# NATIONAL RADIO ASTRONOMY OBSERVATORY

# QUARTERLY REPORT

October 1, 1996 - December 31, 1996

# TABLE OF CONTENTS

## A. TELESCOPE USAGE

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

| | 140 Foot | 12 Meter | VLA | VLBA |
|---|---|---|---|---|
| Scheduled Observing (hrs) | 1524.75 | 1683.25 | 1680.50 | 1082.80 |
| Scheduled Maintenance and Equipment Changes | 203.75 | 61.75 | 226.00 | 208.00 |
| Scheduled Tests and Calibration | 379.50 | 394.50 | 250.60 | 469.00 |
| Time Lost | 63.50 | 203.75 | 71.10 | 45.00 |
| Actual Observing | 1461.25 | 1479.50 | 1609.40 | 1037.80 |

## B. 140 FOOT OBSERVING PROGRAMS

The following continuum programs were conducted during this quarter.

| No. | Observer(s) | Program |
|---|---|---|
| D191 | de Pater, I. (UC, Berkeley)<br>Heiles, C. (UC, Berkeley)<br>Maddalena, R.<br>Millan, R. (UC, Berkeley)<br>Wong, M. (Michigan) | Observations of the aftermath of the comet Shoemaker-Levy with Jupiter crash. |

The following line programs were conducted during this quarter.

| | | |
|---|---|---|
| B654 | Barnbaum, C. (StScI)<br>Morris, M. (UCLA)<br>Omont, A. (IAP, Paris) | Observations of OH and $H_2O$ masers associated with the extraordinary star, U Equ. |
| B660 | Bania, T. (Boston)<br>Rood, R. (Virginia)<br>Balser, D.<br>Wilson, T. (MPIR, Bonn) | Measurements of the cosmic abundance of $^3$He. |
| B662 | Balser, D.<br>Bania, T. (Boston)<br>Huang, M. (Boston)<br>Shah, R. (Virginia)<br>Rood, R. (Virginia)<br>Jackson, J. (Boston) | Measurements of carbon radio recombination line emission in galactic HII regions. |
| B665 | Bell, M. (NRC, Herzberg)<br>Thaddeus, P. (CFA) | Observations to measure the astronomical abundance of long carbon-chain molecules. |

| No. | Observer(s) | Program |
|---|---|---|
| B668 | Burton, W. B. (Leiden)<br>Hartmann, D. (CFA)<br>Blitz, L. (UC, Berkeley) | Observations at 1420 MHz of extensive high-velocity HI gas near M31 and M33. |
| B669 | Burton, W. B. (Leiden) | HI observations of the properties of the Wannier *et al.* enigmatic high-velocity clouds. |
| C310 | Claussen, M.<br>Beasley, A. | A survey of 12.2 GHz methanol masers toward ultra-compact HII regions. |
| S412 | Sembach, K. (MIT)<br>Murphy, E. (Johns Hopkins) | A search for galactic, neutral hydrogen, high-velocity clouds near PKS 2155-304. |
| S415 | Schloerb, F. P. (Massachusetts)<br>Lovell, A. (Massachusetts)<br>De Vries, C. (Massachusetts)<br>Senay, M. (Massachusetts)<br>Irvine, W. (Massachusetts)<br>Wootten, H. A. | OH radio observations of comets Hale-Bopp and Wirtanen. |
| SETI | Tarter, J. (SETI Institute) | Project Phoenix. |
| T336 | Tifft, W. (Arizona) | Terminal 140 Foot standard 21 cm observations. |
| T363 | Turner, B.<br>Xiang, D. (Purple Mountain Observatory) | A search for $H_2O$ in IRC 10216. |
| V085 | Verschuur, G. (Rhodes College) | 21 cm search for evidence of toroidal magnetic field structure around HI filaments. |
| W280 | Wootten, H. A. | $H_2O$ monitoring in star forming cores in Rho Oph. |

The following pulsar programs were conducted during this quarter.

