NATIONAL RADIO ASTRONOMY OBSERVATORY

QUARTERLY REPORT

January 1, 1996 - March 31, 1996

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A. TELESCOPE USAGE

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

	140 Foot	12 Meter	VLA	VLBA
Scheduled observing (hours)	1814.50	1820.00	1609.70	908.00
Scheduled maintenance and equipment changes	188.00	6.00	221.00	316.00
Scheduled tests and calibrations	114.00	358.00	343.40	454.00
Time lost	225.25	187.00	72.44	31.00
Actual observing	1589.25	1632.50	2537.26	867.00

B. 140 FOOT OBSERVING PROGRAMS

The following continuum programs were conducted during this quarter.

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

The following line programs were conducted during this quarter.

No.	Observer(s)	Program
B609	Bania, T. (Boston) Rood, R. (Virginia) Balser, D.	X-band measurements of the cosmic abundance of ^3H_e.
B638	Bell, M. (Herzberg) Feldman, P. (Herzberg) Kolbuszewski, M. (Steacie, NRC)	Observations to determine if there is a chemical link between C_3H_2 and the carriers of the diffuse interstellar bands.
B642	Balser, D. Rood, R. (Virginia) Bania, T. (Boston)	Ionized helium measurements in galactic HII regions.
B643	Braatz, J. (Maryland) Wilson, A. (Maryland)	Monitoring of H_2O megamasers in active galaxies.

No.	Observer(s)	Program
B646	Breen, J. (Virginia) Murphy, E. (Virginia)	Measuring accurate N_H column densities toward clusters of galaxies observed with the ROSAT PSPC.
B654	Barnbaum, C. Morris, M. (UCLA) Omont, A. (IAP, Paris)	Observations of OH and H_2O masers associated with the extraordinary star U Equ.
B657	Balser, D. Lockman, F. J.	Observations of ionized helium in diffuse HII regions.
B658	Butler, B. Wootten, H. A. Palmer, P. (Chicago) Bocklee-Morvan, D. (Meudon) Despois, D. (Bordeaux) Yeomans, D. (JPL)	H_2CO and NH_3 observations of the comet 1996 B2 Hyakutake.
C301	Combes, F. (Paris Obs) Wiklind, T. (Chalmers/Onsala)	A search for O_2 at z = 0.685 at 33 GHz.
H293	Haynes, M. (Cornell) Hogg, D. Maddalena, R. Roberts, M.	Observations evaluating galactic HI envelopes and a search for faint companions.
L311	Liszt, H. Lucas, R. (IRAM)	A survey of NH_3 absorption lines toward extragalactic continuum sources.
S410	Simonetti, J. (VPI&SU) Topasna, G. (VPI&SU) Murphy, E. (Virginia) Lockman, F. J.	HI mapping of the W3 chimney.
T361	Turner, B.	A search for C_4O, HCCCO, and H_2CCCO.
V083	van Zee, L. (Cornell) Haynes, M. (Cornell) Maddalena, R.	HI observations of galaxies with extended hydrogen envelopes.
W340	Wootten, H. A. Mangum, J.	A survey of H_2CO in protostellar clumps.

The following pulsar programs were conducted during this quarter.

No.	Observer(s)	Program
A118	Arzoumanian, Z. (Cornell) Nice, D. Taylor, J. (Princeton) Taylor, H. (Princeton)	Bimonthly timing of 63 pulsars at 550, 800, 1420, and 1660 MHz.
B617	Backer, D. (Calif., Berkeley) Sallmen, S. (Calif., Berkeley) Foster, R. (NRL) Matsakis, D. (NRL)	Pulsar timing array observations at 800 and 1395 MHz.
B656	Boriakoff, V. (Hanscom/AFGL) Cliver, E. (Hanscom/AFGL) Smirnova, T. (Lebedev/Oberlin)	Measurement with the help of pulsars of the magnetic field in the solar corona, a new method.
F132	Foster, R. (NRL) Wolszczan, A. (Penn State) Cadwell, B. (Penn State) Anderson, S. (Caltech)	Timing measurements of two new millisecond pulsars found in the Arecibo high latitude survey.
F133	Fruchter, A. (STScI) Eder, J. (NAIC)	Timing observations of a new, bright, fast pulsar.
L318	Langston, G. Fisher, J. R. McKinnon, M. Ghigo, F.	Gamma ray burster observations at 1400 MHz.
M386	McKinnon, M. Fisher, J. R.	A 1.3-1.8 GHz polarization model test and timing of young pulsar PSR B1823-13.

The following very long baseline programs were conducted.

No.	Observer(s)	Program
A120	Altunin, V. (JPL/Caltech) Migenes, V. (CSIRO) Slysh, V. (Lebedev)	OH masers VLBI survey.
BB058	Bartel, N. (York U.)	VLBI imaging of SN1979C in M100 in the Virgo cluster.
BG051	Gwinn, C. *et al.*	75 MHz observations of the most weakly scattered pulsar, B0950+08, to determine its angular broadening.

No.	Observer(s)	Program
BM056	Moran, J. (CFA) *et al.*	VLB observations of the proper motions of the water vapor masers in NGC 4258.
VT001	Edwards, P. (ISAS, Japan)	VSOP scheduling tests.

C. 12 METER TELESCOPE OBSERVING PROGRAMS

The following line programs were conducted during this quarter.

No.	Observer(s)	Program
A130	Apponi, A. (Arizona State) Ziurys, L. (Arizona State)	Re-evaluating the interstellar $[HCO^+]$ / $[HOC^+]$ abundance ratio.
B650	Bechtold, J. (Arizona) Frayer, D. (Toronto) Papadopoulos, P. (Toronto) Seaquist, E. (Toronto) Yee, H. (Toronto)	Search for CO emission from a protogalaxy at $z = 2.7$ discovered by its young star spectrum.
B652	Bally, J. (Colorado) Maloney, P. (Colorado) Billawala, Y. (Colorado) Latter, W. (NASA/Ames) Jewell, P. (Hawaii) Thaddeus, P. (CFA)	Pilot observations for a 1.3 mm wavelength sky survey: the galactic center, portions of the plane, the Perseus and Orion complexes.
C294	Chernin, L. (Calif., Berkeley) Williams, J. (Calif., Berkeley)	Kinematic analysis of molecular outflows.
C296	Clancy, R. T. (Colorado) Sandor, B. (Colorado)	Mars dust storm observations.
C300	Combes, F. (Paris Obs) Wiklind, T. (Chalmers, Onsala)	A search for O_2 at $z = 0.685$ at 70 GHz.
C302	Chernin, L. (Calif., Berkeley) Wilkin, F. (Calif., Berkeley) Gibson, J. (Calif., Berkeley)	High resolution maps of protostellar jets.
C306	Crutcher, R. (Illinois)	Study of CS in Sgr A.
E062	Evans, A. (Hawaii) Sanders, D. (Hawaii) Mazzarella, J. (Caltech)	CO (1-0) observations of powerful radio galaxies detected by IRAS.

No.	Observer(s)	Program
G345	Gensheimer, P. (MPIR, Bonn)	Search for vibrationally excited SiC_2.
G346	Gensheimer, P. (MPIR, Bonn)	Search for the HCCNC isomer of HC_3N toward IRC+10216.
H319	Holdaway, M. Brown, L. (Connecticut College) Wardle, J. (Brandeis) Roberts, D. (Brandeis)	Integrated polarization measurements of 3 mm Pol VLBI sources.
H320	Hogg, D. Roberts, M.	Study to detect CO (1-0) both in NGC 2777 and in its companion.
I16	Irvine, W. (Massachusetts) Ohishi, M. (Nobeyama Obs) Hjalmarson, A. (Chalmers, Onsala) Dickens, J. (Massachusetts)	Study of the hydrogenation of interstellar molecules.
J129	Jewell, P. (Hawaii) Walker, C. K. (Arizona)	A study of SiO masers in evolved stars — polarization properties.
K353	Kutner, M. (RPI) Schombert, J. (NASA Headquarters) Pildis, R. (CFA)	Study of the molecular content of dwarf spirals.
L312	Lavezzi, T. (Minnesota) Dickey, J. (Minnesota) Mack, J. (Minnesota)	Calibration of the Tully-Fisher relation using the ^{13}CO (1-0) transition.
L314	Lubowich, D. (Hofstra) Turner, B. Sahai, R. (JPL) Meerts, L. (Katholieke U)	A search for LiNC in the super-lithium-rich carbon star IY Hya.
L315	Lo, K. (Illinois) Shen, J. (Illinois) Lord, S. (IPAC)	ISO key project on normal galaxies: molecular phase of ISM.
M353	Minh, Y. (Daeduk, Korea) Turner, B. Kim, K.-T. (Chungnam U.) Irvine, W. (Massachusetts)	Study of the chemistry of cirrus cloud cores.
M398	Henkel, C. (MPIR, Bonn) Chin, Y.-N. (Bonn U.) Mauersberger, R. (Arizona)	Study of interstellar sulfur isotopes and oxygen burning in stars.

No.	Observer(s)	Program
M399	Martin, R. (Arizona) Turner, J. (UCLA) Hurt, R. (Calif., Riverside) Levine, D. (UCLA) Ho, P. (CFA)	CO (2-1) mapping of the barred galaxy IC 342.
P177	Paglione, T. (Boston) Jackson, J. (Boston) Bolatto, A. (Boston)	Study of large-scale chemical and excitation gradients in the galaxy.
P178	Bååth, L. (Chalmers, Onsala Backer, B.(Calif., Berkeley) Biretta, J. (STScI) Booth, R. (Chalmers, Onsala) Bower, G. (Calif., Berkeley) Carilli, C. Conway, J. (Chalmers, Onsala) Diamond, P. Doeleman, S. (Haystack) Emerson, D. Graham, D. (MPIR, Bonn) Gréve, A. (IRAM) Grewing, M. (IRAM) Junor, W. (New Mexico) Kemball, A. Krichbaum, T. (MPIR, Bonn) Lonsdale, C. (Haystack) Perlman, E. (NASA/GSFC) Phillips, R. (Haystack) Ratakyrö, R. (Chalmers, Onsala) Roberts, D. (Brandeis) Rogers, A. (Haystack) Wardle, J. (Brandeis) Wiklind, T. (Chalmers, Onsala) Wink, J. (IRAM) Wright, M. (Calif., Berkeley)	Millimeter VLB network studies.
R263	Roberts, M. Hogg, D.	Study of the distribution of cool interstellar gas in asymmetric isolated galaxies.
S404	Sandor, B. (Colorado) Clancy, R.-T. (Colorado)	Microwave spectroscopy of Earth's atmosphere.
S406	Smith, B. (IPAC)	CO (1-0) mapping of the Sb galaxy NGC 7331.

