US/GR BK/

NATIONAL RADIO ASTRONOMY OBSERVATORY

QUARTERLY REPORT

July 1 – September 30, 1999

TABLE OF CONTENTS

A. TELESCOPE USAGE

The following telescopes have been scheduled for research and maintenance in the following manner during the third quarter of 1999.

	140 Foot	12 Meter	VLA	VLBA
Scheduled Observing (hrs)	417.00	154.00	1748.60	1665.00
Scheduled Maintenance and Equipment Changes	51.00	1716.00	211.80	221.00
Scheduled Tests and Calibration	117.00	334.00	253.70	265.00
Time Lost	35.50	52.75	102.00	36.40
Actual Observing	381.50	101.25	1646.60	1628.60

B. 140 FOOT OBSERVING PROGRAMS

The following line programs were conducted during this quarter.

No.	Observer(s)	Program
L339	Lockman, F. J. Murphy, E. (Johns Hopkins)	Extension of the 140 Foot Galactic Plane HI survey.
M428	Minter, A. Balser, D. Wiersgala, N. (Univ of Minnesota)	Is the turbulence in HII regions inherited or generated?
R276	Rood, R. (Virginia) Balser, D. Bania, T. (Boston)	^{3}He abundances in galactic HII regions.

The following pulsar programs were conducted during this quarter.

No.	Observer(s)	Program
A118	Arzoumanian, Z. (Cornell) Taylor, J. (Princeton) Nice, D. (Princeton)	Bimonthly timing of 63 pulsars at 500 and 800 MHz.
A132	Arzoumanian, Z. (Cornell) Nice, D. (Princeton)	575 MHz monitoring of the evolution of the PSR B1957+20 eclipsing binary system.
B687	Backer, D. (UC, Berkeley) Somner, A. (UC, Berkeley) Sallmen, S. (UC, Berkeley) Foster, R. (NRL)	Pulsar timing array.

C. 12 METER OBSERVING PROGRAMS

No.	Observers	Program
C326	Clancy, R. T. (SSI, Boulder) Sandor, B. (High Altitude Obs)	Thermal and compositional studies of the Mars and Venus atmospheres.
D200	Doelman, S. (Haystack)	Study of SiO masers.
H343	Helfter, T. (Arizona) Thornley, M. Regan, M. (DTM/Carnegie) Sheth, K. (Maryland) Vogel, S. (Maryland) Harris, A. (Maryland) Wong, T. (UC, Berkeley) Bock, D. (UC, Berkeley) Blitz, L. (UC, Berkeley)	Continuing program: Total-power data for BIMA SONG.
L347	Lubowich, D. (Hofstra)	A comparison between the DCN/HCN, D/H, and DCO^+/HCO^+ ratios in the 20 km/s and 50 km/s Sgr A molecular clouds.
S446	Shah, R. (Virginia) McMullin, J. Williams, J. Wootten, H. A.	Probing the chemical evolution of galactic protostellar clusters.
S448	Smith, B. (East Tennessee State)	Study of molecular gas in radio-loud and radio-quiet ellipticals.
S449	Smith, B. (East Tennessee State) Struck, C. (Iowa State)	Study of molecular gas and star formation in extragalactic tails and bridges.

D. VERY LARGE ARRAY OBSERVING PROGRAMS

Third quarter, 1999 was spent in the following configurations: A configuration from July 1 to September 27; BnA configuration from September 27 to September 30.

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

No.	Observer(s)	Program
AA239	Anglada, G. (IAA, Andalucia) Rodriguez, L. (Mexico/UNAM) Torrelles, J. (IAA, Andalucia)	Watching evolution of thermal radio jets from young stellar objects. 3.6 cm
AA240	Anantharamaiah, K. (Raman Institute) Goss, W. M.	Orthogonal rotating gaseous disks in NGC 253. 3.6 cm line
AB908	Brogan, C. (Kentucky) Frail, D. Goss, W. M. Troland, T. (Kentucky)	Zeeman measurements of 1720 MHz OH masers in supernova remnants. 20 cm line

No.	Observer(s)	Program
AB909	Bower, G. Moscadelli, L. (Bologna)	Scattering sizes of OH masers in the Galactic center. 20 cm line
AB910	Bower, G. Falcke, H. (MPIR, Bonn) Backer, D. (UC, Berkeley)	Spectrum of circular polarization in Sagittarius A. 2, 3.6, 6, 20 cm
AB911	Brisken, W. (Princeton) Goss, W. M. McGary, R. (CfA) Fruchter, A. (STScI) Thorsett, S. (Princeton)	Pulsar proper motions. 20 cm
AB912	Browne, I. (Manchester) Jackson, N. (Manchester) Wilkinson, P. (Manchester) Phillips, P. (Manchester) Marlow, D. (Pennsylvania) Rusin, D. (Pennsylvania)	Possible lenses from JVAS/CLASS with separations > 6". 2, 20 cm
AB914	Brotherton, M. (LLNL) Smith, R. (AAO) van Breugel, W. (LLNL) Miller, L. (Oxford) Boyle, B. (AAO)	The NVSS/UVX quasar sample. 20 cm
AB915	Butler, B. Slade, M. (JPL) Haldemann, A. (Caltech) Muhleman, D. (Caltech)	Goldstone/VLA radar observations of Mars. 3.6 cm line
AB917	Blundell, K. (Oxford) Close, L. (Oxford) Leahy, P. (Manchester) Beasley, A.	Multi-frequency high resolution study of hotspots. 0.7, 1.3, 2, 90 cm
AB920	Baum, S. (STScI) Xu, C. (STScI) O'Dea, C. (STScI) Verdes, G. (STScI)	Jets in nearby UGC galaxies. 6, 20 cm

No.	Observer(s)	Program
AB922	Browne, I. (Manchester) Marlow, D. (Pennsylvania) Myers, S. Wilkinson, P. (Manchester) Fassnacht, C. Readhead, A. (Caltech) Xanthopoulos, E. (Manchester) Rusin, D. (Pennsylvania) Biggs, A. (Manchester) Blandford, R. (Caltech) de Bruyn, A. G. (NFRA) Jackson, N. (Manchester) Koopmans, L. (Groningen/Kapteyn) Norbury, M. (Manchester) Pearson, T. (Caltech)	Gravitational lens monitoring combined program. 3.6, 6, 20 cm
AB932	Browne, I. (Manchester) Jackson, N. (Manchester)	CLASS non-detections. 3.6 cm
AC467	Colina, L. (STScI) Alberdi, A. (IAA, Andalucia) Torrelles, J. (IAA, Andalucia) Panagia, N. (STScI) Wilson, A. (Maryland)	Search for radio supernovae in luminous Seyfert galaxies. 2, 3.6 cm
AC524	Cartwright, J. (Caltech) Taylor, G. Readhead, A. (Caltech) Pearson, T. (Caltech)	Polarization monitoring observations of 3C273. 0.7, 1.3 cm
AC526	Carilli, C. (MPIR, Bonn) Verheijen, M. Yun, M. Menten, K. (MPIR, Bonn)	Imaging the z=0.19 HI 21cm absorption in 1830-211. 20 cm line
AC528	Caccianiga, A. (Lisbon) Della Ceca, R. (Brera Obs) Maccacaro, T. (Brera Obs) Wolter, A. (Brera Obs) Gioia, I. (Bologna)	Radio/X-ray selected BL Lacs and radio galaxies. 6, 20 cm
AC529	Cassaro, P. (Catania) Stanghellini, C. (Bologna) Dallacasa, D. (Bologna) Bondi, M. (Bologna) Zappala, R. (Catania)	The unbeamed emission of gamma-ray sources. 20 cm
AC530	Contreras, M. (Mexico/UNAM) Rodriguez, L. (Mexico/UNAM)	Structure and behavior of ionized stellar winds. 0.7, 3.6, 6 cm

No.	Observer(s)	Program
AC531	Carilli, C. (MPIR, Bonn) Fan, X. (Princeton) Strauss, M. (Princeton) Rupen, M. Schneider, D. (Penn State) Yun, M.	Search for radio emission from high redshift QSOs from the SDSS. 20 cm
AC534	Curiel, S. (Mexico/UNAM) Trinidad, M. (Mexico/UNAM)	The powerful thermal HW2 radio jet. 0.7, 1.3, 3.6 cm
AD425	Drake, J. (CfA) Brown, A. (Colorado/JILA) Brickhouse, N. (CfA) Osten, R. (Colorado/JILA) Harper, G. (Colorado/JILA)	Simultaneous radio observations with AXAF of HR 1099. 2, 3.6, 6, 20 cm
AD426	Dougherty, S. (DRAO) Williams, P. (Royal Obs)	The OB type companion in WR 146. 0.7 cm
AD427	De Breuck, C. (LLNL) Carilli, C. (MPIR, Bonn) van Breugel, W. (LLNL) Rottgering, H. (Leiden) Miley, G. (Leiden) Stanford, A. (LLNL) Stern, D. (UC, Berkeley)	The most distant radio galaxy. 3.6, 6, 20 cm
AD428	Dallacasa, D. (Bologna) Stanghellini, C. (Bologna) Fanti, R. (Bologna) Centonza, M. (Bologna)	High frequency peakers. 1.3, 2, 3.6, 6, 20 cm
AD429	Dennett-Thorpe, J. (Groningen/Kapteyn) Best, P. (Leiden) Kaiser, C. (MPIAP, Munich)	Depolarization in FR II radio sources. 20 cm
AE128	Eyres, S. (Liverpool JMU) Bode, M. (Liverpool JMU) O'Brien, T. (Liverpool JMU) Davis, R. (Manchester) Richards, A. (Manchester) Watson, S. (Manchester) Crocker, M. (Manchester) Taylor, A. R. (Calgary) Dougherty, S. (DRAO) Ivison, R. (U. College London) Kenny, H. (Canadian Military)	Contemporaneous VLA-HST observations of symbiotic stars. 1.3, 3.6, 6 cm

No.	Observer(s)	Program
AE131	Edge, A. (Durham) Smail, I. (Durham) Davies, R. (Durham) Bower, R. (Durham) Zielger, B. (Durham)	Low X-ray luminosity clusters with HST imaging. 20 cm
AF350	Falcke, H. (MPIR, Bonn) Lobanov, A. (MPIR, Bonn) Wright, M. (UC, Berkeley) Bower, G. Aller, M. (Michigan) Terasranta, H. (Helsinki) Patnaik, A. (MPIR, Bonn)	Monitoring extremely variable spiral III Zw 2. 1.3, 2, 3.6, 6, 20, 90 cm
AF360	Ferruit, P. (Maryland) Mundell, C. (Maryland) Nagar, N. (Maryland) Wilson, A. (Maryland)	Comparing radio and NLR in Seyferts. 3.6 cm
AF361	Falcke, H. (MPIR, Bonn) Wilson, A. (Maryland)	HST and VLA imaging of radio-quiet quasars. 3.6, 6 cm
AF362	Furuya, R. (Nobeyama Obs) Wootten, H. A. Claussen, M. Kitamura, Y. (ISAS, Japan) Kawabe, R. (NAO, Japan)	Search for central star in the Class 0 source S106 FIR. 0.7, 3.6 cm
AF366	Fey, A. (USNO) Boboltz, D. (USNO) Johnston, K. (USNO) Gaume, R. (USNO)	Lens candidate 1445-161. 3.6 cm
AG568	Gallimore, J. Pedlar, A. (Manchester) Thean, A. (Bologna)	High frequency radio imaging of Seyfert nuclei. 0.7, 1.3, 2, 3.6 cm line
AG570	Guedel, M. (SFIT, ETH) Smith, K. (SFIT, ETH) Benz, A. (SFIT, ETH)	Probing the inner regions of naked protostellar jets. 2, 3.6 cm
AG571	Gaensler, B. (MIT) Frail, D. Kulkarni, S. (Caltech)	The Duck and the Mouse-second epoch proper motion measurements. 20 cm
AG572	Gomez, Y. (Mexico/UNAM) Miranda, L. (IAA, Andalucia) Torrelles, J. (IAA, Andalucia) Anglada, G. (IAA, Andalucia)	Water and OH maser emission toward planetary nebula K 3-35. 1.3, 20 cm line

No.	Observer(s)	Program
AG573	Gomez, Y. (Mexico/UNAM) Rodriguez, L. (Mexico/UNAM) Moran, J. (CfA)	Angular expansion of compact planetary nebulae. 3.6 cm
AG574	Gregg, M. (UC, Davis) Becker, R. (UC, Davis) Laurent-Muehleisen, S. (LLNL) White, R. (STScI)	Bright quasar lensing search. 3.6 cm
AG575	Greenhill, L. (CfA) Chandler, C. (Cambridge) Herrnstein, J.(Renaissance Tech) Reid, M. (CfA)	Orion BN/KL: the maser shell around source I. 0.7 cm line
AG576	Gibb, A. (Leeds) Hoare, M. (Leeds)	Precessing jet from high-mass young stellar object G35.2-0.7N. 3.6, 6 cm
AG578	Greenhill, L. (CfA) Moran, J. (CfA) Reid, M. (CfA) Holder, B. (CfA)	Water masers in the Orion BN/KL region. 1.3 cm line
AH663	Harper, G. (Colorado/JILA) Brown, A. (Colorado/JILA) Ayres, T. (Colorado/JILA) Osten, R. (Colorado/JILA) Drake, J. (CfA) Brickhouse, N. (CfA)	Observations of Capella during an AXAF observation. 1.3, 2, 3.6, 6, 20 cm
AH669	Hjellming, R. Rupen, M. Mioduszewski, A.	Galactic black hole X-ray transients. 1.3, 2, 3.6, 6, 20 cm
AH678	Horellou, C. (Chalmers, Onsala)	Magnetic fields in the ring galaxy Arp 147. 20 cm
AH680	Hunter, T. (CfA) Zhang, Q. (CfA) Sridharan, T. (CfA)	OH masers around high mass protostar 20126+4104. 20 cm line
AH682	Homan, J. (Amsterdam) Fender, R. (Amsterdam) Wijnands, R. (Amsterdam) van der Klis, M. (Amsterdam) Hjellming, R.	Simultaneous VLA/RXTE observations of GX 13+1. 3.6 cm
AH685	Haarsma, D. (Haverford College) Hewitt, J. (MIT) Langston, G. Moore, C. (Groningen/Kapteyn)	Time delay monitoring of gravitational lens 2016+112. 3.6, 6 cm

