butler, B.	Thermal emission from Comet Hale-Bopp. 3.5, 7 cm
AP350	Patnaik, A. (MPIR, Bonn) Menten, K. (MPIR, Bonn)	Gravitational lens candidate HE 2149-2745. 2, 3.6 cm

No.	Observer(s)	Program
AR377	Rudnick, L. (Minnesota) Koralesky, B. (Minnesota) Dickel, J. (Illinois)	Asymmetric expansion of the Kepler SNR shells. 6, 20 cm
AR378	Rudnick, L. (Minnesota) Koralesky, B. (Minnesota) Kassim, N. (NRL) Perley, R.	Dynamical evolution and current particle acceleration in Cas A. 3.6, 6, 20, 90, 400 cm
AR379	Rajagopal, J. (Raman Institute) Srinivisan, G. (Raman Institute) Dwarakanath, K. (Raman Institute)	HI studies of interstellar clouds identified through Ca+ and Na absorption. 20 cm line
AR381	Rodriguez, L. (Mexico/UNAM) Mirabel, I. F. (CNRS, France)	Multi-band observations of GRS 1915+105. 2, 3.6, 6 cm
AR383	Richards, E. (Virginia) Windhorst, R. (Arizona State) Kellermann, K. Partridge, R. B. (Haverford College) Fomalont, E.	Spectral energy distributions of micro-Jansky sources. 3.6 cm
AS568	Sramek, R. Panagia, N. (STScI) Weiler, K. (NRL) Van Dyk, S. (UC, Berkeley)	Properties of radio supernovae. 1.3, 2, 3.6, 6, 20 cm
AS600	Stocke, J. (Colorado/JILA) Rector, T. (Colorado/JILA) Perlman, E. (STScI)	Low-redshift EMSS BL Lacertae objects. 20 cm
AS603	Schiminovich, D. (Columbia) van Gorkom, J. (Columbia) van der Hulst, J. (Groningen/Kapteyn) Wilkinson, A. (Manchester) Oosterloo, T. (CSIRO)	HI study of the shell galaxy NGC 1210. 20 cm line
AS604	Spangler, S. (Iowa) Mancuso, S. (Iowa)	Faraday rotation in the solar corona. 20 cm
AS605	Spangler, S. (Iowa) Mancuso, S. (Iowa)	Hydromagnetic waves in the solar corona via Faraday rotation measurement. 20 cm
AS606	Seaquist, E. (Toronto) Frail, D.	Third epoch observations of the Nova remnant GK Per. 20 cm
AS615	Stringfellow, G. (Colorado/JILA) Brown, A. (Colorado/JILA)	Monitoring the flux of PMS variable EX Lupi. 1.3, 3.6 cm

No.	Observer(s)	Program
AU071	Umana, G. (Bologna) Leone, F. (Catania) Trigilio, C. (Bologna)	Monitoring the radio emission of β Lyrae. 2, 6 cm
AU072	Uson, J. van Gorkom, J. (Columbia)	HI Mapping of Abell 2029. 20 cm line
AW362	White, S. (Maryland)	The stellar activity cycle on active stars. 3.6, 6, 20 cm
AW452	Willson, R. (Tufts) Lang, K. (Tufts) Kile, J. (Tufts)	VLA-SOHO Observations of the solar transition region. 2, 3.6, 90 cm
AW453	Wallace, B. (DRAO) Frail, D. Landecker, T. (DRAO)	P-band imaging of two filled-center supernova remnants. 90 cm
AW460	Wootten, H. A. Claussen, M. Wilking, B. (Missouri) Meehan, L. (Missouri)	Origin of water masers toward low-mass young stellar objects. 1.3 cm line
AW469	Willson, R. (Tufts) Lang, K. (Tufts) Schuhle, U. (MPIA, Heidelberg)	VLA-SOHO observations of global magnetic structures on the Sun. 6, 20, 90 cm
AY082	Yun, M. Carilli, C.	Atomic hydrogen in radio galaxies and quasar host galaxies at z = 3. 90 cm line
AY084	Yusef-Zadeh, F. (Northwestern)	Continuum observations of G359.1-0.5 and the Snake. 6, 20 cm
AZ090	van Zee, L. Salzer, J. (Wesleyan U.) Skillman, E. (Minnesota)	Do star formation thresholds depend on metallicity? 20 cm line
AZ096	Zabludoff, A. (UC, Santa Cruz) van Gorkom, J. (Columbia) Mihos, C. (Johns Hopkins) Zaritsky, D. (UC, Santa Cruz) Shectman, S. (Mt. Wilson)	Distribution and kinematics of HI in post merger galaxies. 20 cm line
BB072	Butler, B. Beasley, A. Wrobel, J. Palmer, P. (Chicago)	Absorption of bright background sources by the OH in Comet Hale-Bopp. 20 cm

E. THE VERY LONG BASELINE ARRAY

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
BB023	Beasley, A Conway, J. (Chalmers, Onsala) Dhawan, V. Walker, R. C. Wrobel, J. Patnaik, A. (MPIR, Bonn) Muxlow, T. (Manchester)	VLBA Calibrator Survey. 4, 13 cm
BB064	Benz, A. (SFIT, ETH) Conway, J. (Chalmers, Onsala) Alef, W. (MPIR, Bonn) Guedel, M. (SFIT, ETH)	Planet search via astrometry of dMe stars. 3.6 cm with phased VLA
BB070	Blundell, K. (Oxford) Beasley, A. Lacy, M. (Oxford)	Are the jets in radio quiet quasars relativistic? 3.6 cm with phased VLA
BB075	Biretta, J. (STScI) Junor, W. (New Mexico)	Search for superluminal motion in the nucleus of M87. 18 cm with VLA single antenna
BB076	Bower, G. (UC, Berkeley) Backer, D. (UC, Berkeley) Wright, M. (UC, Berkeley)	Monitoring of the gamma ray blazar NRAO 530. 0.7, 1.3 cm
BC065	Clark, T. (NASA/GSFC) Ma, C. (NASA/GSFC) Ryan, J. (NASA/GSFC) Vandenberg, N. (Interferometrics) Himwich, E. (Interferometrics) Gordon, D. (NASA/GSFC) Eubanks, T. M. (USNO) Fey, A. (USNO) Gaume, R. (USNO) Fomalont, E. Walker, R. C.	VLBA Geodesy/Astrometry observations for 1997. 3.6 cm
BC067	Coles, W. (UC, San Diego) Ye, S. (UC, San Diego) Massey, W. (UC, San Diego)	Measurement of solar wind speed near the Sun using IPS. 2, 3.6, 6 cm
BC068	Claussen, M. Beasley, A.	12.2 GHz methanol masers. 2 cm

No.	Observer(s)	Program
BD037	Denn, G. (Iowa) Mutel, R. (Iowa)	Polarized VLBI jet of BL Lac. 1.3, 2, 6 cm
BD046	Diamond, P. Kemball, A. Boboltz, D. (VPI & SU)	Monitoring SiO masers through a cycle of Mira-type TX Cam. 0.7 cm with VLA single antenna
BE012	Edwards, P. (ISAS, Japan) Unwin, S. (JPL) Wehrle, A. (JPL) Weekes, T. (CFA)	MKN 501 - a TeV gamma ray blazar. 1.3, 2, 6 cm
BE014	Ellingsen, S. (Tasmania) Phillips, C. (Tasmania) Sobolev, A. (Urals State U.) Beasley, A. Claussen, M. Cragg, D. (Monash U.) Godrey, P. (Monash U.)	Are all Class II Methanol maser transitions coincident? 1.3, 2 cm
BF029	Frail, D. Beasley, A. Claussen, M. Goss, W. M. Desai, K.	1720 MHz OH Masers in W44 and W28. 18 cm
BF031	Falcke, H. (Maryland) Wilson, A. (Maryland) Nagar, N. (Maryland) Ulvestad, J.	Parsec scale properties of radio cores in nearby LINER galaxies. 6 cm
BF033	Frail, D.	GRB 970508. 4 cm
BG064	Gabuzda, D. (Lebedev) Kochanev, P. (Moscow/SSAI)	Polarization observations of six intraday variables. 2, 3.6 cm with phased VLA
BG065	Garrett, M. (NFRA) Patnaik, A. (MPIR, Bonn) Nair, S. (Manchester) Porcas, R. (MPIR, Bonn) Leppanen, K. (NFRA)	Multi-epoch polarization observations of lens 1830-211. 0.7 cm
BG066	Gallimore, J. (MPIfEP, Garching) Baum, S. (STScI) O'Dea, C. (STScI)	Inner Torus of NGC 1068. 6, 18 cm with phased VLA