No.	Observer(s)	Program
S408	Samarasinha, N. (KPNO) McMullin, J. (Arizona) A'Hearn, M. (Maryland) Mangum, J.	Probing the physics of activity in the distant comet Hale-Bopp.
W351	Wootten, H. A. Wilking, B. (Missouri) Mangum, J.	Study of the origin of broad formaldehyde line emission in millimeter-bright low mass star-forming regions.
W353	Williams, J. (Calif., Berkeley) Blitz, L. (Maryland)	Study of clump substructure in the Rosette molecular cloud.
W355	Welch, G. (St. Mary's U.) Mitchell, G. (St. Mary's U.) Sage, L. (Maryland)	Study of the molecular gas of NGC 205.
W360	Wolf-Chase, G. (NASA/Ames) Davidson, J. (NASA/Ames)	CO J = 2–1 observations of outflows in the Mon OB1 dark cloud.
W362	Wiklind, T. (Chalmers, Onsala) Combes, F. (Paris Obs)	Study of molecular absorption at z = 0.247, and T_{cmb}.
W364	Wootten, H. A. Fuller, G. (Manchester)	Mass and morphology of high column density $C^{17}O$ J = 2–1 gas in the ρ Ophiuchi cloud cores.
W366	Womack, M. (Penn State) Stern, A. (Southwest Research Inst.) Festou, M. (Midi-Pyrenees Obs)	Study of carbon monoxide in giant distant comets.
W373	Woodney, L. (Maryland) A'Hearn, M. (Maryland) Samarasinha, N. (KPNO) McMullin, J. (Arizona) Mundy, L. (Maryland)	Monitoring the activity of Comet Hale-Bopp (C/1995 01).
W374	Womack, M. (Penn State) Stern, A. (Southwest Research Inst.) Festou, M. (Midi-Pyrenees Obs)	CO, H_2O, and CH_3OH in Comet Hale-Bopp: primordial ices?
W375	Womack, M. (Penn State) Stern, A. (Southwest Research Inst.) Festou, M. (Midi-Pyrenees Obs)	Study of parent molecules in the newly discovered comet C/Hyakutake (C/1996 B2).
W376	Woodney, L. (Maryland)	Study of molecules in Comet Hyakutake.

No.	Observer(s)	Program
Y16	Yu, T. (Calif., Berkeley) Chernin, L. (Calif., Berkeley) Welch, W. J. (Calif., Berkeley)	A search for shock emission tracers in the VLA 1623 outflow.
Y18	Yusef-Zadeh, F. (Northwestern)	Search for high density molecular gas at -5 km/s toward OH masers surrounding the Galactic center SNR G359.1-0.5.
Z127	Ziurys, L. (Arizona State) Mangum, J.	Study of vibrationally excited emission in protostellar environments.
Z132	Ziurys, L. (Arizona State) Apponi, A. (Arizona State)	A search for interstellar/circumstellar FeCl.
Z134	Zhou, S. (Illinois) Choi, M. (Texas) Evans, N. (Texas)	A $C^{18}O$ J = 2-1 survey of selected regions in Taurus.

D. VERY LARGE ARRAY OBSERVING PROGRAM

First Quarter, 1996 was spent in the following configurations: B configuration from January 1 to January 8; CnB configuration from January 8 to February 5; C configuration from February 5 to March 31

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

No.	Observer(s)	Program
AA195	Alexander, P. (Cambridge) Clemens, M. (Cambridge) Green, D. (Cambridge)	Efficient ram-pressure stripping in close galaxy pairs. 20 cm
AA201	Altenhoff, W. (MPIR, Bonn) Butler, B.	Continuum measurements of Comet Hyakutake. 1.3, 2 cm
AB628	Becker, R. (Calif., Davis) Helfand, D. (Columbia) White, R. (STScI) Perley, R.	Survey of the north galactic cap. 20 cm
AB705	Burke, B. (MIT) Becker, D. (MIT) Lehar, J. (CFA) Hewitt, J. (MIT) Roberts, D. (Brandeis)	Time delay of the gravitational lens 0957+561. 3.6, 6 cm

No.	Observer(s)	Program
AB740	Baum, S. (STScI) Colbert, E. (Maryland) O'Dea, C. (STScI) Pedlar, A. (Manchester)	Three archetypical Seyferts: MKN 6, NGC 3079, MKN 231. 6, 20 cm
AB759	Browne, I. (Manchester) Wilkinson, P. (Manchester) Sykes, C. (Manchester)	Ring and halo in the gravitational lens B0218+357. 20 cm
AB760	Browne, I. (Manchester) Wilkinson, P. (Manchester) Sykes, C. (Manchester) Muxlow, T. (Manchester) Jackson, N. (Manchester) Myers, S. (Caltech) Fassnacht, C. (Caltech) Readhead, A. (Caltech) Pearson, T. (Caltech) de Bruyn, A. (NFRA) Snellen, I. (Leiden)	Deep imaging of the new quadruple lensed system 1608+656. 6 cm
AB766	Blundell, K. (Oxford) Rawlings, S. (Oxford) Lacy, M. (Oxford) Littlewood, C. (Oxford) Willott, C. (Oxford) Serjeant, S. (Oxford)	The evolution of radio quasars and their environments from z = 0.5-3. 3.6, 6, 20 cm
AB772	Bransford, M. (Iowa State) Appleton, P. (Iowa State) McCain, C. (Mt. Stromlo) Freeman, K. (Mt. Stromlo)	Gas dynamics of ring galaxies in two different environments. 20 cm line
AB773	Balser, D. Bania, T. (Boston) Rood, R. (Virginia)	Density structure analysis of W43. 3.6 cm line
AB775	Beck, R. (MPIR, Bonn) Shoutenkov, V. (Lebedev) Shukurov, A. (Moscow/SSAI) Sokoloff, D. (Moscow/SSAI)	Magnetic fields in barred galaxies. 20 cm

No.	Observer(s)	Program
AB778	Bliton, M. (New Mexico State) Roettiger, K. (Maryland) Burns, J. (New Mexico State) Loken, C. (New Mexico State) Owen, F.	Steep spectrum radio sources in rich clusters. 20 cm
AB780	Bridle, A. Perley, R. Swain, M. (Rochester)	Fully sampled imaging of the lobes of 3C 219. 2, 3.6, 6 cm
AB782	Brown, A. (Colorado/JILA) Stringfellow, G. (Colorado/JILA)	An outburst of PMS star V1143 Ori. 3.6 cm
AB798	Butler, B. Wootten, H. A. Palmer, P. (Chicago) Bocklee-Morvan, D. (Meudon) Despois, D. (Bordeaux) Yeomans, D. (JPL)	Continuum, formaldehyde, methanol, and ammonia from Comet Hyakutake. 0.7, 1.3, 2 cm
AC431	Capetti, A. (STScI) Zirbel, E. (STScI) Parma, P. (Bologna)	The properties of intermediate luminosity radio galaxies. 6 cm
AC441	Cotton, W. Swain, M. (Rochester) Bridle, A. Kassim, N. (NRL)	J2146+82 – large radio galaxy with misaligned outbursts? 6, 20 cm
AC443	Chernin, L. (Calif., Berkeley)	Water masers in protostellar outflows. 1.3 cm line
AC447	Crane, P. (Interferometrics) Cowan, J. (Oklahoma) Primini, F. (CFA) Roberts, D. (Illinois) Dickel, J. (Illinois)	Radio and x-ray variability of M31. 3.6 cm
AC456	Chengalur, J. (NFRA) Giovanelli, R. (Cornell) Haynes, M. (Cornell)	HI 1225+01. 20 cm line
AC457	Canzian, B. (NRL)	Geometric phase and co-rotation resonance in NGC 4079. 20 cm line

No.	Observer(s)	Program
AC460	Carkner, L. (Penn State) Feigelson, E. (Penn State) Neuhauser, R. (MPIfEP, Garching) Wichmann, R. (Heidelberg Obs) Krautter, J. (Heidelberg Obs)	Radio survey of dispersed x-ray selected T Tauri stars. 3.6 cm
AD370	Dallacasa, D. (NFRA) Feretti, L. (Bologna) Giovannini, G. (Bologna) Klein, U. (Bonn U.)	Probing the cluster magnetic field in Abell 119. 3.6, 6, 20 cm
AD373	Deguchi, S. (Nobeyama Obs) Miyoshi, M. (Mizusawa Obs) Asaki, Y. (Mizusawa Obs)	Position of OH masers relative to continuum sources. 18, 1.3 cm line
AD376	Drake, S. (NASA/GSFC) Stern, R. (Lockheed) White, N. (NASA/GSFC) Antunes, A. (NASA/GSFC)	Joint XTE/VLA observation program for Algol and HR 1099. 1.3, 2, 3.6, 6 cm
AD377	Di Francesco, J. (Texas) Evans, N. (Texas) Chandler, C. (Cambridge)	Spectral energy distribution of Herbig Ae/Be Stars. 0.7, 1.3, 3.6 cm
AE107	Edge, A. (Cambridge) Allen, S. (Cambridge) Crawford, C. (Cambridge) Fabian, A. (Cambridge) Boehringer, H. (MPIfEP, Garching)	Central galaxies of x-ray selected clusters. 6 cm
AF294	Frail, D. Kulkarni, S. (Caltech) Vasisht, G. (Caltech)	The soft gamma ray repeater SGR 1806-20. 3.6, 6 cm
AF299	Fey, A. (USNO) Kassim, N. (NRL)	Low frequency observations of the Cygnus region. 90 cm
AF301	Fomalont, E. Kellermann, K. Partridge, R. B. (Haverford College) Richards, E. (Virginia) Windhorst, R. (Arizona State)	The HST deep image. 3.6 cm
AF302	Frail, D. Goss, W.M.	Confirmation of supernova remnant/molecular cloud interactions. 20 cm line

No.	Observer(s)	Program
AF306	Frail, D.	Monitoring GRO J1744-28 candidate source. 3.6, 6 cm
AG432	van Gorkom, J. (Columbia) Dwarakanath, K. (Raman Institute) Guhathakurra, P. (Calif., Santa Cruz)	HI imaging of cluster Abell 2670. 20 cm line
AG437	Gray, A. (DAO)	Detailed imaging and polarimetry of G357.1-00.2, a possible SNR. 20 cm
AG438	Gray, A. (DAO) Goss, W.M.	Imaging and polarimetry of G359.1-00.2 (the Snake). 3.6 cm
AG441	Garay, G. (Chile) Brown, R. Lizano, S. (Mexico/UNAM) Gomez, Y. (Mexico/UNAM)	The C+ recombination line emission from S88 B. 20 cm line
AG448	Greenhill, L. (CFA) Henkel, C. (MPIR, Bonn)	Monitoring the acceleration of water megamaser features in NGC 4258. 1.3 cm line
AG449	Gizani, N. (Manchester) Leahy, J. (Manchester) Garrington, S. (Manchester) Perley, R.	Faraday rotation in Hercules A. 3.6, 20 cm
AG459	Guedel, M. (SFIT, ETH) Guinan, E. (Villanova) Schmitt, J. (MPIfEP, Garching) Benz, A. (SFIT, ETH)	Multiwavelength study of enigmatic coronal activity on 47 Cas. 3.6 cm
AG471	Gomez, J. (IAA, Andalucia) Torrelles, J. (IAA, Andalucia) Rodriguez, L. (Mexico/UNAM) Curiel, S. (Mexico/UNAM) Garay, G. (Chile) Ho, P. (CFA)	Warm gas in the circumstellar disk around Cep A-HW2. 1.3 cm line
AG472	Gaensler, B. (Sydney) Frail, D. Manchester, R. (CSIRO) Green, A. (Sydney)	Two unusual barrel supernova remnants. 20, 90 cm
AG474	Gabuzda, D. (Lebedev) Cawthorne, T. (Lancashire)	Rotation measures for 15 BL Lacertae objects. 20 cm