No.	Observer(s)	Program
AJ268	Janardhan, P. (TIFR) Balasubramanian, V. (TIFR) Ananthakrishnan, S. (TIFR)	Low frequency compact sources from Ooty IPS survey. 3.6, 20 cm
AK485	Kulkarni, S. (Caltech) Frail, D. Bloom, J. (Caltech) Djorgovski, S. (Caltech) Harrison, F. (Caltech)	Radio afterglows of gamma-ray bursts. 2, 3.6, 6, 20 cm
AK489	Kotaro, K. (NAO, Japan) Ryohei, K. (NAO, Japan) Yoshinori, T. (Tokyo U.) Kouji, O. (Kyoto) Toru, Y. (Tohoku) Carilli, C. (MPIR, Bonn)	Continuum emission from forming galaxy 1202-0725. 6, 20 cm
AK490	Kurtz, S. (Mexico/UNAM) Carral, P. (Guanajuato U.) Rodriguez, L. (Mexico/UNAM) Hofner, P. (NAIC)	Nature and evolutionary state of ON-2 (H_2O). 1.3, 3.6 cm
AK491	Kukula, M. (Royal Obs) Dunlop, J. (Edinburgh) McLure, R. (Edinburgh) O'Dea, C. (STScI) Baum, S. (STScI)	Detecting the radio cores of radio-quiet quasars. 6 cm
AK492	Kaiser, M. (Johns Hopkins) Baan, W. (NFRA) Bradley, L. (Johns Hopkins)	Resolved narrow line region in M51. 3.6 cm
AL434	Lehar, J. (CfA) Buchalter, A. (Columbia) McMahon, R. (Cambridge) Kochanek, C. (CfA)	Candidate gravitationally lensed radio lobes. 6 cm
AL489	Lazio, T. J. W. (NRL) Cordes, J. (Cornell) Kassim, N. (NRL)	Steep-spectrum sources toward the Galactic center: radio pulsars? 6 cm
AL490	Laine, S. (Hertfordshire) Kotilainen, J. (Turku) Norris, R. (CSIRO) Reunanen, J. (Turku) Ryder, S. (Hawaii)	Seyfert and starburst galaxies with IR line images. 20 cm

No.	Observer(s)	Program
AL491	Lara, L. (IAA, Andalucia) Giovannini, G. (Bologna) Cotton, W. Feretti, L. (Bologna) Venturi, T. (Bologna)	Radio optical jet of 3C 264. 0.7, 1.3, 6, 20 cm
AL494	Lang, C. Goss, W. M. Rodriguez, L. (Mexico/UNAM)	Massive stars in the Arches cluster. 0.7, 3.6 cm
AL496	Lim, J. (SA/IAA, Taiwan) Kwok, S. (Calgary)	The fast wind of the central post AGB star in the bipolar PN M2-9. 1.3, 2 cm
AL497	Lim, J. (SA/IAA, Taiwan) Carilli, C. (MPIR, Bonn) White, S. (Maryland)	Structure and evolution of Betelgeuse's atmosphere. 0.7, 1.3 cm
AL499	Lacy, M. (Oxford) Ridgway, S. (Johns Hopkins)	Radio optical alignments in less luminous radio sources. 3.6, 20 cm
AL500	Laing, R. (Oxford) Parma, P. (Bologna) de Ruiter, H. (Bologna) Bridle, A. Fanti, R. (Bologna)	Decelerating relativistic jets in FRI radio galaxies. 3.6 cm
AL501	Law-Green, J. (Leicester) Hirst, P. (Leicester) Reeves, J. (Leicester) O'Brien, P. (Leicester) Ward, M. (Leicester) Simpson, C. (NAO, Japan)	PDS 456, a nearby radio quiet quasar. 2, 3.6, 6, 20 cm
AL502	Law-Green, D. (Leicester) Hirst, P. (Leicester) Ward, M. (Leicester) O'Brien, P. (Leicester) Bleackley, P. (Leicester) Thean, A. (Bologna)	Radio structures of narrow-line seyferts. 3.6, 6, 20 cm
AL503	Law-Green, D. (Leicester) Zezas, A. (Leicester) Ward, M. (Leicester) Hirst, P. (Leicester)	Radio imaging of X-ray selected starbursts and composite galaxies. 3.6, 6, 20 cm
AL504	Lang, C. Anantharamaiah, K. (Raman Institute) Kassim, N. (NRL) Lazio, T. J. W. (NRL)	Substructure in a recently discovered Galactic center filament. 20 cm

No.	Observer(s)	Program
AM620	McHardy, I. (Southampton) Muxlow, T. (Manchester) Cordova, F. (UC, Santa Barbara)	Faint X-ray galaxies. 20 cm
AM621	Mioduszewski, A. Hjellming, R. Rupen, M.	VLA observations of X-ray nova CI cam. 2, 4 cm
AM623	Myers, S. Jackson, N. (Manchester) Marlow, D. (Pennsylvania) Rusin, D. (Pennsylvania) Fassnacht, C.	Supplementary observations for CLASS: CLASS-4. 3.6 cm
AM639	Monnier, J. (UC, Berkeley) Greenhill, L. (CfA) Tuthill, P. (UC, Berkeley) Danchi, W. (UC, Berkeley)	IR bright Wolf-Rayet stars. 1.3, 2, 3.6, 6, 20 cm
AM640	McLaughlin, M. (Cornell) Cordes, J. (Cornell) Arzoumanian, Z. (Cornell)	Pulsar 1740+09. 20 cm
AN085	Nagar, N. (Maryland) Wilson, A. (Maryland) Falcke, H. (MPIR, Bonn)	Low-luminosity AGN. 0.7, 2, 3.6, 6 cm
AO141	Ohta, K. (Kyoto) Kawabe, R. (NAO, Japan) Kohno, K. (NAO, Japan) Tutui, Y. (Tokyo U.)	High redshift radio-quiet quasars. 3.6, 20 cm
AO142	Owen, F. Carilli, C. (MPIR, Bonn) Ivison, R. (U. College London) Cooray, A. (Chicago)	Deep 20 cm A-array image of A370 and its lensed background. 20 cm
AO143	Owen, F. Carilli, C. (MPIR, Bonn) Ivison, R. (U. College London)	Steep spectrum submillimeter sources and A370. 90 cm
AO146	Osten, R. (CASA) Brown, A. (CASA)	Time-resolved coronal radio and X-ray observations of the RS CVn Binary ER Vul. 3.5, 6, 20 cm
AP380	Pooley, G. (Cambridge) Hardcastle, M. (Bristol, UK) Riley, J. (Cambridge) Alexander, P. (Cambridge) Gilbert, G. (Cambridge)	Radio jets of FRII radio sources. 3.6, 6 cm

No.	Observer(s)	Program
AP381	Paredes, J. (Barcelona) Ribo, M. (Barcelona) Marti, J. (Jaen)	New radio emitting X-ray binary candidates from NRAO VLA sky survey. 3.6, 6 cm
AP383	Pedelty, J. (NASA/GSFC) Hollis, J. (NASA/GSFC)	Additional constraints on the R Aquarii binary system's orbit. 0.7, 3.6 cm
AP389	Peck, A. Taylor, G. O'Dea, C. (STScI) Giovannini, G. (Bologna)	Searching for HI absorption in two nearby radio galaxies. 20 cm line
AR402	Rudnick, L. (Minnesota) Treichel, K. (Minnesota) Katz-Stone, D. (USNA) Giovannini, G. (Bologna)	Non-relativistic sheaths around extragalactic jets. 20 cm
AR410	Rector, T. (KPNO-NOAO) Stocke, J. (Colorado/JILA)	Checking for gravitational lensing in the 1Jy BL Lac object sample. 2, 3.6, 6 cm
AR413	Reid, M. (CfA) Wilner, D. (CfA) Zhang, Q. (CfA)	Radio continuum emission from the high mass protostar 20126+4104. 3.6, 20 cm
AR414	Rawlings, S. (Oxford) Dalton, G. (Oxford) Olding, E. (Oxford) Wegner, G. (Dartmouth)	Primeval ellipticals and distant starbursts from Oxford WFC survey. 20 cm
AR415	Richards, G. (Chicago) Laurent-Muehleisen, S. (LLNL) York, D. (Chicago) Becker, R. (UC, Davis)	Quasars with known absorption line properties. 3.6, 20 cm
AR416	Rusin, D. (Pennsylvania) Myers, S. (Pennsylvania) Marlow, D. (Pennsylvania) Browne, I. (Manchester) Jackson, N. (Manchester) Wilkinson, P. (Manchester) Norbury, M. (Manchester) Readhead, A. (Caltech) Fassnacht, C. (Caltech) Koopmans, L. (Groningen/Kapteyn) de Bruyn, A. G. (NFRA)	Searching for variability in new CLASS lens systems. 3.6 cm

No.	Observer(s)	Program
AR418	Richards, E. (Virginia) Cowie, L. (Hawaii) Barger, A. (Hawaii) Fomalont, E. Kellermann, K. Partridge, R. B. (Haverford College) Windhorst, R. (Arizona State)	A 20 cm deep field. 20 cm
AR426	Reid, M. (CfA)	SiO masers in Mira. 0.7 cm line
AS568	Sramek, R. Weiler, K. (NRL) VanDyk, S. (UCLA) Panagia, N. (STScI)	Properties of radio supernovae. 1.3, 2, 3.6, 6, 20 cm
AS651	Sault, R. (CSIRO) Dulk, G. (Paris Obs.) Leblanc, Y. (Paris Obs.) Bastian, T. (Paris Obs.) Bolton, S. (JPL)	Jupiter's synchrotron radiation belts at 74 MHz. 90 cm
AS658	Sahai, R. (JPL) Claussen, M. Morris, M. (UCLA)	Bipolar protoplanetary nebulae IRAS16342-3814 and IRAS19134+2131. 1.3 cm
AS659	Scheuer, P. (Cambridge) Laing, R. (Oxford)	Detailed spectral distributions in hotspots. 20 cm
AS660	Sjouwerman, L. (NFRA) van Langevelde, H. (NFRA) Lindqvist, M. (Chalmers, Onsala)	Water masers in GMC M-0.13-0.08. 1.3 cm line
AS663	Sahai, R. (JPL) Claussen, M. Morris, M. (UCLA) Zijlstra, A. (ESO) te Lintel Hekkert, P. (CSIRO)	OH masers in protoplanetary nebulae imaged by HST. 20 cm line
AS665	Stern, D. (UC, Berkeley) van Breugel, W. (LLNL)	Highest redshift radio loud quasars. 3.6, 6, 20 cm
AS666	Stern, D. (UC, Berkeley) Eisenhardt, P. (JPL) Elston, R. (Florida) Spinrad, H. (UC, Berkeley) Stanford, S. (UC, Davis)	A luminous, narrow-lined high-redshift galaxy. 20 cm

No.	Observer(s)	Program
AS667	Sarma, A. (Kentucky) Troland, T. (Kentucky) Crutcher, R. (Illinois) Roberts, D. (Illinois)	VLA Zeeman survey of 22 GHz water masers. 1.3 cm line
AS673	Skinner, S. (Colorado/JILA) Zhekov, S. (Colorado/JILA)	Radio emission of Wolf-Rayet stars. 1.3, 2, 3.6, 6, 20 cm
AT226	Tschager, W. (Leiden) Schilizzi, R. (NFRA) Snellen, I. (Cambridge) Rottgering, H. (Leiden) Miley, G. (Leiden)	New sample of faint compact steep-spectrum radio sources. 2 cm
AT227	Turner, J. (UCLA) Beck, S. (Tel-Aviv U.) Crosthwaite, L. (UCLA) Meier, D. (UCLA)	Search for compact HII regions in starburst galaxies. 1.3, 2, 3.6 cm
AU079	Ulvestad, J. Ho, L. (Mt. Wilson)	The Palomar sample of Seyfert galaxies. 20 cm
AW514	Wendker, H. (Hamburg U.) Dougherty, S. (DRAO) Higgs, L. (DRAO) Landecker, T. (DRAO)	High resolution observations of the LBV in G79.29+0.46. 3.6 cm
AW516	Winn, J. (MIT) Hewitt, J. (MIT) Schecter, P. (MIT)	MIT-VLA-Magellan southern gravitational lens survey. 1.3, 2, 3.6 cm
AW518	Wall, J. (Oxford) Blundell, K. (Oxford) Kassim, N. (NRL) Lazio, T. J. W. (NRL) Peck, A.	Search for 74 MHz halos around CSO/GPS sources. 400 cm
AW519	Wilcots, E. (Wisconsin) Bershady, M. (Wisconsin) Jangren, A. (Penn State)	Low redshift, luminous, compact star forming galaxies. 6, 20 cm
AY106	Yun, M. Carilli, C. (MPIR, Bonn) Ulvestad, J.	Resolution of the HI absorption system at z = 3.4 in B2 0902+34. 90 cm line
AY113	Young, C. (Mississippi) Brogan, C. (Kentucky) Taylor, G.	HI absorption in PDS 456. 20 cm line