No.	Observer(s)	Program
BG069	Giovannini, G. (Bologna) Cotton, W. Feretti, L. (Bologna) Lara, L. (IAA, Andalucia) Venturi, T. (Bologna)	An unbiased sample of radio galaxies. 6 cm with VLA single antenna
BH024	Henstock, D. (Manchester) Wilkinson, P. (Manchester) Taylor, G. Readhead, A. (Caltech) Pearson, T. (Caltech) Browne, I. (Manchester)	CJ milli-lens survey—polarization observations. 2, 3.6 cm
BH025	Herrnstein, J. Greenhill, L. (CFA) Moran, J. (CFA) Trotter, A. (CFA) Diamond, P. Nakai, N. (NAO, Japan) Inoue, M. (NAO, Japan) Miyoshi, M. (Mizusawa Obs.)	Nuclear continuum source in NGC 4258. 1.3 cm with phased VLA
BJ025	Jauncey, D. (CSIRO) Reynolds, J. (CSIRO) Kedziora-Chudczer, L. (Sydney) Walker, M. (Sydney) Nicolson, G. (HartRAO) Wieringa, M. (CSIRO) King, E. (CSIRO) Tzioumis, A. (CSIRO) McCulloch, P. (Tasmania) Gabuzda, D. (Lebedev)	Monitoring of the intra-day variable PKS 0405-385. 2, 3.6 cm
BL038	Lestrade, J-F. (Paris Obs.) Phillips, R. (Haystack) Jones, D. (JPL) Preston, R. (JPL)	Search for extrasolar planets by VLBI astrometry. 3.6 cm with phased VLA
BL040	Liljestrom, T. (Helsinki) Leppanen, K. (NFRA) Diamond, P. Gwinn, C. (UC, Santa Barbara)	High temperature maser sources W44, W51M, W51N, W75N. 1.3 cm
BL048	van Langevelde, H. (NFRA) Schilizzi, R. (NFRA) Diamond, P.	Parallax of nearby Miras. 18 cm

No.	Observer(s)	Program
BL049	Lestrade, J-F. (Paris Obs.) Phillips, R. (Haystack) Jones, D. (JPL) Preston, R. (JPL)	A possible Jupiter-mass planet orbiting Sigma 2 CrB. 3.6 cm with phased VLA
BM049	Mioduszewski, A. Gabuzda, D. (Lebedev) Aller, H. (Michigan)	Monitoring of six highly variable BL Lacertae objects. 1.3, 3.6 cm
BM074	Mutel, R. (Iowa) Molnar, L. (Iowa)	Monitoring Algol's radio corona. 3.6 cm with phased VLA
BM078	Marvel, K. (Caltech) Boboltz, D. (VPI & SU)	Water masers associated with a proto-planetary nebula. 1.3 cm
BM082	Mattox, J. (Boston) Buckley, J. (CFA) Marscher, A. (Boston)	Study of the correlation between parsec scale radio structure and TeV gamma ray emission of Mrk 421. 1.3, 2, 6 cm
BM084	Mirabel, I. F. (CNRS, France)	Proper motions of the core of GRS 1915+105. 4 cm
BN004	Nakai, N. (NAO, Japan) Inoue, M. (NAO, Japan) Hagiwara, Y. (Nobeyama Obs.) Diamond, P.	H_20 megamaser in the LINER galaxy IC 1481. 1.3 cm with phased VLA
BP035	Patnaik, A. (MPIR, Bonn) Porcas, R. (MPIR, Bonn) Kemball, A. Garrett, M. (NFRA)	VLBA Polarimetry of gravitational lenses. 2, 3.6 cm
BS029	Stocke, J. (Colorado/JILA) Rector, T. (Colorado/JILA) Gabuzda, D. (Lebedev)	X-ray loud BL Lacs and AGN unification. 3.6 cm
BW032	Wrobel, J. Condon, J. Baum, S. (STScI) Xu, C. (Maryland)	Jets, black holes, and gas disks in UGC radio galaxies. 18 cm
BW033	Walker, M. (Sydney) Beasley, A.	Angular scattering by extragalactic plasmas. 3.6, 6, 18, 90 cm with VLA single antenna
BY005	Yakimov, V. (Lebedev) Gabuzda, D. (Lebedev) Vetukhnovskaya, Y. (Lebedev) Kardashev, N. (Lebedev) Bychkova, V. (Lebedev) Kovalev, Y. (Lebedev)	Polarization observations of gamma ray sources. 2, 6 cm

No.	Observer(s)	Program
CK001	Kemball, A.	SiO CMVA. 0.07 cm
EG017	Garrington, S. (Manchester) Garrett, M. (NFRA)	Survey of VLA FIRST sources. 18 cm
GL020	Lara, L. (IAA, Andalucia) Giovannini, G. (Bologna) Cotton, W. Feretti, L. (Bologna) Venturi, T. (Bologna)	EVN and MERLIN observations of 3C264. 18 cm
GP015	Polatidis, A. (Chalmers, Onsala) Wilkinson, P. (Manchester)	Monitoring the dramatic changes in the nuclear jet of 3C380. 6 cm with VLA single antenna
GR015	Rupen, M. Bartel, N. (York U.) Bietenholz, M. (York U.) Beasley, A. Conway, J. (Chalmers, Onsala) Rius, A. (Barcelona) Altunin, V. (JPL) Jones, D. (JPL) Graham, D. (MPIR, Bonn) Venturi, T. (Bologna) Umana, G. (Bologna)	VLBI Imaging of Supernova 1993J in M81. 3.6, 6, 18 cm with phased VLA
CMVA	Phillips, R. (Haystack)	Combined millimeter VLBI array observations. 0.3 cm
VSOP	Tests/VSOG	HALCA in-orbit checkout. 1.3, 2, 6, 18 cm and 1.3, 6, 18 cm with phased VLA

F. SCIENCE HIGHLIGHTS

Socorro

VLA, VLBA Detect Radio Emission From Gamma-Ray Burster - The VLA made the first detection of radio emission from a gamma-ray burster and this was quickly followed by detection of the object with VLBI observations including the VLBA, VLA, and Effelsburg. The gamma-ray burst was detected by the BeppoSAX satellite on 8 May and the VLA observed the region within four hours of the discovery. Radio emission was first detected by the VLA on 13 May and the observation repeated and confirmed on 15 May. The VLBI detection was made on 16 May, and has yielded a position accurate to less than one milliarcsecond. Continued monitoring has shown the object to be variable in both its intensity and its spectral index, and to have no detectable proper motion. This object also was observed optically, showing a minimum redshift of $z = 0.85$, thus greatly strengthening the case for cosmological distances to these objects.

Investigators: D. Frail, S. Kulkarni (Caltech), G. Taylor, and A. Beasley

First Images Produced Using VLBI Satellite - The first images using an orbiting VLBI antenna have been produced. The Japanese HALCA satellite, launched in February, observed PKS 1519-273 on 22 May. These data were correlated successfully in Socorro on 12 June and an image produced a few days later. The image, a point source, confirmed the proper operation of the entire system, including the Green Bank ground station and the VLBA correlator. A later image, of the QSO 1156+295, showed a core-jet system unrevealed by ground-only observations.

Investigators: J. Ulvestad and J. Romney

Tucson

Comet Hale-Bopp - A number of experiments designed to study the physical and chemical composition and evolution of comet Hale-Bopp have been performed during the last year at the 12 Meter Telescope. Measurements of a number of molecules, including CO, CN, CS, H_2S, HCO+, H_2CO, and CH_3OH, have revealed and chronicled the chemical evolution of the comet both pre- and post-perihelion. These measurements, along with subsequent measurements through perihelion, will be used to derive the kinetic temperature evolution of the comet.