| No. | Observer(s) | Program |
|---|---|---|
| A118 | Arzoumanian, Z. (Cornell)<br>Nice, D. (Princeton)<br>Taylor, J. (Princeton)<br>Taylor, H. (Princeton) | Bimonthly timing of 63 pulsars at 575, 800, and 1420 MHz. |
| B617 | Backer, D. (UC, Berkeley)<br>Sallmen, S. (UC, Berkeley)<br>Foster, R. (NRL)<br>Matsakis, D. (NRL) | Pulsar timing array observations at 800 and 1395 MHz. |
| M386 | McKinnon, M.<br>Fisher, J. R. | A 1.3-1.8 GHz polarization model test and timing of young pulsar PSR B1823-13. |

The following very long baseline programs were conducted during this quarter.

| No. | Observer(s) | Program |
|---|---|---|
| GW014 | Leppanen, K. (Helsinki) *et al.* | A sample of 15 AGN. |
| VT004 | Edwards, P. (ISAS, Japan) | Ground telescope tests for VSOP. |

## C. 12 METER OBSERVING PROGRAMS

The following line programs were conducted during this quarter.

| No. | Observer(s) | Program |
|---|---|---|
| B666 | Beasley, A.<br>Holdaway, M. | Polarization monitoring at 3 mm. |
| C307 | Clancy, R. T. (Colorado/JILA)<br>Sandor, B. (Colorado/JILA) | Mars/Earth studies. |
| C308 | Crosthwaite, L. (UCLA)<br>Turner, J. (UCLA) | CO mapping of interaction structures in the Leo Triplet. |
| C309 | Crosthwaite, L. (UCLA)<br>Turner, J. (UCLA) | Large-scale CO mapping of spiral galaxies. |
| E64 | Evans, N. (Texas)<br>Gregersen, E. (Texas)<br>Mangum, J.<br>Wootten, H. A. | Study of $H_2CO$ in class O sources. |
| G353 | Gensheimer, P. (MPIR, Bonn)<br>Ziurys, L. (Arizona State)<br>Wilson, T. (MPIR, Bonn) | Search for $SiC_2$ in Sgr B2 and Orion KL. |
| G354 | Gensheimer, P. (MPIR, Bonn)<br>Wilson, T. (MPIR, Bonn)<br>Mauersberger, R. (Arizona)<br>Dahmen, G. (Queen Mary)<br>Hüttemeister, S. (CFA) | Mapping of CO in the galactic center. |
| G355 | Gensheimer, P. (MPIR, Bonn) | Search for the J = 14–13 transition of HCCNC toward IRC+10216. |
| G356 | Gensheimer, P. (MPIR, Bonn)<br>Wilson, T. (MPIR, Bonn)<br>Mauersberger, R. (Arizona) | CO observations of ρ Ophiuchi B. |

| No. | Observer(s) | Program |
|---|---|---|
| G358 | Guélin, M. (IRAM)<br>Ziurys, L. (Arizona State)<br>Apponi, A. (Arizona State) | Confirmation of circumstellar $^{26}$AlCl: testing nucleosynthesis in AGB stars. |
| G360 | Giannakopoulou, J. (Waterloo)<br>Fich, M. (Waterloo)<br>Wilson, C. (McMaster U.) | Clues to formation of giant HII regions: the molecular gas content of two giant HII regions in M101. |
| H322 | Hunter, D. (Lowell Obs.)<br>Walker, C. E. (Arizona)<br>Wilcots, E. (Wisconsin) | Molecular gas in the extended HI around the irregular galaxy NGC 4449. |
| K354 | Koo, B-C. (Seoul National U.)<br>Moon, D-S. (Seoul National U.)<br>Turner, B. | Study of the shocked molecular region W51C. |
| K355 | Koo, B-C. (Seoul National U.) | CO J = 2–1 line observations of the shocked molecular gas in W51 SNR. |
| L322 | Lavezzi, T. (Minnesota)<br>Dickey, J. (Minnesota)<br>Mack, J. (Minnesota) | Calibration of the Tully-Fisher relation using the 115 GHz $^{12}$CO (1–0) transition. |
| M395 | Mangum, J.<br>Latter, W. (NASA/Ames)<br>McMullin, J. (Arizona) | A derivation of the physical conditions in the Serpens molecular cloud. |
| M400 | Mauersberger, R. (Arizona)<br>Havenith, M. (IAP, Bonn)<br>Wilson, T. (MPIR, Bonn) | A search for interstellar van der Waals complexes. |
| M401 | Mangum, J.<br>Wootten, H. A.<br>Butler, B.<br>Bockelée-Morvan, D. (Paris Obs.) | Study of the thermal evolution of Comet C/1995 O1 (Hale-Bopp). |
| M403 | Mauersberger, R. (Arizona)<br>Henkel, C. (MPIR, Bonn)<br>Chin, Y. (Bonn U.)<br>Langer, N. (MPIfEP, Garching) | Study of interstellar CS: $^{12}$C/$^{13}$C and $^{34}$S/$^{33}$S ratios. |
| S413 | Smith, B. (IPAC)<br>Pogge, R. (Ohio State) | Study of tidal debris and star formation in the NGC 7714/5 bridge. |
| S414 | Senay, M. (Massachusetts)<br>Schloerb, F. P. (Massachusetts)<br>Irvine, W. (Massachusetts) | Sublimation region mapping of Comet Hale-Bopp. |
| T365 | Turner, B. E. | Study of the nature and evolution of molecular clouds. |