No.	Observer(s)	Program
AG475	Gregg, M. (LLNL) Lehnert, M. (Leiden) Welch, D. (McMaster U.) Cook, K. (LLNL) Alves, D. (Calif., Davis)	Neutral hydrogen in NGC 4911. 20 cm line
AG476	Geller, R. (Calif., Santa Barbara) Antonucci, R. (Calif., Santa Barbara) Ekers, R. (CSIRO) Killeen, N. (CSIRO) Desai, K. de Bruyn, G. (NFRA)	Search for the ionized intergalactic medium via Thomson scattered halos. 20 cm
AG477	van Gorkom, J. (Columbia) Yun, M. Bahcall, J. (Princeton)	PKS 2349-014, possible link between mergers and AGNs. 20 cm line
AG478	Gopal-Krishna (TIFR) Bhatnagar, S. (TIFR) Wisotzki, L. (Hamburg U.) Koehler, T. (Hamburg U.)	Search for radio continuum from QSOs in the Hamburg ESO Survey. 6 cm
AG479	Gopalswamy, N. (Maryland) Kundu, M. (Maryland) Nitta, N. (Lockheed)	Nonthermal emission and plasma flow during bright point flares. 2, 3.6, 6 cm
AG480	Guedel, M. (SFIT, ETH) Guinan, E. (Villanova) Gagne, M. (Colorado/JILA)	Search for active FOV stars. 3.6 cm
AG481	Guedel, M. (SFIT, ETH) Ottmann, R. (MPIfEP, Garching) Duerbeck, H. (Munster U.)	Coordinated observations of RZ Cas. 3.6 cm
AH557	Hofner, P. (Koln) Stecklum, B. (MPIR, Bonn)	M8 revisited: what is ionizing the hourglass? 1.3, 3.6 cm
AH568	Harvanek, M. (Colorado/JILA) Stocke, J. (Colorado/JILA)	Distant 3CR radio galaxies at z = 0.15-0.65. 20 cm
AH570	Horellou, C. (Chalmers, Onsala) Combes, F. (Paris Obs) Casoli, F. (Paris Obs)	HI in the interacting galaxy Arp 119. 20 cm line

No.	Observer(s)	Program
AH571	Huchtmeier, W. (MPIR, Bonn) Westpfahl, D. (NMIMT) Adler, D.	CAS 1 and MB 1: a local group member and a merger victim. 20 cm line
AH572	Hjellming, R. Rupen, M.	Radio and x-ray activity in the galactic black hole candidate J1719. 3.6, 6, 20 cm
AH573	Hjellming, R. Rupen, M.	Radio and x-ray activity in the galactic black hole binary GRO J1655. 2, 3.6, 6, 20 cm
AH577	Halpern, J. (Columbia)	Identification of high energy galactic gamma ray sources. 20, 90 cm
AH579	Helfand, D. (Columbia) Becker, R. (Calif., Davis) White, R. (STScI) Das, S. (Columbia)	FIRST rapid variability in extragalactic radio sources. 3.6, 20 cm
AI059	Ishwara-Chandra, C. (NCRA, India) Kapahi, V. (NCRA, India) Saikia, D. (NCRA, India) Subrahmanya, C. (NCRA, India)	Polarization studies of Molonglo complete sample. 6 cm
AI061	Ivison, R. (Royal Obs) Seaquist, E. (Toronto)	OH/IR color mimics: testing the binary hypothesis. 0.7, 1.3, 2, 3.6, 6 cm
AJ252	Jones, M. (Cambridge) Grainge, K. (Cambridge) Edge, A. (Cambridge) Saunders, R. (Cambridge)	Search for cluster radio halo sources. 20 cm
AJ255	Jore, K. (Cornell) Broeils, A. (Stockholm Obs) Haynes, M. (Cornell)	Formation of counter-rotating components in Sa galaxies. 20 cm line
AK376	Kulkarni, S. (Caltech) Frail, D.	Search for the radio counterparts of gamma ray bursters. 20 cm
AK400	Kobulnicky, H. (Minnesota) Vacca, W. (Hawaii) Hogg, D.	A starburst core and probable radio supernova in Henize 2-10. 2 cm
AK415	Krause, M. (MPIR, Bonn)	The jets in spiral Seyfert NGC 4258. 3.6 cm

No.	Observer(s)	Program
AK420	Kollgaard, R. (Penn State) Ghisellini, G. (Torino) Maraschi, M. (Genova U.) Pesce, J. (STScI) Sambruna, R. (STScI) Urry, C. (STScI)	Multifrequency monitoring of blazars. 1.3, 2, 3.6, 6, 20 cm
AK421	Kobulnicky, H. (Minnesota) Skillman, E. (Minnesota)	HI mapping of the nearby peculiar starburst galaxy NGC 5253. 20 cm line
AK422	Kliem, B. (API, Potsdam) Mazets, E. (AFIPI, Russia)	Solar decimetric microbursts. 20, 90 cm
AK423	Kurtz, S. (Mexico/UNAM) Carral, P. (Guanajuato U.) Rodriguez, L. (Mexico/UNAM) Hofner, P. (Koln) DePree, C. (North Carolina)	Continuum emission, H_20 masers, and cometary HII regions. 0.7, 2, 3.6 cm
AL364	Leitch, E. (Caltech) Myers, S. (Caltech) Readhead, A. (Caltech)	Point source contaminants in the OVRO microwave background fields. 0.7, 1.3, 2, 3.6 cm
AL365	Lim, J. (SA/IAA, Taiwan) Walter, F. (SUNY) Wolk, S. (SUNY)	Radio observations of a candidate isolated neutron star. 3.6 cm
AL366	Lacy, M. (Oxford) Blundell, K. (Oxford)	A search for remnant hotspots in radio-quiet quasar E 1821+643. 20 cm
AL371	Leto, G. (Bologna) Pagano, I. (Catania) Umana, G. (Bologna) Trigilio, C. (Bologna) Rodono, M. (Catania)	Spectral energy distribution of a dMe star. 0.7, 1.3, 2, 3.6, 6 cm
AL372	Lim, J. (SA/IAA, Taiwan) White, S. (Maryland) Drake, S. (NASA/GSFC)	Rotational modulation of magnetic Bp star Sigma Ori E. 2, 3.6, 6, 20 cm
AL373	Lim, J. (SA/IAA, Taiwan) White, S. (Maryland)	Radio survey of nearby, highly magnetized white dwarfs. 3.6 cm
AL376	Lo, K. (Illinois) Tolstoy, E. (STScI)	HI distribution in the transition dwarf galaxy-Phoenix. 20 cm line

No.	Observer(s)	Program
AL379	Lara, L. (Bologna) Cotton, W. Feretti, L. (Bologna) Giovannini, G. (Bologna) Marcaide, J. (Valencia) Venturi, T. (Bologna)	Large angular size radio sources from the NRAO VLA Sky Survey. 6, 20 cm
AL380	de Lapparent, V. (IAP, Paris) Roland, J. (IAP, Paris)	Radio survey of an optically selected sample of galaxies. 6 cm
AL393	Lisse, C. (Maryland) Fernandez, Y. (Maryland) Kundu, A. (Maryland) Neufeld, D. (Maryland)	Continuum emission from Comet 1996 B2 (Hyakutake). 2, 3.6, 6 cm
AM479	Morrison, G. (New Mexico) Owen, F.	Imaging of very rich Abell clusters. 20 cm
AM499	Morrison, G. (New Mexico) Owen, F.	Imaging the two most extreme Butcher-Oemler clusters. 20 cm
AM503	Moffett, D. (NMIMT) Hankins, T. (NMIMT)	Crab pulsar polarization at high radio frequencies. 3.6, 6, 20 cm
AM509	Mehringer, D. (Illinois) Goss, W.M. Palmer, P. (Chicago)	Search for 2 cm H_2CO masers in 6 cm H_2CO maser sources. 2, 6 cm
AM510	van Moorsel, G. Greisen, E.	HI extent of NGC 6503. 20 cm line
AM511	Marti, J. (Barcelona) Mirabel, F. (CNRS, France) Chaty, S. (CNRS, France) Rodriguez, L. (Mexico/UNAM)	Hard x-ray sources in the galactic bulge. 3.6, 6 cm
AM519	Menten, K. (CFA) Carilli, C. Reid, M. (CFA)	Multi-molecule absorption line study of the Einstein Ring 1830-211. 0.7, 1.3, 3.6, 6, 18 cm line
AM520	Menten, K. (CFA) Reid, M. (CFA)	Deep survey for stellar SiO and H_2O masers in the central parsec. 0.7, 1.3 cm line
AM521	Matthews, L. (SUNY) Wilcots, E. (Wisconsin) Gallagher, J. (Wisconsin)	HI rotation curves of extreme late-type spiral galaxies. 20 cm line

No.	Observer(s)	Program
AM522	McMullin, J. (Arizona) White, S. (Maryland) Mundy, L. (Maryland) Blake, G. (Caltech)	Stellar radio population of Lynds 1641. 6 cm
AM523	Mundell, C. (Manchester) Pedlar, A. (Manchester) Thean, A. (Manchester) Shone, D. (Manchester) Done, C. (Durham) Brinks, E. (Guanajuato U.)	Observations of neutral hydrogen in the Seyfert galaxies NGC 4939. 20 cm line
AM524	Meehan, L. (Missouri) Wilking, B. (Missouri) Claussen, M.	Multifrequency continuum survey of five young stellar objects. 2, 3.6, 6 cm
AM525	Moore, E. (Rutgers)	HI observations of spiral galaxies. 20 cm line
AO122	Owen, F. Perley, R. Cotton, W. Postman, M. (STScI) Condon, J.	Deep A-array survey near 1015+51. 20 cm
AO123	O'Donoghue, A. (St. Lawrence U.) Eilek, J. (NMIMT) Owen, F.	Examining the morphological and dynamical basis for FRI/FRII boundary. 20 cm
AO125	Olling, R. (Columbia)	Determining the shape of dark matter halos from the flaring of HI. 20 cm line
AO126	Ohashi, N. (CFA) Chen, H. (CFA) Zhao, J.-H. (SA/IAA, Taiwan) Ho, P. (CFA)	Defining spectral index of dust emissions from circumstellar disks. 0.7, 1.3 cm
AP327	de Pater, I. (Calif., Berkeley) Grossman, A. (Maryland)	Jupiter at the time of the Galileo probe entry. 2 cm
AP330	Pildis, R. (CFA) Eder, J. (NAIC) Schombert, J. (NASA/GSFC) Oemler, A. (Yale)	HI mapping of dwarf spiral galaxies. 20 cm line
AP332	de Pater, I. (Calif., Berkeley)	Jupiter Patrol: aftermath of Comet - Jupiter crash. 6, 20, 90 cm

No.	Observer(s)	Program
AP335	de Pater, I. (Calif., Berkeley) Ostro, S. (JPL) Mitchell, D. (JPL) Yeomans, D. (JPL) Palmer, P. (Chicago) Snyder, L. (Illinois) Hudson, S. (Washington)	Bistatic radar (Goldstone-VLA) on Comet Hyakutake. 3.6 cm
AR334	Roser, H. (MPIA, Heidelberg) Perley, R. Meisenheimer, K. (Royal Obs)	High frequency mapping of the jet of 3C 273. 0.7, 1.3, 2, 3.6, 6 cm
AR335	Rawlings, S. (Oxford) Lacy, M. (Oxford) Blundell, K. (Oxford) Serjeant, S. (Oxford)	An HST sample of quasars at $0.5 < z < 0.7$. 3.6, 6, 20 cm
AR348	Ratnatunga, K. (Johns Hopkins) Hewitt, J. (MIT)	Radio observations of two Einstein cross gravitational lenses. 3.6, 20 cm
AR349	Roberts, D. (Illinois) Yusef-Zadeh, F. (Northwestern) Uchida, K. (MPIR, Bonn)	OH 1720 MHz masers: G359.1-0.5, Sgr A. 20 cm line
AR351	Roberts, M. Hogg, D. Haynes, M. (Cornell)	HI asymmetry in isolated galaxies. 20 cm line
AS564	Slysh, V. (Lebedev) Kanenskii, S. (Lebedev) Valts, I. (Lebedev) Dzura, A. (Lebedev) Kogan, L.	Imaging of Class I methanol masers. 0.7 cm line
AS568	Sramek, R. Weiler, K. (NRL) Van Dyk, S. (Calif., Berkeley) Panagia, N. (STScI)	Properties of radio supernovae. 1.3, 2, 3.6, 6, 20 cm
AS576	Simkin, S. (Michigan State) Mackenty, J. (STScI)	HI envelope of Markarian 315. 20 cm line

