NATIONAL RADIO ASTRONOMY OBSERVATORY

QUARTERLY REPORT

January 1, 1997 - March 31, 1997

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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 1997.

	140 Foot	12 Meter	VLA	VLBA
Scheduled Observing (hrs)	1883.75	1842.75	1667.30	1073.50
Scheduled Maintenance and Equipment Changes	182.75	76.50	213.20	195.00
Scheduled Tests and Calibration	54.00	240.75	269.40	334.00
Time Lost	147.50	232.50	53.35	55.20
Actual Observing	1736.25	1610.25	1613.95	1018.30

B. 140 FOOT OBSERVING PROGRAMS

The following line programs were conducted during this quarter.

No.	Observer(s)	Program
B654	Barnbaum, C. (STScI) Morris, M. (UCLA) Omont, A. (IAP, Paris)	Observations of OH and H_2O masers associated with the extraordinary star, U Equ.
B660	Bania, T. (Boston) Rood, R. (Virginia) Balser, D. Wilson, T. (MPIR, Bonn)	Measurements of the cosmic abundance of ^{3}He.
B662	Balser, D. Bania, T. (Boston) Huang, M. (Boston) Shah, R. (Virginia) Rood, R. (Virginia) Jackson, J. (Boston)	Measurements of carbon radio recombination line emission in galactic HII regions.
B665	Bell, M. (NRC, Herzberg) Thaddeus, P. (CFA)	Observations to measure the astronomical abundance of long carbon-chain molecules.
B667	Bates, N. (Princeton) Maddalena, R.	A 21 cm survey to detect high velocity gas in face-on galaxies.
B676	Braatz, J. (Maryland) Wilson, A. (Maryland)	H_2O maser monitoring and accretion disk dynamics in AGN.
K356	Koo, B-C. (Seoul National U.) Kim, K-T. (Seoul National U.)	H76α and He76α observations of the extended envelopes surrounding 17 ultracompact HII regions.

No.	Observer(s)	Program
L323	Lo, K. (Illinois) Chin, Y. (SA/IAA, Taiwan) Zhao, J. (SA/IAA, Taiwan) Ho, P. (CFA) Ho, L. (CFA) Braatz, J. (Maryland) Wilson, A. (Maryland) Wilson, T. (MPIR, Bonn) Henkel, C. (MPIR, Bonn)	A 22 GHz survey of a complete sample of active galaxies for water vapor megamasers.
M407	Murphy, E. (Johns Hopkins) Sembach, K. (Johns Hopkins) Friedman, S. (Johns Hopkins)	21 cm measurements of galactic HI column densities toward UV bright quasars and AGN.
S415	Schloerb, F. P. (Massachusetts) Lovell, A. (Massachusetts) De Vries, C. (Massachusetts) Senay, M. (Massachusetts) Irvine, W. (Massachusetts) Wootten, H. A.	OH radio observations of comets Hale-Bopp and Wirtanen.
SETI	Tarter, J. (SETI Institute)	Project Phoenix.
T363	Turner, B. Xiang, D. (Purple Mountain Observatory)	A search for H_2O in IRC 10216.

The following pulsar programs were conducted during this quarter.

No.	Observer(s)	ProgramA118
A118	Arzoumanian, Z. (Cornell) Nice, D. (Princeton) Taylor, J. (Princeton) Taylor, H. (Princeton)	Bimonthly timing of 63 pulsars at 1420 MHz.
A132	Arzoumanian, Z. (Cornell) Nice, D. (Princeton)	Monitoring at 575 MHz of the evolution of the PSR B1957+20 eclipsing binary system.
B617	Backer, D. (UC, Berkeley) Sallmen, S. (UC, Berkeley) Foster, R. (NRL) Matsakis, D. (NRL)	Pulsar timing array observations at 800 and 1395 MHz.
N018	Nice, D. (Princeton) Thorsett, S. (Princeton)	Monitoring the irregularities in the rotation and orbital motion of an eclipsing binary pulsar, B1744-24A.
Z146	Zepka, A. (UC, Berkeley) Backer, D. (UC, Berkeley)	Observations for a star-up model of a new 4.8ms pulsar at RA=0^h30^m.

The following very long baseline programs were conducted this quarter.

No.	Observer(s)	Program
BC066	Claussen, M., *et al.*	Water masers in the elliptical galaxy NGC 1052.
BG062	Greenhill, L. (CFA), *et al.*	Jet structure in NGC 4258.
BH025	Herrnstein, J., *et al.*	Nuclear continuum source in NGC 4258.
BH032	Haarsma, D. (MIT), *et al.*	Model constraints for gravitational lens 0957+561.
BR047	Ratner, M. (CFA), *et al.*	Astrometry of the IM Peg (HR 8703) for Gravity Probe-B mission.
BS044	Satoh, S. (NAO, Japan), *et al.*	Monitoring of the continuum and H_2O maser emission in NG 3079.
GM031	Masheder, M. (Bristol, UK), *et al.*	Mainline OH masers in circumstellar envelopes.
GS011	Setia-Gunawan, D. (Utrecht) de Bruyn, A. G. (NFRA) van der Hucht, K. (Utrecht) Williams, P. (Edinburgh) Dougherty, S. (Manchester)	18 cm imaging of the nonthermal emission from a colliding wind in WR146.

C. 12 METER OBSERVING PROGRAMS

The following line programs were conducted during this quarter.

No.	Observer(s)	Program
B671	Bergin, E. (CFA) Plume, R. (CFA) Myers, P. (CFA)	Investigating the importance of ambi-polar diffusion in massive cores.
B672	Bally, J. (Colorado/JILA) Maloney, P. (Colorado/JILA) Billawala, Y. (Colorado/JILA) Latter, W. (NASA/Ames) Jewell, P. (Royal Obs.) Thaddeus, P. (CFA)	Observations for a 1.3 mm wavelength survey: Galactic Plane, Perseus, and Orion Complexes.
C307	Clancy, R. T. (Colorado/JILA) Sandor, B. (JPL)	Mars/Earth studies.
C308	Crosthwaite, L. (UCLA) Turner, J. (UCLA)	CO mapping of interaction structures in the Leo Triplet.
C309	Crosthwaite, L. (UCLA) Turner, J. (UCLA)	Large scale CO mapping of spiral galaxies.

No.	Observer(s)	Program
C312	Crosthwaite, L. (UCLA) Turner, J. (UCLA) Martin, R. (Arizona) Ho, P. (CFA)	Large scale CO mapping of M83.
D194	Devine, D. (Colorado/JILA) Billawala, Y. (Colorado/JILA) Bally, J. (Colorado/JILA) Theil, D. (Colorado/JILA)	Deep J=2–1 CO survey of the L1551 molecular outflow.
G355	Gensheimer, P. (MPIR, Bonn)	Search for the J=14–13 transition of HCCNC toward IRC+10216.
G358	Guélin, M. (IRAM) Ziurys, L. (Arizona) Apponi, A. (Arizona State)	Confirmation of circumstellar $^{26}AlCl$: Testing nucleosynthesis in AGB stars.
G363	Gensheimer, P. (MPIR, Bonn)	Search for NH_2CN toward IRC+10216.
G364	Gao, Y. (Illinois) Lo, K. (Illinois) Gruendl, R. (Illinois) Hwang, C. (SA/IAA, Taiwan)	HCN observations of luminous IR galaxies in a merger sequence.
J129	Jewell, P. (Hawaii) Walker, C. K. (Arizona) Glenn, J. (Arizona)	A study of SiO masers in evolved stars—polarization properties.
L325	Liszt, H. Lucas, R. (IRAM)	Study of CO emission toward extragalactic continuum sources.
M401	Mangum, J. Wootten, H. A. Butler, B. Bockelée-Morvan, D. (Paris Obs)	Study of the thermal evolution of Comet C/1995 01 (Hale-Bopp).
R267	Rupen, M. Knapp, J. (Princeton)	Mapping the molecular gas in elliptical galaxies.
T365	Turner, B.	Study of the nature and evolution of molecular clouds.
T366	Turner, B.	Search for $C_2H_2^+$.
W380 W389	Woodney, L. (Maryland) A'Hearn, M. (Maryland) McMullin, J. Samarasinha, N. (KPNO-NOAO)	Study of sulfur chemistry in Comet Hale-Bopp (C/1995 01).

No.	Observer(s)	Program
W382 W390	Womack, M. (Penn State) Festou, M. (Midi-Pyrenees Obs) Mangum, J. Stern, S. (Southwest Research Inst.)	Study of CO, H_2CO, CH_3OH, and HCN in Comet C/1995 01 (Hale-Bopp).
W386	Wyckoff, S. (Arizona State) Wehinger, P. (Arizona State) Ziurys, L. (Arizona) Apponi, A. (Arizona State)	A 2 mm spectral-line survey of Comet Hale-Bopp (150-170 GHz).
W387	Wyckoff, S. (Arizona State) Wehinger, P. (Arizona State) Ziurys, L. (Arizona) Apponi, A. (Arizona State) Pesch, T. (Arizona State)	Study of HCN and CN in Comet Hale-Bopp.
W388	Wilner, D. (CFA) Reynolds, S. (North Carolina State) Moffett, D. (NMIMT)	Study of the interaction of the supernova remnant 3C 391 with a molecular cloud.
Z140	Ziurys, L. (Arizona) Mangum, J. Apponi, A. (Arizona State)	A study of the vibrationally excited emission in protostellar environments.
Z141	Ziurys, L. (Arizona) Apponi, A. (Arizona State) Robinson, J. (Arizona State) Allen, M. (Arizona State)	Searches for metal monomethyl species: $AlCH_3$ and $FeCH_3$.
Z142	Ziurys, L. (Arizona) Apponi, A. (Arizona State) Pesch, T. (Arizona State) Allen, M. (Arizona State)	A search for interstellar/circumstellar FeC.
Z144	Ziurys, L. (Arizona) Apponi, A. (Arizona State) Pesch, T. (Arizona State)	A search for circumstellar/interstellar NaCCH.

D. VERY LARGE ARRAY OBSERVING PROGRAMS

First quarter, 1997, was spent in the following configurations: A configuration from January 1 to January 15; BnA configuration from January 15 to February 10; and B configuration from February 10 to March 31.

The following 134 research programs were conducted with the VLA during this quarter.

No.	Observer(s)	Program
AA204	Anglada, G. (Mexico/UNAM) Rodriguez, L. (Mexico/UNAM)	Proper motions in radio jets from low luminosity YSOs. 3.6 cm

No.	Observer(s)	Program
AA207	Attridge, J. (Brandeis) Homan, D. (Brandeis) Roberts, D. (Brandeis) Wardle, J. (Brandeis)	Imaging of a large sample of blazars. 3.6, 6, 20 cm
AB628	Becker, R. (UC, Davis) Helfand, D. (Columbia) White, R. (STScI) Perley, R.	Survey of the north galactic cap. 20 cm
AB781	Bock, D. (Sydney) Frail, D. Green, A. (Sydney)	The Vela X region. 20 cm
AB796	Bridle, A. Burns, J. (New Mexico State) Hough, D. (Trinity U.) Laing, R. (RGO) Lonsdale, C. (Haystack) Wardle, J. (Brandeis)	Deep VLA imaging of complete sample of 3CR lobe-dominated quasars. 3.6, 6 cm
AB804	Beasley, A. van Langevelde, H. (NFRA) Diamond, P. Claussen, M.	Water masers in Centaurus A. 1.3 cm line
AB809	Browne, I. (Manchester) Wilkinson, P. (Manchester) Nair, S. (Manchester) Patnaik, A. (MPIR, Bonn) Perley, R. Schneider, P. (MPIAP, Munich) Geiger, B. (MPIAP, Munich)	Time delay measurement in 0218+357. 2 cm
AB815	Baker, J. (Cambridge) Hunstead, R. (Sydney) Dennett-Thorpe, J. (Cambridge) Saunders, R. (Cambridge)	Alignment effect at low redshift. 6, 20 cm
AB816	Braatz, J. (Maryland) Wilson, A. (Maryland)	Are H_20 megamasers linked to accretion events? 6, 20 cm
AB817	Bontemps, S. (Stockholm Obs) Andre, P. (CNRS, France)	Physics and proper motions in radio jet from VLA 16234+2417. 2, 3.6 cm
AB818	Butler, B. Clancy, R. T. (SSI, Boulder)	Observations of water vapor in the atmosphere of Mars. 1.3 cm line