No.	Observer(s)	Program
AZ119	Zhao, J. (CfA) Goss, W. M.	Proper motions of radio components near Sgr A*. 1.3 cm
BC098	Claussen, M. Wootten, H. A. Marvel, K. (AAS) Wilking, B. (Missouri)	Zeeman measurements of water masers in YSO jets. 1.3 cm
V021	Minter, A.	Orbiting VLBI observations of the pulsar 0329+54. 20 cm phased array

E. VERY LONG BASELINE ARRAY OBSERVING PROGRAMS

No.	Observer(s)	Program
BA029	Alberdi, A. (IAA, Andalucia) Gomez, J-L. (ESA, Spain) Marcaide, J. (Valencia) Perez-Torres, M. (Valencia) Marscher, A. (Boston)	Superluminal source 4C39.25. 0.7, 1.3, 2 cm
BA037	Aller, H. (Michigan) Aller, M. (Michigan) Hughes, P. (Michigan) Wardle, J. (Brandeis) Homan, D. (Brandeis)	Sources with rapidly variable polarization. 0.7, 2 cm
BB105	Blundell, K. (Oxford) Beasley, A.	Motion in a radio quiet quasar. 3.6 cm with phased VLA
BB109	Beasley, A. Herrnstein, J.	VLBA monitoring of WR 140 (HD 193793). 2, 3.6, 6 cm with VLA single antenna
BB111	Brisken, W. Dewey, R. (Princeton) Thorsett, S. (Princeton) Beasley, A. Benson, J.	Proper motions of pulsars in supernova remnants. 18 cm
BB113	Backer, D. (UC, Berkeley) Bower, G. Sramek, R.	Imaging of galactic center proper motion calibrator sources. 3.6, 6 cm

No.	Observer(s)	Program
BC091	Clark, T. (NASA/GSFC) Ma, C. (NASA/GSFC) Johnston, K. (USNO) Fey, A. (USNO) Gaume, R. (USNO) Eubanks, T. M. (USNO) Gordon, D. (NASA/GSFC) Vandenberg, N. (Interferometrics) Himwich, E. (Interferometrics) Shaffer, D. (Radiometrics) Boboltz, D. (USNO) Kingham, K. (USNO) Fomalont, E. Walker, R. C.	VLBA geodesy/astronometry observations for 1999. 3.6 cm
BC096	Cohen, A.S. (MIT)	Determining a model of gravitational lens 0218+357. 18 cm with VLA single antenna
BD057	Diamond, P. (Manchester) Kemball, A.	Continuation of the VLBA monitoring of SiO masers around TX Cam. 0.7 cm with VLA single antenna
BD060	Dhawan, V. Kellermann, K. Romney, J.	Monitoring the accelerating, bent jet in 3C84. 0.7 cm with VLA single antenna
BD062	Diamond, P. (Manchester) Kemball, A.	TX Cam: the sequel. 0.7 cm
BE018	Engels, D. (Hamburger Sternwarte) Winnberg, A. (Onsala)	3D mapping of H_20 masers in OH83.4-0.9. 1 cm
BF050	Fanti, C. (IRA) Cotton, W. Fanti, R. (IRA) Mantovani, F. (IRA)	Search for CSS and GPS candidates. 2, 4 cm
BF054	Furuya, R. (Graduate University) Claussen, M. Kawabe, R. (Nobeyama) Kitamura, Y. (ISAS) Wootten, H. A.	Study of evolution of protostellar jets. 1 cm
BF056	Falcke, H. (MPIR, Bonn) Aller, H. (Michigan) Aller, M. (Michigan) Bower, G. Brunthaler, A. (MPIR, Bonn) Terasranta, H. (Metsahovi)	Monitoring the major radio outburst in extremely variable spiral galaxy III Zw 2. 2, 7 cm

No.	Observer(s)	Program
BG063	Gabuzda, D. (Lebedev) Cawthorne, T. (Lancashire) Pushkarev, A. (Moscow State)	Multi-frequency observations of a 1 Jy complete sample of BL Lac objects. 4, 13 cm
BG086	Gomez, J-L. (IAA, Andalucia) Marscher, A. (Boston) Alberdi, A. (IAA, Andalucia) Gabuzda, D. (NFRA)	BL Lac object 0735+178. 0.7, 1.3, 2 cm
BG093	Gallimore, J. Baum, S. (STScI) O'Dea, C. (STScI)	Flat spectrum sources in Seyfert galaxies. 4, 13 cm
BH057	Hough, D. (Trinity University) Homan, D. (Brandeis) Porcas, R. (MPIR, Bonn) Readhead, A. (Caltech) Wardle, J. (Brandeis) Zensus, J. A. (MPIR, Bonn)	Multi-frequency polarization imaging of the nuclei in the lobe-dominated quasars 3C207, 3C212, 3C263,and 3C334. 4, 6 cm
BH063	Hjellming, R. Mioduszewski, A. Rupen, M.	TOO VLBA observations of SAX J1819.3-2525. 2, 4, 20 cm
BK068	Kellermann, K. Cohen, M. (Caltech) Vermeulen, R. (NFRA) Zensus, J. A. (MPIR, Bonn)	Kinematics of quasars and AGN. 2 cm
BL078	Lobanov, A. (MPIR, Bonn) Ros, E. (MPIR, Bonn) Zensus, J. A. (MPIR, Bonn)	Monitoring the ongoing flare in the VLBI core of 3C345. 1, 2, 7 cm
BL080	Lobanov, A. (MPIR, Bonn) Zensus, J. A. (MPIR, Bonn) Ros, E. (MPIR, Bonn) Klare, J. (MPIR, Bonn) Geisecke, A. (MPIR, Bonn)	Multi-frequency monitoring of the parsec scale jet in 3C345. 0.7, 1.3, 2, 3.6, 6 cm
BM108	Moellenbrock, G. (ISAS, Japan) Roberts, D. (Brandeis) Wardle, J. (Brandeis)	Polarization monitoring of gamma-ray blazars. 0.7, 1.3, 2, 3.6 cm
BM110	Mutel, R. (Iowa) Denn, G. (Iowa)	Monitoring BL Lac. 0.7, 1.3, 2 cm

No.	Observer(s)	Program
BM112	Moran, J. (CfA) Bragg, A. (CfA) Bragg, A. (CfA) Diamond, P. J. Greenhill, L. (CfA) Henkel, C. (MPIR, Bonn) Herrnstein, J. Trotter, A. (Harvard)	Next generation study of NGC 4258 accretion disk physics from measurement of month-to-month variations. 1 cm
BM114	Marcaide, J. (Valencia) Guirado, J. (Valencia) Perez-Torres, M. (Valencia) Ros, E. (MPIR, Bonn)	Absolute kinematics of radio source components in complete S5 polar cap sample. 2 cm
BM116	Marscher, A. (Boston) Cawthorne, T. (Lancashire) Gear, W. (Cambridge) Stevens, J. (Cambridge) Marchenko, S. (St. Petersburg) Lister, M. (JPL) Gabuzda, D. (Lebedev) Yurchenko, A. (St. Petersburg) Forster, J. (UC, Berkeley)	Monitoring millimeter-bright AGN. 0.7 cm
BM118	Marlow, D. (Pennsylvania) Myers, S. (Pennsylvania) Rusin, D. (Pennsylvania) Blandford, R. (Caltech) Wilkinson, P. (Manchester) Browne, I. (Manchester) Jackson, N. (Manchester) Norbury, M. (Manchester) de Bruyn, G. (NFRA) Koopmans, L. (Groningen/Kapteyn)	CLASS 3 candidate gravitational lenses. 6 cm with VLA single antenna
BN008	Nagar, N. (Maryland) Falcke, H. (MPIR, Bonn) Wilson, A. (Maryland)	Investigating the parsec-scale jets in the LINERs NGC 4278 and NGC 6500. 2, 4, 6, 20 cm
BN009	Norbury, M. (Manchester) Blandford, R. (Caltech) Browne, I. (Manchester) Jackson, N. (Manchester) Koopmans, L. (Groningen) Marlow, D. (Pennsylvania) Myers, S. Pearson, T. (Caltech) Rusin, D. (Pennsylvania) Wilkinson, P. (Manchester)	Long track observations of top CLASS lens candidates. 20 cm

No.	Observer(s)	Program
BN010	Nakai, N. (NAO, Japan) Ishihara, Y. (NAO, Japan) Inoue, M. (NAO, Japan) Hagiwara, Y. (NAO, Japan) Miyoshi, M. (NAO, Japan) Diamond, P.J. (Manchester)	H_2O megamaser in LINER IC1481. 1.3 cm with phased VLA
BP048	Perlman, E. (STScI) Carilli, C. Minter, A. Langston, G. Ghigo, F. Stocke, J. (Colorado/JILA) Conway, J. (Chalmers, Onsala)	Monitoring PKS 1413+135. 0.7, 1.3, 2, 3.6 cm
BP053	Polatidis, A. (NFRA) Conway, J. (Chalmers, Onsala) Murphy, D. (JPL)	Continued coordinated monitoring of 1928+738. 0.7, 2 cm
BR057	Roberts, D. (Brandeis) Moellenbrock, G. (ISAS, Japan) Wardle, J. (Brandeis) Gabuzda, D. (NFRA) Brown, L. (Connecticut)	Four 3C quasars with VSOP observations. 0.7, 1.3, 2, 3.6 cm
BR060	Rector, T. (NOAO) Gabuzda, D. (Lebedev) Stocke, J. (CASA)	Second epoch observations of X-ray loud BL Lacs. 6 cm
BR063	Ratner, M. (CfA) Bartel, N. (York U.) Bietenholz, M. (York U.) Lebach, D. (CfA) Lestrade, J-F. (Paris Obs.) Ranson, R. (York U.) Shapiro, I. (CfA)	Astrometry of HR 8703 in 1999 for the gravity probe B mission. 3.6, 6 cm
BS071	Stockdale, C. (Oklahoma) Cowan, J. (Oklahoma) Rupen, M. Chu, Y. (Illinois)	Imaging SN 1961V: is it a supernova? 18 cm
BS077	Spangler, S. (Iowa) Mutel, R. (Iowa)	Measurement of solar wind acceleration using VLBI phase scintillation. 3.6, 6 cm
BT046	Taylor, G. Pearson, T. (Caltech) Readhead, A.	High frequency second epoch observations of four compact symmetric objects. 2, 7 cm

No.	Observer(s)	Program
BT047	Taylor, G. Vermeulen, R.	Measuring absolute motions in bi-directional jets of 1946+708. 4, 2 cm
BU012	Ulvestad, J. Vestrand, W. (New Hampshire) Stacy, J. (New Hampshire) Biretta, J. (STScI)	Flaring CGRO Blazar 2255-282. 0.7, 1.3, 2 cm
BU017	Uson, J. Beasley, A.	Spatial and spectral resolution of HI absorption in 0902+343. 90 cm with VLA single antenna
GB035	Bartel, N. (York U.) Rupen, M. Bietenholz, M. (York U.) Beasley, A. J. Conway, J. (Chalmers, Onsala) Altunin, V. (JPL) Graham, D. (MPIR, Bonn) Venturi, T. (Bologna) Umana, G. (Bologna)	Evolving spectral index distribution in images of SN 1993J. 18 cm
GM035	Marcaide, J. (Valencia) Perez-Torres, M. (Valencia) Guirado, J. (Valencia) Alberdi, A. (IAA, Andalucia) Ros, E. (MPIR, Bonn) Diamond, P.J. (Manchester) Shapiro, I. (CfA) Preston, R. (JPL) Schilizzi, R. (NFRA) Mantovani, F. (Bologna) Trigilio, C. (Bologna) Van Dyk, S. (UCLA) Weiler, K. (NRL) Sramek, R. Whitney, A. (Haystack)	Monitoring of the expansion of SN 1993J at 6 and 18cm. 6 cm
V026	Walker, R. C.	3C120 structure from 0.1 to 250 pc. 6 cm
V030	Preston, R. (JPL)	Pearson-Readhead survey from space. 6 cm
V037	Menten, K. (MPIR, Bonn)	Extragalactic OH masers. 18 cm
V085	Schilizzi, R. (NFRA)	Morphological and spectral study of GPS galaxies and quasars. 6 cm
VW018	Snellen, I. (Cambridge)	GPS sources 0626x82. 20 cm

No.	Observer(s)	Program
W004	Venturi, T. (Bologna) Bondi, M. (Bologna) Dallacasa, D. (Bologna) Fanti, R. (Bologna) Mantovani, F. (Bologna) Padrielli, L. (Bologna) Stanghellini, C. (Bologna) Comastri, A. (Bologna) Ferrari, A. (Torino)	Gamma-ray loud blazars. 6 cm
W015	Claussen, M. Ulvestad, J. Diamond, P.J.J. (Manchester) Braatz, J. (CfA) Wilson, A. (Maryland) Henkel, C. (MPIR, Bonn)	Low frequency structure of the NGC 1052 jet. 6, 18 cm
W016	Gabuzda, D. (Lebedev) Pushkarev, A. (Lebedev) Kochanev, P. (Moscow/SSAI) Cawthorne, T. (Lancashire)	Polarization of BL Lac objects. 6 cm
W018	Snellen, I. (Cambridge) Tschager, W. (Leiden) Schilizzi, R. (NFRA) de Bruyn, A. G. (NFRA) Miley, G. (Leiden) Rottgering, H. (Leiden) van Langevelde, H. (Leiden) Fanti, C. (Bologna) Fanti, R. (Bologna)	GPS galaxies and quasars. 18 cm
W020	Minter, A. Langston, G. Ghigo, F. Perlman, E. (STScI) Carilli, C. Stocke, J. (Colorado/JILA) Conway, J. (Chalmers, Onsala)	PKS 1413+135. 6, 18 cm
W027	Murphy, D. (JPL) Conway, J. (Chalmers, Onsala) Polatidis, A. (NFRA) Preston, R. (JPL) Tingay, S. (JPL) Jones, D. (JPL) Meier, D. (JPL) Hirabayashi, H. (ISAS, Japan) Kobayashi, H. (ISAS, Japan)	Monitoring of 1928+738. 6 cm