No.	Observer(s)	Program
AS577	Szomoru, A. (Groningen/Kapteyn) Goldschmidt, P. (Imperial College) Oliver, S. (Imperial College) Mann, R. (Queen Mary) Lawrence, A. (Royal Obs) Taylor, A. (Royal Obs)	HI observations of IRAS galaxies with different rates of star formation. 20 cm line
AS580	Sarma, A. (Kentucky) Troland, T. (Kentucky) Roberts, D. (Illinois) Crutcher, R. (Illinois)	OH Zeeman observations toward NGC 6334. 20 cm line
AS582	Seta, M. (Tokyo U.) Hasegawa, T. (Tokyo U.) Ukita, N. (Nobeyama Obs) Giacani, E. (IAFE) Frail, D. Goss, W.M. Claussen, M.	Search for water maser emission toward the supernova remnants W44, W28. 1.3 cm line
AT184	Thorsett, S. (Princeton) Taylor, J. (Princeton) McKinnon, M. Hankins, T. (NMIMT) Stinebring, D. (Oberlin College)	Timing fast pulsars. 6, 20, 90 cm
AT187	Taramopoulos, A. (Pittsburgh) Briggs, F. (Groningen/Kapteyn)	HI observations of NGC 3894. 20 cm line
AT188	Thornley, M. (Maryland) Mundy, L. (Maryland)	Searching for density wave signatures in nearby flocculent galaxies. 20 cm line
AT189	Taylor, C. (McMaster U.) Brinks, E. (Guanajuato U.) Skillman, E. (Minnesota) Thomas, D.	Star formation in low surface brightness dwarf galaxies. 20 cm line
AT192	Torrelles, J. (IAA, Andalucia)	Two compact planetary nebulae. 3.6 cm
AU063	Umana, G. (Bologna) Trigilio, C. (Bologna) Franciosini, E. (Florence) Chiuderi-Drago, F. (Florence)	Radio spectra of active binaries during flares. 1.3, 2, 3.6, 6, 20 cm

No.	Observer(s)	Program
AV221	Verdes-Montenegro, L. (IAA, Andalucia) Yun, M. Huchtmeier, W. (MPIR, Bonn) del Olmo, A. (IAA, Andalucia) Perea, J. (IAA, Andalucia)	HI in Hickson groups. 20 cm line
AV222	Venturi, T. (Bologna) Morganti, R. (CSIRO) Bardelli, S. (Trieste Obs) Hunstead, R. (Sydney)	J1324-316, a possible relic radio source in cluster of galaxies. 90 cm
AW362	White, S. (Maryland)	The stellar activity cycle on active stars. 3.6, 6, 20 cm
AW404	Wilcots, E. (Wisconsin) Hodge, P. (Washington)	HI study of nearby irregular IC 1613. 20 cm line
AW419	Watson, A. (Lowell Obs) Cox, A. (Wisconsin) Wilcots, E. (Wisconsin)	Sub-arcsecond imaging of nuclear starbursts. 2, 6 cm
AW425	Whiteoak, J. (MPIR, Bonn) Reich, W. (MPIR, Bonn) Wiebelbinski, R. (MPIR, Bonn) Megeath, S. (MPIR, Bonn) Uchida, K. (MPIR, Bonn)	Clumped regions and star formation in S296. 20 cm
AW427	White, S. (Maryland) Franciosini, E. (Florence) Umana, G. (Bologna)	Survey of coherent emission from RS CVn systems at low frequencies. 20 cm
AW430	Wilcots, E. (Wisconsin) Elmegreen, B. (IBM) Gallagher, J. (Wisconsin)	HI observations of late-type spiral galaxies. 20 cm line
AW431	Windhorst, R. (Arizona State) Fomalont, E. Kellermann, K. Partridge, R. B. (Haverford College) Richards, E. (Virginia)	VLA 8.4 GHz observations of a cluster of young compact galaxies. 3.6 cm
AW434	Wilner, D. (CFA) Hofner, P. (Koln)	Warm gas and dust emission from the Turner-Welch object in W3(OH). 0.7, 1.3 cm line
AW435	Wilner, D. (CFA) Ho, P. (CFA)	Gravitational contraction in G45.47+0.05? 1.3 cm line

No.	Observer(s)	Program
AZ075	Zhang, Q. (CFA) Ho, P. (CFA)	Contracting molecular cloud cores. 1.3 cm line
AZ077	Zwaan, M. (Groningen/Kapteyn) Briggs, F. (Groningen/Kapteyn)	Giant, HI selected galaxies at 22,000 km/sec. 20 cm line
AZ078	Zabludoff, A. (Mt. Wilson) van Gorkom, J. (Columbia) Shectman, S. (Mt. Wilson) Zaritsky, D. (Calif., Santa Cruz)	Distribution and kinematics of HI in post merger galaxies. 20 cm line
AZ079	van Zee, L. (Cornell) Broeils, A. (Stockholm Obs) Haynes, M. (Cornell) Salzer, J. (Wesleyan U.)	Star formation thresholds of isolated dwarf galaxies. 20 cm line
AZ080	Zuckerman, B. (UCLA) Palmer, P. (Chicago) Webb, R. (UCLA)	Search for circumstellar HI around young stars. 20 cm line
AZ081	Zepka, A. (Calif., Berkeley) Lundgren, S. (NRL) Kassim, N. (NRL) Cordes, J. (Cornell) Frail, D.	Search for the supernova remnant of young pulsar J0631+1036. 20, 90 cm
AZ082	Zhang, Q. (CFA) Ho, P. (CFA)	Physical properties of UC HII regions. 0.7 cm
BG051	Gwinn, C. (Calif., Santa Barbara) Britton, M. (Calif., Santa Barbara) Bloemhof, E. (Arizona)	Angular broadening of the least-scattered pulsar. 400 cm with phased VLBI array

E. THE VERY LONG BASELINE ARRAY OBSERVING PROGRAM

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

No.	Observer(s)	Program
BA009	Alberdi, A. (ESA, Spain) Marcaide, J. (Valencia) Krichbaum, T. (MPIR, Bonn) Graham, D. (MPIR, Bonn) Witzel, A. (MPIR, Bonn) Marscher, A. (Boston)	VLBI observations of the peculiar quasar 4C 39.25. 0.7 cm

No.	Observer(s)	Program
BB023	Beasley, A. Conway, J. (Chalmers, Onsala) Dhawan, V. Walker, R. C. Wrobel, J. Patnaik, A. (MPIR, Bonn) Muxlow, T. (Manchester)	VLBA calibrator survey. 3.6 cm
BB041	Beasley, A. Fomalont, E.	Absolute core motions of superluminal radio sources. 3.6 cm
BB045	Benz, A. (SFIT, ETH) Conway, J. (Chalmers, Onsala) Alef, W. (MPIR, Bonn) Guedel, M. (SFIT, ETH)	VLBA observations of nearby dMe stars. 3.6 cm with phased VLA
BB050	Blundell, K. (Oxford) Lacy, M. (Oxford)	PC-scale jets and core of the radio-quiet quasar E 1821+643. 3.6, 6 cm
BB055	Biretta, J. (STScI) Junor, W. (New Mexico)	Origin of the nuclear x-ray emission in M87. 1.3, 18 cm with single VLA antenna
BB058	Bartel, N. (York U.)	VLBI imaging of SN 1979C in M100 in the Virgo cluster. 18 cm with phased VLA
BC053	Clark, T. (NASA/GSFC) Ryan, J. (NASA/GSFC) Himwich, W. (Interferometrics) MacMillian, D. (Interferometrics) Gordon, D. (NASA/GSFC) Niell, A. (Haystack) Corey, B. (Haystack) Rogers, A. (Haystack) Eubanks, T. (USNO) Fomalont, E. Walker, R. C.	NASA space geodesy program: geodetic observations for 1996. 3.6 cm
BD022	Diamond, P. Kemball, A.	Observations of the SiO masers in OH/IR stars. 0.7 cm
BD027	Diamond, P. Kemball, A.	Multi-epoch observations of stellar SiO masers. 0.7 cm with single VLA antenna
BD030	Denn, G. (Iowa) Mutel, R. (Iowa)	Polarization and monitoring of BL Lac as a test of AGN jet models. 1.3, 2, 3.6 cm

No.	Observer(s)	Program
BD032	Dewey, R. (Princeton) Beasley, A.	Proper motions of pulsars in supernova remnants. 18 cm
BF015	Fomalont, E. Bradshaw, C. (George Mason) Geldzahler, B. (George Mason)	The parallax of Sco X-1. 6 cm
BG045	Greenhill, L. (CFA) Moran, J. (CFA) Danchi, W. (Calif., Berkeley) Bester, M. (Calif., Berkeley)	Snapshot survey of SiO maser stars at maximum and minimum luminosity. 0.7 cm
BG049	Gallimore, J. (MPIfEP, Garching) Baum, S. (STScI) O'Dea, C. (STScI)	VLBA mapping of thermal emission from the Torus in NGC 1068. 3.6, 18 cm with phased VLA
BG050	Greenhill, L. (CFA) Chernin, L. (Calif., Berkeley)	Collimation and launch of protostellar outflows. 1.3 cm with VLA single antenna
BG052	Gwinn, C. (Calif., Santa Barbara) Greenhill, L. (CFA)	Study of masers in a disk around a hidden AGN. 1.3 cm with phased VLA
BH014	Hough, D. (Trinity U.) Vermeulen, R. (Caltech) Readhead, A. (Caltech)	Search for superluminal motion in lobe dominated quasars: 3C 270.1, 275.1. 2 cm
BH017	Ho, P. (CFA) Patel, N. (CFA) Torrelles, J. (IAA, Andalucia) Gomez, J. (IAA, Andalucia) Rodriguez, L. (Mexico/UNAM) Curiel, S. (Mexico/UNAM)	Proper motions of circumstellar water masers in Cepheus A. 1.3 cm
BJ021	Jones, D. (JPL) Dressel, L. (ARC)	Compact radio sources asociated with nuclear emission line regions. 18 cm

No.	Observer(s)	Program
BJ022	Jackson, N. (Manchester) Browne, I. (Manchester) Nair, S. (Manchester) Wilkinson, P. (Manchester) Myers, S. (Caltech) Fassnacht, C. (Caltech) Pearson, T. (Caltech) Readhead, A. (Caltech) Blandford, R. (Caltech) de Bruyn, G. (NFRA) Schilizzi, R. (NFRA) Miley, G. (Leiden) Bremer, M. (Leiden)	Structure of the gravitational lens system 1600+434. 2, 6 cm
BL025	Lazio, T. (Cornell) Cordes, J. (Cornell)	Compact doubles and AU scales in the neutral interstellar medium. 21 cm
BL027	Lestrade, J.-F. (Paris Obs) Phillips, R. (Haystack) Jones, D. (JPL) Preston, R. (JPL)	Astrometric monitoring of Sigma2 CrB. 3.6 cm
BL028	Leppanen, K. (Helsinki) Gabuzda, D. (Lebedev) Lobanov, A. (NMIMT) Cawthorne, T. (Lancashire)	Linearly polarized structure of eight bright quasars. 1.3 cm
BL029	Lonsdale, C. (Haystack) Smith, H. (Calif., San Diego) Lonsdale, C. (Caltech)	Phase-referenced mapping of ultraluminous IR galaxies. 18 cm
BM049	Mioduszewski, A. (Michigan) Gabuzda, D. (Lebedev) Aller, H. (Michigan)	Monitoring of six highly variable BL Lacertae objects. 1.3, 3.6 cm
BM050	Moellenbrock, G. (Brandeis) Roberts, D. (Brandeis) Wardle, J. (Brandeis)	Polarization of gamma-ray blazars. 1.3, 2 cm
BM055	Mantovani, F. (Bologna) Junor, W. (New Mexico) Saikia, D. (NCRA, India) Salter, C. (NAIC)	Polarization imaging of CSS sources with very high rotation measures. 3.6 cm