As part of a study of the chemical properties of Hale-Bopp, HNC has been detected— the first detection of this species in such an object. Along with measurements of HCN, these data imply an [HNC]/[HCN] ratio of about 0.5—close to values found in dark clouds. This ratio indicates that Hale-Bopp was formed from pristine interstellar matter and did not undergo much processing in the pre-solar nebula.

Investigators: M. A'Hearn (Maryland), M. Festou (Obs. Midi Pyrenees), J. Mangum, J. McMullin, N. Samarasinha (NOAO), S. Stern (Southwest Research Institute), M. Womack (Penn State, Erie), L. Woodney (Maryland)

The Extended Envelope Emission Around Ultra-Compact HII Regions - Extended radio continuum emission has recently been detected surrounding 16 ultracompact (UC) HII regions. In these UC HII regions one also finds several compact cores. In order to study the relationship between the compact cores and the extended envelopes, and to place this relationship within the context of massive star evolution, the 13CO 1-0 emission has been mapped from these extended envelopes. These data have been used to reveal the interaction of molecular gas with ionized gas, the physical properties of molecular clouds associated with UC HII regions, and the molecular outflow properties of massive young stellar objects.

Investigators: Kee-Tae Kim and Bon-Chul Koo (Seoul National University)

Green Bank

Two consecutive transitions of the long cyanopolyyne $HC_{11}N$, J = 39-38 and J = 38-37, have been detected in the cold dust cloud TMC-1 at the frequencies expected from recent laboratory measurements at the Center for Astrophysics, and at about the expected intensities. The column density for $HC_{11}N$ is calculated to be $2.8x10^{11}$ cm^{-2}. The abundance of the cyanopolyynes decreases smoothly from HC_5N to $HC_{11}N$, the decrement from one to the next being about six for the longer carbon chains.

This detection of $HC_{11}N$, a molecule with a molecular weight (147 amu) nearly twice that of the amino acide glycine, demonstrates that detectable quantities of fairly large organic molecules can form in astronomical sources under conditions markedly different from those on Earth.

Investigators: M. Bell (HIA), P. Feldman (HIA), M. Travers (CFA), M. McCarthy (CFA), C. Gottlieb (CFA), and P. Thaddeus (CFA).

G. PUBLICATION

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

H. CHARLOTTESVILLE ELECTRONICS

Amplifier Development, Design and Production

Most of the activity this quarter has been in the MAP area. It was found that a satisfactory amplifier for the highest frequencies could not be made with the passivated MAP wafer, and the decision was made to use the NRAO devices for W-band. Six prototype amplifiers were sent to Princeton and used to build a satisfactory W-band radiometer. Flight configuration Q-band prototype amplifiers have been built and perform well. The design for V-band (60 GHz) is complete and awaiting prototype fabrication. Designs for K- and Ka-band are in process.

The delivery of MAP flight amplifiers has been considerably delayed by continuing difficulties satisfying NASA quality control personnel.

Low-frequency amplifier development (particularly for the GBT prime focus receivers) has been delayed due to the need for almost all amplifier resources for the MAP program. A plan is now in place for completing these amplifiers during the next six months.

As part of the development effort, there was a visit by Pat Madigan and Walter McLain to the Central Development Lab (CDL) shop which resulted in programs for using the new CNC milling machine to make amplifier bodies. Buildable V-band prototypes were produced. We expect that use of this machine will reduce the time required to make an amplifier body by two days.

Superconducting (SIS) Millimeter-Wave Mixer Development

The status of SIS mixer development work in the CDL is as follows:

ISM371 - A 200-300 GHz SIS sideband-separating mixer on a single quartz chip. The 2 x 1 mm quartz chip is mounted in a waveguide block with separate RF and LO waveguide ports. A modest image rejection of 10-15 dB across the band will be adequate to suppress atmospheric noise in the image band, which otherwise will degrade the system sensitivity of broadband SIS receivers. The first wafer of these mixers fabricated at JPL has been tested with encouraging results. At 230 GHz an overall receiver noise temperature of ~70 K DSB was measured with 9-15 dB of image rejection. However, the performance was strongly frequency dependent, which we believe is due to excitation of a waveguide mode under the substrate by which some of the LO power is diverted to the signal port and passes through the quadrature hybrid to the SIS mixers with inappropriate phase relative to the desired LO power. We were aware of the existence of this undesired waveguide mode, which would normally be suppressed with absorbing material above and below the substrate, but decided to try the mixer initially without the absorber. Experiments with absorber are beginning.

SIS302 - This 260-300 GHz SIS mixer will be made in both tunerless and tunable versions, the latter to allow receivers to be tuned for single-sideband operation on the 12 Meter Telescope. Because only two junctions are used, the LO power required will be lower than for the older SIS301 and SIS371 mixers (which have four or six junctions). We have received the first wafer of these mixers from UVA and are preparing to test them.

BM371 - A balanced mixer for 200-300 GHz on a single quartz chip. Component designs are complete. The final chip layout and mask design must be completed, and mixer block designed.

We presented two invited papers this quarter:

A. R. Kerr, "Anatomy of a Millimeter-Wave Radio Astronomy Receiver," presented at the Workshop on Cryogenic Packaging of Electronic Subsystems and Their Applications at the IEEE International Microwave Symposium, Denver, June 1997.

A. R. Kerr, "The Quest for the Perfect mm-Wave Receiver," presented at the Harvard-Smithsonian meeting "Molecules in Space and in the Lab—in Honor of Prof. Patrick Thaddeus on his 65th Birthday," June 1997.

During this quarter we have assembled and tested eight SIS mixers using chips from two UVA wafers and two JPL wafers.

Electromagnetic Support

VLA - The far-field patterns and input return loss of a K-band feed for the 18-26.5 GHz band were measured. The feed had good symmetry of patterns in the two principal planes through most of the band. However, at the high end of the band starting at 26 GHz, the cross-polarized lobes had a peak of -17 dB below the peak of the main beam. A second feed with more corrugations per wavelength in the throat section was designed. This feed also has ring-loaded corrugations in the mode converter. The fabricated feed, in addition to good pattern symmetry, has cross-polarization better than -25 dB throughout the band. The measured input return loss is better than -23 dB.

A GTD-Jacobi-Bessel program was modified to analyze a system of shaped main reflector and analytical subreflector. Work is in progress to handle a shaped subreflector as well. The goal is to analyze precisely the VLA shaped reflector system with emphasis on spillover calculations at the low end of the band from the secondary focus.

GBT Spectrometer

During the last quarter, system testing and system programming on the GBT spectrometer continued. VME computer software now exists to assist in testing the system to a reasonable level, but little software of an operational nature has yet been written. Initial end-to-end spectra were obtained for both the high speed and low speed samplers.

About one-half of the modes planned for the GBT spectrometer have been programmed and are being tested at this time. Software to program the system signal path selection automatically has been studied, but actual software development for this function has not been started.

There are no known problems in the spectrometer at this time, but few long-term tests have been run yet.

Parts for the Tucson spectrometer and for the UMass purchase order have been ordered. Correlator cards have been assembled for both these projects and are awaiting flow soldering and testing.

Initial consideration of the MMA correlator has been started with the release of a MMA memo on a proposed lag correlator design. A group of engineers and technicians for the MMA correlator design and construction has been formed.

Frequency Coordination

Dick Thompson attended International Telecommunication Union (ITU) meetings of Working Party 7D and Study Group 7 in Geneva during 2-10 June. Eight different projects and topics affecting radio astronomy were covered in the program of the working group. Thompson was particularly involved in action to determine the boundaries of coordination zones around observatories for protection from uplinks of Mobile Satellite System (MSS) users. There is heavy pressure from mobile satellite services for acceptance of an analysis based on the Monte Carlo method. Development of a computer program for this analysis is continuing through a correspondence group of which Thompson is a member. A full report of the meetings has been submitted to the CORF and the NSF.