No.	Observer(s)	Program
AB819	Balcells, M. (Laguna) van Gorkom, J. (Columbia) Sancisi, R. (Groningen/Kapteyn)	Accreting HI on NGC 3656. 20 cm line
AB822	Brown, A. (Colorado/JILA) Gagne, M. (Colorado/JILA) Stern, R. (Lockheed) Ayres, T. (Colorado/JILA) Osten, R. (Colorado/JILA)	Coordinated observations of the RS CVn Binary Sigma 2 CrB. 3.6, 6, 20 cm
AC469	Contreras, M. (Mexico/UNAM) Rodriguez, L. (Mexico/UNAM) Tapia, M. (Mexico/UNAM) Cardini, D. (IAS, Frascati) Persi, P. (IAS, Frascati)	Angular separation of the radio binary CYG 0B2 No. 5. 6 cm
AC478	Cox, A. (Iowa) Sparke, L. (Wisconsin) Sackett, P. (Groningen/Kapteyn)	Observations of polar ring galaxies. 20 cm line
AC479	Cox, A. (Iowa) Sparke, L. (Wisconsin)	Radio continuum survey of polar ring galaxies. 20 cm
AC480	Carilli, C. Menten, K. (CFA) Reid, M. (CFA) Rupen, M.	Imaging of the 1830-211 molecular absorption system at z = 0.88582. 0.7, 1.3, 2, 3.6 cm line
AC481	Carkner, L. (Penn State) Feigelson, E. (Penn State) Wilking, B. (Missouri)	Radio observations of x-ray emitting protostars. 3.6 cm
AC482	Christianto, H. (Toronto) Seaquist, E. (Toronto)	Angular expansion of compact planetary nebula Vy 2-2. 2, 3.6, 6, 20 cm
AD391	Dougherty, S. (DRAO) Williams, P. (Royal Obs) van der Hucht, K. (Utrecht)	WR 146. 0.7, 1.3, 3.6, 6, 20, 90 cm
AD392	DeBreuck, C. (LLNL) van Breugel, W. (LLNL) Rottgering, H. (Leiden) Miley, G. (Leiden)	Highest redshift radio galaxies. 6, 20 cm
AD398	DeBreuck, C. (LLNL) van Breugel, W. (LLNL) Rottgering, H. (Leiden) Miley, G. (Leiden)	Highest redshift radio galaxies. 20 cm

No.	Observer(s)	Program
AD399	Dunn, D. (Iowa) Molnar, L. (Iowa) Fix, J. (Iowa)	Multi-wavelength observations of Saturn's rings at low inclination. 0.7, 1.3, 2, 3.6, 6, 20 cm
AE108	Edge, A. (Cambridge) Grainge, K. (Cambridge) Jones, M. (Cambridge) Saunders, R. (Cambridge) Pooley, G. (Cambridge)	Extreme GigaHertz peaked sources. 0.7, 1.3, 2, 3.6, 6, 20 cm
AF302	Frail, D. Goss, W. M.	Confirmation of supernova remnant/molecular cloud interactions. 20 cm line
AF310	Fassnacht, C. (Caltech) Pearson, T. (Caltech) Readhead, A. (Caltech) Myers, S. (Pennsylvania) Browne, I. (Manchester) Wilkinson, P. (Manchester)	VLA monitoring of the gravitational lens system 1608+656. 3.6 cm
AF312	Felli, M. (Arcetri) Taylor, G. Staude, H. (MPIA, Heidelberg)	Ionized wind of IRAS 08159-3543. 2, 3.6 cm
AF318	Florkowski, D. (USNO)	Monitoring the radio emission from the Wolf-Rayet Binary HD 192641. 0.7, 2, 6, 20 cm
AF320	Furuya, L. (Ibaraki U.) Kawabe, R. (NAO, Japan) Kitamura, Y. (ISAS, Japan) Saito, M. (Tokyo U.) Umemoto, T. (NAO, Japan)	H_20 maser observations of Class 0 protostar candidates. 1.3 cm line
AF321	Frail, D. Goss, W. M.	Identifying new pulsar wind nebulae. 20 cm
AF322	Fernandez, Y. (Maryland) Lisse, C. (Maryland) Kundu, A. (STScI) A'Hearn, M. (Maryland)	Observations of the nucleus and dust coma of comet C/1995 01. 3.6 cm
AF324	Frail, D. Vasisht, G. (Caltech) Kulkarni, S. (Caltech)	Further monitoring of the soft gamma repeater SGR 1806-20. 3.6 cm
AG448	Greenhill, L. (CFA) Henkel, C. (MPIR, Bonn)	Monitoring the acceleration of water megamaser features in NGC 4258. 1.3 cm line

No.	Observer(s)	Program
AG485	Galama, T. (Amsterdam) de Bruyn, A. G. (NFRA) van Paradijs, J. (Amsterdam) Hanlon, L. (Dublin)	Candidate counterparts to GRB 940301. 3.6, 6, 20, 90 cm
AG494	Guedel, M. (SFIT, ETH) Mewe, R. (Utrecht) Guinan, E. (Villanova) Kaastra, J. (Utrecht)	Early FOV star 47 Cas: observations with SAX and EUVE. 3.6 cm
AG498	Giovannini, G. (Bologna) Cotton, W. Feretti, L. (Bologna) Lara, L. (IAA, Andalucia) Venturi, T. (Bologna)	Core flux density monitoring of the radio galaxies 1144+35 and 3C338. 3.6, 6, 20 cm
AG499	Goodrich, R. (STSCI)	Radio axes of broad-absorption line QSOs. 3.6 cm
AG501	Gaume, R. (USNO) MacLeod, G. (HartRAO)	High mass star formation region G351.78-0.54. 1.3, 2, 3.6, 6, 20 cm line
AG509	Gunn, A. (Manchester) Spencer, R. (Manchester) Migenes, V. (NAO, Japan) Doyle, J. (Armagh Obs)	Eclipse mapping of active binary stars. 6 cm
AG510	Gunn, A. (Manchester) Spencer, R. (Manchester) Migenes, V. (NAO, Japan) Umana, G. (Bologna) Trigilio, C. (Bologna) Budding, E. (Carter Obs)	Microwave survey of Northern Algol systems. 6 cm
AG511	Gregory, P. (British Columbia) Poller, B. (British Columbia) Scott, W. (British Columbia)	A new sample of short term highly variable radio sources. 1.3, 3.6, 20 cm
AG513	Guedel, M. (SFIT, ETH) Benz, A. (SFIT, ETH) Guinan, E. (Villanova)	Intermediate age solar type stars. 3.6, 6 cm
AG515	Gabuzda, D. (Lebedev) Wardle, J. (Brandeis) Gornich, N. (Moscow/SSAI) Roberts, D. (Brandeis)	High resolution, deep VLA imaging of a 1 Jy BL Lac sample. 6 cm
AG516	Gao, Y. (Illinois) Lo, K. (Illinois) Gruendl, R. (Illinois) Hwang, C. (SA/IAA, Taiwan)	Luminous IR galaxies in a merger sequence. 20 cm

No.	Observer(s)	Program
AG517	Greenhill, L. (CFA)	Water maser in NGC 3735. 1.3 cm line
AH592	Hjellming, R. Rupen, M.	Monitoring galactic black hole x-ray transients. 2, 3.6, 6, 20 cm
AH593	Hewitt, J. (MIT) Moore, C. (Groningen/Kapteyn) Haarsma, D. (MIT)	Gravitational lens time delays. 2, 3.6 cm
AH594	Herrnstein, J. Greenhill, L. (CFA) Moran, J. (CFA) Trotter, A. (CFA)	Monitoring the rapidly varying compact continuum source in NGC 4258. 1.3, 2, 3.6, 6 cm
AH596	Hagiwara, Y. (Nobeyama Obs) Kawabe, R. (NAO, Japan) Diamond, P. Kameno, S. (NAO, Japan) Katagiri, S. (NAO, Japan) Nakai, N. (NAO, Japan)	H_20 megamaser in NGC 5793. 1.3 cm line
AH603	Harper, G. (Colorado/JILA) Brown, A. (Colorado/JILA) Bennett, P. (Colorado/JILA) Hummel, C. (USNO) Walder, R. (SFIT, ETH)	Radio modulation of Zeta Aur's orbitally varying HII region. 3.6, 6 cm
AH604	Haarsma, D. (MIT) Hewitt, J. (MIT) Lehar, J. (CFA) Burke, B. (MIT)	Monitoring gravitational lens 0957+561. 3.6, 6 cm
AI066	Ivison, R. (Royal Obs) Eyres, S. (Keele) Davis, R. (Manchester) Kenny, H. (Canadian Military) Bode, M. (Liverpool JMU) Lloyd, H. (Liverpool JMU)	VLA/Merlin imaging of quiescent symbiotic binaries. 6 cm
AI067	Irwin, J. (Queens) Widrow, L. (Queens)	Possible foreground absorption from NGC 3079 in front of quasar 0957+561. 20 cm line
AI068	Ishwara-Chandra, C. (NCRA, India) Saikia, D. (NCRA, India) Kapahi, V. (NCRA, India) Subrahmanya, C. (NCRA, India)	Polarization studies of radio galaxies and quasars from Molongo sample. 3.6 cm

No.	Observer(s)	Program
AJ256	Jones, D. (JPL) Sanchez, J. (JPL) Preston, R. (JPL) Weissman, P. (JPL)	Search for radio emission from nearby star GL 710. 3.6 cm
AK397	Kulkarni, S. (Caltech) Frail, D.	Search for radio counterparts of gamma ray bursters - SAX followup. 20 cm
AK425	Kollgaard, R. (Penn State) Ghisellini, G. (Torino) Maraschi, L. (Genova U.) Pesce, J. (STScI) Sambruna, R. (STScI) Urry, C. M. (STScI)	Multifrequency monitoring of blazars. 1.3, 2, 3.6, 6, 20 cm
AK437	Karovska, M. (CFA) Mattei, J. (AAVSO) Carilli, C.	Possible jet formation in the CH Cyg symbiotic system. 2, 3.6, 20 cm
AK440	Kurtz, S. (Mexico/UNAM) Carral, P. (Guanajuato U.) Rodriguez, L. (Mexico/UNAM) Hofner, P. (NAIC) De Pree, C. (Agnes Scott College)	Exciting sources of water masers near cometary HII regions. 1.3, 2 cm
AL380	de Lapparent, V. (IAP, Paris) Roland, J. (IAP, Granada)	Radio survey of an optically selected sample of galaxies. 20 cm
AL397	Longair, M. (Cambridge) Best, P. (Cambridge) Eales, S. (Wales) Rawlings, S. (Oxford) Rottgering, H. (Leiden)	6C radio galaxies at z~1. 3.6, 6 cm
AL400	Ledlow, M. (New Mexico State) Owen, F. Keel, W. (Alabama)	A powerful radio galaxy in a spiral host. 3.6, 20 cm
AL401	Lacy, M. (Oxford) Ridgway, S. (Oxford) Rawlings, S. (Oxford) King, L. (Oxford)	Rotation measures of z~1 radio sources. 3.6, 6, 20 cm
AL403	Leitch, E. (Caltech) Pearson, T. (Caltech) Readhead, A. (Caltech)	Monitoring of point sources in the OVRO microwave background fields. 1.3, 2, 3.6 cm
AL408	Lovell, J. (Tasmania) Reynolds, J. (CSIRO) Jauncey, D. (CSIRO)	Locating the z=0.19 lensing galaxy in PKS 1830-211. 2 cm

No.	Observer(s)	Program
AL410	Lehar, J. (CFA) Falcke, H. (Maryland) Barvainis, R. (Haystack) Menten, K. (CFA) Birkinshaw, M. (Bristol, UK) Elvis, M. (CFA) Blundell, K. (Oxford)	Variability of radio quiet quasars. 3.6 cm
AL412	Lara, L. (IAA, Andalucia) Cotton, W. Feretti, L. (Bologna) Giovannini, G. (Bologna) Marcaide, J. (Valencia) Venturi, T. (Bologna)	Large angular size radio sources from the NRAO VLA Sky survey. 6, 20 cm
AM534	Marti, J. (CNRS, France) Rodriguez, L. (Mexico/UNAM) Reipurth, B. (ESO)	Monitoring the high proper motion thermal radio jet in HH 80-81. 3.6 cm
AM540	Mirabel, I. F. (CNRS, France) Rodriguez, L. (Mexico/UNAM)	Proper motions in the superluminal source GRS 1915+105. 3.6 cm
AM543	Menten, K. (CFA) Reid, M. (CFA)	Resolving the power source in the Orion BN/KL region. 0.7, 3.6 cm line
AM552	Magazzu, A. (Catania) Umana, G. (Bologna) Martin, E. (Laguna)	Radio survey of new young low-mass stars south of Taurus-Auriga. 3.6 cm
AM553	Mirabel, I. F. (CNRS, France) Piro, L. (IAS, Frascati) Marti, J. (CNRS, France) Chaty, S. (CNRS, France) Rodriguez, L. (Mexico/UNAM) Mereghetti, S. (Milano Obs) Giommi, P. (ESA) Heise, J. (Utrecht)	Galactic hard x-ray sources at time of Sigma observations. 6, 20 cm
AM554	Mundell, C. (Manchester) Done, C. (Durham) Pedlar, A. (Manchester) Shone, D. (Manchester) Thean, A. (Manchester) Brinks, E. (Guanajuato U.)	Neutral Hydrogen observations of Seyfert galaxy NGC 5506. 20 cm line
AN074	Neff, S. (NASA/GSFC) Ulvestad, J. Smith, D. (NASA/GSFC) Fanelli, M. (NASA/GSFC)	HII regions and SNR in NGC 4038/9 ("the Antennae"). 3.6, 6 cm