No.	Observer(s)	Program
W030	Tingay, S. (JPL) Jauncey, D. (CSIRO) Reynolds, J. (CSIRO) Tzioumis, A. (CSIRO) King, E. (CSIRO) Edwards, P. (ISAS, Japan) Lovell, J. (CSIRO) Hirabayashi, H. (ISAS, Japan) McCulloch, P. (Tasmania)	Gamma-ray loud and quiet AGN. 6 cm
W032	Romney, J. Alef, W. (MPIR, Bonn) Backer, D. (UC, Berkeley) Benson, J. Dhawan, V. Kellermann, K. Readhead, A. (Caltech) Vermeulen, R. (NFRA) Walker, R. C.	Core of 3C84. 18, 6 cm
W044	Krichbaum, T. (MPIR, Bonn) Witzel, A. (MPIR, Bonn) Kraus, A. (MPIR, Bonn) Lobanov, A. (MPIR, Bonn) Zensus, J. (MPIR, Bonn)	Intraday variables. 6 cm
W048	Taylor, A. R. (Calgary) Dougherty, S. (DRAO) Peracaula, M. (Barcelona) Paredes, J. (Barcelona)	The core of radio star LSI + 61 303. 6 cm
W049	Hagiwara, Y. (MPIR, Bonn) Kameno, S. (NAO, Japan) Miyoshi, M. (NAO, Japan) Edwards, P. (ISAS, Japan) Kawabe, R. (NAO, Japan) Miyaji, T. (NAO, Japan)	OH absorption in NGC 4945. 18 cm
W059	Kedziora-Chudczer, L. (Sydney) Jauncey, D. (CSIRO) Reynolds, J. (CSIRO) Tzioumis, A. (CSIRO) Wieringa, M. (CSIRO) Nicolson, G. (HartRAO) Quick, J. (HartRAO) Walker, M. (Sydney) McCulloch, P. (Tasmania)	Complete sample of intra-day variables. 6 cm

No.	Observer(s)	Program
W060	Lovell, J. (ISAS, Japan) Edwards, P. (ISAS, Japan) Jauncey, D. (CSIRO) Reynolds, J. (CSIRO) Tzioumis, A. (CSIRO) King, E. (CSIRO) Preston, R. (JPL) Tingay, S. (JPL) Murphy, D. (JPL)	Southern high brightness temperature AGN. 6 cm
W069	Zensus, J. A. (MPIR, Bonn) Lobanov, A. (MPIR, Bonn) Unwin, S. (JPL) Cohen, M. (Caltech)	Jet in quasar 3C345. 6, 18 cm
W079	Meier, D. (JPL) Tingay, S. (JPL) Preston, R. (JPL) Murphy, D. (JPL) Jones, D. (JPL) Fujisawa, K. (NAO, Japan) Hirabayashi, H. (ISAS, Japan) Kobayashi, H. (ISAS, Japan) Edwards, P. (ISAS, Japan)	Centaurus A. 6 cm
W081	Moellenbrock, G. (ISAS, Japan) Roberts, D. (Illinois) Wardle, J. (Brandeis)	Polarization monitoring of gamma-ray blazars. 6, 18 cm
W094	Hirabayashi, H. (ISAS, Japan) Wehrle, A. (JPL) Unwin, S. (JPL) Makino, F. (ISAS, Japan) Kii, T. (ISAS, Japan) Kobayashi, H. (ISAS, Japan) Edwards, P. (ISAS, Japan) Okayasu, R. (ISAS, Japan) Valtaoja, E. (Turku)	3C279. 6 cm polarization

F. SCIENCE HIGHLIGHTS

Green Bank

The 140 Foot Telescope has been used to make a new survey of Galactic HI within 10 degrees of the Galactic plane from longitudes 45 degrees to 185 degrees. Spectra are spaced every 8 arcmin in longitude and latitude and cover a velocity range of -300 to +200 km/s. The new survey is a substantial improvement over previous data in angular resolution, completeness, and sensitivity. The data are now undergoing editing, calibration, baseline removal and correction for stray radiation. The observations should be valuable for studies of HI shells and supershells, the association of HI with molecular clouds and star-forming regions, and supernova remnants.

Investigators: F. J. Lockman; E.M. Murphy (Johns Hopkins)

Socorro

VLA Detects Large-Scale Plasma Structures in Solar Corona - Using an extended radio galaxy as a background source at an average distance of 8.6 solar radii from the Sun's center, observers measured Faraday rotation changes for a polarized component of the background source. A time series of rotation-measure observations showed variations attributed to large-scale gradients and static plasma structures in the solar corona. Weak detection of rotation-measure fluctuations on time scales of 15 minutes to an hour may be due to coronal Alfven waves. These results were used to place model-dependent upper limits on the Alfven wave flux at the base of the corona, limits below the wave flux needed to heat and accelerate the solar wind to its observed values. This corroborates other observational evidence indicating that long wavelength magnetohydrodynamic waves are not responsible for heating and accelerating the solar wind.

Investigators: S. Mancuso and S.R. Spangler (Iowa).

Tucson

Tentative Detections of Two New Interstellar Big Molecules $CH_3OC_2H_5$ and $(C_2H_5)^2O$ - Recent modeling of gas-grain chemistry has demonstrated that many of the organic species in the interstellar medium are not the products of grain-surface reactions. These organic species must in fact be synthesized in the warm gas from simpler species produced on grains. To test this gas-grain chemistry scenario, in particular alcohol chemistry, a search for $(C_2H_5)_2O$ (diethel ether) and $CH_3OC_2H_5$ (methyl ethyl ether) has been made toward the giant molecular cloud cores Sgr B2(N), W51 e1/e2, and Orion-KL. These three molecular cores are good candidates for regions where alcohols have been evaporated from ice mantles.

The preliminary 12 Meter Telescope results indicate clean detections of various line transitions of the two molecular species in the 1 mm, 2 mm, and 3 mm regimes in all three molecular cloud cores. Furthermore, BIMA maps show a clear concentration of CH_3OH toward Sgr B2(N), the Large Molecule Heimat. BIMA detections of $CH_3OC_2H_5$ and $(C_2H_5)_2O$ toward Sgr B_2(N), instead of the more evolved Sgr B_2(M), are also observed unambiguously as predicted by alcohol chemistry. These detections of the two complex molecules not only further confirm the gas-grain chemistry but also require specifically that methanol (CH_3OH) and ethanol (C_2H_5OH) be formed in grain mantles. Methyl ethyl ether ($(C_2H_5)_2O$) is the largest molecule ever discovered in the interstellar medium.

Investigators: Y-J. Kuan (Nat'l Taiwan Normal U. & ASIAA), S. Charnley (NASA/Ames & UC, Berkeley), T. Wilson (SMTO/U. Arizona), M. Ohishi (NAO, Japan), H-C. Huang (Nat'l Taiwan Normal U.), L. Snyder (UIUC).

G. PUBLICATIONS

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

H. CHARLOTTESVILLE ELECTRONICS

Amplifier Development, Design, and Production

During this quarter, two K-band, two Q-band, and four W-band amplifiers were delivered to Socorro in support of receiver upgrade programs. Five additional W-band amplifiers are being held in inventory for support of Socorro and Tucson.

Two of these nominal "W-band" amplifiers represent new development work in support of the ALMA project and the early testing of ALMA antennas to be conducted at the VLA. These modified amplifiers, of robust HFET design, will permit observations from 68 to 118 GHz. Noise performance of less than 70 K was measured from 73 to 113 GHz, with a minimum of 40 K near 78 GHz. Gain is greater than 30 dB from 70 to 118 GHz.

Prototyping and initial tests have been completed on a lower frequency, coaxial input/output amplifier which will see duty both as a low-noise front-end and IF amplifier. The initial development work has yielded an amplifier covering 8 to 18 GHz, with average noise performance below 10 K, and minimum noise of 7.5 K. Further development of the basic design will continue, with the goal of implementing a state-of-the-art, indium phosphide amplifier with excellent performance down to 4 GHz.

Seven C-band amplifiers and two K-band amplifiers were delivered to non-NRAO organizations.

Superconducting (SIS) Millimeter-Wave Mixer Development

During this quarter, work has focused mainly on ALMA development tasks.

SIS Mixers

The first 210-270 GHz mixer made at SUNY/Stony Brook was successfully tested, and found to be comparable with similar mixers made at UVA. The design of a 600-720 GHz building-block mixer is now well under way.

We are following two approaches to the design of balanced and sideband separating mixers for the ALMA. The first uses a single chip containing two SIS mixers, RF quadrature hybrid, and other circuit elements. Balanced and sideband separating mixers of this type have been demonstrated successfully in the 210-270 GHz band, but at higher frequencies the difficulty of attaching the very small waveguide probes to the mixer chip may preclude this approach. The second approach uses a waveguide quadrature hybrid in the mixer block coupled to two simple (building-block) mixers. A quadrature hybrid in WR-10 waveguide has been designed and tested, which should be scalable to ~700 GHz. We have started working with the Hertzberg Institute in Canada to build such a balanced mixer in the 210-270 GHz band as a demonstration of this technology.

During the last quarter we built (or rebuilt) and tested a total of eight SIS mixers: three balanced mixers fabricated at UVA, and five building-block mixers fabricated at SUNY.

SIS Mixer Test Equipment

Work continues on automating SIS mixer testing. This is crucial to production of SIS mixers at the required rate during ALMA construction.

A chopper wheel system was designed and built to allow automated hot/cold load measurements. This included programming the stepper motor controller, designing a trigger circuit that synchronizes chopper motion and data acquisition software, and integrating the control software into the general mixer measurement software (developed earlier). Software was written to produce a real-time plot of the Y-factor, and we are currently examining the trade-off between maximizing the graph's update rate and minimizing data variance. Additional development of the cold load is also required to reduce its effective noise temperature; we have found that the warm (*i.e.*, warmer than 77 K) fog above the LN surface adds significantly to the effective temperature of the cold load.

We completed two refrigerator controllers and two coaxial switch controllers which will be used in the JT mixer test systems.

We have updated the design and documentation of the IF amplifier bias supply which powers the 4 K IF amplifier located in the Dewar immediately after the SIS mixer. Three of these chassis are under construction for use in the two mixer test systems and for development of broadband IF pre-amps. The five printed circuit board designs in each chassis were updated to incorporate as-built changes and additional connectors were added to minimize point-to-point wiring and simplify maintenance.

The user interface for the SIS bias measurement software has been redesigned to minimize data entry errors.

We completed construction of the programmable IF filter chassis, used to scan the 4-12 GHz IF range during mixer measurements.

Components for a gas cell have been ordered. This will permit measurements of a narrow-band source at known temperature in one sideband to confirm receiver performance deduced from the usual simpler but indirect measurement methods.

We have begun the design of optical components for the 600-720 GHz receiver, and have built an optical bench for measuring horns and lenses.

Broadband IF Development

We have begun designing a 4-12 GHz IF amplifier, with 50-ohm input and output, using discrete components. This is based on an existing design for 8-10 GHz and will use GaAs transistors initially. With the experience gained from this, an IF preamplifier for operation inside the SIS mixer blocks will be developed starting in the next quarter.

Work has begun on a 4-12 GHz bias-T for biasing bias SIS mixers connected to an IF preamp inside the mixer block. The parasitic capacitance and inductance of the bias-T must be minimized to avoid reducing the useful IF bandwidth.

Work has also begun on the 4 K, 4-12 GHz IF test plate for the mixer test Dewars. This plate holds an IF selector switch, directional coupler, and a balanced amplifier consisting of two quadrature hybrids and two amplifiers.

We have done simulations of two of S. Weinreb's new InP MMIC amplifier designs connected to SIS mixers. Both look very promising for the 4-12 GHz IF band. These are being fabricated at TRW and should be available to us for evaluation by the end of the year. We are designing test mounts for measurements of these chips.

Millimeter Sources

For mixer development in the 600-720 GHz band, we have ordered two Gunn/multiplier sources from Radiometer Physics in Germany. These will have six mechanical tuners, and so are not ideal for use in automated test equipment.

For low-level measurements such as sideband ratio and antenna patterns of SIS receivers, high order harmonic generators may be more suitable. To this end, we are working with the University of Virginia to develop a simple high-order (n = 5-10) harmonic generator with output in the 600-720 GHz band.

Vacuum Windows

The need for extremely low-loss, low-leakage, vacuum windows on the ALMA has led to the development of solid dielectric windows with multiple matching layers. These are tuned for a single receiver band and must be assembled with considerable precision to achieve the desired pass band. This work was on hold for twelve months following the loss of the key technician, and is now being continued by our engineering staff. At present, we are searching for a suitable adhesive for polyethylene.

To measure low-loss windows and window materials accurately in the 68-950 GHz range, we have been looking into the possibility of using a Fourier transform spectrometer. We have visited several laboratories with commercial FTS's and find that the sensitivity of most instruments below ~300 GHz is insufficient for our needs. This is because of the low output of broadband sources at the lower frequencies. We have applied for time on the National Synchrotron Light Source at Brookhaven, whose far-IR port is equipped with two FTS's. It is quite probable that the NSLS is the only facility where sufficiently accurate FTS measurements can be made in the 68-300 GHz range.

A possible alternative method for measuring windows and materials is to use the HP8510 VNA, and we have designed an optical bench with sample holders for measurements up to 110 GHz. If this method is successful, it can be used to 330 GHz with commercial frequency extenders for the VNA.