No.	Observer(s)	Program
BM056	Moran, J. (CFA) Herrnstein, J. (CFA) Greenhill, L. (CFA) Miyoshi, M. (Mizusawa Obs) Inoue, M. (Nobeyama Obs) Nakai, N. (Nobeyama Obs) Diamond, P. Henkel, C. (MPIR, Bonn)	The proper motions of the water vapor masers in NGC 4258. 1.3 cm with phased VLA, GB
BM057	Marcaide, J. (Valencia) Ros, E. (Valencia) Alberdi, A. (ESA, Spain) Diamond, P. Shapiro, I. (CFA) Guirado, J. (JPL) Preston, R. (JPL) Jones, D. (JPL) Witzel, A. (MPIR, Bonn) Krichbaum, T. (MPIR, Bonn) Schilizzi, R. (NFRA) Mantovani, F. (Bologna) Trigilio, C. (Bologna) Whitney, A. (Haystack)	Radio-shell expansion in SN 1993J. 6 cm with phased VLA
BM065	Mundell, C. (Manchester) Pedlar, A. (Manchester) Wrobel, J. Baum, S. (STScI) Gallimore, J. (MPIfEP, Garching)	HI absorption in NGC 4151. 18 cm with phased VLA
BN002	Nakai, N. (NAO, Japan) Inoue, M. (NAO, Japan) Miyoshi, M. (NAO, Japan) Diamond, P.	H_2O megamaser in the Seyfert galaxy IC 2560. 1.3 cm with phased VLA
BO003	Ojha, R. (Brandeis) Aaron, S. (Brandeis) Holdaway, M. Wardle, J. (Brandeis) Roberts, D. (Brandeis)	Structure and polarization of hotspots. 18 cm
BP025	Pearson, T. (Caltech) Readhead, A. (Caltech) Worrall, D. (CFA)	Nucleus of the quasar 3C 48. 2, 3.6, 18 cm

No.	Observer(s)	Program
BP028	Patel, N. (CFA) Zhang, Q. (CFA) Herrnstein, J. (CFA) Ho, P. (CFA) Greenhill, L. (CFA) Moran, J. (CFA) Goldsmith, P. (NAIC)	Proper motion of water masers around IRAS 21391+5802. 1.3 cm
BP029	Perley, R. Bridle, A. Swain, M. (Rochester)	Compact substructure in the jets of 3C 219. 18 cm with single VLA antenna
BR034	Roberts, D. (Brandeis) Wardle, J. (Brandeis) Ojha, R. (Brandeis) Homan, D. (Brandeis) Aller, H. (Michigan) Aller, M. (Michigan) Hughes, P. (Michigan)	Sources with rapidly varying polarization. 1.3, 2 cm
BR038	Reid, M. (CFA) Readhead, A. (Caltech) Treuhaft, R. (JPL) Vermeulen, R. (Caltech)	Trigonometric parallax to Sgr A*. 0.7 cm
BR039	Reid, M. (CFA) Menten, K. (CFA) Argon, A. (CFA)	Polarization mapping of OH masers. 18 cm
BR040	Ratner, M. (CFA) Bartel, N. (York U.) Lebach, D. (CFA) Lestrade, J.-F. (Paris Obs) Shapiro, I. (CFA)	Reference sources for astrometry of HR 1099 and IM Peg. 3.6 cm
BS019	Sjouwerman, L. (Chalmers, Onsala) Diamond, P. van Langevelde, H. (NFRA) Winnberg, A. (Chalmers, Onsala) Habing, A. (AAO) Lindqvist, M. (Leiden)	Stellar proper motions in galactic center from SiO and H_20 masers. 1.3 cm
BS024	Shen, Z. (CFA) Moran, J. (CFA) Kellermann, K.	Southern blazar 1921-293. 0.7, 6 cm

No.	Observer(s)	Program
BS029	Stocke, J. (Colorado/JILA) Rector, T. (Colorado/JILA) Gabuzda, D. (Lebedev)	X-ray loud BL Lacs and AGN unification. 3.6 cm
BT021	Tingay, S. (Mt. Stromlo) Jauncey, D. (CSIRO) Reynolds, J. (CSIRO) Tzioumis, A. (CSIRO) Preston, R. (JPL) Meier, D. (JPL) Jones, D. (JPL) Murphy, D. (JPL) Lovell, J. (Tasmania) McCulloch, P. (Tasmania) Costa, M. (Tasmania) Costa, M. (West Australia)	Short time scale monitoring of Centaurus A at 8.4 GHz. 3.6 cm
BW021	Wardle, J. (Brandeis) Attridge, J. (Brandeis) Roberts, D. (Brandeis)	Comparing emission-line BL Lacs and OVV/HPQ quasars. 6 cm
BW024	Wilkinson, P. (Manchester) Henstock, D. (Manchester) Readhead, A. (Caltech) Taylor, G. Pearson, T. (Caltech)	Completing the search for milli-lenses in the PR, CJ1, and CJ2 survey. 1.3 cm
BW025	Walker, R. C. Fomalont, E.	VLBA baselines – service/test project. 3.6 cm with single VLA antenna
BZ015	Zensus, J. A. Krichbaum, T. (MPIR, Bonn) Lobanov, A. (NMIMT) Witzel, A. (MPIR, Bonn)	Monitoring the helical trajectories in 3C 345 at 43 GHz. 0.7 cm
VT001	Edwards, P. (IRAS, Japan)	VSOP scheduling test. 18 cm with GB.

F. SCIENCE HIGHLIGHTS

Green Bank

Ammonia is thought to contain a significant fraction of the nitrogen in cometary atmospheres, but there has never been a secure detection of this species except from the *in situ* measurements of Halley by the Giotto spacecraft. The situation has

now changed with the detection of ammonia in Comet Hyakutake using the 140 Foot Telescope. From the strength of the measured lines, it can be determined that the kinetic temperature of the cometary gas is 67 K and that the ammonia abundance is about 0.3 percent that of water, much less than the 1.5 percent derived for comet Halley.

Investigators: H. A. Wootten, B. Butler (NRAO), D. Bockelee-Morvan, J. Crovisier (Observatoire de Paris-Meudon), D. Despois (Obs. de Bordeaux), P. Palmer (U. Chicago), and D. Yeomans (JPL)

Socorro

Redshifted Absorption Lines Detected in Gravitational Lens System. VLA studies of the Einstein ring radio source PKS 1830-211, the brightest radio gravitational lens, have revealed redshifted absorption lines from eight different molecular species. These include a line of HCO+ redshifted from 89.2 GHz to 47.3 GHz. The VLA images show that the absorption occurs in only one of the two bright radio components of the lens. The size of the Einstein ring implies a massive lensing galaxy, and adopting the standard assumption that the lensing galaxy is a giant elliptical, the observations imply that we see evidence for a giant molecular cloud in the interstellar medium of a young giant elliptical galaxy at a galactocentric radius of about 5 kpc. Studies of radio sources such as this provide the most direct means of learning about the neutral and molecular ISM in galaxies at cosmologically significant redshifts, and can provide information on the parameters of the lensing system, including the gravitational mass of the lensing galaxy.

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

Observations Suggest New Galaxy Formed from Interaction Debris. VLA observations of NGC 5291 have provided evidence that small, new galaxies can form from material removed from older galaxies in interacting systems. The VLA maps show a large cloud of HI surrounding NGC 5291 and a nearby object, called the Seashell, with which it appears to be interacting. Within that HI cloud are several condensations, one of which appears to meet the criteria for classification as an actively star-forming dwarf irregular galaxy.

Investigators: S. Gottesman (Florida), T. Hawarden (Joint Astronomy Center, Hawaii), C. Simpson (Florida International Univ.), and B. Malphrus (Morehead State Univ.)

Tucson

Large-Scale CO Surveys with the Eight-Beam Receiver. A survey of ^{12}CO and ^{13}CO J = 2-1 emission from selected regions in Perseus, Orion, and the Galactic Center has been undertaken using the new eight-beam receiver and the 12 Meter Telescope. These observations serve as a pilot program to investigate the feasibility of a large-scale sky survey in the 1.3 mm CO transitions. Although large-scale CO surveys have been done before, they have been limited by coarse spatial resolution or low sensitivity. By comparison, each beam of the eight-beam receiver has a beamwidth of 30" at 230 GHz. Combining the sensitivity of SIS mixers, the speed of a multi-beam array, and the efficiency of the on-the-fly observing mode yields a very powerful imaging system. Thus, for the first time it appears possible to perform a high-spatial-resolution, high-sensitivity CO survey of large parts of the sky.

The sensitivity and spatial resolution of the survey make several scientific objectives possible. For example, it will be possible to delineate individual molecular clouds that are confused in low-resolution surveys. Such confusion alters the apparent size and mass spectrum of molecular cloud distributions. It will also be possible to identify molecular cores and clumps and to study the initial mass function of stars. The observations should also lead to an unbiased survey of molecular outflow sources and to a much-improved database for the distribution and velocity of gas in the Milky Way. Data obtained from any large-scale surveys will be placed in the public domain as quickly as possible.

In the recent 4-day pilot program, about 20 square degrees were mapped to an rms sensitivity of about 1 K, at the full spatial resolution. About 90 fields of ~0.25 square degrees each were imaged. Approximately two-thirds of the observations were done in ^{12}CO emission and the remaining one-third in ^{13}CO emission. Large portions of the Orion complex and the Galactic plane near longitudes l = 0 and l = 30 degrees were imaged.

Investigators: J. Bally (Colorado), Y. Billawala (Colorado), P. Maloney (Colorado), W. Latter (NASA/Ames), P. Thaddeus (CFA), and P. Jewell (Royal Obs)

Monitoring the CO Emission Production Toward Comet Hale-Bopp. A monitoring program to study the changes in the CO emission production rate toward comet C/Hale-Bopp continues to be a scientifically productive project at the 12 Meter. This program has found that Comet Hale-Bopp (1995 O1) appears to be an object similar to Chiron, yet is presently a long-period comet that has evolved from an Oort cloud quasi-parabolic trajectory. Carbon monoxide is thought to be the dominant outgassing agent in this comet, and the group has observed CO via both the J = 1-0 and J = 2-1 transitions. The main goal of this work is to measure for the first time the evolution of the production rate of CO with heliocentric distance and to compare it to the rate of water production.

Investigators: M. Womack (Penn State), A. Stern (Southwest Research Inst.), and M. Festou (Midi-Pyrenees Obs.)

Molecular Spectral Line Studies of Comet Hyakutake. The recent near-Earth passage of Comet Hyakutake (C/1996 B2) afforded a great opportunity to conduct detailed ground-based studies of a comet. A number of programs designed to measure the abundances of parent molecules in Hyakutake were conducted at the 12 Meter. Measurements of the H_2CO 3(12)-2(11), HCN 3-2, and CO 2-1 emission toward the comet were made on March 16 and 17. The derived production rates for these species indicate that the HCN production rate is similar to that measured for CN, suggesting a direct link between these two species. The CO and H_2CO production rates, on the other hand, indicate that H_2CO is not the main parent of the observed CO. This suggests that CO and H_2CO are parent species (species left-over from the formation of the comet), while HCN is not. Comparison to other CO measurements done previous to these March measurements indicates very rapid changes in the production rate over time scales of weeks.

Investigators: M. Womack (Penn State), M. Festou (Midi-Pyrenees Obs), and A. Stern (Southwest Research Inst.)

Discovery of OCS in Comet Hyakutake. Measurements of the OCS 12-11 emission toward Comet Hyakutake were made on March 19, 1996. The measured OCS production rate is similar to that predicted by theory (Q(OCS)/Q(OH) = 0.004), and indicates that OCS is a parent species within the comet. This is the first discovery of OCS in a comet.