| No. | Observer(s) | Program |
|---|---|---|
| W363 | Wannier, P. (JPL)<br>Andersson, B. (JPL)<br>Moriarty-Schieven, G. (Royal Obs.) | An unusual, dusty ring in Perseus: CO observations. |
| W370 | Ziurys, L. (Arizona State)<br>Wyckoff, S. (Arizona State)<br>Wehinger, P. (Arizona State)<br>Kleine, M. (Arizona State) | $^{12}C/^{13}C$ ratios in molecular clouds from CN: Chemical processing in the pre-solar nebula. |
| W380 | Woodney, L. (Maryland)<br>A'Hearn, M. (Maryland)<br>McMullin, J. (Arizona)<br>Samarasinha, N. (KPNO-NOAO) | Study of sulfur chemistry in Comet Hale-Bopp (C/1995 O1). |
| W381 | Wyckoff, S. (Arizona State)<br>Wehinger, P. (Arizona State)<br>Ziurys, L. (Arizona State)<br>Apponi, A. (Arizona State)<br>Pesch, T. (Arizona State) | Study of HCN and CN in Comet Hale-Bopp. |
| W382 | Womack, M. (Penn State)<br>Festou, M. (Midi-Pyrenees Obs.)<br>Mangum, J.<br>Stern, A. (Southwest Research Inst.) | Study of CO, $H_2CO$, $CH_3OH$, and HCN in Comet C/1995 O1 (Hale-Bopp). |
| W383 | Womack, M. (Penn State) | Study of Comet Tabur. |
| Y11 | Yu, T. (UC, Berkeley)<br>Welch, W. J. (UC, Berkeley) | Study of ρ Ophiuchi B1. |
| Y19 | Yun, M.<br>Verdes-Montenegro, L. (IAA, Andalucia)<br>Perea, J. (IAA, Andalucia)<br>del Olmo, A. (IAA, Andalucia) | CO survey of Hickson groups. |
| Z140 | Ziurys, L. (Arizona State)<br>Mangum, J.<br>Apponi, A. (Arizona State) | A study of the vibrationally excited emission in protostellar environments. |
| Z141 | Ziurys, L. (Arizona State)<br>Apponi, A. (Arizona State)<br>Robinson, B. (Northwestern)<br>Allen. M. (Arizona State) | Searches for metal monomethyl species: $AlCH_3$ and $FeCH_3$. |
| Z145 | Ziurys, L. (Arizona State) | Study of NaCCH in IRC+10216. |

The following VBLI programs were conducted this quarter.

| No. | Observer(s) | Program |
|---|---|---|
| CB07 | Bower, G. (UC, Berkeley)<br>Backer, D. (UC, Berkeley)<br>Wright, M. (UC, Berkeley) | Study of the anatomy of a millimeter-wave flare. |
| CD05 | Doeleman, S. (Haystack) | Evolution of a new radio flare in N-Galaxy 3C111. |
| CG03 | Greve, A. (IRAM) | A 2 mm test experiment between Pico Veleta, Kitt Peak, and SEST. |
| CJ02 | Junor, W. (New Mexico)<br>Biretta, J. (STScI) | Close to the edge: within 30 $r_g$ of the supermassive core of M87. |
| CK03 | Krichbaum, T. (IRAM) | Evolution of the sub-parsec scale jets in highly active blazars. |
| CP01 | Porcas, R. (MPIR, Bonn)<br>Rioja, M. (NFRA)<br>Graham, D. (MPIR, Bonn)<br>Machalski, J. (Krakow U.) | Investigation of the quasar pair 1308+326/1308+328 at 86 GHz. |
| CZ01 | Zensus, J. A.<br>Krichbaum, T. (IRAM)<br>Witzel, A. (MPIR, Bonn)<br>Graham, D. (MPIR, Bonn)<br>Grewing, M. (IRAM) | Physics of the jet in quasar 3C 345 at sub-parsec resolution. |