Miscellaneous

We have been asked to propose waveguide flange standards for the ALMA. To this end, we have studied the mechanical characteristics and alignment tolerances of the commonly used flange types. Also, we have done a study of the effects of misalignment, both lateral and angular, between flanges. This report will be completed in the next quarter.

At the request of the ALMA photonics group, we designed wideband bias circuits with high and low input impedance for use in the photomixer RFP being prepared in Tucson.

We interviewed applicants for positions as microwave technicians. The very few with the desired qualifications have declined our offers.

Publications

R. S. Amos, A. W. Lichtenberger, C. E. Tong, R. Blundell, S.-K. Pan, A. R. Kerr, "Nb/Al-AlOx/Nb Edge Junctions for Distributed Mixers," *IEEE Trans. Applied Superconductivity*, vol. 9, no. 2, pp. 3878-3881, June 1999.

D. Koller, G. A. Ediss, J. Hesler and C. Cunningham, "FTS Measurements of Some Window Materials," Electronics Division Technical Note No. 184, National Radio Astronomy Observatory, Charlottesville, VA, 31 August 1999.

G. A. Ediss, A. R. Kerr, H. Moseley, K. P. Stewart, "FTS Measurements of Eccosorb MF112 at Room Temperature and 5 K from 300 GHz to 2.4 THz," ALMA Memorandum 273, National Radio Astronomy Observatory, Charlottesville, VA, September 1999.

Electromagnetic Support

GBT - Far-field pattern measurements were done on the Q-band feed. There is good symmetry between the two principal plane patterns. The worst cross-polarization is -27 dB below the peak of the main beam in the 40-50 GHz range. Phase measurements were also done, and the phase center locations at different frequencies have been determined.

VLA - A parametric study of the K-band (18-26.5 GHz) phase shifter was completed using the Quick Wave software. The input waveguide dimensions were found to be critical in relation to the absolute value of the differential phase shift.

Spectrometers/Correlators

During the last quarter, a board layout for the ALMA filter card was completed and sent out for manufacturing. Work was started on the layout for the memory card and the design of the filter card test fixture.

All personalities for the ALMA (GBT clone) test correlator were completed and tested. A small amount of time was spent on testing the GBT clone system as software for it was being written.

Work progressed on the definition of the ALMA correlator chip and back-end. Evaluation of vendors to design the ALMA correlator chip is under way.

Some support was provided for the GBT and Tucson spectrometers.

ALMA Frequency Multipliers

The design of the 85/225 GHz tripler is currently being finalized. A new simulation procedure was developed that integrates the HFSS electromagnetic simulations with MDS harmonic balanced analysis so that multiple varactor circuits can be simulated over a wide operational frequency bandwidth. The tripler design requires the use of a spiral inductor with air bridge and a parallel-plate capacitor—new structures for the UVA fabrication group. 100 GHz test structures for these components were developed. A test fixture was designed and a network analysis calibration procedure devised. Fabrication of the test structures is currently under way at UVA.

I. GREEN BANK ELECTRONICS

GBT Spectrometer

Good progress was made on programming the Spectrometer. The cooling mods have been made. We are still uncomfortable with the final temperature of the chips, but we have decided that we will press on. Backup methods to shut down the spectrometer in case of a cooling failure were implemented.

GBT Fiber IF System

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

GBT Servo System

The servo system has not been operated this quarter since the feedarm was disconnected and rigged for lifting onto the structure. The servo will be reconnected and testing resumed sometime in Q4 1999.

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

GBT Active Surface

An apparent bug has been found in the intelligent I/O Processors used to communicate with the actuators. The vendor worked for a long time on isolating the problem, which the NRAO eventually found and fixed.

The Active Surface software is in good shape. Some work remains in the interface between the Active Surface and the Metrology systems to allow calibration of the actuator using rangefinder data.

GBT Mockup

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

Quadrant Detector

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

Holography System

Further tests of the GBT holography system occurred in July. Some additional dynamic range problems were found, and have been addressed. The tests were a success, and they assure us of early holography success on the GBT.

Equipment Room

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

GBT Receiver Systems

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

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

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

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

GBT Cryogenics

The previously installed cryogenic tubing on the GBT has all been replaced with the fully-welded runs of tubing. About 60 percent of the tubing installation is complete.

Site Operations

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

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

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

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

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

J. TUCSON ELECTRONICS

1mm Array, 220-250 GHz Receiver

This receiver is now in routine use. Several early operational problems have been identified and solved. We have identified two faults in this system which may be the source of the problems with baseline stability which sometimes affects wide-bandwidth measurements. This receiver is the ideal candidate for the development of automatic tuning of receivers, and the software to realize this has been developed and implemented. Although all of our receivers are tuned remotely over the computer network at the telescope site (or even tuned over the Internet from our downtown offices), the precise tuning still relies on the telescope operator closing the loop. The receiver characteristics are such that a simple lookup table of tuning parameters is not adequate to ensure optimum performance. With eight receivers to tune, this clearly puts considerable demand on the operator and can lead to inefficiency in the setup time needed for a new observer, even though the individual receiver channels are less complex to tune than our regular single-beam systems. We are currently using the experience gained with automating the 1mm Array system to modify the tuning procedure for all receivers on the 12 Meter Telescope.

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

A commercially available frequency tripler for the LO has been tested and works well at 4 K. This validates the concept of using coaxial lines to input the LO to the dewar at one third of the LO frequency. The dewar has been built and is currently being tested. The design and fabrication of the basic receiver insert has been completed. A crossed-grid polarization diplexer designed to operate at 4 K has also been constructed and tested. A prototype 2-channel system is currently being tested.

Planned Wideband Continuum Receiver

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

New Phase-Lock Control

One of the most efficient observing modes, generally applicable to relatively narrow bandwidth observations, is frequency switching. Unlike other switching schemes, in this observing mode the object of interest is in the telescope beam and in the spectrometer passband for 100 percent of the time. At present we are limited in our ability to frequency switch, in both switching rate and in total frequency throw, by the analog phase-lock system. We have designed, tested, and installed a digital phase-lock system into our 2/3 mm receiver that combines both frequency and phase control and provides faster, reliable switching over a broader frequency range. We can now routinely switch by as much as ±35 MHz, making frequency switching useable for a wide variety of research projects. We are currently producing digital phase-lock systems for all of our receivers.

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

Receiver Component Servo Systems

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

Cryogenics

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

Quadrant Detector and Thermal Sensors

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

New Digital Spectrometer

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

Software

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

ALMA - The ALMA receiver system development, laser local oscillator and cryogenics, and antenna design are all based in Tucson. The current site testing activities and logistics support are managed out of Tucson. It is important to put effort into these activities, but until ALMA resources become available the staff involved are shared between ALMA development and 12 Meter support. This has been a major factor in delays with the new 8-feed 3-mm receiver, for example.

K. SOCORRO ELECTRONICS

VLA K-Band Front-End

Front-end 8 was installed this quarter. Front-end 9, is undergoing lab testing . Front-ends 10, 11, and 12 are in the process of fabrication.

Two F14s were built and tested last quarter, to make a total of six this year. An additional two units will be assembled and tested for next quarter. As each antenna rotates through the AAB, the F-rack will be wired to accept these units. Additional parts for the 2000 build have been placed on order. In addition, all metalwork has been completed for next years effort.

VLA Water Radiometer

Two units have been installed on Antennas 26 and 28. Due to re-work on the water radiometer detector units, results on this effort remain pending.

VLA-Pie Town Link

Although observations in the PT /VLA mode in A array have proved relatively successful, there still are a number of outstanding hardware tasks.

1. The revised digital optical transceiver card. This card is currently under PCB manufacture. A good number of the components including the laser devices are in hand. This card is desperately needed to overcome current reliability problems encountered with the uni-solated, poorly thermally controlled, low power, high-chirp (but cheap) devices. In addition the precision wavelength control will allow straight-forward transition to a single fiber system.
2. Optical Mux for the single fiber system. We have been analyzing the recently acquired thin film optical filters. Some look better than expected. Three more fixed wavelength filters will be needed to guarantee desired optical properties. As an interim measure the variable optical filters can be used.
3. Installation of revised High Power Analog laser module. A prototype laser card tested now for some weeks works well. Optical heterodyne techniques have been used to analyze both wavelength drift and phase noise characteristics and now have a better idea of what compromises these devices impart on the RF/LO transmission. Another card will need be made and the "old" analog laser be restored to former glory if Alcatel supply free a replacement laser device.
4. The analog optical receiving unit will be upgraded with a lower noise-figured front-end. This will buy an easy 2 dB extra dynamic range.

Amplitude Equalizers for the VLA

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

Increasing the VLA Continuum Bandwidth

Work on increasing the VLA continuum bandwidth on all four IFs continues. The 70 MHz low-pass filters in the screen room have all been tested and retuned as necessary to match group delay. The T3 modules are having several new filters installed. The mixers are being biased and retuned to lower secondary mixer products. Approximately 90 percent of the T3s are complete.

Wye-Com Phone Replacement

When the Wye-Monitor system was installed a couple of years ago, this freed up enough pairs on the wye-com cable to allow installation of regular telephones in the antennas. We have tested the spare pairs and we believe that telephones can be installed.

Analog Sum Fiber Link

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

GPS Receivers

All Truetime GPS receivers for the VLBA stations have been installed. A dual-frequency GPS receiver has been installed at the AOC for testing. This receiver will be moved to the VLA and will be used for ionospheric monitoring.

VLBA Masers

Maser 11 continues to have problems. It ran out of hydrogen and has been refilled. This maser is still under evaluation. Maser 4 is operational at the factory and is awaiting testing. This maser is due to be returned to the AOC in December.

Q-Band Front-ends

Fabrication of three new front-ends was completed early in the third quarter. Two front-ends have been installed and the third is undergoing lab tests. We experienced some problems with the Spacek Mixers that are still under investigation.

VLBA 3-mm Front-ends

The four front-ends were returned to the AOC lab to be outfitted with the new LNAs from the CDL during the third quarter. This depended on the delivery schedule from the CDL. The front-end for Pie Town (PT) was tested in the lab and returned to PT. The front-end from Mauna Kea (MK) was tested in the lab with its old style LNAs and returned to Fort Davis. This will make it easier to return the lab to replace the old LNAs. The front-end from FD had the new LNAs installed and tested in the lab and returned to MK. The front-end from Los Alamos is being configured with new LNAs and the new dewer design. It will be available in mid-November.

Interference Protection

The RF-Environmental Monitoring System (RF-EMS) at the VLA has been undergoing tests the past quarter in order to determine the cause of repeated front-end amplifier failures. The web based setup and control system is being used to check the status of the UHF receiver and the lightning control circuitry. Some preliminary UHF (800-900 MHz) data was taken and plotted for use on the VLA Expansion project. Although there have been some problems with the FE amps, military surplus receivers, and monitor control software, all the hardware and software components are now in place for a wide-band, remotely controlled, spectral logging station.

Assembly is well underway on a prototype mock-up of a satellite tracking station at the VLA. A pad has been poured on which to mount the dish and gimbal assembly, and electric power and control wiring is being run. Bench tests of the tracking control hardware and software have started and the results look good so far. This system should allow IPG monitoring of the power levels and spectral characteristics of emissions from the IRIDIUM, GLONASS, and other planned P- through U-band satellite systems.

Electromagnetic compatibility (EMC) tests of an IRIDIUM handset were performed at the VLA site and at the AOC. The data recorded is being analyzed in order to predict VLA susceptibility to handset transmissions.

Frequency coordination efforts worked on during the summer included informal agreements with WSMR spectrum users regarding VLA notification and coordination. Talks continued with the NM-ARES, and the USFS on the addition or modification of electronic sites near the VLA, and on-site discussions were held with a manufacturer of medical telemetry devices regarding frequency coordination and notification requirements. Recurring notifications and coordination efforts with seven US Air Force Frequency Coordinators continued, as well as special coordination with the US Space Command for GPS tests.

VLBA FRM Rotation Improvements

The control system for the VLBA FRM is being studied in order to improve the response for the rotation axis. The current effort is focused upon a firmware, rather then hardware solution. The VLBA Hancock site was chosen for testing. Work on this project will continue into the fourth quarter. Early results indicate that accuracy and consistent positioning will be traded for speed. The current software can position itself very well, although it can take minutes to do so. Other priorities overshadowed this effort for the third quarter. However, results indicate that the rotational axis changes its response with changes in the elevation axis. More testing will be needed to determine the details of this effect , and if any solution can be found.

Pulsar Fast A/D Card

A system prototyping phase is nearly complete. Testing of the complete path from data gathering to the computer is complete. The next stage of producing a printed circuit board will begin in the fourth quarter. Refinements and some redesign of the timing card also will take place and should be complete in the fourth quarter.

IAT Clock

Both IAT Clocks will be modified to add an indication of whether or not a critical signal is present. This will be complete early in the fourth quarter.

VLBA Weather Station

The VLBA Weather Station TSL Units were plagued by numerous error messages and adjustment problems at each site. The problem appears to be that the infrared transmitters are ageing and thus need to be replaced. The DCS Group will be replacing all IR transmitters at all sites. All should be replaced by next quarter.

VLBA Formatter

Four of the VLBA stations have been outfitted with the formatter expansion which allows 512 Mbit per second recording. More stations will receive the retrofit starting in early 2000. Testing of the new mode has begun.

VLBA Tape Recorders

It is planned to continue outfitting the VLBA tape drives with dry air kits in 2000, dependent on funding. Work is now being done to fully document the kit, this would enable other users of the drive to build it.