No.	Observer(s)	Program
AO127	O'Dea, C. (STScI) Baum, S. (STScI) DeVries, W. (STScI) Biretta, J. (STScI) Macchetto, D. (STScI)	High resolution observations of optical synchrotron jets. 0.7, 1.3 cm
AP334	Perley, R. Carilli, C. Dreher, J. (SETI)	VLA Observations of Cygnus A at 43 GHz. 7 cm
AP344	Perley, R. Roser, H. (MPIA, Heidelberg)	Low frequency observations of Pictor A. 90, 400 cm
AP346	Perley, R. Wall, J. (RGO) Djorgovski, G. (Caltech) de Carvalho, R. (Caltech)	Radio loud fraction and redshift cutoff of z>4 quasars. 6 cm
AP347	Palmer, P. (Chicago) de Pater, I. (UC, Berkeley) Snyder, L. (Illinois)	Observations of OH from Comet Hale Bopp. 20 cm line
AQ013	Quirrenbach, A. (MPIfEP, Garching) Witzel, A. (MPIR, Bonn) Krichbaum, T. (MPIR, Bonn) Kraus, A. (MPIR, Bonn) Zensus, J. A.	Coordinated observations of intraday variables with ISO. 2, 3.6, 6, 20 cm
AR277	Rodriguez, L. (Mexico/UNAM) Gomez, Y. (Mexico/UNAM) Canto, J. (Mexico/UNAM) Lizano, S. (Mexico/UNAM) Escalante, V. (Mexico/UNAM)	First images of protoplanetary disks. 0.7, 3.6 cm
AR362	Reid, M. (CFA) Menten, K. (CFA)	VLA Observations of the 43 GHz SiO masers and stellar size of red giants. 0.7 cm line
AR380	Richards, E. (Virginia) Saslaw, W. (Virginia)	Core of 3C 435. 3.6 cm
AS568	Sramek, R. Weiler, K. (NRL) Van Dyk, S. (UC, Berkeley) Panagia, N. (STScI)	Properties of radio supernovae. 1.3, 2, 3.6, 6, 20 cm
AS595	Schoenmakers, A. (Utrecht) de Bruyn, A. G. (NFRA) Rottgering, H. (Leiden)	1.4 GHz observations of the enigmatic radio source 1834+620. 20 cm

No.	Observer(s)	Program
AS597	Strelnitski, V. (Air & Space Museum) Butler, B. Kogan, L. Palmer, P. (Chicago)	Imaging of Comet Hale-Bopp in the 1.35cm H_20 line. 1.3 cm line
AS598	Serjeant, S. (Imperial College) Lacy, M. (Oxford) King, L. (Oxford) Rawlings, S. (Oxford) Blundell, K. (Oxford)	Are damped Ly absorbers gravitational lenses? 1.3, 2 cm
AS599	Stockton, A. (Hawaii) Ridgway, S. (Oxford)	Radio optical alignment in z~1 quasars. 3.6, 6 cm
AS601	Slee, O. (CSIRO) Roy, A.	Structure of a steep spectrum source near the center of Abell 4038. 20 cm
AS602	Smette, A. (Groningen/Kapteyn) Petitjean, P. (IAP, Paris) Carilli, C. van Gorkom, J. (Columbia)	HI imaging of a damped Ly-a system at z = 0.1. 20 cm line
AS603	Schiminovich, D. (Columbia) van Gorkom, J. (Columbia) van der Hulst, J. (Groningen/Kapteyn) Wilkinson, A. (Manchester) Oosterloo, T. (CSIRO)	HI study of the shell galaxy NGC 1210. 20 cm line
AS605	Spangler, S. (Iowa) Mancuso, S. (Iowa)	Hydromagnetic waves in the solar corona via Faraday rotation measurement. 20 cm
AS607	Sarma, A. (Kentucky) Troland, T. (Kentucky) Rupen, M.	HI Zeeman observations of NGC 5128 and NGC 1275. 20 cm line
AT202	Trotter, A. (CFA) Moran, J. (CFA) Rodriguez, L. (Mexico/UNAM)	Anisotropic scattering of NGC 6334B. 2, 3.6, 6 cm
AU071	Umana, G. (Bologna) Leone, F. (Catania) Trigilio, C. (Bologna)	Monitoring the radio emission of β Lyrae. 2, 6 cm
AW230	Wrobel, J.	International Monitoring of the Seyfert NGC 5548. 3.5 cm
AW362	White, S. (Maryland)	The stellar activity cycle on active stars. 3.6, 6, 20 cm
AW419	Watson, A. (Lowell Obs) Cox, A. (Iowa) Wilcots, E. (Wisconsin)	Sub-arcsecond imaging of nuclear starbursts. 2, 6 cm

No.	Observer(s)	Program
AW446	Wilson, A. (Maryland) Falcke, H. (Maryland)	Radio outflows and the narrow line region in Seyfert galaxies. 2, 3.6 cm
AW451	Wolszczan, A. (Penn State) Frail, D.	Proper motion of PSR B1257+12: the next epoch. 20 cm line
AW457	White, S. (Maryland) Lim, J. (SA/IAA, Taiwan)	Quiescent radio emission in x-ray selected nearby late type stars. 3.6, 20 cm
AW459	Wilner, D. (CFA) Ho, P. (CFA) Rodriguez, L. (Mexico/UNAM)	Continuum mapping of the HL Tau circumstellar disk. 0.7 cm
AW460	Wootten, H. A. Claussen, M. Wilking, B. (Missouri) Meehan, L. (Missouri)	Origin of water masers toward low mass YSOs. 1.3 cm line
AY074	Yun, M.	Spin temperature of HI tidal debris in M81 group. 20 cm line
AY081	Yun, M. Rupen, M.	Radio recombination lines from circumnuclear disks. 3.6, 6, 20 cm line
AY084	Yusef-Zadeh, F. (Northwestern)	Continuum observations of G359.1-0.5 and the Snake. 6, 20, 90 cm
AZ087	Zhao, J-H. (SA/IAA, Taiwan) Goss, W. M. Yusef-Zadeh, F. (Northwestern) Falcke, H. (Maryland) Sjouwerman, L. (Chalmers, Onsala)	Sgr A* and its nearby sources. 0.7, 1.3 cm
AZ090	van Zee, L. Salzer, J. (Wesleyan U.) Skillman, E. (Minnesota)	Do star formation thresholds depend on metallicity? 20 cm line
BB072	Butler, B. Beasley, A. Wrobel, J. Palmer, P. (Chicago)	Absorption of bright background sources by the OH in comet Hale-Bopp. 20 cm

E. VERY LONG BASELINE ARRAY OBSERVING PROGRAMS

The following 60 research programs were conducted with the VLBA this quarter:

No.	Observer(s)	Program
BA024	Attridge, J. (Brandeis) Homan, D. (Brandeis) Roberts, D. (Brandeis) Wardle, J. (Brandeis)	Deep VLBA imaging of four blazars with distorted structures. 6 cm
BB023	Beasley, A. Conway, J. (Chalmers, Onsala) Dhawan, V. Walker, R. C. Wrobel, J. Patnaik, A. (MPIR, Bonn) Muxlow, T. (Manchester)	VLBA calibrator survey. 3.6 cm
BB069	Beasley, A.	FK Comae. 3.6, 6 cm
BB073	Blundell, K. (Oxford) Beasley, A. Axon, D. (STScI) Lacy, M. (Oxford) Rawlings, S. (Oxford) Muxlow, T. (Manchester) Robinson, A. (Herfordshire)	Morphology of jets in radio-quiet quasars. 18 cm
BB075	Biretta, J. (STScI) Junor, W. (New Mexico)	Search for superluminal motion in the nucleus of M87. 18 cm
BC056	Carilli, C. Menten, K. (CFA) Claussen, M. Reid, M. (CFA) Rupen, M.	Imaging the pc-scale structure in molecular clouds at z = 0.89. 0.7, 3.6 cm
BC057	Carrara, E. Zensus, J. A. Abraham, Z. (Sao Paulo) Lobanov, A. (MPIR, Bonn)	Parsec scale structure of the 3C273 jet: multi-frequency monitoring. 0.7, 1.3, 3.6, 6 cm

No.	Observer(s)	Program
BC065	Clark, T. (NASA/GSFC) Ma, C. (NASA/GSFC) Ryan, J. (NASA/GSFC) Vandenberg, N. (Interferometrics) Himwich, E. (Interferometrics) Gordon, D. (NASA/GSFC) Eubanks, T. M. (USNO) Fey, A. (USNO) Gaume, R. (USNO) Fomalont, E. Walker, R. C.	VLBA Geodesy/Astrometry observations for 1997. 3.6 cm
BC066	Claussen, M. Diamond, P. Braatz, J. (Maryland) Wilson, A. (Maryland) Henkel, C. (MPIR, Bonn)	Water masers in elliptical galaxy NGC 1052. 1.3 cm with phased VLA
BD037	Denn, G. (Iowa) Mutel, R. (Iowa)	Polarized VLB jet of BL Lac. 1.3, 2, 6 cm
BD040	Doeleman, S. (Haystack) Claussen, M.	Evolution of a new radio flare in N-galaxy 3C111. 0.7, 1.3, 2 cm
BE013	Ellingsen, S. (Tasmania) Norris, R. (CSIRO) Diamond, P. Phillips, C. (Tasmania) McCulloch, P. (Tasmania)	Proper motion study of 12 GHz methanol masers. 2 cm
BF024	Fey, A. (USNO) Desai, K.	Shape of scatter broadened images. 18, 90 cm
BF025	Fey, A. (USNO) Gaume, R. (USNO) Johnston, K. (USNO) Eubanks, T. M. (USNO) Ma, C. (NASA/GSFC) Fomalont, E.	Celestial reference frame: defining the "Super-calibrators." 3.6 cm
BG059	Guirado, J. (JPL) Gomez, J. (IAA, Andalucia) Marscher, A. (Boston) Alberdi, A. (ESA, Spain) Marcaide, J. (Valencia)	BL Lac object 0735+178. 0.7, 3.6 cm

No.	Observer(s)	Program
BG062	Greenhill, L. (CFA) Herrnstein, J. Trotter, A. (CFA) Moran, J. (CFA) DePree, C. (Agnes Scott College) Cecil, G. (North Carolina)	Jet structure in NGC 4258. 18 cm with phased VLA
BG063	Gabuzda, D. (Lebedev) Cawthorne, T. (Lancashire) Pushkarev, A. (Moscow/SSAI)	A 1 Jy complete sample of BL Lac objects. 2, 3.6, 6 cm
BG065	Garrett, M. (NFRA) Patnaik, A. (MPIR, Bonn) Nair, S. (Manchester) Porcas, R. (MPIR, Bonn) Leppanen, K. (NFRA)	Multi-epoch polarization observations of lens 1830-211. 0.7 cm
BH020	Hagiwara, Y. (Nobeyama Obs) Kawabe, R. (NAO, Japan) Diamond, P. Kameno, S. (NAO, Japan) Nakai, N. (NAO, Japan) Inoue, M. (NAO, Japan) Kohno, K. (NAO, Japan)	Newly found H_20 megamaser in galaxy NGC 5793. 1.3 cm with phased VLA
BH025	Herrnstein, J. Greenhill, L. (CFA) Moran, J. (CFA) Trotter, A. (CFA) Diamond, P. Nakai, N. (NAO, Japan) Inoue, M. (NAO, Japan) Miyoshi, M. (Mizusawa Obs)	Nuclear continuum source in NGC 4258. 1.3 cm with phased VLA
BH031	Horiuchi, S. (NAO, Japan) Deguchi, S. (NAO, Japan) Migenes, V. (NAO, Japan) Umemoto, T. (NAO, Japan) Tsuboi, M. (Ibaraki U.)	H_20 maser polarization in high mass star forming regions. 1.3 cm
BH032	Haarsma, D. (MIT) Lehar, J. (CFA) Shapiro, I. (CFA)	Model constraints for gravitational lens 0957+561. 13 cm with phased VLA
BH034	Hough, D. (Trinity U.) Vermeulen, R. (NFRA) Readhead, A. (Caltech)	Tests of AGN unification: complete sample of 3CR Lobe-dominated quasars, Part I. 3.6 cm

No.	Observer(s)	Program
BH035	Hough, D. (Trinity U.) Vermeulen, R. (NFRA) Readhead, A. (Caltech)	Tests of AGN unification: complete sample of 3CR Lobe-dominated quasars, Part II. 3.6 cm
BH039	Hjellming, R.	Cyg X-3. 2 cm
BI005	Imai, H. (Tohoku, U.) Sasao, T. (Mizusawa Obs) Miyoshi, M. (Mizusawa Obs) Kameya, O. (Mizusawa Obs) Deguchi, S. (NAO, Japan) Asaki, Y. (Nobeyama Obs)	Proper motions of water masers in W3 IRS 5. 1.3 cm
BJ025	Jauncey, D. (CSIRO) Reynolds, J. (CSIRO) Kedziora-Chudczer, L. (Sydney) Walker, M. (Sydney) Nicolson, G. (HartRAO) Wieringa, M. (CSIRO) King, E. (CSIRO) Tzioumis, A. (CSIRO) McCulloch, P. (Tasmania) Gabuzda, D. (Lebedev)	Monitoring of the intra-day variable PKS 0405-385. 2, 3.6 cm
BK047	Kollgaard, R. (Fermi NAL) Gabuzda, D. (Lebedev) Laurent-Muehleisen, S. (LLNL)	Polarization survey of ROSAT-Green Bank BL Lac objects. 6 cm
BK048	Kellermann, K. Zensus, J. A. Vermeulen, R. (NFRA) Cohen, M. (Caltech)	Kinematics of quasars and AGN. 2 cm
BL038	Lestrade, J-F. (Paris Obs) Phillips, R. (Haystack) Jones, D. (JPL) Preston, R. (JPL)	Search for extrasolar planets by VLBI astrometry. 3.6 cm with phased VLA
BL040	Liljestrom, T. (Helsinki) Leppanen, K. (NFRA) Diamond, P. Gwinn, C. (UC, Santa Barbara)	High temperature maser sources W44, W51M, W51N, W75N. 1.3 cm
BL048	van Langevelde, H. (NFRA) Schilizzi, R. (NFRA) Diamond, P.	Parallax of nearby Miras. 18 cm