## D. VERY LARGE ARRAY OBSERVING PROGRAMS

Fourth quarter, 1996 was spent in the following configurations: AD Configuration from October 1 to October 15 and A Configuration from October 15 to December 31.

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

| No. | Observer(s) | Program |
|---|---|---|
| AA205 | Anantharamaiah, K. (Raman Institute)<br>Goss, W. M.<br>Subrahmanyan, R. (Raman Institute) | Recombination lines towards PKS 1830-211. 20 cm line |
| AA206 | Aoki, K. (NAO, Japan)<br>Wilson, A. (Maryland)<br>Yoshida, M. (NAO, Japan)<br>Ohtani, H. (Kyoto)<br>Kosugi, G. (NAO, Japan) | High velocity outflow in the Seyfert galaxy NGC 7319. 3.6, 6, 20 cm |
| AA207 | Attridge, J. (Brandeis)<br>Homan, D. (Brandeis)<br>Roberts, D. (Brandeis)<br>Wardle, J. (Brandeis) | Imaging of a large sample of blazars. 3.6, 6, 20 cm |

| No. | Observer(s) | Program |
|---|---|---|
| AB705 | Burke, W. B. (MIT)<br>Becker, D. (MIT)<br>Lehar, J. (CFA)<br>Hewitt, J. (MIT)<br>Roberts, D. (Brandeis) | Time delay of the gravitational lens 0957+561. 3.6, 6 cm |
| AB796 | Bridle, A.<br>Burns, J. (New Mexico State)<br>Hough, D. (Trinity U.)<br>Laing, R. (RGO)<br>Lonsdale, C. (Haystack)<br>Wardle, J. (Brandeis) | Deep VLA imaging of a complete sample of 3CR lobe-dominated quasars. 3.6, 6 cm |
| AB805 | Biretta, J. (STScI)<br>Owen, F.<br>Zhou, F. (NMIMT) | VLA monitoring of the M87 jet. 0.7, 1.3 cm |
| AB806 | van Breugel, W. (LLNL)<br>Stanford, A. (LLNL)<br>DeBreuck, C. (LLNL)<br>Lehnert, M. (Leiden)<br>Rottgering, H. (Leiden) | Radio loud far infrared galaxies. 20 cm |
| AB807 | Brown, A. (Colorado/JILA) | Proper motions in complex radio source IRS7 in the CrA cloud. 3.6, 6 cm |
| AB808 | Blundell, K. (Oxford)<br>Rawlings, S. (Oxford) | Complete sample of $z \geq 2$ radio sources. 1.3, 2, 3.6 cm |
| AB809 | Browne, I. (Manchester)<br>Wilkinson, P. (Manchester)<br>Nair, S. (Manchester)<br>Patnaik, A. (MPIR, Bonn)<br>Perley, R.<br>Schneider, P. (MPIAP, Munich)<br>Geiger, B. (MPIAP, Munich) | Time delay measurement in 0218+357. 2 cm |
| AB811 | Bastian, T. | Solar wind turbulence during solar minimum. 2, 3.6, 6, 20 cm |
| AB812 | Becker, R. (UC, Davis)<br>Helfand, D. (Columbia)<br>White, R. (STScI) | Rapidly varying FIRST radio sources. 3.6, 20 cm |
| AC308 | Condon, J.<br>Cotton, W.<br>Perley, R. | All sky survey. 20 cm |
| AC468 | Contreras, M. (Mexico/UNAM)<br>Rodriguez, L. (Mexico/UNAM) | Nature of the clumps in the wind of WR 147. 3.6 cm |