Fully-Sampled, Focal Plane Array

A nineteen-element prototype focal plane array receiver was built and evaluated on the 140 Foot Telescope. The receiver consisted of nineteen 1.2-1.8 GHz sinuous antenna feeds followed by nineteen ambient temperature low-noise amplifiers and corresponding downconverters to an IF of 400 MHz. A digitally-controlled, high-isolation cross point switch matrix was developed to route the nineteen channels to the eight IF modules of the spectral processor. The spectral processor cross-correlates four pairs simultaneously, sequentially stepping through all 171 combinations. With this prototype system, a complete map of the electromagnetic fields at the focal plane was achieved together with an illustrative set of synthesized beams. Improvements are under way to reduce the system temperature of the individual elements.

Adaptive Interference Canceling Receiver

Work continues on the adaptive interference canceling receiver system. A prototype system consisted of a 100 MHz receiver and crossed-dipole feed to form the primary channel while a dual-polarized yagi and rotator was used to form the reference channel. Both channels were downconverted to baseband where an eight-tap digital adaptive filter attempts to remove interference in the primary channel through real-time adaptive cross-correlation with data from the reference channel. On the 140 Foot Telescope, interference attenuation of 10 dB was achieved on average, with some signals canceled up to 20 dB. The canceling effectiveness of the prototype system was limited because of the single reference channel. Multiple interference signals in the filter passband and possible spatial depolarization effects between the primary and reference antennas compromised performance. Improvements are currently under way to increase the number of reference channels.

I. GREEN BANK ELECTRONICS

GBT IF System

The testing of the nine 1.6 GHz sampler/filter modules is complete.

The testing of the seventeen 100 MHz converter filter modules is in progress. We anticipate this testing to be complete by November.

The seventeen 1-8 GHz converter modules, completed last quarter, are installed in the GBT Mockup. We are in the process of integrating them with the software and the system.

GBT Fiber IF System

We have put together a prototype system with external modulation and loop feedback and have successfully closed the loop. We tested the Automatic Gain Control with second order feedback loop with bandwidth 88 Hz and damping factor 0.6. This loop corrects gain fluctuations on the order of 1 Hz due to polarization changes to better than the measurement limit of two 10^{-4}. An analysis of a second order loop with a step function * sinusoidal input (I Hz) predicts an improvement of 0.00012, or a total long term gain variation of 0.00024 * 0.015 (photo diode sensitivity) = 1.8 10^{-6}. The gain change due to the transient response is 0.003, or the total variation being 0.003 * 0.015 = 45 10^{-6}.

In addition, a temperature control circuit for the laser diode was designed and tested. The control loop holds the temperature of the laser to 0.002 percent at ambient temperature.

We measured the second and third order products through the link. The quadrature point for the Mz modulator was calculated from the second order products and found to be within one degree of quadrature.

Presently, long-term gain variation tests are ongoing with the additional temperature control loop. Previous long-term tests showed little difference between RF gain changes and detected photo diode current with the closed-loop system.

GBT Receivers

The GBT Prime Focus four band receiver (290-920 MHz) will be complete and ready for tests as soon as we receive the input HEMTs. We have begun design and purchasing of parts for Band 5 electronics, its dewar, and the ortho-mode transducer (OMT).

The GBT C-Band receiver is going through extensive rework and testing. We will be mounting it on the 140 Foot in August and using it for VSOP/VLBI observations.

The pace of the design of the GBT S-Band receiver has picked-up this quarter. All of the RF components have been ordered. We modified the OMT ridge profile program so that it could be used in generating a new flat-tipped ridge for the OMT. We hope that the new ridge design will eliminate the trapped-mode resonances that have plagued previous designs. Drawings have been submitted to the shop for the fabrication of this OMT, the thermal transition, refrigerator adapter and the lower dewar vessel.

The GBT L-Band receiver was completed this past quarter with 90 percent of the testing complete. The HEMTs will be redesigned and replaced later this year by the CDL for better input match.

LO Reference Distribution System

The LO Reference system is 95 percent complete. System components are installed in the Timing Center and the GBT Mockup. We are still waiting for a few parts from the shop before we can finish this system.

GBT Servo System

Weekly teleconferences were held with personnel from PCD. The main items of discussion included all those which are presently preventing PCD from returning to finish the feed arm tests. At this point, the only such item is the refurbishing of the Kolmorgen motors. Three of the nine Kolmorgen brushless motors suffered significant corrosion due to, presumably, condensation. All nine motors were returned to the factory for inspection and retrofit of modifications to prevent condensation damage. This quarter, Comsat/RSI delivered the revised field test procedure and a package of drawings.

As part of its quality assurance plan for the GBT, NRAO sent a mechanical engineer and technician to the Kolmorgen plant to witness the disassembly and refurbishing of a few of the motors.

Subreflector actuator Y3 had to be sent to the factory to investigate its high torque requirement. Also, since feedback from this actuator was noisy, its position transducer was replaced. Upon its return to site, NRAO completed the task of recalibrating the linearity and gain of the new transducer.

GBT Mockup

The GBT Mockup has been used primarily for software-hardware integration over the past quarter. A few minor hardware problems have cropped up and we are addressing them.

GBT Feed Defroster

We have been working on RFI generated by various components within this system. The original motor has been replaced by a 1/2 hp three-phase motor. We are now unable to detect any RFI generated by this motor in our anechoic chamber. We are continuing to test and modify other system components to eliminate other RFI sources.

GBT Atmospheric Monitoring System (Tipper)

The preliminary design plan was distributed and reviewed on May 30. The optics design is complete and a report was written on the analysis of mirror motion control options. An order was placed for the mixer, Gunn oscillator, and IF amplifier. A drawing for a circular-to-rectangular waveguide transition has been submitted to the shop.

Site Operations

Project Phoenix (SETI) - We have worked with the people from Project Phoenix on receiver maintenance, upgrades, and installations. Our latest installation was completed in record time with only the normal NRAO electronics and maintenance staff.

OVLBI - Electronics has worked diligently with the OVLBI group over the past quarter. During this time fringes have been detected, so station design is now proven to be successful.

Interference Protection Group - Electronics is an integral part of the Interference Protection Group. Over the past quarter we have tested over 12 major GBT subsystems identifying sources of RFI in each subsystem.

As usual, maintenance, repair, and installation support was supplied to the 140 Foot, USNO 20 Meter, and the OVLBI earth-station telescopes. This includes electronic maintenance, electronic design projects to assist users for special projects, and cryogenic support for 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

68-115 GHz Receiver

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

8-Beam 220-250 GHz Receiver

This receiver is now in routine use. Several early operational problems have been identified and solved. 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 8-feed system to modify the tuning procedure for all receivers on the 12 Meter Telescope.

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

A commercially available frequency tripler for the LO has been tested and works well at 4 K. This validates the concept of using coaxial lines to input the LO to the dewar at one third of the LO frequency. The dewar has been built and awaits testing. The design of the basic receiver insert has been completed, and fabrication has begun. A crossed-grid polarization diplexer designed to operate at 4 K has been constructed and tested. A prototype 2-channel system will be tested later this year.

Planned Wideband Continuum Receiver

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

New Phase Lock Control

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

Another capability which will become practical thanks to the enhanced digital phase lock is sideband smear operation. This is a powerful technique of reducing confusion in spectral line observations from features appearing in the unwanted sideband. The principles have been established during some ad hoc test observations performed at the 12 Meter, 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. We will install the first production version of this system on the 2/3 mm receiver this summer.

Cryogenics

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

Quadrant Detector and Thermal Sensors

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

New Digital Spectrometer

Work has begun on a new digital spectrometer for the 12 Meter Telescope which will be copied from the GBT design. The new spectrometer will have twice the instantaneous bandwidth currently available for our multibeam systems, and will use a single wideband 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.

K. SOCORRO ELECTRONICS

VLA Upgrade Prototype: K-band Front End

Development work continued on a full waveguide band front end in the frequency range of 18 GHz to 26.5 GHz. The CDL completed an improved prototype polarizer consisting of a waveguide phase shift section and an OMT section. Most components for two front ends are on hand. The VLA machine shop has fabricated the first dewar, and started on the second. Assembly of the first front end is completed. The assembly of the second front end has started and will include three sub-band total power system temperature monitors for estimating atmospheric phase variations. After testing the second unit in the array, the first will be retrofitted with the total power monitors. The components for the third and fourth front ends are being ordered, and the units will be installed early in 1998.