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

G. PUBLICATIONS

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

H. CHARLOTTESVILLE ELECTRONICS

Amplifier Development, Design and Production

A total of 13 amplifiers was delivered this quarter:

three each: 290-395 MHz
one each: 680-920 MHz
five each: 3.95-5.85 GHz
four each: 12-18 GHz

The 290-395 MHz balanced amplifier was completed. Measurements indicate an average noise temperature of 2.3 K and an average gain of 25 dB across the band. Work has begun on the balanced 385-520 MHz amplifier.

The GBT 1.7-2.6 GHz amplifier has been designed and a prototype unit is currently under construction.

A production version of the 65-90 GHz amplifier has been developed and two units have been built. Both units were tested in a laboratory version of the 65-90 GHz receiver and yielded average noise temperatures of 48.5 K and 63.5 K. The slightly worse performance of the second unit is under investigation. A prototype of a 70-110 GHz amplifier has been designed and is under development.

Superconducting (SIS) Millimeter-Wave Mixer Development

Mixer fabrication work this quarter was focused on producing a well-matched set of tunerless mixers for the eight-beam 210-250 GHz receiver on the 12 Meter Telescope.

Work continues on the design of a new tunerless SIS mixer, initially for 200-300 GHz. This design requires no anodization and will be compatible with both the UVa and JPL SIS fabrication processes. It will have low capacitance in the IF circuit to allow wide IF bandwidth; the IF capacitance is a limiting factor in some present SIS mixer designs. If successful, this mixer design will be incorporated into the planned single-chip image separating mixer.

Work also continues on components for the new 8-channel 3-mm SIS receiver at the 12 Meter Telescope. The four 3.5" vacuum windows of Hercules plastic-film supported by Goretex expanded Teflon have been completed, as well as the eight backshort drives. We have almost completed eight of the new six-wire SIS bias-T's. The other components for this receiver are in the shop at present.

Cryogenic tests were conducted on four 1-2 GHz quadrature hybrid couplers from different manufacturers. Such a hybrid is needed to separate the IF components in an image separating receiver. Initial tests indicate that all four couplers performed acceptably at 15 K, and it is assumed the same will be true at 4 K. These results will be described in a future Electronics Division Technical Note.

The Seventh International Symposium on Space Terahertz Technology was held at UVa on March 12-14. This brought many visitors to the CDL, and led to a number of useful discussions. Three symposium papers were presented by NRAO authors:

"SIS Mixer Analysis with Non-Zero Intermediate Frequencies,"
(S.-K. Pan and A. R. Kerr).

"Design of Planar Image-Separating and Balanced SIS Mixers,"
(A. R. Kerr and S.-K. Pan).

"Submillimeter Wavelength Waveguide Mixers Using Planar Schottky Barrier Diodes," (J. L. Hesler, W. R. Hall, T. W. Crowe, R. M. Weikle, B. S. Deaver, R. F. Bradley, and S.-K. Pan).

During this quarter we have assembled and tested nine SIS mixers, using chips from three different UVa wafers.

Electromagnetic Support

VLA. Work on the phase shifter for the 18-26.5 GHz band continues. When the first prototype, reported earlier, was cleaned and remeasured, it exhibited a phase shift between the two orthogonal polarizations of 89.5° at 22 GHz. At 18 GHz and 26.5 GHz, it has a phase shift of 98.8° and 87.8°, respectively. Problems in manufacturing are being studied and a second phase shifter will be fabricated to check on reproducibility. Two split block assemblies of the orthomode transducer that goes with the phase shifter have been fabricated in the Green Bank shop. Final assembly and test are currently under way.

GBT. Orthomode transducers for the 930-1230 MHz and 1.73-2.60 GHz bands have been designed.

A feed for the 1.73-2.60 GHz receiver has been designed and manufacturing drawings have been completed.

GBT Spectrometer

During the last quarter construction of the GBT spectrometer digital rack was completed and wiring of the sampler rack begun. System testing was also begun.

Testing of the prototype long-term accumulator for the spectrometer is almost complete, and production units have been sent out for wirewrapping.

Testing of other cards for the spectrometer has progressed and is also almost complete. Testing of the production samplers for the spectrometer has not begun yet.

Assembly language programming of the system microprocessors has begun and is about 25 percent complete. High-level programming of the VME control computer has not begun and is awaiting assignment of a programmer to do the task.

The frame decoder for the Russian Radioastron OVLBI satellite was shipped to Moscow during the quarter. The unit was provided to the Russian Astro Space Center for testing of the Russian Radioastron ground support system. As of this time, the unit has not been powered up in Russia.

Spectrum Management

Activity in the area of frequency coordination during the first quarter of 1996 has mostly been concerned with preparation for meetings of Working Group 7D in Nançay, March 25-29, Task Group 1-3 in Paris, April 1-5, and the World Radiocommunication Conference in 1997. WP7D is concerned with general frequency coordination issues involving radio astronomy, and at the coming meeting a number of subjects will be discussed, including interference effects of the Mobile Satellite System and protection of radio astronomy at frequencies above 60 GHz. TG1-3 is a special group dealing with the specific question of limits on spurious emissions, and a paper on the effects of spurious emissions from satellites has been prepared for the meeting. The WRC in 1995 called for numerous studies on subjects to be discussed at the next WRC which will be in 1997, and brief papers on two of these that are of concern to radio astronomy have been prepared jointly with T. Gergely of the NSF. These concern potential interference from low earth orbit satellites in radio astronomy bands below 1 GHz and potential interference in the 15.35-15.4 GHz band from intersatellite links in the 15.4-15.7 GHz band.

I. GREEN BANK ELECTRONICS

GBT Development

Spectrometer. The long term acculumulator (LTA) prototype has been partially tested. The remaining LTAs have been sent out to be fabricated. The sampler and control cards are being assembled.

IF / Converter Racks. The construction of the seven 1.6 GHz filter modules are complete. The testing of these modules is on hold because of lack of personnel.

The testing of the 100 MHz filter module was in progress but because of lack of personnel it is on hold.

We have found a problem with our IF fiber optic system which we have been working on for the past quarter. Detailed reports of our findings and direction have been written up.

Receivers: Construction is continuing on prime focus receiver #1. We started design work on prime focus receiver #2 earlier this quarter. Design and fabrication of the OMT for this receiver has begun.

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

The L-band OMT has been tested and needs some redesign and shop work to improve it. The L-band feed modifications are about 50 percent complete.

The C-band receiver is being tested and should be complete by the end of April.

The S-band receiver is on hold because of lack of personnel. The S-band feed fabrication should start in April. The S-band OMT design has slid to late summer or early fall due to a lack of personnel.

Servo System. We have been working closely with the Comsat/RSI servo division on the GBT servo system. We are monitoring their progress, working out technical details and reviewing their test procedures and documentation. The areas of focus this past quarter has been the feed arm servo system, the auto-stow protocol/implementation for both the azimuth/elevation and the feed arm systems and the delivery of these systems to Green Bank. The factory tests took place at CRSI's Servo division (PCD) in Richardson, Texas January 15 through 26. We tested the feed arm system and the auto stow sequence of the Az/El and feed arm servo systems. Since that time we have had weekly teleconferences with PCD monitoring closure of action items generated during the factory tests. We are also monitoring their delivery schedules and the completeness of their documentation.

Cryogenics. Due to the recent budget problems we have lost one of our two cryogenic technicians. We have assigned other lab technicians to work with the lead cryogenic technician when necessary.

Site Operations

As usual, maintenance, repair, and installation support was supplied to the 140 Foot, the 85-1/2/3, USNO 20 meter, and the OVLBI earth-station telescopes. This includes electronic maintenance, electronic design projects to assist users for special projects, and cyrogenic support for virtually every receiver in Green Bank.

Normal day to day support of UNIX workstations, weather station, time systems, personal computers, and local area networks are carried out.

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 SIS Receiver

This receiver is now in routine use. Several early operational problems have been identified and solved. This receiver is the ideal candidate for the development of automatic tuning of receivers, and the software to realize this has been partially 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. The experience gained with automating the 8-feed system will eventually be applied to 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 designed 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 will be tested at 4 K in early March. We hope for completion of this receiver within one year, subject to manpower limitations.

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 overcome is the 1/f noise which has been reported from early experiments. Although not necessarily worse in this system than in other HEMT amplifiers, the extremely large (bandwidth times integration time) product means that much lower levels of 1/f gain modulation can dominate the residual noise in the detected output from the receiver. Progress with this project is dependent on available manpower.

New Phase Lock Control.

One of the most efficient observing modes, generally applicable to relatively narrow bandwidth observations, is frequency switching. Unlike other switching schemes, in this observing mode the object of interest is in the telescope beam and in the spectrometer passband for 100 percent of the time. At present we are limited in our ability to frequency switch, in both switching rate and in total frequency throw, by the analog phase lock system. We are designing a new digital phase lock system that combines both frequency and phase control, and should provide faster, reliable switching over a broader frequency range.

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

Cryogenics

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

Quadrant Detector and Thermal Sensors

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

K. SOCORRO ELECTRONICS

VLA 1.3 - 1.7 GHz Receiver Improvements

Prototypes of a new Walsh function phase switching scheme in the 200 MHz output of the L2 first local oscillator successfully removed the out-of-band signals which are imaged to appear in-band. The scheme also greatly reduces the 1400 MHz spurious signal in L-band. This method replaces the formerly planned frequency converter F15 with a much less expensive system. We expect to evaluate microstrip prototypes on five antennas early next quarter. All antennas should be outfitted in the third quarter.

VLA Upgrade Prototype: K-band Front End

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

VLA F14 Module for K-Band Upgrade

Three F14 modules will be built for this project. Certain module elements are in the final outside production stages. Drawings are being updated to allow the modules to be built either inside or outside NRAO. This module now has front-panel cyro controls, and incorporates analog monitoring via a panel meter. The target for completion is July 1996.

VLA HTRP Improvements

A new rack mounted PC passive backplane with 14 ISA/PCI slots has been ordered to upgrade the high time resolution processor (HTRP) for pulsar observing. A Pentium 133 MHz single-board computer will be installed in this backplane as well as a PCI video card, a SCSI controller, and 4 DAC boards. Current plans are to double the current capability from 28 to 56 channels for measurements of the four polarization Stokes parameters. An attempt will be made to complete a prototype system for an April experiment.

New VLA Correlator Controller

A new project plan was developed. Work in hardware and software areas continues. The optical fiber link and serial I/O subsystems will be tested next quarter.

VLA Antenna B-Rack Shields and Optical Fibers

Twenty-eight shields with optical fibers have been installed in antennas. However, tests indicated shielding effectiveness is about 15 dB at P-band instead of the expected 35 dB. Leakage paths will be located and corrected.

VLA T4/T5 Baseband Filter/Driver Upgrade

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

VLA Virtual Instrument Recorder (VIR)

This system is being developed to replace the eight channel Digital Data Tap which uses an eight channel analog recorder. Next quarter, we will complete all hardware and software to provide AOC access to on-line VLA site monitoring and data recording using a graphical interface. The system provides simultaneous multichannel and multiuser capability.

GPS Receivers

The Radio Code (U.K.) GPS receiver distributed by Brandywine Comm was ordered as a direct replacement for the Odetics 325. It was received seven months late. It is not quite a direct replacement, since it has some connector hardware and software differences. Early AOC tests showed many improved operational features over the Odetics. However, when the RC unit was installed at the VLA for evaluation with the VME/VLBA software, an operational defect appeared, which is being investigated.

VLBA Baseband Converters

A modification to more than 100 baseband converter (T122) modules was completed. This reduced sensitivity to transients on the 1 pps resync signal. Many transients caused synthesizer phase jumps during the one-second period.

VLBA M105 D-Rack Interface Module

Testing of sixteen modules has begun. Planning for the field installation has begun. Wiring harnesses still need to be built. The field installations are planned to be completed by June 1996.