No.	Observer(s)	Program
BL049	Lestrade, J-F. (Paris Obs) Phillips, R. (Haystack) Jones, D. (JPL) Preston, R. (JPL)	A possible Jupiter-mass planet orbiting Sigma 2 CrB. 3.6 cm with phased VLA
BL050	Lara, L. (IAA, Andalucia) Cotton, W. Feretti, L. (Bologna) Giovannini, G. (Bologna) Marcaide, J. (Valencia) Venturi, T. (Bologna)	Looking for two-sided parsec scale jets: weak radiogalaxy nuclei. 6 cm
BM056	Moran, J. (CFA) Herrnstein, J. Greenhill, L. (CFA) Miyoshi, M. (Mizusawa Obs) Inoue, M. (NAO, Japan) Nakai, N. (NAO, Japan) Diamond, P. Henkel, C. (MPIR, Bonn)	The proper motions of the water vapor masers in NGC 4258. 1.3 cm with phased VLA
BM067	Mattox, J. (Maryland) Marscher, A. (Boston) Wagner, S. (Heidelberg Obs)	Gamma ray blazar 1622-297. 0.7, 1.3, 2 cm
BN005	Nakai, N. (NAO, Japan) Inoue, M. (NAO, Japan) Miyoshi, M. (Mizusawa Obs) Hagiwara, Y. (Nobeyama Obs) Diamond, P.	Water megamaser newly detected in a radio galaxy. 1.3 cm with phased VLA
BP033	Polatidis, A. (Chalmers, Onsala) Conway, J. (Chalmers, Onsala) Xu, W. (JPL) Wilkinson, P. (Manchester) Readhead, A. (Caltech) Pearson, T. (Caltech) Vermeulen, R. (NFRA) Taylor, G.	Confirmation of candidate compact symmetric objects from PR and CJ1. 2, 3.6, 18 cm
BR038	Reid, M. (CFA) Readhead, A. (Caltech) Treuhaft, R. (JPL) Vermeulen, R. (NFRA)	Trigonometric parallax to Sgr A*. 0.7 cm

No.	Observer(s)	Program
BR043	Roy, A. Claussen, M. Diamond, P. Wrobel, J. DePree, C. (Agnes Scott College) Greenhill, L. (CFA) Herrnstein, J. Moran, J. (CFA)	Non-thermal nucleus of NGC 4258. 2, 6 cm with phased VLA
BR047	Ratner, M. (CFA) Bartel, N. (York U.) Lebach, D. (CFA) Lestrade, J-F. (Paris Obs) Shapiro, I. (CFA)	Astrometry of IM Peg for Gravity Probe-B mission. 3.6 cm with phased VLA
BS037	Slysh, V. (Lebedev) Kogan, L. Kalenski, S. (Lebedev) Valtts, I. (Lebedev) Dzura, A. (Lebedev)	Class I methanol masers. 0.7 cm
BS044	Satoh, S. (NAO, Japan) Inoue, M. (NAO, Japan) Nakai, N. (NAO, Japan) Shibata, K. (NAO, Japan) Migenes, V. (NAO, Japan) Kameno, S. (NAO, Japan) Fujisawa, K. (ISAS, Japan)	Monitoring of the continuum and H_20 maser emission in NGC 3079. 1.3, 2, 3.6 cm with phased VLA
BS053	Spencer, R. (Manchester) Stirling, A. (Manchester) Ogley, R. (Open U.)	Search for milliarcsecond jets in Cygnus X-1. 2 cm
BS054	Spencer, R. (Manchester) Stirling, A. (Manchester) Newell, S. (Manchester) Garrett, M. (NFRA)	Anomalous expansion in Cygnus X-3. 2 cm
BS055	Shen, Z. (CFA) Lo, K. (Illinois) Zhao, J-H. (SA/IAA, Taiwan) Ho, P. (CFA)	Multi-wavelength VLBA Imaging of Sgr A*. 0.7, 1.3, 2, 3.6, 6 cm

No.	Observer(s)	Program
BT027	Tingay, S. (JPL) Preston, R. (JPL) Jones, D. (JPL) Murphy, D. (JPL) Meier, D. (JPL) Jauncey, D. (CSIRO) Edwards, P. (ISAS, Japan) Costa, M. (Tasmania)	EGRET—identified radio sources in the southern hemisphere. 6 cm
BT028	Tingay, S. (JPL) Preston, R. (JPL) Jones, D. (JPL) Murphy, D. (JPL) Meier, D. (JPL) Jauncey, D. (CSIRO) Reynolds, J. (CSIRO) Tzioumis, A. (CSIRO) McCulloch, P. (Tasmania) Lovell, J. (Tasmania) Costa, M. (Tasmania)	Monitoring of Centaurus A at 8.4 GHz and 22 GHz. 1.3, 3.6 cm
BT029	Taylor, G.	Investigating extreme Faraday rotation measures in quasar cores. 2, 3.6, 6 cm
BT030	Taylor, G. Marr, J. (Union College) Crawford, F. (MIT)	Evolution of CSO 0108+388. 2, 3.6 cm
BU008	Ulvestad, J. Roy, A. Colbert, E. (STScI) Wilson, A. (Maryland) Norris, R. (CSIRO)	Radio structure of Seyfert nuclei on Parsec scales. 2, 3.6, 6, 18 cm
BW026	Wehrle, A. (JPL) Unwin, S. (JPL) Zook, A. (Pomona College) Xu, W. (JPL)	3C279: coordinated multiwavelength observations and evolution. 1.3, 2 cm
BW031	Wehrle, A. (JPL) Unwin, S. (JPL) Zook, A. (Pomona College) Xu, W. (JPL)	3C279: coordinated multi-wavelength observations and evolution. 0.7, 1.3, 2, 6 cm
GG030	Giovannini, G. (Bologna) Cotton, W. Feretti, L. (Bologna) Lara, L. (IAA, Andalucia) Venturi, T. (Bologna)	The BL-Lac Mkn 421. 6 cm

No.	Observer(s)	Program
GM027	Marcaide, J. (Valencia) Ros, E. (Valencia) Alberdi, A. (ESA, Spain) Diamond, P. Shapiro, I. (CFA) Guirado, J. (JPL) Preston, R. (JPL) Jones, D. (JPL) Witzel, A. (MPIR, Bonn) Krichbaum, T. (MPIR, Bonn) Schilizzi, R. (NFRA) Mantovani, F. (Bologna) Trigilio, C. (Bologna) Whitney, A. (Haystack)	Monitoring the expansion of SN 1993J. 6 cm with phased VLA
GM028	Marcaide, J. (Valencia) Ros, E. (Valencia) Alberdi, A. (ESA, Spain) Diamond, P. Shapiro, I. (CFA) Guirado, J. (JPL) Preston, R. (JPL) Jones, D. (JPL) Witzel, A. (MPIR, Bonn) Krichbaum, T. (MPIR, Bonn) Schilizzi, R. (NFRA) Mantovani, F. (Bologna) Trigilio, C. (Bologna) Whitney, A. (Haystack)	Monitoring the expansion of SN 1993J. 13 cm
GM031	Masheder, M. (Bristol, UK) Cohen, R. (Manchester) Richards, A. (Manchester) Gray, M. (Bristol, UK) Greenhill, L. (CFA) van Langevelde, H. (NFRA)	Mainline OH masers in circumstellar envelopes. 18 cm
GP015	Polatidis, A. (Chalmers, Onsala) Wilkinson, P. (Manchester)	Monitoring the dramatic changes in the nuclear jet of 3C380. 6 cm
VT008	Gurvits, L. (NFRA)	Qualification tests for VSOP ground telescopes.
VT009	Gurvits, L. (NFRA)	Qualification tests for VSOP ground telescopes.

F. SCIENCE HIGHLIGHTS

Socorro

VLBA, VLA Produce Significant New Data on an AGN's Central Region. Observations with the VLBA and the VLA have yielded significant new information about the central region of the unusual active galaxy NGC 4258. Ongoing studies of the warped disk of water molecules surrounding a supermassive object at the galaxy's core have yielded a precise position for the central object, presumably a black hole with 3.5 x 10^7 solar masses. Proper motions have been measured for individual maser spots within the disk. Finally, continuum emission has been detected in the nuclear region. The continuum emission shows an offset from the calculated position of the central object consistent with the jet model proposed by R. Blandford and A. Konigl in 1979. The proper-motion detections will allow trigonometric determination of the distance to NGC 4258 to within five percent.

Investigators: *J. Herrnstein; J. Moran (SAO); L. Greenhill (CfA); P. Diamond; M. Miyoshi (Misusawa Astrogeodynamics Observatory); N. Nakai (Nobeyama); and M. Inoue (Nobeyama).*

Tucson

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

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

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

The CO Emission Distribution in NGC6946. The 12 Meter on-the-fly (OTF) images of the CO 1-0 and 2-1 emission from the relatively normal SAB(rs)cd galaxy NGC6946 have been used to study the dust/gas correlation in this spiral galaxy. Preliminary analysis has revealed that the CO emission correlates with IRAS 60 and 100 micron flux, variations in the [CO 1-0]/[CO 2-1] ratio correlate with variations in the 60/100 micron dust temperature variations, and that the extent of the CO emission is equal to or greater than the optical extent of the galaxy.

Investigators: *L. Crosthwaite and J. Turner (UCLA)*

Green Bank

A large HI supershell has been discovered near the Galactic plane in Aquila. Observations with the 140 Foot Telescope show an irregular spherical shell sitting atop a well-defined massive cone which connects to a molecular cloud in the Galactic plane. The shell extends at least 550 pc up into the Galactic halo. The system requires the energy of 10-100 supernovae over 10 million years for its creation. It is associated with a complex of supernovae, star-forming regions and HII regions, some of which may have been induced by a shock wave related to formation of the supershell.

Investigators: *W. Maciejewski, B. Savage (Wisconsin); E. Murphy (Johns Hopkins); F. J. Lockman*

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

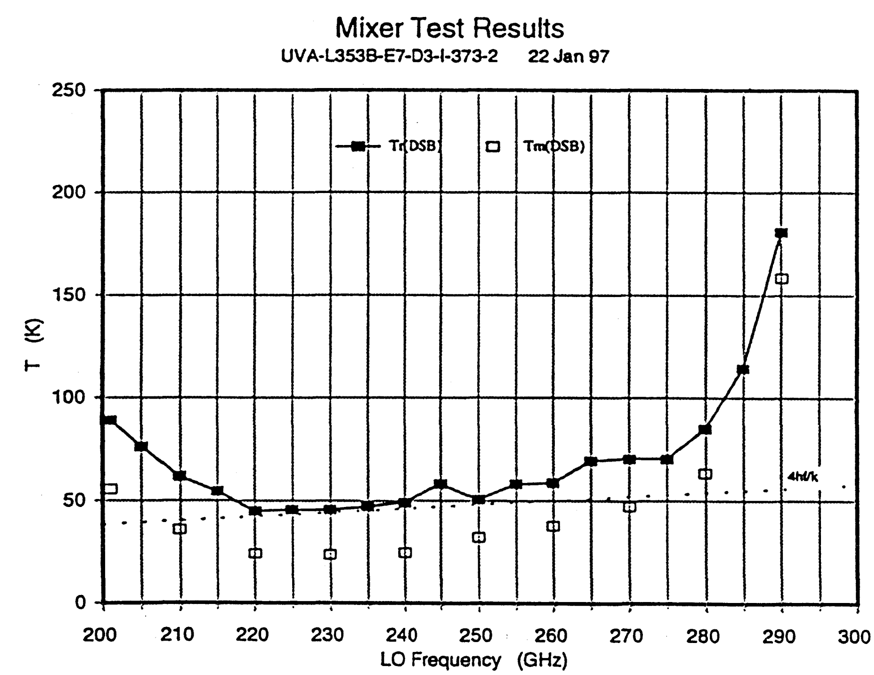
The chief focus of the amplifier group continues to be on the MAP project. The pre-prototype W-band amplifiers needed for radiometer development have been delivered. A set of prototype Q-band amplifiers using devices from the MAP wafer was also delivered to Princeton. The performance of the MAP wafer versus the NRAO wafer was fully evaluated, leading to the conclusion that use of the passivated MAP devices in the W-band amplifiers would necessitate moving the observing center frequency from 95 GHz down to 85 GHz, with a corresponding loss in angular resolution. This situation is presently being evaluated by NASA in order to make the decision whether the W-band devices from the NRAO wafer must be used (about 500 of the 1,500 existing devices will be required) to complete the project.

Major facilities upgrades were completed, including the new darkroom facility at Edgemont Road, the new clean-room and amplifier assembly lab, and various additions to the manufacturing and test facilities for amplifiers.