VLA, VLBI, and Pulsar Improvements

Project planning and implementation for major improvements in the VLBI and Pulsar back-ends continued this quarter. An analog-sum buffer equalizing amplifier for the four IF outputs. This buffer isolates the new VLBI Switch from the new Pulsar Patch Panel.

A VLBI Baseband Switch connects any of 16 baseband inputs to the four inputs of the 600 MHz VLBA upconverter. Four inputs will be from the analog-sums and 12 inputs will be grouped as four IFs from one antenna on each arm. The switch was constructed by modifying surplus Wandel & Goltermann matrix switch boxes. Each box has 24 inputs which allows future expansion. All modifications to the switches are completed and the switches are due to be installed early next quarter.

A new patch panel will connect the four IF outputs from the analog-sum buffer to a new four channel upconverter for the 14-channel video converter pulsar system and the pulsar wideband detectors. The patch panel will have power monitoring and computer controlled level setting. The Pulsar Patch Panel has been constructed and is currently undergoing tests. Power monitoring circuits are designed and awaiting parts. The buffer amps are to be installed early next quarter. Design is complete on the level setting amps and construction is starting.

VLA Correlator Controller

The project plan was revised again. The software slowed because of little available programmer time. The hardware was completed except for the data link during the last quarter. The data link will be tested during the third quarter of 1997.

VLA Atmospheric Phase Monitor

All the significant parts of the Mauna Kea site testing interferometer are now at the AOC or the VLA. The entire system was installed at the VLA in March as a near-real-time atmospheric phase monitor. The off-line software for data processing is complete and on line. This project is complete.

Amplitude Equalizers for the VLA

The average passband for the VLA antennas has a large slope across 50 MHz passband. This reduces the effective bandwidth and changes the effective center frequency during the 50 MHZ bandwidth continuum observations. A simple R-L-C equalizer circuit to correct the bandpass slope has been tested using a spectrum analyzer in the laboratory. The circuit is placed between two existing amplifier stages in the output of the T4 module to provide adequate isolation for impedance mismatch caused by the network. The attenuation caused by the circuit can be compensated by removing the 7.5 dB attenuator at the output of the T4 module. This is an inexpensive solution to flatten the bandpass and the effective continuum bandwidth will be limited by the low pass filter in the T4 module. We plan to further investigate and implement the equalizer modification during the second half of this year.

Increasing the VLA Continuum Bandwidth

Work on increasing the VLA continuum bandwidth on all four IFs from three antennas continues. We plan to increase the bandwidth, in first stage, to 70 MHz/IF using essentially existing electronics in the back-end. The IF filters needed in the F7 and F8 front-end modules are being fabricated in the VLA machine shop. The dollar cost of the modifications to increase the bandwidth to 70 MHz should be less than about $1000 per antenna. We plan to have the system ready for tests during the next quarter.

VLA FRM Tester

A FRM repeatability tester to replace the current 1979 unit has been designed. This new unit will use a laptop computer and the special DCS interface will be on a PCMCIA card. This has some future implications for other field testing of VLA equipment, and possible field testing of future NRAO antenna systems.

GPS Receivers

The VLBA Odetics 325 GPS receivers will not function after September 1999 and are not fixable. We are searching for low cost compatible replacements. One possibility is the Radiocode model which has worked well at the VLA and now is at VLBA Pie Town. Next quarter a second Radiocode unit and TrueTime XL-AK-600 will be evaluated.

VLBA Masers

Maser #6 was returned to the AOC to repair the outer Vac Ion pump current transients. Additionally, the 5 MHz buffer distortion was reduced, the PPL bandwidth was reduced from 10 to 6 Hz, and the Cavity Register control range was improved.

VLBA Prototype 3-mm Receiver

A prototype 80-90 GHz receiver, was assembled , and installed in the Pie Town antenna in December 1996. Initial single dish tests show aperture efficiency of ten percent, a reasonable beam shape, and zenith system temperature of about 130 K. Interferometric tests were made in January. A second receiver will be installed at Los Alamos next quarter.

VLBA Correlator

Four old ASICs have failed in the second quarter (as of June 20). The new ASICs continue to work with no failures. Parts for the new correlator backplane cables have been received and the new cables are being fabricated.

A problem in the fractional sample time correction circuit for 1 K and 2 K FFTs was recently identified. For negative delay rates of more than one half bit per 4 msec, there is a phase offset between the odd and even spectral point corrections. These rates do not occur for terrestrial observations, but will occur for VSOP observations. A fix for 1 K FFTs has been tested. A fix for 2 K FFTs is still being worked on.

Testing has begun on a new test rack for the correlator. This rack will provide a two-station, four-baseband channel system that will allow testing of system related problems independent of the actual correlator system.

VLBA Data Acquisition and Playback

Playback quality has improved and maintenance problems have been reduced on the VLBA playback drives as a result of designating each drive as "thick tape only" or "thin tape only." NRAO has ordered two triplecap headstacks each from Metrum and Datatape. These headstacks will be tested on some of the playback drives. If these tests show that the headstacks perform well, NRAO may order only triple cap headstacks in the future, rather than the headstack which is currently used. Triple cap headstacks cost about the same as our current headstacks, but their anticipated lifetime is about twice as long. Samples of Quantegy thin tape were tested for data quality. These samples performed well and we now consider Quantegy to be another source of thin tape for VLBA recorders. The sample headstack, which was provided to NRAO by Datatape, performed well and NRAO has now purchased several more Datatape headstacks. Now, we consider Datatape to be another source of headstacks for VLBA recorders.

Development work continues for a humidity reduction system in the headstack area of the VLBA recorders. It is hoped that units will be installed on some playback drives for the humid season which will start soon.

Development work continues on the VLBA Formatter expansion project to double the data output of the VLBA Formatter. This would make it possible to double the current recorded bandwidth at the VLBA sites by recording on two tape drives at the same time. A lab prototype has been set-up, and is working. Modifications to the Formatter source code to support the 512 MBps mode have been done and passed preliminary testing. More in-depth testing is awaiting software support and will include testing at Pie Town.

Interference Protection

A part-time student continues to improve software to display the data and derive useful statistics for the VLA antenna pad W8, P- and L-band monitor. The spectrum analyzer in the W8 monitor is controlled from the AOC and logs peak and average spectra at 15, 5, or 1 minute intervals. Previously designed data plotting software is being migrated from PV-WAVE to IDL. Additions are being made to the gray scale (frequency vs. time vs. gray scale power level) plotting software which will allow a single plot to display W8 monitor data accumulated over 24 hours, one week, or one month. The archived files are being converted to a common data format that will allow a seamless selection of any time period since the W8 Monitor went on-line in 1996 for plotting.

A co-op student is in the initial check-out stage of hardware and software designed to control and log data from a military surplus, Electro-Magnetic Interference (EMI) monitoring system. The equipment includes a channelizing receiver with the capability of automatically scanning selectable-width channels from 30 MHz to 40 GHz, and outputting a digital word representing the detected power level in each variable width channel. The system is being controlled via custom software written in C, and executing on a PC running the LINUX OS.

The channelizing receiver and a digitizing oscilloscope are being integrated into a new RF, Environmental Monitoring Station (RF-EMS) which is being assembled at the southeast corner of the VLA site. The EMS system will include autonomous data logging of RF power levels from the channelizing receiver, as well as event triggered logging of RF spectral information sampled at 100 MHz by the digitizing oscilloscope. The RF-EMS equipment will be housed in the existing, RF monitoring trailer. A 60 foot fold-over tower has been purchased for mounting IPG antennas on at the site, and an Az-El rotor and rotor control system will provide automatic DF and search capability under the control of the RF-EMS control computer.