L. COMPUTING AND AIPS

Observatory-wide Computing

Security: A formal security policy is being developed, and key computing staff are receiving additional training in computer security issues to ensure that we understand our options and their potential impact. We plan to enhance our incident response procedures, and to make changes in our networking configuration that will minimize our vulnerability to intrusions without significantly affecting access to essential services by legitimate outside users. We are also making plans to increase security awareness among NRAO's computer users. All NRAO sites are conducting an inventory of computer-based services provided to sites outside the NRAO Intranet.

To reduce the risks associated with remote access, the NRAO has strongly recommended, and may eventually require, the use of the secure shell (*ssh*) package for login connections between NRAO sites and our users' home systems. *ssh* encrypts the transmitted data, including passwords, and thus hides account information from "sniffer" programs. *ssh*, which is available for both UNIX and Windows in free and commercial versions, is supported at all NRAO sites, and we continue to urge NRAO's user community to install *ssh* on the computers that they will use to connect to our systems. A number of licenses of SecureCRT, a product for Windows computers which incorporates *ssh*, have been purchased for use by NRAO staff at work, on laptop computers used while traveling, and for accessing NRAO facilities via modem connections.

Document Formats: The Adobe PDF and PostScript formats are very popular for exchanging documents in a platform- and application-independent way. We are encouraging greater use of such formats as an alternative to sending binary files specific to applications such as Microsoft Word or Corel WordPerfect, which may not be available to all recipients, and are providing the capability of writing PDF format (which is more compact than PostScript) to more users of both the MS-Windows and UNIX environments.

AIPS

Versions: At present we are in the process of creating the final standard distribution of AIPS (15OCT99). TST will become 31DEC99, the so-called "AIPS for the Ages." It will be available from our ftp site continuously, and will continue to be patched and developed where necessary over the next two to three years. AIPS is currently distributed nightly to all NRAO sites and to seven non-NRAO sites in the US, Europe, and Japan. In the future, we expect the nightly distribution list to grow as the "Midnight Job" becomes the standard method for obtaining AIPS. Full support for SVLBI processing has been available since 15APR98.

The 15OCT98 version of AIPS has been distributed to over 300 sites, running Solaris, Linux, DEC Alpha, HP, and SGI versions. The overall number of AIPS installations has continued to grow over the last two years.

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

General Issues:

- Continued support of GPS external calibration information.
- Various bug fixes in support of single-dish beam-switched processing.
- Bug fixes and upgrades to PCCOR.
- New pseudoverbs were added in support of task-based SAVE/GET files.
- Improvements to interactive editing tasks.

- Improvements/bug-fixes to experimental data-writing task FITAB.
- New task to generate IMAGR clean regions based on NVSS information; this task is very useful for low-frequency imaging.
- EXTAB: A new task to export AIPS table data to other programs (e.g. spreadsheets and databases) via text files. Also serves as a paraform for translating AIPS tables to text formats with data selection.
- CLIPM - New task - a CLIP geared to multi-source input files with flag table output.
- The solution SNR calculations in KRING for the Least-Squares and FFT sections now agree; other capabilities were also added.
- The NRAO midnight job now uses Secure Shell for access control.

Hardware

Computers: The budget for hardware acquisition and refurbishment has been small, and highest priority has been given to hardware needed for the upgrade to the VLA on-line system, to wide-bed printers required for engineering design and large-format astronomical presentations, and to computer-driven projectors. Only a limited number of workstation upgrades has been possible, and these are essentially complete. Approximately 50 upgrades must be done each year to sustain even a five-year lifetime for UNIX workstations; this year we were able to do less than 20, with the drastic reduction affecting both staff desktops and facilities for visiting observers. Five years is the longest that a system can be considered useful in the face of vendor support restrictions and the steady increase in resources required by operating systems and applications.

Networking: The installation of videoconferencing capability, which is funded by a special grant from the NSF, is well underway at all four major NRAO sites (Charlottesville, Green Bank, Socorro, and Tucson). Networking bandwidth is being increased Observatory-wide, both to support videoconferencing and to provide faster data transfer. These augmentations are complete in Charlottesville, Green Bank and Tucson and will soon be completed in Socorro. The increased bandwidth between Charlottesville and Green Bank also enhances Green Bank's connectivity to the Internet, which will be required to support remote observing with the GBT. Orders have been placed for some of the videoconferencing equipment, and we are in the process of obtaining quotes for the remainder. The systems should be installed at all sites by the end of 1999 and available for general use early in 2000. The NRAO equipment will use H.323 protocol, with a gateway to H.320 (ISDN). Because of this adherence to common standards, we expect our facilities to operate well with most popular videoconferencing equipment.

GB Computing

As part of the Observatory-wide computer upgrade, we purchased five PCs earlier this year. These were used initially to provide workstations for the summer students. They are now being deployed in the manner for which they were acquired—to replace aging Sun workstations. At the same time, we will be moving the computers which were used for the 140 Foot Telescope into general service to replace other old machines. We were also able to purchase a more modern dual-processor Sun as a general purpose workstation to replace the central computer server (arcturus). The delivery of this was delayed because of production problems at the manufacturer (Sun Microsystems), but it has now been received and is being configured for general use.

It is not surprising that tests have shown that 64 MB is totally inadequate memory for a Sun Ultra computer to support AIPS++ applications for the GBT, especially when they have to coexist with other major applications requiring a large amount of memory. Since all public machines in Green Bank and all computers used by the GBT scientific support staff are Ultras, we made the decision to upgrade all Sun Ultra computers to at least 256 MB main memory.

We have undertaken a major effort to apply all recommended security patches to the Linux and Solaris operating systems. Although this is a job that is never complete, we have installed all security patches recommended by the vendors on all but three systems. These three systems are scheduled to be replaced by PCs running Linux. We have installed a computer on the input port of our router to monitor all network traffic for security breaches. Also, to shield us from unwanted intrusion, electronic mail, Telnet, and rlogin are now only supported on our primary domain server (sadira) from non-NRAO locations.

To provide a more uniform environment for our Windows users, we have embarked on a program to upgrade all of the Windows 95 computers to Windows NT.

SO Computing

Hardware - In the first year of centrally administered Linux support, the AOC has added approximately 40 workstations and laptops that run this operating system. Nearly all standard software packages available under Solaris have been installed for use under Linux, including but not limited to AIPS, AIPS++, IRAF, miriad, GIPSY, SCHED and JOBSERVE.

Y2K Preparation - The NRAO-NM computing department will begin the final phases of ensuring Y2K compliance over the next few months. All SGI systems have been upgraded to IRIX 6.5.3. All of the Sparc systems at both the AOC and VLA will be upgraded to Solaris 2.6. The Linux systems will be upgraded to Redhat 6.0. All system upgrades should be completed by the end of November. For the two remaining SunOs 4.x machines we will install software patches because they must continue to run SunOS 4.x for 9-track tape compatibility reasons.

The operating system for the VLA control computers now has been updated with the Y2K patches. Application software for Y2K compliance was also installed during the September update.

User Support - The AOC help desk has been in existence since the beginning of July. During the first 2.5 months approximately 200 requests were received, 130 of those requests have been resolved. Many of the remaining requests are long term projects. The help desk is staffed Monday through Friday 9 a.m. to 12 p.m. and 1 p.m. to 4 p.m. The office may be reached at 835-7213. Tickets may be submitted by either sending mail to helpdesk@aoc.nrao.edu or by pointing a web browser at http://helpdesk.aoc.nrao.edu and filling out the form.

Software Support - We updated our local IRAF installation, allowing our local users of this system access to its latest release. We also installed a completely new version of the TeX typesetting package. We expect this new package to interact much better with the TeX macros provided by the American Astronomical Society for electronic submission of papers to their journals.

VLA Online System - Testing of the new VLA correlator controller has begun. This system will eventually replace the VLA correlator's system controller, a Modcomp computer, and the Array Processor. Enough hardware and software is now complete to allow initial testing at the VLA site.

The VLA Expansion computing team is defining system requirements, evaluating technology, and developing a computing plan. They have begun development of an interface to the VLA monitor and control system. This interface will be used by the new control system during the transition from current to modified VLA antennas, and as a testbed for the expansion computing design.

A prototype of a computer system which will deliver geometric delays for the VLA Expansion and the VLBA correlator has been built. This model server is built on Goddard Space Flight Center Calc version 9.1 and runs on an independent computer. Requests from the instruments for delays come over a network connection. The prototype is under test with the VLBA correlator.

Public Relations - The Computer Division provided programming support in transferring the slide show in the VLA visitor center from VCR tape to a completely PC based version. At the same time, we used modern software techniques to enhance the sound quality of the show.

Y2K Issues

Telescope Operations: With the exception of the GBT, for which the software is still under development, all NRAO telescopes that are expected to be in operation after December 31, 1999, have now been tested successfully. Tests of the GBT monitor and control software, which is designed for Y2K compliance, are scheduled for late 1999, well in advance of commissioning. Some final minor tests on the VLBA will be done in the fall to insure that the correlation still functions properly with all parts of the observing and correlation process using dates beyond the rollover; however, since the computer's clock is not used in correlation and the operating system is known from other testing to be compliant, no problems are anticipated. One of the two VLBA operations database servers also needs an upgrade to its DBMS software to ensure Y2K compliance; this has been scheduled.

Fiscal: Extensive tests of the NRAO software and databases used for Fiscal purposes, such as Purchasing and Accounts Payable, were successfully conducted in July on the IBM AS/400 computer in Green Bank. The most recent patch levels were first applied to both the operating system and the JD Edwards applications software, including patches specific to Y2K problems. Testing was conducted using a duplicate copy of current production data, and involved both monitoring the behavior of the system during the transition from 1999 to 2000 and subsequent data entry by several users. The tests simulated normal activity at the beginning of 2000, particularly year-end closing procedures for 1999 (a vital operation). All critical functions were exercised, including report-generation routines written in-house. Month-end processing for January was also simulated.

No problems occurred in any of the tests. For the remainder of 1999, the release of vendor-supplied Y2K-related patches for these systems will be monitored and any new fixes will be applied promptly.

Computing: With one exception, the compliance of all critical computing systems has already been verified. The exception is a database server in Socorro which is used to handle the inventory and maintenance history of the VLA and VLBA antennas and electronics. This function is being moved to a Y2K-compliant Windows NT-based server in early November. The Windows-based system has been running and tested for several months, and preparations for this migration are in their final stages. For the few remaining non-critical NRAO systems which are not already Y2K-compliant, the final round of upgrades and patches to operating systems is currently underway. We expect these to be completed by November.

Y2K compliance information is being maintained for as many as possible of the most common third-party software packages in use by NRAO staff, as part of our overall software inventory. (Note: mission-critical software was identified in 1997 and has already been specifically addressed; we refer here to programs used regularly but which would not seriously affect fundamental Observatory operations should they malfunction.) The inventory is accessible via the web only from within the NRAO/AUI. For a copy of the inventory, please contact Ruth Milner, rmilner@nrao.edu .

In-house utilities on UNIX systems are being evaluated for date sensitivity; since these programs are primarily used for logging and reporting functions, we do not anticipate that any significant operational issues will be found.

Outside Services: Our efforts to obtain Y2K compliance status information from outside providers such as utilities, communications, financial institutions, and emergency services affecting all NRAO sites have met with mixed success. In some cases these organizations have made fairly extensive information available on the web; in others it has proven more difficult to get a response. Where response has not been satisfactory, we are following up with further contact to obtain up-to-date information. Contingency plans are being developed to deal with problems that may occur with critical services and/or those which do not appear to be Y2K-ready.

Contingency Planning - Although the NRAO has conducted a thorough and comprehensive program of internal assessment and testing, the year 2000 transition may still cause disruptions in its operations through the potential effects on services from outside providers.

In July of 1999, a memo regarding the need for Y2K contingency planning in specific areas was circulated to all NRAO management responsible for site operations. Most operations divisions have now reviewed their contingency plans. This activity will continue as the rollover approaches and more explicit information about the preparedness of external agencies becomes available.

In general, the NRAO will handle Y2K situations by following the emergency procedures already in place to deal with severe weather and other natural disasters, which may similarly affect critical services such as power, communications (data and voice), and transportation (including shipping and supply). Site management, and key divisions such as Computing and Telescope Operations, will have critical personnel either on NRAO premises or available at short notice during and immediately after the year-end rollover, both to resolve any in-house problems and to determine the appropriate response to any externally-caused disruptions.

All critical computing equipment for all telescopes and NRAO offices is equipped with UPSs which can support equipment through short-term power failures (generally 30-120 minutes). Green Bank, the VLA, the 12 Meter, and all VLBA sites are also equipped with generators and fuel tanks. The VLA and the 12 Meter can generate power for the entire site for well over a week in the event of a prolonged continuous electricity outage. It is not generally advisable to continue observing under these conditions, but the backup will ensure "safe hold" status to prevent damage to telescope equipment and electronics. Stored fuel can also be used to ensure that NRAO vehicles are available to transport essential staff to and from the telescope sites. However, a protracted shortage of fuel and/or external electrical power at any site will necessarily result in partial or complete shutdown of telescope operations.

Except for the submission of telescope observing files, problems with data and voice communications will cause little or no disruption to VLA and 12 Meter operations. Observers will be asked to send files for early 2000 well in advance.

Operating the VLBA requires special planning for the availability of data tapes at all sites, communications between the sites and the AOC, the possibility of isolated failures affecting individual antennas and thus the scheduling of suitable observing programs. Plans are being developed to handle all of these situations.

The Fiscal division has made contingency plans to cover its critical functions, including both payroll and accounts payable, in the absence of electricity, communications, banking services, computer equipment, and/or delivery services.

In June, the computer divisions at all sites inventoried their requirements for such supplies as paper, toner, and magnetic media, and a three-month reserve has been stocked in case of supply problems in early 2000. Other divisions across the Observatory have been encouraged to do the same for any easily-storable items required for their work. Warehouse locations at the VLA site and in Green Bank carry sufficient inventory of many consumables to last a minimum of several weeks.