VLBA Correlator

We have now received all 1000 new replacement ASICs from LSI Logic. The final 139 chips were received and installed in the correlator in early January. Out of this shipment, one additional chip failure occurred within the first 24 hours, for a total of two such failures out of the total of 1000 new chips. The new replacement chips are installed in the FFT cards, leaving the old chips in the MAC cards. One old chip failed this quarter (as of March 19). This can be compared to a year ago when the failure rate was approximately two chips per month.

VLBA Data Acquisition and Playback

New firmware is in place at the Los Alamos VLBA site for the tape recorders and the formatter. The new recorder firmware is expected to reduce vacuum losses during observing. The new formatter firmware fixes a problem which caused the formatter to sometimes not respond to the station computer. The rest of the VLBA sites will receive the new firmware soon. Tests have been completed on three samples of Ampex recording tape, and a report will be issued shortly. Tests to determine head stack wear rates as a function of humidity are underway. Design work continues on methods to deliver lower RH air to the head stack area.

Interference Protection

A low-sensitivity survey of the electromagnetic environment at the VLA was begun in earnest for use by VLA upgrade planners. The resulting data plots will provide peak and average measurement of RF signal activity in frequency segments of 100 MHz up to 2.4 GHz and wider above 2.4 GHz. Each segment is measured over one 24-hour week day. The plan is to cover from 50 MHz up to at least 6 GHz; so far the bandwidth covered is 50 MHz - 1.3 GHz. For sensitivity, the goal is -100 dBW or better at the monitor antenna output.

A test of interference in X-band at the VLA uncovered weak interference at 8408 MHz and 8420 MHz in addition to stronger better-known internal interference at 8400 MHz and 8600 MHz. The source of the weak signals has not yet been identified, but the default settings for X-band were changed to avoid signals at 8400 MHz and 8408 MHz.

Representatives of NRAO and Motorola are discussing plans for mitigating potential interference in the OH band at 1610.6 MHz - 1613.8 MHz from the planned IRIDIUM constellation of Low Earth Orbit (LEO) communication satellites. One or more of the first-launch space vehicles will simulate full-scale operation. NRAO, as required by the MOU with Motorola, plans to measure the test signal and its effect on the OH band later this year.

The online receiver monitor at the VLA mentioned in the previous Quarterly Report is currently being used to measure activity in P-band (300 MHz - 345 MHz) before, during, and after P-band observations. The success of the coordination program with the DoD Area Frequency Coordinator at WSMR for P-band observations is being evaluated using the results.

So far the measurements confirm that RF activity in P-band drops off dramatically from midnight to 6 a.m. on weekdays and all day on weekends. As well, there is a zone of relative quiet from 327 MHz - 345 MHz.

The Final Review of the Range Wide WSMR (White Sands Missile Range) EIS (Environmental Impact Statement) includes several paragraphs about the effect of non-ionizing radiation as a result of missile range activities on the VLA and New Mexico area VLBA sites.

A prototype auto-correlator for use in RFI monitoring has been constructed. The correlator uses the GBT 100 MHz sampler card and the GBT correlator card. The hardware currently supports four 50 MHz bandwidth channels of 4096 lags each, for a spectral resolution of 12.2 kHz in each of the four bands. The correlator is controlled by a PC, using an off-the-shelf parallel I/O card on the ISA bus. The integration period on the GBT Correlator Card is 1 second, with a cycle of 2 msec off, 998 msec on. Lags are read into the PC and a FFT performed every 1 second. The spectra from the FFT are accumulated into one buffer for an average spectrum and accumulated into a second buffer for a peak spectrum for each of the four bands. Initial bench testing of the prototype is complete. The next phase of testing will be done at the VLA using baseband IFs from a D rack. The autocorrelator will achieve much better sensitivity than a spectrum analyzer operating at the same resolution bandwidth and frequency span because of its 99.8 percent real-time duty cycle.

L. COMPUTING AND AIPS

General

The long-term outlook for computing at NRAO remains cloudy due to resource constraints. RE funds for computing have not yet been budgeted for 1996, although there is hope that it can be remedied if savings in computing related maintenance materialize. The limited investment in computing is certainly a cause for concern, with a negative impact on the research carried out using NRAO facilities.

Strategic Partnership between NRAO and NCSA

NRAO and the National Center for Supercomputing Applications (NCSA) have formally established a partnership for the purpose of supporting and enhancing scientific research. The primary goal of the partnership will be to stimulate research in radio astronomy by providing straightforward access to high performance computing facilities at NCSA to the radio astronomy community. This partnership will lower barriers and remove bottlenecks which individual researchers and NRAO users might face in obtaining access to high performance computing facilities and developing applications.

The partnership will focus on a number of select areas, which include:

- Support for computationally intensive data reduction using AIPS,
- Image mosaicing and high dynamic range imaging using specialized packages,
- Development and use of AIPS++,
- Mechanical design calculations related to the Green Bank Telescope and Millimeter Array projects,
- Site configuration studies for the Millimeter Array, and
- Archiving of various NRAO data products.

NCSA plans to provide time and accounts on the large machines for peer reviewed research projects and official NRAO projects such as the Green Bank Telescope or the Millimeter Array. This time will be managed by NRAO. Projects which require high performance computing resources found at NCSA are especially encouraged, as are development projects which lead to significant improvements in performance or functionality for community application codes. NRAO users and

researchers will continue to be able to directly apply for allocations of time through the normal NCSA peer review process outside of the agreement between NRAO and NCSA.

Currently, NRAO is using NCSA facilities to perform dynamical modeling calculations for the Green Bank Telescope, and is also in the process of completing an AIPS port to the computing systems at NCSA. As experience is gained at NRAO with NCSA's facilities, procedures will be worked out to enable NRAO users with need for high performance computing to access the facilities at NCSA.

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

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

The preliminary program for the Conference will be available in April; watch the Conference home page for further details as they become available: http://www.cv.nrao.edu/adass/.

VLA Archiving

In the VLA re-archiving project, which reformats and copies all VLA data onto Exabyte tape, we finished the 1989 data. This leaves us to do the data from 1984 through 1988. It is difficult to estimate the date of completion, since a sizable fraction of the remaining tapes are likely to be of poor quality. It is our intention to move the data from Exabyte to another medium as soon as the current project is finished. Details of the implementation will depend on developments in affordable technology in the coming year or two. Recent hardware changes, such as the acquisition of a dedicated PC and a special interface to access the old Telex tape drives, have made it easier to handle problematic tapes, and we expect an increase in the throughput. The new VLA database which is being created automatically during the re-archiving is directly accessible via the NRAO home page and offers standard search facilities. We are currently in the process of improving the user interface to the catalog of this archive.

Visitor Support

We completed the *Socorro Visitor's Information Package* that is accessible via the Socorro WWW page. The list of public workstations and the visitor's registration form were already accessible on-line. To this we have added information about current and future workstation bookings. Together this information system should greatly assist prospective visitors to the AOC in planning their visit.

Hardware Changes

The AOC has purchased two Sparc Ultra I machines which will replace two of the current Sparc IPX visitor's workstations. We hope that with these machines we can better serve the needs of scientists with very large VLBA and VLA projects. Tests using the AIPS *dirty dozen test* (DDT) indicate that for typical AIPS applications these machines are faster than our IBMs – currently our fastest machines – by a factor of 1.6. The machines will be installed during the second half of March and will be available to visitors and local staff from the beginning of April.

AIPS Release Information

The 15JAN96 version of AIPS was released. Partly due to the new GNU licensing, the 15JUL95 version of AIPS was one of the most popular ever, with 281 shipped copies, 230 of them electronically. First statistics of the 15JAN96 version suggest that it may be as popular as its predecessor. The next version of AIPS will be 15OCT96, after which we intend to release again every six months, with release dates in April and October.

The GNU licensing system used for AIPS allows us to track the users who register as well as the copies shipped from NRAO. For the 15JUL95 release of AIPS, 206 non-NRAO sites retrieved a copy of the software (~80% via ftp), and 75 have registered (remaining copies were shipped to NRAO sites). These non-NRAO sites indicate they will run one or more copies of AIPS as follows:

Architecture	**Number**
Sun4	174
Solaris	168
PC-Linux	48
DEC-Alpha	39
HP-UX	27
SGI-Irix	21
IBM-AIX	13
DEC-Ultrix	4
Sun3	2
PC-LinuxELF	2
Convex	1
Total	499

The availability of the Astrophysical Journals Letters on-line allowed a small test of the impact of AIPS on astronomical research. Between 1 July 1995 and 20 March 1996, of the 427 papers published in the Astrophysical Journal Letters (Vol. 447 through Vol. 460 #1), 25 papers (5.9%) explicitly mentioned AIPS. Few scientific instruments or software packages achieve this level of impact on scientific research.

General AIPS Developments

We concluded the rewrite of the AIPS Cookbook with the new Chapter 12: *AIPS for the more sophisticated user*. As before, the latest version of every Cookbook Chapter is available via the WWW. The very strict compiler of the DEC Alpha uncovered a number of potential problems, all of which were fixed before they could lead to real trouble. A critical look at AIPS buffer usage uncovered a number of cases of inefficient buffer use. As a result, improved buffer usage was implemented, along with a general cleanup of unused buffers throughout AIPS. For the user, this means that many AIPS tasks will be somewhat more modest in their memory requirements. As usual, a large number of existing and potential problems were solved.

VLBI Related AIPS Developments

The objectives of VLBI-related development in AIPS during this quarter remain the maintenance of existing code used for VLBI data reduction and the development of new software required for the VLBA and Space VLBI. This has included the first release of an interactive model-fitting task, which is designed primarily for orbiting VLBI data. A new algorithm

implemented for polarization self-calibration of spectral line VLBI data has been used successfully to calibrate 43 GHz VLBA observations. In addition, pulse-calibration of VLBA data has been improved for the case of non-contiguous IF channels. The first phase of an initiative to routinely test AIPS software against simulated data has been completed. This has included new tasks to generate simulated data and measure test compliance after processing. The core calibration tasks are currently being included in these standard tests. A significant number of general changes also have been made during this quarter to improve reliability, functionality, and the documentation of VLBI support in AIPS.

M. AIPS++

A very significant milestone in the development of AIPS++ has been passed. We have produced a first demonstration of the application of the AIPS++ MeasurementEquation formalism to synthesis imaging. We have developed a program, imager for polarization imaging that allows simultaneous cleaning of the Stokes parameters, IQUV, and self-calibration of the antenna-based polarization leakage D-terms. More information, including images and example source code, can be found at the URL: http://www.nrao.edu/~tcornwel/synthesis/synthesis.html. A substantial amount of effort was expended on optimization of this program, with results that should benefit general applications development in AIPS++. However, the speed can still be substantially improved by rewriting some of the gridding routines, something that we plan for the near future. Calibration information derived by imager is written to AIPS++ tables, in which form it can be viewed by tools in Glish/Glishtk such as the tablebrowser and the plotting utilities. All these are steps on the way to a full calibration package. The design and implementation of the MeasurementEquation has been performed in collaboration with Mark Wieringa, who is spending six months working at the Center with the synthesis group (this visit is funded by ATNF and NFRA).

In Single Dish, a development plan was formulated and fixed for the time being. This plan includes work needed for both the GBT development and the Parkes HI survey. Work has continued in a number of areas:

- Changes to the AIPS++ data store: the MeasurementSet,
- A plan for the development of the GUI for single dish processing,
- Development of specific Glish clients needed for processing.

A member of the ATNF Parkes HI survey team spent eight weeks working with the SD group in Charlottesville.

In Measures, the design has been frozen and work is beginning on the implementation. Completion of all major features except high precision VLBI support is expected in April. Parts of the code are now being reviewed. In Visualization and Image Analysis, the NCSA group made various improvements to the aipsview visualization tool with the goal of a beta release by April 15. The major area of improvement is the inclusion of contour plotting via the PGPLOT library.