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 agreed not to exceed a spectral power flux density (SPFD) of -223 dB(W/m^2/Hz)at the VLA at all times. Tests on one or more of the IRIDIUM satellites in orbit will occur in August 1997. VLA test objectives are to measure A) the impact of IRIDIUM emissions on VLA observations of 162 MHz OH, and B) the spectral power flux density (SPFD) of IRIDIUM emissions in the 1610.6 - 1613.8 MHz radio astronomy band.

Our test plan for objective A) calls for measurements with two subarrays. One subarray of three antennas will use special 1612 MHz bandpass filters to minimize gain compression from the satellite's main emissions at 1621.35 - 1626.50 MHz. The second subarray will use 24 antennas in normal mode to determine the effects of gain compression caused by the satellite's main emission.

Tests for objective B) will use the antenna at W8 with a modified L-band front end, a direct coax connection from the front end to the test back-ends in the control building. Test back-ends will include a digital spectrometer and the pulsar HTRP. Spectral differences taken synchronously with the IRIDIUM transmission on/off cycle will remove GLONASS satellite emissions.

A cooled bandpass filter for the 1612 MHz RA band will be used inside the W8 antenna L-band dewar for IRIDIUM testing. Cooled switches will bypass it for normal operation. The normal unfiltered cryo-amplifier configuration could gain compress sufficiently to impair satellite spurious emission measurements when the satellite is in the VLA main beam.

The synchronous detection algorithm for the digital spectrometer has been tested in the lab and on the VLA noise cal switch signal and appears to be working properly.

L. COMPUTING AND AIPS

This past quarter has seen the planning and implementation for computing related Research Equipment procurements, as well as testing and evaluation of lower cost computing hardware.

Staff Workstations

Replacing or upgrading aging workstations used by NRAO staff has become a high priority. Many workstations at the Observatory are upwards of five years old, and are reaching the end of their useful life. Fortunately, this year's Research Equipment budget has allowed the start of a long-term effort to address these problems. A "Workstation Technical Planning Committee" was convened to explore what options would best address the problems and concerns expressed by the scientific and technical staff. With the constraints on support and personnel at NRAO, it was vital to find technical options that both addressed the most pressing problems faced by staff members and at the same time did not create a long-term support burden. Two options emerged from these discussions of particular interest:

(1) Evaluate the support and technical requirements for moving a large part of NRAO's desktop computing to Linux-based machines. Linux is a free UNIX clone which supports a variety of different computer hardware architectures, including Intel X86 workstations, DEC Alpha workstations, and Sun Microsystems workstations.

(2) Explore options for upgrading a large number of our existing Sun workstations to newer, faster machines.

Options to consider alternative vendors of workstations were deferred as less promising. These other options generally had lower price/performance ratios (based on reliable published benchmarks and estimated discount prices), or posed serious support burdens within the computing infrastructure at NRAO. There must be compelling reasons to implement a major operating system change, since the burden on our already overloaded support staff would increase substantially.

Option 1 had the advantage of moving NRAO towards lower cost, mass-market hardware, and lower cost system software. The support for Linux on multiple architectures is also of great interest, because of the practical and economic benefits of not being tied firmly to any particular vendor. There is significant and growing expertise with Linux at the NRAO, and many of our users are likely to benefit as NRAO supports Linux more fully. Both AIPS and AIPS++ already support Linux. A disadvantage of Linux is that the performance of compiled FORTRAN programs within Linux is somewhat lower than that seen with vendor-specific compilers on other architectures. As a result, the primary AIPS benchmark performs approximately 40 percent more slowly than the simple floating point performance of Intel-based machines would predict. There are several vendors of promising compilers, but these have not yet been tested in detail. There are minor headaches associated with Linux in a networked environment as well, although there appear to be no major problems—just many small problems that require experience to resolve. The committee therefore decided that a small test involving approximately six Linux boxes (see below) should be started to gain more experience with the architecture and find out if there are solutions to the performance concerns about Linux. Note that the performance of Linux-based dual processor machines is still very good, and that these machines remain very interesting from a price/performance standpoint.

Option 2 had the advantage that it minimized the both the temporary disruption of installing or upgrading machines and the longer lasting support costs for the next few years. Price/performance was a very significant issue for this option.

The Observatory received a very competitive offer from Sun to upgrade existing workstations (since the purchase was of significant size). This option was selected. 48 of our oldest workstations (typically IPC's) will be upgraded to Sun UltraSparc 170's, with 2-4 GB of disk space and 64 MB of memory. Delivery and installation will take place during July and August (as of 7 July, some of the machines had already been received). The new machines have a measured performance under AIPS about 12 times greater than the five to six year old machines being upgraded, yet the price of the upgrade is less than half of the original cost of the machines, in inflation adjusted dollars.

While no other option currently available had the same level of compatibility and performance, the rapid changes in computing hardware underscore the benefits to NRAO of keeping our options flexible. We are therefore pursuing active exploration of other architectures, especially Linux-based machines, in anticipation of this process continuing into the future. Especially promising are workstations based on the DEC Alpha processor and running Linux, which conceivably have today's best available price/performance ratio. We anticipate acquiring one of these workstations for testing and evaluation in the near future.

Linux Testing and Evaluation

As part of the effort to upgrade staff workstations at NRAO, a medium scale effort was begun to install and support approximately six Linux workstations. A number of technical issues are being resolved, part of the process of NRAO becoming familiar with and comfortable with Linux. The two outstanding issues at present are (1) supporting a large number of Linux machines in a networked computing environment (this appears to be feasible, but experience is needed before a large-scale effort would make sense at NRAO) and (2) maximizing the FORTRAN performance of Linux-based machines (several promising compilers are being tested). The test installation will be used by users with a variety of levels of Linux competence, from system gurus and developers to scientific staff members who are focused on running applications.

The small Linux installation will accomplish two goals: (1) devising efficient methods for NRAO to support its small (but growing) population of Linux workstations, and (2) allow a detailed evaluation of the current readiness (or lack thereof) of Linux for a major installation at NRAO in the future.

Software

AIPS - The next AIPS release for our users originally targeted for May 1997 was deliberately delayed to allow testing of the release with real data from the HALCA orbiting VLBI experiment. The routines and modifications required for orbiting VLBI appear to be functional and have been tested carefully, including tests with real data from HALCA. As the data rate from the HALCA mission increases in the coming months further changes, corrections, or bug fixes may be needed in AIPS; a minor release of AIPS might be done in October to make any changes required for HALCA data available. The next major release of AIPS of general interest will likely be in April 1998. Given the considerable effort which has gone into insuring its stability and reliability, the 15APR97 AIPS promises to become a classic which every AIPS aficionado will want to add to his or her collection. The release is expected on 1 August 1997. Further information listed below in AIPS Details section.

1997 RE Budget

As discussed above, the major effort with this year's RE funding was to upgrade staff workstations. In addition there are also sufficient funds within the RE budget for printers to address the needs at NRAO for improved color output. Planning has started for the procurement of a high quality color network printer for each of NRAO's principle sites. A small committee will evaluate the available options; under consideration is a dual printer option which would make available low-cost inkjet-based printing (satisfactory for much of our color output for viewgraphs and the like) and a high quality full color printer with near-photographic quality at somewhat higher per-page costs.

Partnership with NCSA

The NSF has formally decided to fund the NCSA (the National Computational Science Alliance, formerly the National Center for Supercomputing Applications). NRAO is a part of the "Alliance", and will be funded at a modest level starting 1 October 1997 through an internal transfer of funds at the NSF. During the first year, funds will be available for about 1.5 positions at NRAO, increasing to two full time positions in subsequent years. The emphasis for NRAO's involvement will be in two areas: (1) Developing applications which can efficiently utilize parallel architecture computers to solve large problems in Radio Astronomy, and (2) Networking support and development to devise methods to allow NRAO users straightforward access to large computing facilities. The latter will enable access to facilities whose capabilities are well beyond those available at either NRAO or our users' home institutions. We anticipate that NCSA will become one node on NRAO's Intranet, allowing guaranteed levels of network access to NCSA's facilities in Illinois from NRAO.

AOC Computing

Three SGI workstations were installed; one, an Origin 200, is a fast four-processor server, the other two are lower level front-end machines. This set-up is intended exclusively to handle extremely time-consuming space VLBI projects. The most recent AIPS "DDT" test on the fast server led to an record AIPS mark of 14.1 per processor.