M. AIPS++

The first public release of AIPS++ was issued on October 4. This follows many months of testing and defect fixing by the project staff. In addition, we have had some feedback from scientists testing the system.

There is a binary release that can be run from the CDROM, or installed to a local disk and run from there. Installation is very straightforward and requires no special access. The operating systems supported are Linux (RedHat 5.1, 5.2, and 6.0, SuSE 5.2, 6.0, 6.1, and 6.2), and Solaris (2.5.2 and 2.6).

This version of AIPS++ offers the scripting environment Glish, a graphical user interface, a wide range of general purpose and astronomical tools, extensive capabilities for synthesis imaging, straightforward calibration of VLA data, image analysis and display, extensive web-based help and documentation. The next release is planned for April 2000, and will expand on these capabilities, particularly in the areas of mosaicing, and synthesis calibration.

N. GREEN BANK TELESCOPE

The Antenna Structure

The tip of the Upper Feed Arm was raised on Tuesday, July 20, with attendance from many COMSAT and NRAO personnel. The topping-off was made with traditional ceremony, including the appropriate flags. The welding of the Upper Feed Arm was completed just one week later. On July 28, the antenna was moved in elevation from 96 degrees back down to the access position at 77.6 degrees, to continue the installation of the man-lift up the arm, and of the various platforms on the arm. Additional counterweights totaling nearly 200,000 pounds were put in place. This work was completed on August 12, and the antenna was rotated to the "birdbath" position at elevation 66 degrees, the attitude at which the surface panels will be installed.

With this milestone passed, the antenna structure is essentially complete. Work continues on details such as ladders and platforms. The grease in the main azimuth bearing has been flushed and the seal adjusted. The azimuth wheels are scheduled for alignment.

A number of the remaining tasks must await the installation of the panels. Included are such items as the final measurement of the surface using photogrammetry, alignment of the gear sectors in the regions of the elevation gear which have not yet been traversed, checkout and acceptance of the servo systems, and the painting of surfaces marred by welding during the erection of the structure.

The large S-70 derrick crane, a feature of the Green Bank skyline for many years, is no longer needed. The GBT was rotated in azimuth to get it out of the way of the disassembly of the S-70. One of the crawler cranes has been modified for use in the dismantling. The single-most difficult task, the lowering to the ground of the 250 foot boom of the S-70, has been completed. It is currently anticipated that the entire task will be finished by the end of October.

The Surface Panels

The manufacturing of the panels is continuing at the RSI facility in Sterling, Virginia. At the time of this writing the manufacture of 1,710 panels has been completed. After the panel surfaces have been measured on a Coordinate Measuring Machine (CMM) NRAO verifies the calculation of the RMS for each panel, visually inspects selected panels, and witnesses a new set of CMM measurements on selected panels. A total of 1,514 panels (76 percent of the total of 2,004) from 30 tiers have passed the requirement of surface accuracy. The median RMS manufacturing accuracy is 60 microns (2.4 mils); 93 percent of the panels have an RMS of 75 microns or less, and no panel RMS exceeds

100 microns (4 mils). The panels are then painted, and again inspected by NRAO to ensure that the thickness of the paint coat meets the spec for uniformity and adhesion. At this time, 951 panels have passed the paint inspection.

The panels are shipped to Green Bank in modified sea shipping containers, each of which holds between 14 and 20 panels, depending upon the panel size. COMSAT plans to use a total of 20 sea vans. The first van arrived in Green Bank during the week of July 12. At this time, 736 panels had reached Green Bank where they are kept in a temporary storage area near the GBT.

After the antenna was tipped to birdbath, the checking and alignment of the actuators was begun. COMSAT is using two metrologists, each with a total station. One instrument is applied to the alignment of the actuators which support the panels. In order to facilitate the installation of the panels, the actuators are being aligned to within 1/8 inch in each of the three coordinates. After the actuators are aligned to accord with the design parabola they are welded in anticipation of the placement of the panels. By mid-September, 702 actuators (32 percent of 2,209 total) were positioned, and 572 of these had been welded.

The process of installing the panels is now underway. The second metrologist with a total station is supervising the positioning of the panels, but care must also be taken to ensure that the panel gaps are correct for the ambient temperature obtaining at the time of installation. A significant effort was devoted to the installation of the panels of the centrally located tier 26 since that tier is the key to the entire job. Once the placement of the panels of tier 26 was completed satisfactorily, the pace of installation began to accelerate. A total of 217 panels are now in place. When a number of tiers of panels have been installed, a crew will return to make a fine adjustment to the corners, so that the panels will be set with precision with respect to both the actuator and the adjacent panels. This process will use a panel setting tool developed at NRAO by David Parker and Tim Weadon.

GBT Systems

Major scheduled activities completed during the third quarter of 1999 include the completion of the S-band receiver, the installation of an emergency motor generator set for the GBT Electronics and Control Rooms, and the installation of the optical fiber cable between the Jansky laboratory and the GBT. The GBT X-band receiver, VLBA Data Acquisition Rack, and spectral processor were moved from the 140 Foot Telescope to the Jansky laboratory. All major components for the dual beam, dual polarization Q-band receiver were purchased, and the assembly of the receiver is well underway. A beta release of CLEO, the operator and engineer graphical user interfaces for the GBT, was made for users to evaluate. A GBT cable routing plan and a laser safety training program were developed. Drafts of the GBT Operations Plan and Preliminary Specifications for the GBT Archive and Data Analysis Systems were written. An optical guide telescope was acquired.

The GBT holography receiver was tested on the 140 Foot Telescope. The receiver is being modified so that it can be operated at the GBT Gregorian focus in addition to prime focus.

The metrology group measured ranges to a retroreflector on the GBT feedarm. Measurement accuracies were on the order of 10 microns; a factor of 10 less than anticipated.

A two-element, 12 GHz interferometer is being developed at NRAO-Tucson for the GBT. The interferometer will be used to monitor atmospheric phase stability near the telescope. Preliminary estimates indicate that the interferometer can be installed in early 2000.

The proposal for setting GBT surface panels states that the panel corners will be set to an accuracy of 0.002 inch and that most actuator assemblies will be positioned to an accuracy of 0.25 inch. Since the maximum deflection which can be measured with holography is a quarter wavelength, or 0.25 inch at 12 GHz, a consequence of this proposal is that the GBT holography receiver will not be able to accurately measure the large deformations in the surface as originally set. The large deformations will need to be removed with the active surface, using photogrammetry data or laser rangefinder measurements, before holography measurements can be made.

The setting of surface panels, testing of actuator cables, and outfitting of the actuator control room will place large demands upon the NRAO staff, particularly in the Electronics Division.

The duration of control room outfitting will be long because of the amount of work required and the limited amount of space available to perform the work. Most of these activities are not likely to start before early November when COMSAT anticipates cable testing will begin.

Wells showed how a servo-shaping technique called "Posicast" could be used to effectively eliminate the oscillations which occur in the GBT feedarm when the telescope is abruptly moved in azimuth. Posicast appears to be much more effective than other servo control methods (e.g. CPP-B) in removing feedarm oscillations.

GBT Software

We say goodbye to our student Kevin Crump, who is returning to complete his studies at Davis & Elkins College. His skill and enthusiasm working on the Operators' and Engineers' Screens were much appreciated. We wish him well. We are also pleased to welcome Christine Rebinski, another student from Davis and Elkins.

In order to expedite progress in the Monitor and Control group, the Operations group has kindly agreed to process the engineering drawings for the receivers and to produce computer code that will be used to emulate the RF/IF connections in them.

Monitor and Control

We produced a revised schedule for M&C. The main change was to bring forward the IF software manager, which, among other things, is needed for balancing of the IF signals for the spectrometer. It is now complete three months earlier than previously planned. The IF software manager provides a unified way of configuring and monitoring the GBT IF connectivity between the front-ends and the back-ends. The connectivity of each IF as seen by the back-ends is now recorded in a FITS file, so that the tasks reading GBT output data can determine precisely the frequency and bandwidth of the observations.

We have completed the implementation of the algorithm to minimize impulsive motion of the axes of the GBT. Included in this is the option of a sine-cubed profile in addition to the lower order trajectories. In simulations, this shows improved behavior over the sine-squared algorithm proposed by the Jet Propulsion Laboratory. An initial version of a jerk-canceling algorithm has been analyzed with extremely promising results. It looks as if the simple sine profile in addition to the jerk-canceling algorithm may provide almost zero vibration excitation. We have just begun the process of integrating this into the M&C system.

The high level status processing facility is complete. This will continuously monitor and check all antenna drive systems. Alarms for all known abnormal conditions are included. If a problem occurs on an axis, that drive will be disabled by the software and placed in "safe" mode. Only the affected axis will be disabled, allowing normal operation of all other axes to continue. The control software for the holography back-end seems to have worked flawlessly during the tests on the 140 Foot Telescope.

Progress on the GBT spectrometer has been slower than hoped. We completed an end-to-end test of the spectrometer control software. By monitoring an input signal with two bits of the three- and nine-level samplers, we could see the expected changes produced by varying the control parameters. The design and implementation of the Direct Memory Access drivers for the spectrometer is now complete; the progress here was hampered by a subtle hardware error in the controller.

Operators' and Engineers' Displays

With the completion of the screen to support the operation of the 4-6 GHz front-end, the screens to support all existing receivers are now available. We are now in the advantageous position that, although there are several screens still to be written, these are for hardware devices and for software components of M&C that are not yet complete. For the first time, these do not constitute a pacing item: screens can be produced when needed for testing of the components.

O. MILLIMETER ARRAY PROJECT

At the end of the past quarter the MMA/ALMA Project had completed three of the four major milestones set for the MMA Design and Development phase of the Project; these are:

- Recommendation to the NSF of an international partnership in the Project—this was completed in June 1999 with the agreement between the NSF and European partners for the joint ALMA Project;

- Provision to the NSF of a thorough cost estimate for the construction of the MMA that could be audited—the cost estimate for the Millimeter Array US Reference Project was audited by a NSF Lehman Review Panel in July 1999;
- Receipt of bids from antenna contractors for fabrication of a prototype antenna that meets MMA specifications and is within the budget envelope specified by the Project—these bids from four potential antenna contractors were received at the end of June 1999.

The fourth major Project milestone in the Design and Development phase, permission to use the selected site in Chile, is one that the NSF and our European partners in the ALMA Project agreed would be done in common: its achievement is no longer solely in the province of the US MMA Project.

The milestones and deliverables remaining on the MMA Project list for the Design and Development phase are all focused on preparing for the construction phase of the Project. They include hardware designs and prototypes, many of which will be evaluated on the test interferometer, together with the preliminary and critical design reviews that are part of the process by which the design for each major subsystem is adopted by the Project. These steps will all be done in close collaboration with our European partners in the ALMA Project.

ALMA planning is proceeding in three steps that are being taken in parallel. First, the US Division Heads and their counterparts in Europe and engaged in the process of outlining a joint tasking for the ALMA Design and Development phase. Second these Division Heads are each assisted by an advisory committee of experts that is given the task of reviewing critically the planning as it is made. The US and European advisory committees meet together so that a common, joint, vision can be established for each task. For the US part of the ALMA Project the composition of each of the advisory committees is made up of representatives from the NRAO and the MDC. Finally, the ALMA Executive Committee receives the input from the respective Divisions and has the responsibility to establish a Work Breakdown Structure (WBS) for the joint D&D program. This includes the schedule of tasks to be accomplished and the resources to be assigned to each task.

The process of establishing the scope of the joint ALMA Design and Development program, and a division of tasks between the US and European partners began in earnest at an ALMA Project workshop arranged for this purpose in conjunction with the August meeting of URSI in Toronto. In several of the principal WBS areas the division of tasks is a straightforward extension of the work presently in progress on both sides. This includes work on the IF, LO, the HFET amplifiers in receiver bands 1 and 2, and the baseline Project correlator, all of which is taking place at the NRAO and will continue to be assigned to the US side of the joint Project. In some other areas, principally regarding the site development work that must be done in Chile, the European side is better positioned to take responsibility for the joint effort. In the antenna area it has been agreed that in addition to each side providing a prototype antenna to the Project, the Europeans will take responsibility for design of the antenna transporter, temperature probes, tiltmeters and the reflector panel anti-solar surface treatment. The US side will take responsibility for the design of the nutator, optical pointing telescope, subreflector quadrant detector, and feedleg anti-scattering profile. Finally, for development of the receiver system, and for development of the Project software, joint meetings of the staff on both sides of the Project are being held to set the scope of the Design and Development tasks and to divide the effort equitably.

A draft of the joint WBS will be given to the ALMA Coordinating Committee in November. With their approval, the joint ALMA Project will have the framework needed to operate effectively in 2000. On this same timescale it is expected that the two contracts for antenna prototypes, one placed by the Europeans with a vendor and the other placed by the NRAO with another vendor, will be signed. This dual procurement should not only lead to a superior product keeping technical and cost competition in the process until the time that the contract for the production run of antennas can be placed, but it will also represent a major milestone for the joint US-European ALMA Project.