The prototyping and production of the new 386-520 MHz balanced amplifier for the GBT prime focus receiver was completed. The design for the next higher band, 510-690 MHz, was completed and is awaiting prototype fabrication.

Superconducting (SIS) Millimeter-Wave Mixer Development

We have tested the first of the new SIS373 SIS mixers fabricated at the University of Virginia (UVA). This is a broadband tunerless SIS mixer for 200-300 GHz. It has low capacitance in the IF circuit to allow wide IF bandwidth, a problem with some SIS mixer designs. It requires no anodization, and is compatible with both the UVA and JPL fabrication processes.



The receiver noise temperature measured in front of the test dewar, and the mixer noise temperature are shown in the figure as functions of frequency. We hope to use this design as a building block for sideband separating and balanced mixers in the future, and it is incorporated into the sideband separating mixer described below.

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

ISM371—A 200-300 GHz SIS sideband-separating mixer on a single quartz chip. The 2 x 1 mm quartz chip is mounted in a waveguide block with separate RF and LO waveguide ports. A modest image-rejection of 10-15 dB across the band will be adequate to suppress atmospheric noise in the image band, which otherwise degrades the system sensitivity of broadband SIS receivers. The first wafer of these mixers has been received from JPL, and will be tested shortly. Preliminary tests on one chip show reasonable I-V curves for both mixing elements (both sets of SIS junctions).

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

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

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

We presented two papers at the Eighth International Symposium on Terahertz Technology:

"Receiver Noise Temperature, the Quantum Noise Limit, and the Role of the Zero-Point Fluctuations," by A. R. Kerr, M. J. Feldman, and S.-K. Pan.

"Why Don't Back-to-Back Abrupt-Junction Frequency Triplers Work?" by R. F. Bradley, A. R. Kerr, and N. R. Erickson.

One Technical Note was published this quarter:

"Ground Loops in SIS Bias Circuits," Electronics Division Technical Note No. 179, by A. R. Kerr, 6 March 1997.

Members of the CDL millimeter group have visited the SMA receiver group at Smithsonian Astrophysical Observatory, Lockheed-Martin Labs at Nashua, New Hampshire, and J & E Precision Tool Company in Westford, Massachusetts.

During this quarter we have assembled and tested eight SIS mixers, and mounted and DC-tested two SIS chips from two UVA wafers and one JPL wafer.

Electromagnetic Support

GBT. Far-field patterns of the L-band feed were measured between 1 and 2 GHz. The illumination taper of the feed at the edge of the GBT subreflector varies between -14.1 and -15.2 dB in the 1.15 to 1.75 GHz frequency band. Cross-polarized sidelobes are at least -24.5 below the beam peak. The phase center of the feed has a travel of about 32 inches within the frequency band and agrees well with predicted values. At frequencies above 1.8 GHz, the beam pattern has an asymmetry due to higher order modes generated by possible asymmetry in the feed.

Efficiency loss as a result of deformation of the structure at elevations other than the rigging angle is compensated by repositioning the subreflector. Based on geometric optics, D. Wells calculated the translations and rotations of the subreflector required at different elevation angles. An analysis which includes diffraction effects was carried out to check the subreflector translations and rotations.

VLA. A preliminary design of a feed to cover the 1.25 to 1.75 GHz band was done as a part of the VLA upgrade plans. The performance of this feed was evaluated down to 1 GHz and up to 2 GHz. This evaluation was done to determine if the same feed could be used to provide a 2:1 bandwidth ratio. Efficiency and spillover temperature of the VLA antenna were calculated.

VLBA. Input return loss of machined feeds for the 86 GHz band was measured and found to be better than 25 dB between 75 and 95 GHz. This measurement was done to verify if the corrugations near the throat of the feed had been machined properly.

GBT Spectrometer

During the last few months, system test and system programming on the GBT spectrometer began. For most system testing, all cards are installed in the system except for eight correlator cards from two quadrants that are left out to reduce the heat generation in the lab. By moving cards from quadrant to quadrant, all card slots have been tested in this way.

System programming has begun and so far a variety of test routines has been written. System testing is being performed by doing integrations on pseudo-random data in place of the sampler outputs. System correlation results from the input data can be read from all LTA cards through the normal LTA-interface card-VME bus data path and tested for precise replication from integration to integration. End-to-end 4096 point spectra from the 1.6 GHz samplers have also been obtained.

The serial interface between the spectrometer VMA computer and the microprocessors has been tested for several hours error-free at 62.5 kbaud. This data rate has been made the final serial communication rate in the system.

The only known problems in the spectrometer at this time are occasional errors seen in the LTA results as read over the VME bus; this is being investigated.

Initial consideration of the MMA correlator has been started with the release of an MMA memo on a proposed design plan.

Frequency Coordination

Monthly teleconferences have continued with IRIDIUM staff in preparation for tests. It had been expected that the first satellites would be launched in February, resulting in tests of emissions in the radio astronomy band in April. However, problems with the launch vehicle have delayed the first launch which is now expected in May, with tests likely to be in July.

MMA

The systems group has met once so far this year to discuss the Atacama array scheme in which the MMA antennas would be combined with those of the Japanese LMSA (the proposed Large Millimeter and Submillimeter Array). The conclusions are discussed in MMA Memo No. 165 and were briefly described at the workshop in Tokyo, March 16-19.

VSOP

Final adjustments were made to the demodulator module, which was largely developed in the CDL, and satisfactory operation in the Green Bank ground station obtained. Documentation of the module is being completed.

I. GREEN BANK ELECTRONICS

GBT IF System

The testing of the 1.6 GHz sampler/filter modules is on hold, testing will begin in April.

The testing of the 100 MHz converter/filter modules is on hold and should begin late in the second quarter.

Eight of the seventeen 1-8 GHz converter modules are installed in the GBT Mockup (Converter Rack A) and are awaiting software and systems integration.

Fiber IF System. Considerable research has taken place over the past quarter in this area. GBT MEMO 163 "Status Report: GBT Fiber IF System", dated 2/28/97, reviews the progress to date. It then proposes a plan of action: "Our goal is to have most technical decisions made for a design approach by July, and by then to at least know with some confidence if our performance requirements are achievable. Assuming success in that, we would attempt to have at least one 'production' IF channel constructed and ready to begin integrated tests by September, although with component lead time and limited engineering resources, that will be ambitious." Please refer to that memo for more details.

GBT Receivers

Detailed Receiver Noise Budgets for the GBT Prime Focus and Gregorian receivers were completed this quarter. These budgets, with writeups, will be archived in the GBT Memo series shortly.

L-band noise temperature measurements were made and are approximately 6 K at the dewar waveguide flange. Polarization measurements were performed but due to cryogenic amplifier input mismatches, ripples in the passband are too large. A circular waveguide attenuator was built to minimize the ripple caused by the triple-travel. (Note that this is really only a measurement issue since there will be no reflected waves back into the receiver in the real system.)

Prime Focus receiver noise temperature measurements were found to be approximately 16 K at 800 MHz with the feed connected and looking at the sky. The feed was a short feed (a section of the full GBT feed) setup for the 140 Foot Telescope. Due to a delay in the delivery of the HEMTs from the Central Development Lab we fabricated dummy amplifiers for the remaining Prime Focus amplifiers. The construction of the dewar electronics and mechanics is progressing. We will be ready to perform receiver testing when the HEMTs arrive, if their dimensions do not change.

The design and fabrication drawings for the 910 MHz-1230 MHz Prime Focus receiver ortho-mode transducer (OMT) was completed in 1996. Changes which we made in the L-Band OMT are being incorporated into its drawings and the shop will proceed with fabrication sometime in May.

The C-Band receiver is built and awaiting testing. Due to limited staffing, very limited progress has been made in this area. Testing and fitting on the 140 Foot will be done in time for VSOP/VLBI observations this summer.

The design of the S-Band receiver is progressing slowly as a background task to all other systems deemed critical to the operation of the GBT. We anticipate this receiver to pickup speed early this spring.

The LNB for the Holography receiver was tested for phase stability vs. temperature. The temperature coefficient was large enough so that active temperature compensation is necessary. The concept of a temperature controlled box was discussed with the shop. Two phase stabilized Heliax coax cables were ordered and an additional LNB was ordered.

LO Reference Distribution System. The four resynchronization circuits have been built and tested. These contain the added 1 PPS circuitry. The units were tested for phase stability with temperature and they passed. The new 1 PPS sync circuit guarantees a stable phase relationship between the 5 MHz and the 1 PPS at the output of the LO Rx module.

100 MHz Distributor modules were built and tested. Testing include phase vs. temperature. These units are temperature compensated.

Assembly and testing of the 500 MHz PLL units was completed this quarter.

All five Wenzel 500 MHz VCXOs were tested. This includes phase noise measurement, which all units passed. Two units failed on harmonic level. Long term burn-in is being done now.

An LO Reference Distribution System test station was built. This includes a Reference Generator module that makes 10 MHz, 100 MHz, and 1 PPS from a 5 MHz input. The test system resides in a short rack in the Jansky Lab. It will be used to store all of the system module spares, and will serve as a testbed for troubleshooting field returns and testing new modules.

The second and final LO Transmitter module was built and tested. The second and final 500 MHz Buffer module was completed. The last five of ten optical detector units were assembled. Final testing of these is planned for the beginning of the second quarter. Assembly of four LO Receiver modules continued, they are 95 percent complete.

During RTPM testing, a timing problem was identified. The circuit has not yet been modified to correct the problem.

GBT Servo System

We have been working closely with the Comsat/RSI Servo Division on the GBT Servo system. We are monitoring their progress, working out technical details and reviewing their test procedures and documentation. A technician arrived in late March and testing is scheduled for mid April.

GBT Mockup

Over the past quarter we have put together a Mockup lab for the GBT Electronics equipment. In this Mockup we will integrate hardware and software, perform testing on various racks, and perform integration testing on various parts of the system.

The GBT Mockup is located in the basement of the Jansky Lab. In it we have put most of the electronic racks which will eventually be located in the GBT control room, equipment room, alidade servo room, and receiver room. Each *room* is in its own designated area. Cables connecting the different rooms, which are typically fiber-optic, are installed as they will be on the GBT. The only significant difference is the length of the fiber cables. There are only a few exceptions to this rule.

In this Mockup most, if not all, of the GBT receivers will be sequenced through it. The entire IF and LO signal paths from the receivers to the backends will be exercised. To the extent that is possible, all control signals are generated from the equipment which will be used on the GBT. It is, however, impractical to get all of the backends into the mockup. The DCR (Digital Continuum Backend) and the GBT Spectrometer will be there. The Spectral Processor will remain at the 140 Foot Telescope but fiber lines will connect the IF and switching signals between them. In addition to testing our system with the Spectral Processor in place, we will also be able to use the power of the Spectral Processor to extensively test our own equipment. The VLBA Data Acquisition System will remain at the 140 Foot' and will not be tested.

GBT Feed Defroster

A chassis for the defroster control was designed, and fabricated. The control cards for the defroster have been built and tested.

This system was then placed in the anechoic chamber for interference testing. The first tests showed that we were able to see the control logic. We then mounted the control electronics inside a shielded box. With the electronics shielded, we could still see some interference, but also detected interference from the motor and heater. We found that some circuit breakers were also generating interference. After removing the circuit breakers from the test chamber, we could still see interference generated by the motor. The heater didn't seem to generate any interference.

Switching Signals

The two Calibration-Signal/Reference buffer chassis have been tested and installed in the Mockup room. While we were looking at RFI, we checked the switching signal chassis, which will be located in the receiver room. We found that this chassis does generate interference and it may be necessary to house this electronics in a shielded enclosure.

Site Operations

Project Phoenix (SETI). The Electronics Division has assisted the SETI Institute in preparing for observations with the 140 Foot Telescope. Over the past quarter much time was spent upgrading the receiver and debugging various problems in the system.

Jansky Lab Addition. Electronics has spent considerable time setting up the fiber-optic system in the new addition. Some groups are presently moving into the building and others will move after the RFI shielded areas are finished.

OVLBI. The Electronics Division assisted the OVLBI group in various ways to insure a successful contact with the VSOP satellite.

Cryogenics. A residual gas analyzer was borrowed from Tucson. A special dewar was constructed to accommodate the sensor. The RGA was tried and determined that calibration was necessary for a full understanding of the results. Testing of the S/X dewars revealed a prodigious amount of nitrogen permeating through the windows. With the calibrated system, we should achieve a better understanding of the various leaks and the improvements, if any, of charcoal traps. The RGA was sent to the manufacturer for recalibration. The cryogenic group plans to test the windows of the S/X dewars and compare them with the permeability calculations.

Navy Kokee Antenna Upgrade. A project to upgrade the receiver system on the Navy Kokee Park antenna requires that the monitor and control hardware in the receiver package and in the control room rack be rebuilt. Work on this project was completed this quarter, with the testing of both the control room chassis and receiver module. Updated test procedures were also written.

Interference Protection Group. Meetings were held to discuss priorities and requirements. These meetings were documented in separate memos. Work has begun on the design of an IF link which will allow the use of the spectral processor for very sensitive interference tests of various pieces of equipment in the anechoic chamber. The anechoic chamber is being specially outfitted by this group to allow interference testing of all GBT electronic equipment.