In AIPS++ Infrastructure, a large number of improvements were made in response to the requirements arising from applications development:

The capabilities of Glishtk were expanded to include nearly all of the widgets needed. An improved and redesigned tablebrowser was implemented in Glishtk and the AIPS++ table system underwent a number of improvements, the most important being a Tiled Storage Manager to allow efficient access to multidimensional data sets along various axes.

A number of miscellaneous utilities, such as least squares and interpolation classes, were developed.

The implementation of the Tasking system was completed and coding of applications based upon it is now proceeding.

In Documentation, we decided on an overall approach to programmer documentation, and began to implement it. An initial version of a revised programmers manual is now in place and being improved.

In the System area, we worked on the implementation of shared libraries under the Sun native compiler, and changed to rely upon native exception handling. In addition, we have made ports to various compilers:

- HP/UX, required for NFRA, is basically successful and is now being completed,
- The GNU Project g++ compiler has been completed successfully,
- Dec Alpha port has been delayed owing to what we believe are bugs in the recently released compiler.
- SGI, desired by NCSA, is proceeding.

The g++ port is very important since it gives us the ability to run on a very large number of machines.

In management, we continued the implementation of a more formal scheme for proposing and accepting changes to AIPS++. A description of the scheme and a list of accepted proposals is available from: http://www.cv.nrao.edu/aips++/docs/project/change-proposals/change-proposals.html.

N. GREEN BANK TELESCOPE PROJECT

Following a tough construction winter, which included both early *and* record snowfalls, the Green Bank Telescope site is showing more activity each day. As spring begins to come to Green Bank, the pace of the construction progress, both on the ground and on the structure, will quicken.

The elevation wheel is completely assembled and welded and sixteen of the counterweight boxes are installed. Three of the 10 trusses of the box structure already have been moved from the trial erection area onto the structure.

There is also significant activity being accomplished on the ground around the structure. For instance, on the northwest side of the antenna, the box structure trial erection is now complete. Over the next couple of months, this huge assembly will be moved from the ground onto the structure in a series of modular lifts. In addition, the upper feed arm (the section of the feed arm which ultimately will be above the receiver room) has been assembled on the ground near the COMSAT RSI warehouse and is awaiting welding. This erection will allow the feed and subreflector positioning mechanisms to be tested and calibrated prior to lifting the assembly onto the antenna.

On the south side of the antenna is the back-up structure (BUS) assembly pad, where sixteen of the BUS ribs have been trial assembled (the center rib plus eight left and seven right) from hoops 15 to 33 (when complete there will be 57 total ribs, the center plus 28 right and 28 left, extending from the apex at the base of the feed arm for 44 hoops to the outer edge of the dish). Essentially all the interconnecting beams and fill-in members are also in place. Right now on site, there are approximately 4000 of the 7100 required members for the reflector BUS. One of the interesting construction staging problems facing COMSAT RSI is cataloging and keeping track of all the parts on site. As the pieces are put together, the magnitude of the completed structure and of the erection job becomes more evident every day.

Main reflector panel production continues at the COMSAT RSI Sterling, Virginia plant. Delivery of the subreflector (an ellipsoid 7.55m x 7.95 m) and the feed arm servo hardware were slipped from last quarter into the spring.

Open Loop Active Surface

Most of the software work this period centered around the Remote Procedure Call (RPC) interface between the active surface master and an external client controller. A client test program was written, debugged, and tested to fully exercise the interface.

A design review covering the active surface, with emphasis on control strategies, was held.

The printed circuit for the LVDT temperature sensing circuit has been completed and is in the photographic department being processed. The artwork to the printed circuit have been sent to a manufacturer.

Listings of the mapping from rib-hoop coordinates to iiop-module-channel coordinates were generated to allow error checking of the software in the master processor. A number of actuators were successfully cross-checked.

Closed Loop Active Surface

140 Foot Demonstration. Pointing problems with the laser mirror system have been resolved. The ROD 500 encoders have been tested on ZP10 with good results. Use of these encoders will require some modifications to the mirror heads and the base assembly. Measurements have been made on the elevation and azimuth bearing rings. The azimuth rings are all fine, but the elevation rings are out of specification and will have to be made again. Monument laser assembly pointing measurements and calculations have been tested and confirmed to be correct.

The changeover to the new ZIY program took place February 22. This ZIY program will be the basis for a prototype tracking control system.

Weather has impeded outdoor testing of the laser, but all four control systems and pointing calculations have been tested, with very good results.

Panel Setting Tool. Mechanical modifications were completed on the panel setting tool, including the addition of a sighting telescope to orient the instrument with respect to the vertex. The algorithm for correcting the panel heights for tilts of the instrument was programmed into the CMT computer. The inclinometer was calibrated for tilts in both directions. The nominal tilts for the birdbath elevation have been calculated for each actuator position.

The instrument has been demonstrated and a memo has been issued on the algorithms used. Required changes in the inclinometer, A/D converter, and mechanical tolerances have been noted.

Optics. The optical design has been checked using a ray tracing program and a report issued. A ray tracing analysis of the retrosphere and experimental data is underway. A report was issued in early March.

Production. The drawings for mirror and base assembly hardware are being revised and parts for four units are ready to be sent out for anodizing. The encoder and end cap revisions have been made. Parts for four units are in production, and replacement encoders are due for delivery in early March. The engineering for the cover is done, and the drawings were distributed for review. Delivery of the retrospheres is now scheduled for April.

GBT Architecture. Work on the GBT laser system architecture is now a major focus of attention. Identification of cardinal points on the structure and agreement with control systems designers on coordinate systems, measurement frequency, etc., will be a topic for the next few months.

Subreflector Actuators. The GBT subreflector positioner consists of six linear actuators configured to provide six degrees of freedom – three translations and three tilts. Accurate pointing of the GBT requires detailed knowledge of the actuator's physical length vs the length indicated by its position transducer. The non-linearity and gain of the six transducers was calibrated this month in a cooperative effort with several groups. An effort is on-going to measure the absolute physical length of the actuators for a given transducer reading.

Servo

Several meetings and teleconferences have been held this period with the contractor with regard to the Feed Arm Servo factory test. Factory testing started on January 16 and continued through January 26.
Most of the testing was successful; however, not all. The contractor will re-run the test at their factory before shipping the system to Green Bank late next month. Field tests this spring will repeat most of the factory tests and include additional tests as well to ensure all tests are successful.

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

Subreflector

An RFQ for photogrammetric measurements of the subreflector surface and positioning mechanism has been written and sent to four vendors.

Additional simulations have been run to gauge the effects of various setups, measurement, and setting errors on the subreflector surface. A memo describing these is in preparation. The simulation and analysis technique has been reviewed by a member of the scientific staff.

Electronics

Receiver Room. Work has been performed on conduit routing in the receiver room.

Converter Rack B and Sampler Filter Modules. Work has been completed on construction/retrofit of nine 1-8 GHz converter modules for converter rack B. In addition, construction of seven 1.6 GHz sampler/filter modules was begun. Gain stability tests over temperature for a 1.6 GHz sampler filter module were performed. Testing has begun on the 100 MHz converter/filter prototype module. Monitor and control interface specifications for the analog rack have been written, and the GBT IF system design description document has been updated.

Switching Signals. The PC board artwork for the distribution of the time critical switching signals has been sent out for fabrication.

Holography. NRAO is investigating the best location for the reference receiver and will begin designing the receiver when the physical constraints are known.

Fiber Optics. In performing exhaustive tests on the fiber optic system, we have narrowed down the problem to either polarization sensitivities of the optical receiver or standing waves due to mismatch problems of the receiver, or a combination of both. Tests of polarization-maintaining fiber from Corning is planned to better understand the problem.

C-Band Receiver. The C-band refrigerator failed in the lab; it has been cold-trapped and purged. Electrical testing on the receiver continues.

Ku-Band Receiver. The dewar developed a leak and as a result the system warmed up. Considerable time was spent locating and fixing the leak, which was in one of the Ku-band's vacuum windows. The window was sealed off with a temporary cover plate and the system was cooled back down. The receiver will have to be brought to the lab for repair.

X-Band Receiver. The refrigerator failed, and a new one was installed.

K-Band Receiver. We are beginning also to experience problems with the system's cryogenic system. The refrigerator is making noises and temperatures are cycling (2 K). The temperatures now are 20 K and 77 K.

LO Reference Distribution System. A phase lock indicator and alarm circuit was designed and installed at the 140 Foot Telescope. This circuit is used to detect and monitor the phase lock status of the 10.5 GHz oscillator in the Cassegrain house which serves as the third LO.

Monitor and Control

In software library development, work on the console rewrite was completed and released as part of 2.1. In device implementation work on the rewrite of the timing center was completed and also released in 2.1.

In this period, NRAO software was used in Dallas to test the system. A number of protocol issues were resolved. That is, (1) OCU displays for prime focus focus, prime focus translations are always positive. NRAO agreed that this would be acceptable. Monitor and control displays should have the same ranges. (2) NRAO requested that the subreflector actuators be treated as a unit, under computer control. This implies that any single actuator fault would disable all subreflector actuators. Much of the NRAO-PCD interface was exercised including auto-stow, all of the SCU/CCU ethernet RPC procedures, Gregorian feed changes, mode changes (e.g., prime focus mode to Gregorian mode), drive all prime focus axes, drive subreflector in XYZ mode, drive subreflector in raw actuator mode, configure CCU/SCU servo parameters, recall CCU/SCU configuration, and clearing axis faults/limit conditions. A visit was made to JPL at Goldstone and we learned a number of things about their system that will improve the NRAO design.

Design work has begun on monitor and control software for allowing the user to specify and interrogate system settings for controlling the observing frequency formula, including RF routing and mixing from the receivers to the backends.

The initial version of the Gregorian focus tracking algorithm was completed. The action of the algorithm is checked by tracing a wavefront from the Gregorian feedhorn to the GBT aperture plane, and analyzing the phase across the aperture. The focal length of the primary and the positioning of the horn relative to it are determined by the structural model and best fitting paraboloid for the GBT. The present algorithm is able to position the subreflector so that the worst case tilt of the wavefront (i.e., the pointing error of focus tracking) is less than two arcseconds and the worst case phase errors are less than two millimeters. Work continues on determining the tilt of the subreflector which will give minimum phase error. It is anticipated that this optimization will further reduce the pointing and wavefront residuals of the focus tracking algorithm.

Data Analysis

Work within the AIPS++ single-dish project continued to progress in several areas. Conversion of the gbtfiller application to produce a Measurement Set table format is nearing completion. Work continues on improvements to the table Browser application, a spreadsheet-like display tool for the data tables. Completion of the Phase 1 table Browser improvements is expected in March. Work also continues on Glish internal functions to improve stability and robustness.

The Green Bank Glish installation was brought up to the current version, and Glish functions used in the 140 Foot tests were brought up to the current syntax requirements. Tests of the GBT LO1 synthesizer at the 140 Foot are scheduled for early March and will utilize the existing data analysis utilities.

O. PERSONNEL

New Hires

Bania, T.	Visiting Scientist	03/01/96
Carilli, C.	Assistant Scientist, Socorro Operations	01/15/96
Davis, E.	Visiting Electronic Engineer I	01/24/96
Desai, K.	Assistant Scientist - Research Support	03/01/96
Goldman, M.	Electronic Engineer I	01/05/96
Marson, R.	Assistant Scientist, Socorro Operations	01/18/96
Yun, M.	Research Associate	01/02/96

Terminations

Senter, R.	Business Manager, Charlottesville	01/02/96
Wilkinson, P.	Visiting Scientist	01/05/96

Change in title

Rupen, M.	to Assistant Scientist, Research Support	01/01/96

Other

Holdaway, M.	Transfer from Socorro to Tucson	01/01/96

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