| No. | Observer(s) | Program |
|---|---|---|
| AC470 | Conway, J. (Chalmers, Onsala)<br>Owsianik, I. (Chalmers, Onsala) | Search for HI absorption and OH maser emission in FR I radio galaxies. 20 cm line |
| AC473 | Chambers, K. (Hawaii) | Faint low frequency radio source population. 3.6, 90 cm |
| AC476 | Cotton, W.<br>Bridle, A.<br>Bondi, M. (Bologna)<br>Feretti, L. (Bologna)<br>Giovannini, G. (Bologna)<br>Laing, R. (RGO)<br>Lara, L. (Bologna)<br>Venturi, T. (Bologna) | Imaging and polarimetry of NGC 315. 6 cm |
| AD388 | Dahlem, M. (STScI)<br>Bade, N. (Hamburg U.) | NGC 5905—search for an AGN. 3.6 cm |
| AD389 | DePree, C. (Agnes Scott College)<br>Gaume, R. (USNO)<br>Goss, W. M. | Continuum observations of Sgr B2. 0.7 cm line |
| AD391 | Dougherty, S. (DRAO)<br>Williams, P. (Royal Obs)<br>van der Hucht, K. (Utrecht) | WR 146. 0.7, 1.3, 3.6, 6, 20, 90 cm |
| AD392 | DeBreuck, C. (LLNL)<br>van Breugel, W. (LLNL)<br>Rottgering, H. (Leiden)<br>Miley, G. (Leiden) | Highest redshift radio galaxies. 6, 20 cm |
| AD394 | Dulk, G. (Paris Obs)<br>Leblanc, Y. (Paris Obs)<br>Bastian, T. | Magnetic fields of extrasolar planets. 20, 90 cm |
| AD395 | Desai, K.<br>Anantharamaiah, K. (Raman Institute)<br>Dhawan, V.<br>Gothaskar, P. (NCRA, India) | Scattering of 3C279 in the Solar Wind. 20, 90 cm |
| AD397 | Davis, R. (Manchester) | Alpha Orionis—short baselines for Merlin Map. 6 cm |
| AF307 | Fiebig, D. (Heidelberg Obs) | Confined water masers in Orion-A West. 1.3 cm line |
| AF309 | Frayer, D. (Toronto)<br>Seaquist, E. (Toronto)<br>Papadopoulos, P. (Toronto)<br>Yee, H. (Toronto)<br>Bechtold, J. (Arizona) | Two high redshift protogalaxy candidates. 3.6, 20 cm |

| No. | Observer(s) | Program |
|---|---|---|
| AF310 | Fassnacht, C. (Caltech)<br>Pearson, T. (Caltech)<br>Readhead, A. (Caltech)<br>Myers, S. (Pennsylvania)<br>Browne, I. (Manchester)<br>Wilkinson, P. (Manchester) | VLA monitoring of the gravitational lens system 1608+656. 3.6 cm |
| AF311 | Fassnacht, C. (Caltech)<br>Myers, S. (Pennsylvania)<br>Browne, I. (Manchester)<br>Wilkinson, P. (Manchester)<br>Pearson, T. (Caltech)<br>Readhead, A. (Caltech) | Deep imaging of the gravitational lens candidate 2045+265. 2, 3.6, 6, 20 cm |
| AF313 | Fabian, A. (Cambridge)<br>Taylor, G. | Searching for HI gas in 2 newly discovered cooling flow clusters. 20 cm line |
| AF314 | Falcke, H. (Maryland)<br>Zhao, J-H. (SA/IAA, Taiwan)<br>Goss, W. M.<br>Minter, A.<br>Zylka, R. (MPIR, Bonn)<br>Blitz, L. (Maryland)<br>Wilson, A. (Maryland) | Multiband campaign to measure the flux of Sgr A*. 0.7, 1.3, 2, 3.6, 6, 20 cm |
| AF315 | Falcke, H. (Maryland)<br>Wilson, A. (Maryland)<br>Ho, L. (UC, Berkeley) | Search for Sgr A*'s in other nearby galaxies. 2 cm |
| AF318 | Florkowski, D. (USNO) | Monitoring the radio emission from the Wolf-Rayet Binary HD 192641. 0.7, 2, 6, 20 cm |
| AF320 | Furuya, L. (Ibaraki U.)<br>Kawabe, R. (NAO, Japan)<br>Kitamura, Y. (ISAS, Japan)<br>Saito, M. (Tokyo U.)<br>Umemoto, T. (NAO, Japan) | VLA $H_20$ maser observations of class 0 protostar candidates. 1.3 cm line |
| AG448 | Greenhill, L. (CFA)<br>Henkel, C. (MPIR, Bonn) | Monitoring the acceleration of water megamaser features in NGC 4258. 1.3 cm line |
| AG493 | Gagne, M. (Colorado/JILA)<br>Linsky, J. (Colorado/JILA)<br>Brown, A. (Colorado/JILA)<br>Gudel, M. (SFIT, ETH) | Flare star EQ Peg. 3.6 cm |
| AG499 | Goodrich, R. (Caltech) | Radio axes of broad absorption line QSOs. 3.6 cm |
| AG500 | Gaume, R. (USNO)<br>Martin-Pintado, J. (Yebes Obs)<br>Kassim, N. (NRL)<br>Johnston, K. (USNO) | Spectral index of MWC 349. 2, 3.6, 6, 20, 90 cm |