As usual, maintenance, repair, and installation support was supplied to the 140 Foot, the USNO 20 Meter and the OVLBI earth-station telescopes. This includes electronic maintenance, electronic design projects to assist users for special projects, and cryogenic support for virtually every receiver in Green Bank. Normal day to day support of UNIX workstations, weather station, time systems, and local area networks.

J. TUCSON ELECTRONICS

68-115 GHz Receiver

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

8-Beam 220-250 GHz Receiver

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

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

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

Planned Wideband Continuum Receiver

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

New Phase Lock Control

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

Another capability which will become practical thanks to the enhanced digital phase lock is "sideband smear" operation. This is a powerful technique of reducing confusion in spectral line observations from features appearing in the unwanted sideband. The principles have been established during some ad hoc test observations performed at the 12 Meter, 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. All four of these units have been fabricated, tested, and installed on the telescope.

Quadrant Detector and Thermal Sensors

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

New Digital Spectrometer

Work has begun on a new digital spectrometer for the 12 Meter which will be copied from the GBT design. The new spectrometer will have twice the instantaneous bandwidth currently available for our multibeam systems, and will use a single wideband sampler for each IF channel, thus avoiding the persistent platforming problems experienced with our existing hybrid correlator spectrometer. This new correlator will support the existing 1.3 mm and 3 mm, and any future, multi-beam systems on the telescope. In anticipation of this development, the Tucson programming staff have been participating in the development of real time software for the GBT spectrometer.

K. SOCORRO ELECTRONICS

VLA Upgrade Prototype: K-band Front End

Development work continued on a full waveguide band front end in the frequency range of 18 GHz to 26.5 GHz. The Central Development Lab completed an improved prototype polarizer consisting of a waveguide phase shift section and an OMT section. Most of the components required for two front ends are on hand. The VLA machine shop has fabricated the first dewar, and started on the second. Assembly of the first front end has started and will be completed in the second quarter of 1997. The second front end will include three sub-band total power system temperature monitors for estimating atmospheric phase variations. After testing the second unit in the array, the first will be retrofitted with the total power monitors. Parts for the third and fourth front ends will be ordered next quarter, and the units will be installed early in 1998.

VLA, VLBI, and Pulsar Improvements

Project planning and implementation for major improvements in the VLBI and Pulsar back-end continued this quarter. An analog-sum buffer for the four IF outputs from the correlator will isolate the new VLBI Switch and the new pulsar patch panel. Frequency response equalizing amplifiers have been designed and parts are on order. Circuits for local display and computer monitoring of power levels will be designed next quarter.

A VLBI Baseband Switch will connect any of 16 inputs to each of the four VLBI IF inputs which upconvert to 600 MHz VLBA IF inputs. Four inputs will be from the analog sums and 12 inputs will be grouped as four IFs from one antenna each on the west, north, and east arms. The switch is being constructed by modifying four surplus Wandel & Goltermann matrix switch boxes. Each box has 24 inputs, which allows future expansion. Modifications include an impedance change from 75 to 50 ohms and a new controller card to interface with the DCS system. A network of power dividers interface the inputs to the switch boxes.

A new patch panel will connect the four IF outputs from the analog-sum buffer to the 2-channel 250 MHz upconverter for the 14-channel video converter pulsar system and to the pulsar wideband detectors. It will have power monitoring and computer controlled level setting. Design continues.

A 32-channel baseband level-setting system will maintain ideal signal levels out of the High Time Resolution Processor (HTRP) Multiplying Polarimeter. The HTRP PC will set the levels as well as acquire the high speed data samples.

The VME Timing prototype board was tested in February. Design started on the VME Analog board and completion is expected in June.

VLA Correlator Controller

The project plan was revised again. Work on hardware continues, but software work was slowed because of little available programmer time. The hardware was completed during this quarter. The data link will be tested during the second quarter of 1997.

VLA Atmospheric Phase Monitor

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

Increasing the VLA Continuum Bandwidth

We have investigated the possibility of increasing the VLA continuum bandwidth from the present 4*50 MHz to 4*80 MHz (VLA Electronics Memos # 148, 227) by increasing the spectrum of the signals going into the existing 100 MHz complex samplers and delay-multiplier system. Proper combining of complex samples enables cancellation of aliased frequencies up to the sampling frequency. The conceptual design makes minimum modifications to the existing hardware. Tests in March of the prototype design on IF A of two antennas (13 and 16) demonstrated the expected increase in system sensitivity (signal to noise ratio) of about 25 percent. All four IF channels of three antennas will be modified and tested during the next two quarters.

If software could allow the full complex correlation capability which exists in the hardware, the continuum SNR could improve by an additional eight percent for bandwidths nearly up to 100 MHz. The practicality of modifying software will be investigated by on-line programmers.

GPS Receivers

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

VLBA Masers

Maser 10, at the AOC, is being monitored for long term level stability after retuning the 405 KHz IF stage. Next quarter, Maser 6 at Los Alamos may be returned to the AOC for replacement of a deteriorating upper vacuum pump.

VLBA Prototype 3-mm Receiver

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

VLBA Correlator

Four old ASICs have failed in the first quarter (as of March 20). The new ASICs continue to work with no failures. Parts have been ordered to allow replacing the backplane data cables with new ones that have higher tension contacts. This should eliminate the occasional system test errors resulting from poor contacts. Initial tests to see if we can blank out the header bits from Mark III and Mark IV modes appear successful, eliminating the spectral features in the self-spectra caused by header bits. The final implementation for this fix still needs to be planned.

VLBA Data Acquisition and Playback

Efforts continue toward improving performance of the VLBA tape drives. Tests are ongoing to find ways to improve the performance margin with high density recording. One result of these tests is that the frequency band of the clock recovery chips on the playback drives is being changed. This results in better error rates when the tape speed is adjusted to maintain sync. A prototype of a humidity reduction system is being tested. It is planned to reduce the humidity in the area of the headstack in order to achieve longer headstack life. All playback drives have been designated as "thick tape only" or "thin tape only," in order to achieve good head-to-tape contact by maintaining proper contour of the headstack. A second manufacturer of headstacks, Datatape, has provided NRAO a sample headstack. This headstack is now successfully being used on one of the playback drives. Samples of thin tape from Quantegy (formerly Ampex) have been received, and will be tested soon. Sony is discontinuing the thin tape product which NRAO has purchased in the past, and will be manufacturing another product in its place. Tests will be conducted when NRAO receives samples of the new product from Sony.

Work is in progress to implement the Formatter two-tape drive mode, which will allow doubling the bandwidth recorded. The first step, moving the source code to the Unix environment using the GNU compiler, has been completed. The resulting firmware has passed initial tests in the lab. Modifications to the source code to support the two-tape drive mode have begun.

Interference Protection

A part-time student continues to develop software to display the data and derive useful statistics for the VLA antenna pad W8 P- and L-band monitor. The spectrum analyzer in the W8 monitor is controlled from the AOC and dumps peak and average spectra to the AOC at 15 minute intervals. New software now produces grayscale plots of spectra vs. time for 24 hour periods.

The W8 monitor was moved to VLBA Los Alamos for mid-March to early April to determine the levels, times, and required filtering for very strong interfering signals in S-band. A co-op student has developed user interface and data display software for the digital auto-correlator spectrometer. It will initially be used as the primary back-end for the IRIDIUM satellite emissions tests. Later, we will monitor the 4 baseband IFs of the antenna at W8. Eventually a frequency downconverter will allow the auto-correlator to replace the spectrum analyzer in the W8 P- and L-band RFI monitor.

Protection efforts are ramping up from minimal to normal since our new RFI Protection Engineer, Dan Mertely, joined us in March.

IRIDIUM Satellite Tests

The 1994 MOU between NRAO and Motorola Satellite Communications, Inc., requires cooperative work on a test program to determine the IRIDIUM satellite system signal levels at the Observatory sites. Motorola agreed not to exceed a spectral power flux density (SPFD) of -223 dB(W/m^2/Hz)at the VLA at all times. Tests on one or more of the IRIDIUM satellites in orbit will occur in July - August 1997. VLA test objectives are to measure A) the impact of IRIDIUM emissions on VLA observations of 1612 MHz OH, and B) the spectral power flux density (SPFD) of IRIDIUM emissions in the 1610.6-1613.8 MHz radio astronomy band.

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

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

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

We are building a multi-frequency signal source emulating the IRIDIUM satellite's multichannel emissions. This will allow us to determine intermodulation levels within our own equipment. The synchronous detection algorithm for the digital spectrometer has been tested in the lab and on the VLA noise cal switch signal and appears to be working properly.

L. COMPUTING AND AIPS

General

Computing at the Observatory has made progress on several fronts during the past quarter. Improvements in the computing facilities at NRAO remain constrained by both budget and personnel; the personnel situation was especially acute during the past quarter because of various problems in filling two support positions in computing.

1997 RE Budget

Replacement and upgrading of computing hardware at NRAO has been slow due to budgetary constraints. Fortunately, the 1997 RE budget will allow the start of a multi-year effort to address the desktop workstation problem. It is vital that this upgrade effort continue into future years, so that obsolete computing hardware can be replaced before it becomes completely useless or impossible to support. Planning has just begun in this effort; the goal is to replace about one-fifth of NRAO's workstations this year, and continue that level of replacement into the future. The target machines are expected to improve performance over our current standard-issue desktop machine by a factor of four. The final decision on which architecture to procure will rest on both performance and support costs of the architecture selected.

There are also sufficient funds within the RE budget for printers to address the needs at NRAO for improved color output. Planning has just started for the procurement of a high quality color network printer for each of NRAO's principle sites.

Software

IDL. This commercial data processing package is now available observatory-wide, replacing our previous use of PV-Wave. Thanks to the Intranet, a pool of 10 "floating" licenses is being shared among the four major NRAO sites and the VLA.

Public Workstations

In January the Observatory took delivery on a number of large public workstations, aimed at filling the needs of NRAO visitors and users for high capability machines for data processing. These machines have now been fully installed and are in regular use. Two of these are in Tucson, one in Green Bank, two in Charlottesville, and six in Socorro. All except the Dec Alpha 500/400 in Charlottesville are Sun Ultra2 computers. The new machines each have more than 20 GB of user disk space available, and 384 MB of memory (512 MB on the Dec Alpha). Prospective users of these machines are encouraged to browse the NRAO Web site for information about booking these workstations.

The cost of the recent acquisitions was covered partially by removing the old public IBM RS/6000 computers in Socorro and Charlottesville from their maintenance contract. Most of the IBMs are still available for use, but will not be repaired when they break. In the case of CPU failure, data on disk can be recovered (with difficulty). Their use will be gradually phased out.

Three Silicon Graphics workstations, including a powerful four-CPU Origin 200, have been delivered for space VLBI processing and are expected to be installed in April. The Origin 200 holds the current AIPSmark(93) record with an impressive 13.7 per processor! These machines will focus on the processing needs of space VLBI, particularly the challenges of finding and fitting fringes to a small antenna moving at 7 km/sec.

VLA Archive

In the VLA archive project, significant progress was made in fixing the "antenna file" problem associated with the VLA archive data from 1976 through 1982. Soon we expect to be able to resume the copying and reformatting of the remaining old nine track tapes to exabyte tapes. We expect to conclude this project in the course of 1998.

Networking

The upgrade of networking within the AOC to switched Ethernet is in progress, but will take some time to complete. As part of the upgrade, most Suns in the building will be given a dedicated 10Mbps Ethernet link. The new equipment has also allowed us to provide 100Mbps (FastEthernet) networking capability for all of our Ultras.

We have plans for improvements to some services, including dedicating a SPARCstation IPC as our WWW and anonymous ftp server. This should be installed during the spring. The move will be transparent for users that use the "www.nrao.edu" and "ftp.aoc.nrao.edu" addresses.

Currently both of these services are provided by systems that have a very heavy load from their other required uses.

Personnel

We still have two positions open: a network analyst and a scientific programmer.

The network analyst position in Socorro has proved to be very hard to fill; the main reason is that network specialists are very much in demand, and NRAO cannot compete very well with the salaries and/or professional challenges offered elsewhere. The candidate we selected in the second round of advertising decided to decline our offer of employment. Nonetheless, we are moderately optimistic; our third round of advertising has resulted in three promising candidates whom we are interviewing at the time of writing. Though some degree of emergency network support is being provided by the efforts of Charlottesville based specialists, general network support and development is suffering and we are keen on filling this position.

We have good hopes that we are close to filling the position of scientific programmer; we currently have two good candidates between which we intend to decide shortly.

AIPS System

The first quarter of 1997 saw a lot of activity related to the VSOP launch in February. All major elements needed to support space-based VLBI were added to AIPS. We expect the first scientific data to be available in early April. Since we are reluctant to release a version of AIPS that has not undergone at least one pass of real data, we are seriously contemplating delaying the release date by one month. This will give us the time to correct some of the errors that without doubt will become evident once we use AIPS on true VSOP data. Institutes that need new AIPS before that later date already have the latest version of AIPS available through the *midnight job*.

A total of six non-NRAO sites is running the AIPS midnight job. Another is currently inactive, and two more sites have expressed interest. Midnight job sites are located in the U.S., Japan, and Europe.