P. PERSONNEL

New Hires

Breyerton, E.	Electronics Engineer I	08/09/99
Cohen, A.	Junior Research Associate	09/01/99
Donahoe, P.	Vice President, AUI	07/01/99
Giacconi, R.	President, AUI	07/01/99
Harris, G.	Sr Scientific Programmer Analyst	09/20/99
Hayward, R.	Electronics Engineer I	08/02/99

Lauria, E.	Electronics Engineer I	07/26/99
Mares, J.	Junior Engineering Associate	08/23/99
Myers, S.	Associate Scientist	09/01/99
Palmer, P.	Visiting Scientist	07/01/99
Prestage, R.	Associate Scientist - TU Operations	09/15/99

Terminations

Bania, T.	Visiting Scientist	07/12/99
Barnbaum, C.	Visiting Scientist	07/16/99
Faison, M.	Junior Research Associate	08/20/99
Hardee, P.	Visiting Scientist	07/09/99
Helfer, T.	Assistant Scientist - Research Support	08/13/99
Herrnstein, J.	Research Associate	09/28/99
Palmer, P.	Visiting Scientist	07/31/99
Peck, A.	Junior Research Associate	09/15/99
Ray, J.	Junior Engineering Associate	08/13/99
Shores, K.	Junior Engineering Associate	08/20/99
Sumner, M.	Junior Engineering Associate	08/06/99
van Zee, L.	Research Associate	09/30/99

Deceased

Peery, G.	Civil Engineer	08/31/99

Promotions

Frail, D.	to Scientist with Tenure	07/01/99
Hibbard, J.	to Assistant Scientist - Research Support	07/01/99
Runion, G.	to Electronics Engineer I	07/01/99
Schiebel, D.	to Senior Scientific Programmer Analyst	07/01/99
Yun, M.	to Assistant Scientist	07/01/99

Other

Bastian, T.	to Leave for Professional Advancement	07/01/99
Cotton, W.	to Leave for Professional Advancement	08/03/99
Lilie, P.	to Leave of Absence	08/23/99
Roberts, M.	to Gradual Retirement, 50%	07/01/99

PREPRINTS RECEIVED, JULY - SEPTEMBER 1999

ALTENHOFF, W.J.; BIEGING, J.H.; BUTLER, B.; BUTNER, H.M.; CHINI, R.; HASLAM, C.G.T.; KREYSA, E.; MARTIN, R.N.; MAUERSBERGER, R.; MCMULLIN, J.; MUDERS, D.; PETERS, W.L.; SCHMIDT, J.; SCHRAML, J.B.; SIEVERS, A.; STUMPFF, P.; THUM, C.; VON KAP-HERR, A.; WIESEMEYER, H.; WINK, J.E.; ZYLKA, R. Coordinated Radio Continuum Observations of Comets Hyakutake and Hale-Bopp from 22 to 860 GHz.

APPLETON, P.N.; CHARMANDARIS, V.; HORELLOU, C.; MIRABEL, I.F.; GHIGO, F.; HIGDON, J.L.; LORD, S. Plasma and Warm Dust in the Collisional Ring Galaxy VII Zw 466 from VLA and ISO Observations.

BALSER, D.S.; ROOD, R.T.; BANIA, T.M. The 3He Abundance in the Planetary Nebula NGC 3242.

BEASLEY, A.J.; GUDEL, M. VLBA Imaging of Quiescent Radio Emission from UX Ari.

BOWER, G.C.; FALCKE, H.; BACKER, D.C. Detection of Circular Polarization in the Galactic Center Black Hole Candidate Sagittarius A*

BOWER, G.C.; WRIGHT, M.C.H.; BACKER, D.C.; FALCKE, H. The Linear Polarization of Sagittarius A*. II. VLA and BIMA Polarimetry at 22, 43 and 86 GHz.

BRITZEN, S.; WITZEL, A.; KRICHBAUM, T.P.; MUXLOW, T.W.B. The Radio Structure of 1803+784.

BURTON, W.B.; LOCKMAN, F.J. HI Observations Towards the Sagittarius Dwarf Spheroidal Galaxy.

CARILLI, C.L.; KURK, J.D.; VAN DER WERF, P.P.; PERLEY, R.A.; MILEY, G.K. High Resolution Millimeter and Infrared Observations of the Hotspots of Cygnus A.

CHENGJIN, J.; GARRETT, M.A.; NAIR, S.; PORCAS, R.W.; PATNAIK, A.R. Changes in the Angular Separation of the Lensed Images PKS 1830-211 NE & SW.

DALE, D.A.; GIOVANELLI, R.; HAYNES, M.P.; CAMPUSANO, L.E.; HARDY, E. Seeking the Local Convergence Depth. V. Tully-Fisher Peculiar Velocities for 52 Abell Clusters.

DALE, D.A.; GIOVANELLI, R.; HAYNES, M.P.; HARDY, E.; CAMPUSANO, L.E. Seeking the Local Convergence Depth. IV. Tully Fisher Observations of 35 Abell Clusters.

DESMURS, J.-F.; BUJARRABAL, V.; COLOMER, F.; ALCOLEA, J. Observational Support for Radiative Pumping of SiO Masers in Evolved Stars.

DWARAKANATH, K.S.; OWEN, F.N. On the Different Radio Source Populations in the Butcher-Oemler Clusters Abell 2125 and 2645.

FINLEY, D.G. Educating the Public About Interference to Radio Observatories.

FURUYA, R.S.; KITAMURA, Y.; CLAUSSEN, M.J.; WOOTTEN, H.A.; SAITO, M.; MARVEL, K.B.; KAWABE, R. A Micro Jet in the Extremely Young Protostar S106 FIR.

FURUYA, R.S.; KITAMURA, Y.; SAITO, M.; KAWABE, R.; WOOTTEN, H.A. VLA Observations of H2O Masers in the Class 0 Protostar S106 FIR: Evidence for a 10 AU-Scale Accelerating Jet-Like Flow.

GALLIMORE, J.F.; BAUM, S.A.; O'DEA, C.P.; PEDLAR, A.; BRINKS, E. Neutral Hydrogen (21 cm) Absorption in Seyfert Galaxies: Evidence for Free-Free Absorption and Sub-kiloparsec Gaseous Disks.

GIOVANELLI, R.; DALE, D.A.; HAYNES, M.P.; HARDY, E.; CAMPUSANO, L.E. No Hubble Bubble in the Local Universe.

GOMEZ, J.-L.; MARSCHER, A.P.; ALBERDI, A. 86, 43, and 22 GHz VLBI Observations of 3C 120.

HAN, J.L.; BECK, R.; EHLE, M.; HAYNES, R.F.; WIELEBINSKI, R. Magnetic Fields in the Spiral Galaxy NGC 2997.

HIBBARD, J.E.; YUN, M.S. Luminosity Profiles of Merger Remnants.

HOMAN, D.C.; WARDLE, J.F.C. Detection and Measurement of Parsec-Scale Circular Polarization in Four AGN.

HUARD, T.L.; SANDELL, G.; WEINTRAUB, D.A. Submillimeter Maps of Bok Globule Cores: Evidence for Multiple Epoch Star Formation.

PREPRINTS RECEIVED, JULY - SEPTEMBER 1999

HUNTER, D.A.; VAN WOERDEN, H.; GALLAGHER, J.S. Neutral Hydrogen and Star Formation in the Irregular Galaxy NGC 4449.

IMAI, H.; DEGUCHI, S.; MIYOSHI, M. VLBA Observation of SiO Masers in the M Giant IRC-10414.

ISHWARA-CHANDRA, C.H.; SAIKIA, D.J. Giant Radio Sources.

JARRETT, T.H.; HELOU, G.; VAN BUREN, D.; VALJAVEC, E.; CONDON, J. Near/Mid Infrared-Wavelength Study of the Interacting Galaxy Pair UGC 12914/5 -- 'Taffy'

JUNOR, W.; SALTER, C.J.; SAIKIA, D.J.; MANTOVANI, F.; PECK, A.B. Large Differential Faraday Rotation in the CSS Quasar 3C147 and Jet-Medium Interactions.

KAPLAN, D.L.; CORDES, J.M.; CONDON, J.J.; DJORGOVSKI, S.G. Compact Radio Sources with the Steepest Spectra.

KAUFMAN, M.; BRINKS, E.; ELMEGREEN, B.G.; ELMEGREEN, D.M.; KLARIC, M.; STRUCK, C.; THOMASSON, M.; VOGEL, S. The Interacting Galaxies NGC 5394/5395: A Post-Ocular Galaxy and Its Ring/Spiral Companion.

KELLERMANN, K.I.; RICHARDS, E.A. The Nature of Microjansky Radio Sources and Implications for the Design of the Next Generation Very Sensitive Radio Telescopes.

KOBULNICKY, H.A.; JOHNSON, K.E. Signatures of the Youngest Starbursts: Optically-Thick Thermal Bremsstrahlung Radio Sources in Henize 2-10.

KRAUS, A.; WITZEL, A.; KRICHBAUM, T.P. Intraday Radio Variability in Active Galactic Nuclei.

KULKARNI, S.R.; FRAIL, D.A.; SARI, R.; MORIARTY-SCHIEVEN, G.H.; SHEPHERD, D.S.; UDOMPARSERT, P.; READHEAD, A.C.S.; BLOOM, J.S.; FEROCI, M.; COSTA, E. Discovery of a Radio Flare from GRB 990123.

LANG, C.C.; ANANTHARAMAIAH, K.R.; KASSIM, N.E.; LAZIO, T.J.W. Discovery of a Nonthermal Galactic Center Filament (G358.85+0.47) Parallel to the Galactic Plane.

LANG, C.C.; FIGER, D.F.; GOSS, W.M.; MORRIS, M. Radio Detections of Stellar Winds from the Pistol Star and Other Stars in the Galactic Center Quintuplet Cluster.

LANG, C.C.; MORRIS, M.; ECHEVARRIA, L. A Radio Polarimetric Study of the Galactic Center Threads.

LOBANOV, A.P.; KRICHBAUM, T.P.; WITZEL, A.; ZENSUS, J.A. High Resolution Imaging of Parsec-Scale Radio Jets: Impact of the VSOP Observations.

MANGUM, J.G.; WOOTTEN, A.; BARSONY, M. The Kinetic Temperature Structure within NGC 2024.

MASHEDER, M.R.W.; VAN LANGEVELDE, H.J.; RICHARDS, A.M.S.; GREENHILL, L.; GRAY, M.D. VLBI Observations of OH Stars: S Persei.

MATTHEWS, L.D.; GALLAGHER, J.S. III; VAN DRIEL, W. The Extraordinary 'Superthin' Spiral Galaxy UGC 7321. I. Disk Color Gradients and Global Properties from Multiwavelength Observations.

MIGENES, V.; HORIUCHI, S.; SLYSH, V.I.; VAL'TTS, I.E.; GOLUBEV, V.V.; EDWARDS, P.G.; FOMALONT, E.B.; OKAYASU, R.; DIAMOND, P.J.; UMEMOTO, T.; SHIBATA, K.M.; INOUE, M. The VSOP Pre-launch H2O Maser Survey. I. VLBA Observations.

MILLER, N.A.; OWEN, F.N.; BURNS, J.O.; LEDLOW, M.J.; VOGES, W. An X-ray and Optical Investigation of the Environments Around Nearby Radio Galaxies.

MOFFETT, D.A.; HANKINS, T.H. Polarimetric Properties of the Crab Pulsar Between 1.4 and 8.4 GHz.

MUNDELL, C.G.; WILSON, A.S.; ULVESTAD, J.S. Parsec-Scale Images of Flat-Spectrum Radio Sources in Seyfert Galaxies.

PANAGIA, N.; WEILER, K.W.; LACEY, C.; MONTES, M.J.; SRAMEK, R.A.; VAN DYK, S.D. Radio Studies of Supernovae.

PREPRINTS RECEIVED, JULY - SEPTEMBER 1999

PEREZ-TORRES, M.A.; MARCAIDE, J.M.; GUIRADO, J.C.; ROS, E. Differential Astrometry over 15 deg.

REID, R.I.; KRONBERG, P.P.; PERLEY, R.A. VLA Images at 5 GHz of 212 Southern Extragalactic Objects.

RIOJA, M.R.; PORCAS, R.W.; GARRINGTON, S.; ALBERDI, A.; SAIKIA, D.J. Phase-Reference Mapping of a Weak-Cored Double-Lobed Source in the 1636+473 System Using MERLIN and Global VLBI.

ROMNEY, J.D. NRAO Contributions to the VSOP Mission.

ROMNEY, J.D. The VLBA GigaBit-per-Second Data Recording System.

ROS, E.; MARCAIDE, J.M.; GUIRADO, J.C.; RATNER, M.I.; SHAPIRO, I.I.; KRICHBAUM, T.P.; WITZEL, A.; PRESTON, R.A. High Precision Difference Astrometry Applied to the Triplet of S5 Radio Sources B1803+784/Q1928+738/B2007+777.

ROS, E.; ZENSUS, J.A.; LOBANOV, A.P. Multiband Polarimetric and Total Intensity Imaging of 3C 345.

TACCONI, L.J.; GENZEL, R.; TECZA, M.; GALLIMORE, J.F.; DOWNES, D.; SCOVILLE, N.Z. Gas Dynamics in the Luminous Merger NGC 6240.

TURNER, B.E. Translucent Clouds as Testbeds of Basic Chemical Networks.

VAN LANGEVELD, H.J.; DIAMOND, P.J.; VLEMMINGS, W.; BAUDRY, A.; HABING, H.J.; SCHILIZZI, R.T. VLBI Measurementss of the Parallax & Proper Motion of U Herculis.

VAN ZEE, L.; BRYANT, J. Neutral Gas Distribution and Kinematics of the Nearly Face-On Spiral Galaxy NGC 1232.

VENTURI, T.; TAYLOR, G.B. The Galactic Magnetic Field in the Quasar 3C 216.

YUN, M.S.; CARILLI, C.L.; KAWABE, R.; TUTUI, Y.; KOHNO, K.; OHTA, K. Sensitive Radio Observations of High Redshift Dusty QSOs.

YUN, M.S.; HO, P.T.P.; LO, K.Y. New 24 Field VLA Mosaic Imaging of HI in M81 Group.