Local computer support at the AOC received a boost when we hired two new people: Tom Wilson will we responsible for further developing our Web site, for supporting visitors and staff in areas related to non-NRAO software systems (IRAF, IDL, TeX, etc.), and in lending programming support to the VLA archive project. Victor Kiff joins the systems support staff; his arrival enables us to streamline contact between users and system staff. We have devoted one office to user support and have introduced a generic "nmhelpdesk" account for visitors and staff to receive prompt support. Theresa McBride, our tape librarian/archivist/secretary left the Computing Division, and was replaced by Gayle Rhodes. We have initiated the process of filling Gayle's previous position of Junior Computer Operator. This is expected to cause some delay in the archiving project. In this archiving project we expect to soon finish the task of retrieving all antenna files from 1976 - 1982, which due to a software bug were not copied initially. After this, we will continue to convert and copy data from 1985 - 1987. This project is expected to be completed during the second half of 1998.

We are in the process of loosening our ties with the database system Ingres. Owing to increases in licensing costs with Ingres we started looking into alternatives. A detailed study of competing systems resulted in a choice of Powerbuilder, a Sybase-based database system that runs on PCs. We intend to gradually move database applications across, starting with the library database, followed by the VLA database and—at a later stage—Maint.

After almost three months of Observatory wide discussions about the NRAO workstation upgrade, we recently decided to accept a very good offer made by Sun. For the AOC, this translates into 23 Ultra 1/170 workstations that will be used to replace the aging IPX's on the desks of the heaviest users. We looked very hard at PCs as an alternative platform, but considered them yet unsuitable for heavy scientific applications.

AIPS Details

System - During the second quarter of 1997 we continued our emphasis on Space VLBI related applications. Due to the delays in the VSOP launch, obtaining scientific data, and finally in finding fringes in these data, we decided to postpone the release of AIPS until July 1997. In the meantime, fringes have been found and the first set of data has passed through the system. Though admittedly this is a very simple case, we consider the relative ease with which AIPS handled these data as encouraging.

The *midnight job* is rapidly gaining popularity as a means to gain quick access to the latest AIPS developments. The number of non-NRAO sites running the AIPS midnight job has increased from six to nine.

Software

1) AIPS failed on handling data taken with a 84-element Heliograph. A major rebuild using a larger maximum number of baselines fixed this particular problem.

2) CLCAL now allows pass-through calibration, as well as "proper" FQID and SOURCEID selection. By choosing 'CALP', CLCAL can now be made to pass CL table records for which no SN table record is found. This is dangerous but necessary if SN tables are constructed piecemeal as may be necessary for VSOP data.

3) Dave Gordon of USNO has made a series of modifications to the Haystack Fringe (HF) table handling routines CL2HF and HF2SV. We have pushed these modifications through the Solaris compiler and have removed most non-standard FORTRAN statements.

4) We added the ability to change the default printer from within AIPS. Previously, changing the default printer or file made it necessary to exit and re-start AIPS.

5) The new task OBEDT allows editing data depending on values in the Orbit (OB) table. Another task, OBPLT, plots two columns in the Orbit table against each other.

6) Tape access for the SGI machines failed, which prompted an update of several fundamental tape access routines.

8) Space VLBI observations may require more than the 20 table types, which is the current AIPS maximum. An effort was started to increase this number to 50.

9) Increasingly, new operating systems support file sizes exceeding the 2.1 GByte limit. Work was initiated to add support of these file sizes to AIPS. Due to their inherently large sizes, this development is particularly useful for Space VLBI datasets.

10) We further increased the support of parallelization by introducing the new verb PARALLEL. It allows the user to specify the number of processors that will be used for AIPS tasks that have been compiled with multiprocessor support.

11) We modified IBLED to allow an overlay plot of model amplitude as derived from an external CLEAN component table. This plot can be selected or de-selected using a new "PLOT MODEL" option of the left-hand menu. The model plotting supports multi-field data, and is particularly useful for editing gravitational lens datasets.

12) A new routine to fit polynomials was written, and was used in ACFIT to improve spectral baseline fitting.

13) In the "designated AIP" program we continued to lend support both to in-house and to external AIPS users.

Personnel - Athol Kemball left the AIPS group to join the AIPS++ group. A 12-month plan was issued in which we agree not to replace Kemball and concentrate on selected AIPS targets only. Two of these targets are porting of single dish applications from CVEX and parallelizing selected pieces of code. The main aim of this plan is to guide the personnel transition from AIPS to AIPS++. It assumes that AIPS++ can take over major AIPS responsibilities one year from now; if this should not be the case, we will have to reconsider the AIPS staffing situation.

M. AIPS++

In Single Dish support, we continued the development of the Single Dish analysis program. The current version of the program allows selection, averaging, baseline fitting, smoothing, and application of a function to the data. It is tightly integrated with a plotter based upon the PGPLOT library. Browsing of records is well-supported, via either textual or graphical display. The Measures system is utilized to allow the user to choose the units and coordinates in the displays.

In Synthesis support, as planned, we have re-written the gridding and FFT code to improve the performance for both spectral line and large continuum processing. Gridding is now performed using a novel sort-less algorithm. Thus, optimally, one would keep at least one patch per baseline. The FFT classes were also rewritten to perform multi-dimensional disk-based transforms. Since the AIPS++ Table system has excellent support for efficient tiled access of large, multi-dimensional datasets, this FFT code was extremely straightforward to write. We also changed the synthesis code by adding support for off-line Doppler tracking, by improving speed of access to the MeasurementSet by avoiding unnecessary re-formatting, and by simplifying the way that model and calibrated data are handled in the MeasurementSet.

We have spent considerable effort considering how the data tables needed for the Measures system are to be distributed and updated. This initiative has been spear-headed by Wim Brouw of the ATNF. The implications for AIPS++ are quite large and a sufficiently-detailed proposal has taken much discussion. We expect to implement this over the next quarter. AIPS++ will then contain mechanisms for delivering not only data needed for internal testing, but data needed for a multitude of purposes.

In AIPS++ Infrastructure, our work continues to be driven by the needs of applications development. Thus, in the Table system we added a moderate number of changes as needed by applications development. For example, as we had known what would be necessary, we added Table locking to allow access to Tables by multiple processes (e.g. one writer and multiple readers). The Distributed Object system has been revised to allow support for locking. Another example of a change required for applications development is the addition of caching to the Incremental Storage Manager, thus considerably speeding access to Table columns stored using this manager.

We also continue to develop a graphical user interface for standard AIPS++ Distributed Objects, based upon the tk widgets now bound to Glish. The prototype allows interaction with the Image Distributed Object that provides access to and manipulation of AIPS++ Images from Glish. An additional component of the interface is a general purpose plotter, based upon PGPLOT, that can be used from both Glish and C++ programs. This plotter has a display list that can be edited interactively by the user, thus allowing great flexibility in the plots that can be generated. These GUIs are based upon a flexible record-based GUI factory that we expect to be useful in other contexts.

We have developed a system for invoking AIPS functionality from within AIPS++. This is based upon a quite general client-server mechanism that has a number of possible applications, but currently we can use it to start AIPS tasks. The record-based GUI described in the previous paragraph has been used to provide a GUI interface to AIPS tasks.

We started an evaluation of the Kuck and Associates C++ compiler. This includes a number of optimizations not present in other C++ compilers and may improve the performance of our code. If this is successful, we plan to use this compiler for generating binaries for distribution.

N. GREEN BANK TELESCOPE PROJECT

Antenna

The Green Bank Telescope (GBT) reached a major milestone during the week of June 23, 1997, when the telescope's backup structure (BUS) was completed. The assembly of the 100 meter diameter BUS on the ground took two years, during which time the 7,652 members of the BUS were erected and welded on 17 main temporary supports and 110 shoring towers. After the BUS was completed, a survey of 400 points was taken. Then the shoring towers were disconnected from the structure allowing it to set only on the 17 supports, in effect "turning on" gravity. A second survey of the 400 points was made to measure the effect of gravity on the shape of the BUS. Although the survey results were not complete at the time of this writing, it is anticipated that all the measurements will be within the acceptable range.