The AIPS DDT was used to test new SGI workstations considered for purchase by the VSOP project. The four-processor SGI *Origin 200* set a new record at 13.7 for a single processor, or 12.0 per processor when all four processors were used in parallel. This enormous power is required for the computationally demanding steps of fringe-fitting and imaging space VLBI data.

At the AOC, we installed a PC with the Pentium Pro 200 processor to test AIPS under Linux for an extended period for day-to-day data reduction. A serious problem in the tape accessing routines that did not allow Exabyte drives to be used under Linux, was fixed.

As described in more detail below, we started porting several selected pieces of code from CVX (the Charlottesville based experimental version of AIPS) to classic AIPS. For this particular release, crucial for space VLBI processing, we deliberately restricted ourselves to code that is considered very useful and would not interfere too much with the integrity of AIPS. We plan to port more pieces of code after the upcoming release.

Software

1) The key task FRING was further improved by adding the adverb SEARCH, which specifies alternative reference antennas in the initial FFT search. We added the "exhaustive fringe searching" and "subset solve" options. The latter option was implemented in CALIB as well.

2) Some of the more fundamental code was changed, causing UV scratch files to be much smaller than before when baseline selection is used. Especially for large space VLBI datasets this is a major improvement.

3) BLING now uses quadratic interpolation in delay, rate, and acceleration, which speeds up the task considerably.

4) A beginning was made porting some of the features found in the experimental version of AIPS running in Charlottesville (CVX). New tasks EDITA and EDITR were introduced. EDITA edits UV data based on calibration tables, and EDITR allows interactive editing—based on a secondary dataset—of a number of baselines. In the existing task SCMAP, the "Edit Data" menu command from CVX was enabled in AIPS.

5) The VLBA correlator can change correlation modes with great flexibility. This can lead to time-variable rate and delay decorrelation corrections which depend on the type of frequency and time filtering performed in the correlator. In order to solve this problem we implemented a new correlation-id random parameter for VLBA datasets. This parameter points to the recorded correlation modes stored in the existing CQ table. A new form of decorrelation corrections using this new random parameter was implemented.

6) The new orbit table (OB) was introduced, and a new task was written to fill this table with additional information. The FITS reading task FITLD was modified to support both the new OB table and the new random parameter.

7) A new UV sorting task MSORT was written. It reproduces the functionality of UVSRT. MSORT does an in-memory sort of a UV-data file. At best, MSORT should be about three times faster than UVSRT (in case when the data is only weakly mis-sorted, as is the case for normal VLA and VLBA data). At worst MSORT should take no more than 50 percent longer. In either case, MSORT requires no ancillary disk space—making this the preferred sorting method for large data files.

8) Another new task is RESEQ, which will renumber antennas in a UV file. This is the first step for the space VLBI requirement that stations may need to be aliased together at some point in the data reduction stream.

9) Numerous smaller improvements were made and bugs were fixed. Many of these improvements were prompted by the *designated AIP* program that continues to be popular with users around the world.

The next AIPS release for our users is targeted for May 1997. Work during this quarter has focused on completing and testing routines needed for processing data from the space VLBI satellite Halca. The timing of the release gives users of Halca data (and others!) access to the latest version of AIPS, including the specialized routines needed for space VLBI. Considerable effort has gone into insuring that this release is stable and reliable. Various editing and imaging programs have also been implemented for this release.

M. AIPS++

AIPS++ passed an important milestone with the beta release of the system in February 1997 to a small number of users. The beta release was announced on February 26, 1997. The sites involved are all consortium sites, and Caltech, University of Iowa, Kapteyn Astronomical Institute, and the National Optical Astronomy Observatory. User comments on the beta release may be found on an e-mail exploder that is archived at http://aips2.nrao.edu/aips++/mail/aips2-beta.

We plan two more beta releases before the limited public release: the next targeted towards adding spectral line capabilities and improving memory use and speed; and the second targeted towards improvements in the user interface. Documentation will be addressed in both.

In a demonstration that AIPS++ can be used by an external group for primarily scientific work, AIPS++ has been elected as the platform for reduction of data from a scientific project by an external group at Parkes using a multi-beam system to survey extra-galactic HI. More details on the Parkes MB project can be found at http://www.atnf.csiro.au/Research/multibeam/and a live display of spectra from the receivers can be found at http://wwwpks.atnf.csiro.au/people/multi/public_html/live/multibeam_live.html.

The AIPS++ contribution to the Parkes MB program concluded when we added the ability to read and write SDFITS format to and from the Measurement Set. In more general single dish work, we have progressed considerably on the single dish analysis program, SDCalc. A browser is now available, the limited plotter has been replaced by the binding of PGPLOT to Glish, and a demonstration script has been checked in to the system so that others may try out the existing program.

In Synthesis support, we worked extensively with scientists at the AOC to improve the documentation. We added spectral line support in the Measurement Equation, though this is still undergoing some revision. We added a variant of the Clark Clean to the existing imager, allowing cleaning of either I alone, I and V, or I, Q, U, and V simultaneously. We started work on sort-less gridding for spectral line data, and disk-based FFTs, both of which benefit considerably from the advanced capabilities of the AIPS++ library classes. We completed working versions of fillers to the Measurement Set for WSRT and BIMA formats. We also completed a writer of UVFITS from a Measurement Set, needed for inter-operability with existing analysis packages.

We finished the development of a GUI front end to the Units and Measures classes. Testing indicates that this general tool should now be supplemented by more specific-purpose GUIs for particular purposes. We wrote very extensive documentation for the measures object in Glish.

In Glish support, we fixed a number of bugs, added cursor support for the PGPLOT binding, added a number of additional tk widgets, investigated alternatives to the transport layer SDS, added command and output logging, and made a number of other miscellaneous changes in response to testing and use of Glish.

In AIPS++ Infrastructure, we introduced a new improved Coordinates class. We added new capabilities to the Distributed Object system such as a progress bar. We have defined and described a standard framework for GUIs in AIPS++.

In Visualization and Image Analysis, we continued development of the visualization toolkit. We added a number of convenience features to Aipsview, the principal one being the ability to control the line-graphics from a menu. We have largely incorporated the Glish-PGPLOT binding in the system, the work outstanding being on the documentation.

In the System area, we enabled installation of AIPS++ from a binary release (needed for the beta release). We completed a port of AIPS++ to a Pentium Pro 200 MHz machine running Linux. This machine fits our definition of a canonical machine, costing less than $5,000 and having memory of 64 Mbytes and disk space of several gigabytes. It is a very satisfactory AIPS++ platform, running at roughly twice the speed of the Sparc 20 in Socorro, for both compiling and production. We have completed a port to the SGI using the GNU compiler.

In Documentation, we spent a considerable amount of time working to improve various introductory material. We added a capability to search the entire documentation tree. The bug tracking system has a new interface allowing bug reports to be entered directly from Glish.

N. GREEN BANK TELESCOPE PROJECT

Antenna

Thanks to a mild Green Bank winter (the mildest on record by some accounts), work on the Green Bank Telescope has progressed well since the last report. The site is a busy place with close to 100 workers engaged in the construction, including iron workers, operating engineers, painters, electricians, and management staff. On the antenna, the Horizontal Feed Arm is now complete with the exception of the four small cubes which tie the two ends together. In addition, all counterweight boxes are now in place and welded, and the actuator room and access walkway are in position. Electricians are wiring the three remaining servo control cabinets in the equipment room on Level One.

On the ground, the backup structure (BUS) is approximately 90 percent complete. All BUS parts are on site and of the 6,652 pieces in the BUS, about 6,000 are in place in the trial erection. Truss assembly is continuing and all the trusses should be made within two months. In addition, some of the large weldments which make up the permanent BUS supports are being added to the structure. Walkways to facilitate the installation of the over 2,200 active surface active surface actuators also are being built The Upper Feed Arm with all of its mechanisms and the feed room are nearly ready for testing.

About three-quarters of the surface panels have been manufactured; they pass inspection (a 75 micron tolerance) at an approximate 90 percent rate; those that do not pass are reworked to our satisfaction.

Active Surface

The periodic status monitor in the master computer is software which checks most of the available hardware and software monitor points every second or two, and reacts to anomalies. During this reporting period, the review of the design was completed, and coding was begun. Coding of this module is approximately 40 percent complete.

The integration of the Monitor and Control group's revised message system into existing status monitor code was completed.

Servo

NRAO's primary responsibility with regards to the servo system is to monitor the progress of the servo contractor. To this end, several teleconferences were held in the past quarter. Work completed by the contractor this period includes the fabrication and wiring of the filter box for the feed arm servo, the updating of the action item list, the updating of the system schematic, and some updating of the feed arm servo test procedure.

A cable to the prime focus positioner, x-axis, that had been found badly damaged in January with much of the wiring insulation melted, was repaired by the manufacturer and reinstalled recently.

Efforts to clarify NRAO's testing requirements for the turret were begun. Issues being considered include the testing of the turret deflection due to unbalance torque, turret holding torque with the locking pin removed, repeatability of the positioning prior to locking pin insertion, and manufacturing accuracy of locking pin sockets.

Work on an accelerometer system to measure vibrations of the tip of the feed arm and target support tower was begun. The design is complete and construction is 75 percent complete.

GBT Spectrometer

Construction of the new GBT spectrometer is nearing completion and debugging is underway. Software for the spectrometer is now under development, and our goal is to move the spectrometer to Green Bank during the fourth quarter of 1997 for integration with the IF system and with the GBT monitor/control software.

Software

Work continues to divide the ZIY program into two parts in order to interface to the pointing group. Also, some maintenance was done on the camera program in order to facilitate calibration lab experiments with the spherical retroreflector.

GBT Architecture

No comments were received on the draft Structural-to-RF Model Report, therefore it will be issued in April 1997.

Metrology

Production. The machine shop in on schedule to finish the detector boxes by early April 1997. The optics assemblies will be completed by mid April. These parts then will be sent to be anodized. The machine ship has started building a complete 10-inch spherical retroreflector mounting fixture for evaluation. This also should be completed by mid April. The contractor will complete the earthwork on the GBT monuments early in the next quarter. Some QC problems have been discovered with some of the spherical retroreflectors. Tests are being conducted to verify the correction procedure/ The 200 retroreflectors sent out for calibration will be complete and returned in April.

Electronics

Prime Focus Receiver. Continued redesign of dewar assembly to accommodate current HEMT amplifiers. The drawings detailing the construction of the 450 MHz feed was submitted to the shop to permit fabrication of the feed. Completed noise budget calculations for all five bands. Started back on design of Band 5.

Holography. During the period the LNB was tested for phase stability versus temperature. The temperature coefficient was large enough so that active temperature compensation is necessary. The concept of a temperature controlled box was reviewed with the machinists. Two phase-stabilized Heliax coax cables were ordered and an additional LNB was ordered.

Fiber Optics. A GBT memo was generated explaining the results of various attempts to correct a fiber optics problem and, also, a plan of action for future developments was assembled. An analysis of the external modulation scheme and the direct modulation scheme allowed direct comparison. The performance, for signal-to-noise ratio considerations, was nearly the same for the best DFB direct modulation and the external modulation. The decision was made to prototype an external modulation optic link. An arrangement with UTP was reached to buy a DFB 1550 nm laser and borrow a 2.5 GHz external modulation for prototyping the purchased component were placed on order.

Mockup. A laser transmitter has been installed in the LAN rack. Also, a laser receiver was installed at the 140 Foot Telescope. This arrangement is being used to transmit the 1-8 GHz converter output to the spectral processor at the 140 Foot.

IF Rack. The digital attenuator in the optical fiber driver modules 2 and 3 was not the correctly responding to commands via the MCB interface module. The MCB interface unit has been repaired. A problem in the noise source module was noted. Noise generated by an amplifier when the noise source was turned off was enough to have the M&C software attempt a balance function. This occurred only when the optical driver digital attenuator was set to 0 dB. A relay was installed in the noise source module to turn off the bias to the amplifier whenever the noise source was turned off. The time constant for the square law detector video amp output in the optical driver module was changed. This was done to help improve the response time of the M&C autobalance function. Capacitors were installed across op-amp feedback resistors to limit bandwidth response of the video amplifier.

Feed Defroster. The control circuitry to run the heater and blower motor from three phase power was modified. It is expected that the changes implemented will improve the interference performance of the system.

1PPS Distribution. The printed circuit board for this system has been finished and the artwork sent out for fabrication. A chassis has been designed and submitted to the shop for fabrication.

L-Band Receiver. The half-amp board modifications were completed. Monitor and control testing continued this period.

Digital phase shifter was tested at the vendor's facility. The vendor agreed that the phase shifter did not meet spec, and will repair it at no cost to NRAO.

The machine shop finished fabrication of the circular waveguide section for the new attenuator.

C-Band Receiver. The new continuum detection scheme would require LO and IF frequencies to be changed. All oft he LO and IF components were tested this period to determine which would work at the new frequencies.

Ku/Ka-Band Receiver. The receiver was taken off the telescope in March and brought to the lab. A new Ka-band amplifier will be installed, and the receiver will be put back on the telescope in April.

K-Band Receiver. A VLBA phase cal generator was tested in the lab, then installed at the 140 Foot. the comb was injected into the 18-22 GHz front end and detected in the IF (VLBI test).

The new continuum detection scheme will require LO and IF frequencies to be changed. LO and IF components were tested this period to determine which would work at the new frequencies.

Lo Reference Distribution System. The second and final LO Transmitter module was built and tested. The second and final 500 MHz Buffer module also was completed this period. The last five of ten optical detector units ere assembled this month. Final testing of these is planned for April. Assembly of four LO Receiver modules continued this period. The are approximately 95 percent complete.

Monitor and Control

During this period, the prototype software was completed for the IF rack which contains the receiver room IF router, IF noise source, and IF optical fiber transmitters; and for the tracking LO (LO1). They are prototypes, because the requirements for system monitoring and the consoles are still being worked out. Most of the coding for the 1-8 GHz converters, the analog filters and the C-band and L-band receivers was completed, though tests on the hardware were not yet begun.

The task of making the monitor system robust is more complex than originally assumed, and work continues on this key system.

O. PERSONNEL

New Hires		
G. Anderson	Electrical Engineer	1/22/97
J. Herrnstein	Research Associate	2/03/97
J. McMullin	Assistant Scientist-Research Support	3/03/97
D. Mertely	Electrical Engineer	3/03/97
R. Millner	Systems Analyst	2/06/97
D. Pedtke	Electrical Engineer	1/02/97
Terminations		
E. Davis	Visiting Electrical Engineer	1/10/97
M. Waddel	Electrical Engineer	2/28/97
L. Young	Junior Research Associate	3/31/97
Change in Title		
J. Mangum	to Deputy Assistant Director for Tucson	1/01/97
R. Norrod	to Deputy Assistant Director for Green Bank	1/01/97

PREPRINTS RECEIVED, JANUARY - MARCH, 1997

AALTO, S.; RADFORD, S.J.E.; SCOVILLE, N.Z.; SSARGENT, A.I. Variation of Molecular Line Ratios and Cloud Properties in the Arp 299 Galaxy Merger.

APPONI, A.J.; ZIURYS, L.M. New Observations of the [HCO+]/[HOC+] Ratio in Dense Molecular Clouds.

BAATH, L.B.; MANTOVANI, F.; RANTAKYRO, F.T. High Resolution Interferometry of the QSO 1422+202.

BALSER, D.S.; BANIA, T.M.; ROOD, R.T.; WILSON, T.L. The 3He Abundance in Planetary Nebulae.

BARVAINIS, R.; LONSDALE, C. Radio Spectra of Radio Quiet Quasars. II. Broad Absorption Line Quasars.

BECKER, R.H.; GREGG, M.D.; HOOK, I.M.; MCMAHON, R.G.; WHITE, R.L.; HELFAND, D.J. The FIRST Radio-Loud Broad Absorption Line QSO and Evidence for a Hidden Population of Quasars.

BOWER, G.C.; BACKER, D.C.; PLAMBECK, R.L.; WRIGHT, M.C.H. Removal of Tropospheric Path Length Variations in Very Long Baseline Interferometry with Measurement of Tropospheric Emission.

BOWER, G.C.; BACKER, D.C.; WRIGHT, M.; FORSTER, J.R.; ALLER, H.D.; ALLER, M.F. A Dramatic Millimeter Wavelength Flare in the Gamma-Ray Blazar NRAO 530.

BRAUN, R. The Temperature and Opacity of Atomic Hydrogen in Spiral Galaxies.

BUTLER, B.J.; BEASLEY, A.J.; WROBEL, J.M.; PALMER, P. The Occultation of the QSO J0237+2848 by Comet C/1996 B2 (Hyakutake)

CARILLI, C.L.; ROTTGERING, H.J.A.; VAN OJIK, R.; MILEY, G.K.; VAN BREUGEL, W.J.M. Radio Continuum Imaging of High-Redshift Radio Galaxies.

DALLACASA, D.; FANTI, C.; FANTI, R.; COTTON, W.D.; SCHILIZZI, R.T.; SPENCER, R.E. Compact Peaked-Spectrum Radio Sources.

DE PATER, I.; SCHULZ, M.; BRECHT, S.H. Synchrotron Evidence for Amalthea's Influence on Jupiter's Electron Radiation Belt.

DE PREE, C.G.; MEHRINGER, D.M.; GOSS, W.M. Multifrequency, High Resolution Radio Recombination Line Observations of the Massive Star-Forming Region W49A.

DI FRANCESCO, J.; EVANS, N.J. II; HARVEY, P.M.; MUNDY, L.G.; GUILLOTEAU, S.; CHANDLER, C.J. Millimeter and Radio Interferometry of Herbig Ae/Be Stars.

EMERSON, D.T. The Works of Jagadis Chandra Bose: 100 Years of Mm-Wave Research.

ENGELS, D.; WINNBERG, A.; WALMSLEY, C.M.; BRAND, J. Mode Switching of the Water Maser in OH 39.7+1.5.

FEY, A.L.; CHARLOT, P. VLBA Observations of Radio Reference Frame Sources. II. Astrometric Suitability Based on Observed Structure.

FRAIL, D.A. Young Neutron Stars in Supernova Remnants.

GAO, Y.; SOLOMON, P.M.; DOWNES, D.; RADFORD, S.J.E. Molecular Gas in the Spectacular Ring Galaxy NGC 1144.

GENSHEIMER, P.D. Detection of HCCNC from IRC+10216.

GIOVANNINI, G.; ARBIZZANI, E.; COTTON, W.D.; FERETTI, L.; LARA, L.; VENTURI, T.; TAYLOR, G.B. Parsec Scale Properties of Low Power Radio Galaxies.

GORDON, M.A.; EMERSON, D.T. Radio Astronomy.

GREENHILL, L.J.; MORAN, J.M.; HERRNSTEIN, J.R. The Distribution of H2O Maser Emission in the Nucleus of NGC 4945.

HAARSMA, D.B.; HEWITT, J.N.; LEHAR, J.; BURKE, B.F. The 6 Centimeter Light Curves of B0957+561, 1979-1984: New Features and Implications for the Time Delay.

HOLLOWAY, A.J.; STEFFEN, W.; PEDLAR, A.; AXON, D.J.; LOPEZ, J.A.; MEABURN, J. The Kinematics and Morphology of the Peculiar Active Galaxy IRAS 04210+0400.

HUGHES, V.A. An Evolving Radio Source in the Young Star Forming Region Cepheus A.

HUGHES, V.A. Jets in the Star Forming Region Cepheus A.

PREPRINTS RECEIVED, JANUARY - MARCH, 1997

HUMMEL, C.A.; KRICHBAUM, T.P.; WITZEL, A.; WULLNER, K.H.; STEFFEN, W.; ALEF, W.; FEY, A. The Radio Jet of Quasar 0153+744.

IRWIN, J.A.; FRAYER, D.T.; SARAZIN, C.L. Is There Molecular Gas in the H I Cloud Between NGC 4472 and UGC 7636?

JONES, D.L.; WEHRLE, A.E. VLBI Imaging of NGC 4261: Symmetric Parsec-Scale Jets and the Inner Accretion Region.

KATZ-STONE, D.M.; RUDNICK, L. A Spectral Analysis of Two Compact Steep-Spectrum Sources.

KEMBALL, A.J.; DIAMOND, P.J. Imaging the Magnetic Field in the Atmosphere of TX Cam.

KOO, B.-C.; MOON, D.-S. Interaction Between the W51C SNR and a Molecular Cloud. II. Discovery of a Shocked CO and HCO+

KRICHBAUM, T.P.; WITZEL, A.; GRAHAM, D.; LOBANOV, A. MM-VLBI Monitoring of Broad-Band Active Blazars.

KUKULA, M.J.; DUNLOP, J.S.; HUGHES, D.H.; RAWLINGS, S. The Radio Properties of Radio-Quiet Quasars.

LAURENT-MUEHLEISEN, S.A.; KOLLGAARD, R.I.; RYAN, P.J.; FEIGELSON, E.D.; BRINKMANN, W.; SIEBERT, J. Radio-Loud Active Galaxies in the Northern ROSAT All-Sky Survey I. Radio Identifications.

LEAHY, J.P.; BLACK, A.R.S.; DENNETT-THORPE, J.; HARDCASTLE, M.J.; KOMISSAROV, S.; PERLEY, R.A.; RILEY, J.M.; SCHEUER, P.A.G. A Study of FRII Radio Galaxies with z < 0.15 - II. High Resolution Maps of Eleven Sources at 3.6 cm.

MANTOVANI, F.; JUNOR, W.; FANTI, R.; PADRIELLI, L.; SAIKIA, D.J. VLA Polarimetry of Compact Steep Spectrum Sources.

MIAO, Y.; SNYDER, L.E. Full Synthesis Observations of CH3CH2CN in Sagittarius B2: Further Evidence for Grain Chemistry.

MONTES, M.J.; VAN DYK, S.D.; WEILER, K.W.; SRAMEK, R.A.; PANAGIA, N. Radio Detection of SN 1986E in NGC 4302.

PAGLIONE, T.A.D.; JACKSON, J.M.; ISHIZUKI, S. The Average Properties of the Dense Molecular Gas in Galaxies.

POSPIESZALSKI, M.W.; LAKATOSH, W.J.; WOLLACK, E.; NGUYEN, L.D.; LE, M.; LUI, M.; KIU, T. Millimeter-Wave Waveguide-Bandwidth Cryogenically-Coolable InP HEMT Amplifiers.

RICHARDS, E.A. The Optical Identification of Faint Microwave Sources.

SARMA, A.P.; GOSS, W.M.; GREEN, A.J.; FRAIL, D.A. Australia Telescope Observations of the CTB 33 Complex.

SCHULMAN, E.; BRINKS, E.; BREGMAN, J.N.; ROBERTS, M.S. UGC 12732: A Galaxy Lacking High-Velocity Clouds.

SHEPHERD, D.S.; CHURCHWELL, E.; WILNER, D.J. A High Spatial Resolution Study of the ON2 Massive Star Forming Region.

SLYSH, V.I.; KALENSKII, S.V.; VAL'TTS, I.E.; GOLUBEV, V.V. Detection of a New Methanol Maser Line with the Kitt Peak 12 Meter Telescope by Remote Observing from Moscow.

SMITH, B.J.; STRUCK, C.; POGGE, R.W. Atomic Hydrogen and Star Formation in the Bridge/Ring Interacting Galaxy Pair NGC 7714/7715 (Arp 284)

SPINRAD, H.; DEY, A.; STERN, D.; DUNLOP, J.; PEACOCK, J.; JIMENEZ, R.; WINDHORST, R. LBDS 53W091: An Old, Red Galaxy at z = 1.552.

THORNLEY, M.D.; MUNDY, L.G. Are Flocculent Spirals Devoid of Density Waves? Gas Morphology and Kinematics in NGC 5055.

TIFFT, W.G. Cosmological Redshifts and Fundamental Particle Theory.

TIFFT, W.G. Galaxies, Cosmology and the Redshift.

TIFFT, W.G. Redshift Quantization in the Cosmic Background Rest Frame.

TIFFT, W.G. Redshift Quantization in Virgo Cluster Dwarfs.

TURNER, B.E. The Nature of Molecular Clouds.

PREPRINTS RECEIVED, JANUARY - MARCH, 1997

ULVESTAD, J.S.; ANTONUCCI, R.R.J. VLA Observations of NGC 253: Supernova Remnants and H II Regions at 1-pc Resolution.

VALERIO, C.; JUNOR, W.; MANTOVANI, F. High Resolution VLBI Observations of 3C273.

VAN OJIK, R.; ROTTGERING, H.J.A.; VAN DER WERF, P.P.; MILEY, G.K.; CARILLI, C.L.; VISSER, A.; ISAAK, K.G.; LACY, M.; JENNESS, T.; SLEATH, J.; WINK, J. A Search for Molecular Gas in High Redshift Radio Galaxies.

VAN ZEE, L.; HAYNES, M.P.; SALZER, J.J.; BROEILS, A.H. A Comparative Study of Star Formation Thresholds in Gas-Rich Low Surface Brightness Dwarf Galaxies.

VAN ZEE, L.; MADDALENA, R.J.; HAYNES, M.P.; HOGG, D.E.; ROBERTS, M.S. Obtaining High Precision H I Fluxes for Galaxies.

VOURLIDAS, A.; BASTIAN, T.S.; ASCHWANDEN, M.J. The Structure of the Solar Corona Above Sunspots as Inferred from Radio, X-ray, and Magentic Field Observations.

WOLF-CHASE, G.A.; GREGERSEN, E. Possible Infall Around the Intermediate-Mass Young Stellar Object NGC 2264 IRS.

YUN, M.S.; SCOVILLE, N.Z.; CARRASCO, J.J.; BLANDFORD, R.D. Resolution and Kinematics of Molecular Gas Surrounding the Cloverleaf Quasar at z = 2.6 Using the Gravitational Lens.

YUSEF-ZADEH, F.; WARDLE, M.; PARASTARAN, P. The Nature of the Faraday Screen Toward the Galactic Center Nonthermal Filament G359.54+0.18.

ZHAO, J.-H.; ANANTHARAMAIAH, K.R.; GOSS, W.M.; VIALLEFOND, F. High Density, Compact H II Regions in the Starburst Galaxies NGC 3628 & IC 694: High-Resolution VLA Observations of the H92 alpha Radio Recombination Line.