Almost all of the effort on the construction site currently is directed toward preparing the R1 module for lifting out of the center portion of the BUS and onto the antenna box structure, and installing a large guy derrick in the hole in the BUS where the R1 module comes out. This derrick will be used to pick the BUS modules from the left half of the structure and lift them into the air where they will be transferred overhead to the main derrick which will then place the modules on the box structure. The modules on the right half of the structure will be picked directly by the main derrick. Altogether, there are 22 modules in the BUS.

In addition, the horizontal feed arm is now complete and the walkway to the vertical feed arm elevator platform is in place. Wiring to the elevation drives is almost complete. Servo testing of the upper feedarm is currently on hold awaiting the return of the subreflector actuator motors sent out for repair.

Panel painting at the contractor's plant has been on hold while an evaluation was made of the dry powder paint process versus the traditional Triangle 6 wet paint process. The contractor has determined through testing that the powder paint heat curing process alters the panel shape too much to allow the panels to meet the specification requirements. At this time, plans are to use the Triangle 6 wet process, and the contractor has submitted a revised paint procedure for NRAO's review.

Servo

Weekly teleconferences have been held with personnel from the antenna contractor. The main items of discussion included all those which are currently preventing a return to finish the feed arm tests. At this writing, the only remaining item is the refurbishing of the motors. Three of the nine brushless motors suffered significant corrosion due to, presumably, condensation. All nine motors were returned to the factory for inspection and retrofit of modifications to prevent condensation damage. As part of its quality assurance plan for the GBT, NRAO sent a mechanical engineer and technician to the manufacturer's plant to witness the disassembly and refurbishing of a few of the motors.

In order to test the position, velocity, and acceleration properties of the subreflector positioner, NRAO agreed to command a variety of trajectories via the M&C interface. This period the trajectories were designed, specified and coded.

Subreflector actuator Y3 had to be sent to the factory to investigate its high torque requirement. Also, since feedback from this actuator was noisy, its position transducer was replaced. Upon its return to site, NRAO completed the task of recalibrating the linearity and gain of the new transducer.

Several documents were written this period. The first, Subreflector Actuator Calibration Procedure, documents the procedure NRAO has developed to calibrate the linearity and gain of the subreflector actuators using an HP laser interferometer and various other equipment available in the laser lab. The second document discusses the major problems seen thus far in testing the feed arm servo; the purpose of this document is to list potential "show stoppers" for the contractor's benefit. The final memo discusses NRAO's plans relative to the tip of the feed arm and receiver building during the construction period.

Active Surface

The state transition table, part of the Master Status Monitor, was completed this period. This effort included completing the state transition code for testing the actuator positions, velocities, and error bits generated by the slaves. State transition code was also written to monitor the tool stow bit, the actuator retract fault bit, the actuator extend fault bit, and the actuator enable bit.

After they are installed on the GBT, the panel actuators will remain unused for one to two years while the remainder of the telescope is completed. This period is when the actuators may be most vulnerable to damage by weather exposure. A panel mock-up test, begun in 1992, had been idle since March of 1995; it was viewed as an opportunity to test the effects of weather exposure to nine actuators. In June, the nine actuators were tested. All performed well, starting on the first attempt. On one actuator, the DC drive current had an AC component (about 1 second period) riding on top of it for a short while, presumably due to the redistribution of lubricant. Inspection for corrosion due to condensation yielded negative results.

Metrology

Optics assemblies (laser, detector, optics) are being tested at the calibration lab and will be ready well ahead of base plate completion. Calibration techniques have been developed to match the as-built spherical retroreflectors to the as-built spherical mounts. Three units have been assembled with total front run out (including the vee mount) of under 0.001 inches. Two of these units are built using spherical retroreflectors that match the drawing specifications, and one unit is typical of retroreflectors that do not meet the drawing specifications. They will be tested in the calibration lab to confirm the source of the error. If confirmed, a number of retroreflectors will be returned to the Optical Sciences center for rework. Mechanical work to mount three units on the 140 Foot Telescope is about 90 percent complete and these first three units should be in place by late July. The machine shop has started on seven additional mounts. The machine shop also has five additional weld plates finished and delivered to the antenna contractor for mounting on the GBT (three earlier plates are already in place). Material for 20 more is on hand and material for 15 additional plates will be here by mid-July. The first article base castings are on site and ready to be machined. ZY110-ZY104 control panels and the local ZIYP computer are fully functional, including a modem interface and PCAnywhere software for remote monitoring. The laser monuments have been rough-leveled, surveyed, and tied to the center mark in the pintle room to about 1 mm accuracy.

The panel setting tool has been interfaced to a higher resolution A/D converter in order to use a higher accuracy inclinometer model. Calibration lab testing exposed errors introduced by the geometry of the mounting plate. A new plate is being built to higher accuracy, and the inclinometer will be mounted in the lab in order to insure higher accuracy in the orientation with respect to the indicators.

Spectrometer

Progress on the GBT spectrometer is addressed in the Charlottesville Electronics section of this report.

Electronics

Progress on the GBT electronics is addressed in the Green Bank Electronics section of this report.

Monitor and Control

During the quarter, a review of the monitor system revealed a number of modifications which needed to be made. The majority of this work was completed by the end of May; however, transition to the new monitor system was aborted because of a lack of staff for continued maintenance during shakedown on the Mockup and to investigate an alternative approach using a multicast protocol. A prototype was started in June.

Work has been completed on five changes planned for the control software. The completed changes are: ensuring stop and abort commands always pass a device through the Stopping and Aborting states respectively; addition of a new parameter flag "inactive" to allow the system to ignore parameters that are irrelevant to the current setup; addition of a reset command to cause the hardware to be brought into sync with the current setup; a change to the Internet software that will allow for more informative feedback to the user when connectivity is lost; and allowing clients of our device servers to control the flow of feedback information back to the client. The last change should greatly reduce the load on the Ethernet and on the various clients, especially the console and Glish clients. All changes to the control system were integrated into the Mockup last month. In addition, a review of the control system came up with a short list of changes to be made. The simpler changes were added by the end of the month.

The Antenna Control Unit (ACU) has been tested controlling the SCU (Subreflector Control Unit which controls the subreflector, prime focus, receiver turret & stow pin, and the prime focus feed boom) along with a simulated CCU (Central Control Unit, which controls the azimuth and elevation axes). Scenarios such as changing Gregorian receivers, and optical path reconfiguration (e.g. prime focus to Gregorian mode) were tested. Motions of the subreflector were made, using both XYZ coordinates and actuator coordinates. Prime focus axes were also tested. Several simple trajectories were executed. Mechanical problems restricted some of the more stressful testing. In all cases the ACU drove both the CCU and SCU updating positions at 10 Hz, collecting position feedback at 10 Hz, and status information at 1 Hz. This data was transported via the M&C monitor system. The ACU Glish interface was used for control.

Various FITS utilities were developed and enhanced for gathering statistics on engineering logs. New versions of libraries for focus tracking and the traditional pointing model have been integrated into the antenna system. In addition, work has begun on the trajectory preprocessor. And, a number of changes and enhancements were made to the device drivers, specifically the MCB and GPIB libraries.

O. PERSONNEL

New Hires

Beresford, Ronald	Visiting Systems Engineer	6/02/97
Bronfman, Leonardo	Visiting Scientist	6/02/97
Clarke, Jeffrey	Electrical Engineer	6/16/97
Fore, Samantha	Junior Engineering Associate	5/21/97
Hicks, Steven	Junior Engineering Associate	5/29/97
Kiff III, Elliott	Systems Analyst	6/09/97
Ray, Jason	Junior Engineering Associate	6/09/97
Waddel, Matt	Electrical Engineer	6/16/97
Wilson, Thomas	Scientific Programmer	5/19/97

Terminations

Benett, Aaron	Scientific Programmer Analyst	6/06/97
Boboltz, David	Junior Research Asociate	6/27/97

Other

Bignell, R. C.	To Head, Green Bank Telescope Services, transferred from Socorro to Green Bank	5/27/97

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