| No. | Observer(s) | Program |
|---|---|---|
| AH573 | Hjellming, R. | Radio and x-ray activity in the galactic black hole binary GRO J1655-40. 2,3.6, 6, 20 cm |
| AH587 | Hollis, J. M. (NASA/GSFC)<br>Pedelty, J. (NASA/GSFC) | Attempt to resolve the R Aquarii binary system. 0.7 cm |
| AH588 | Helfand, D. (Columbia)<br>Becker, R. (UC, Davis)<br>White, R. (STScI) | Rapid variability in extragalactic radio sources. 3.6, 20 cm |
| AH589 | Hirano, N. (Hitotsubashi)<br>Umemoto, T. (NAO, Japan)<br>Furuya, L. (Ibaraki U.) | Water maser observations of the very young outflow source 1623-242. 1.3 cm line |
| AH592 | Hjellming, R.<br>Rupen, M. | Monitoring galactic black hole x-ray transients. 2, 3.6, 6, 20 cm |
| AH593 | Hewitt, J. (MIT)<br>Moore, C. (MIT)<br>Haarsma, D. (MIT) | Gravitational lens time delays. 2, 3.6 cm |
| AH594 | Herrnstein, J. (CFA)<br>Greenhill, L. (CFA)<br>Moran, J. (CFA)<br>Trotter, A. (CFA) | Monitoring the rapidly varying compact continuum source in NGC 4258. 1.3, 2, 3.6, 6 cm |
| AH595 | Hankins, T. (NMIMT)<br>Moffett, D. (NMIMT)<br>Delaney, T. (NMIMT) | Wide-bandwidth studies of the crab pulsar "giant" pulses. 6, 20, 90 cm |
| AH597 | Hoare, M. (Leeds U.) | Deep imaging of GL 490. 3.6 cm |
| AH598 | Hoare, M. (Leeds U.)<br>Gaume, R. (USNO)<br>Fischer, J. (NRL) | High frequency continuum from the ionized winds of luminous YSOs. 0.7, 2, 3.6, 6 cm |
| AH605 | Hofner, P. (Koln)<br>Stecklum, B. (MPIR, Bonn)<br>Henning, P. (New Mexico) | UC HII region G5.97 in M8. 2 cm |
| AI063 | Ivison, R. (Royal Obs)<br>Seaquist, E. (Toronto) | Third-epoch imaging of RX Puppis during a phase of low excitation. 3.6 cm |
| AI064 | Ishida, C. (Hawaii)<br>Sanders, D. (Hawaii)<br>Barnes, J. (Hawaii) | Morphology of luminous infrared galaxies. 3.6, 20 cm |

| No. | Observer(s) | Program |
|---|---|---|
| AI066 | Ivison, R. (Royal Obs)<br>Eyres, S. (Keele)<br>Davis, R. (Manchester)<br>Kenny, H. (Canadian Military)<br>Bode, M. (Liverpool JMU)<br>Lloyd, H. (Liverpool JMU) | VLA/Merlin imaging of quiescent symbiotic binaries. 6 cm |
| AK376 | Kulkarni, S. (Caltech)<br>Frail, D. | Search for the radio counterparts of gamma ray bursters. 20 cm |
| AK397 | Kulkarni, S. (Caltech)<br>Frail, D. | Search for radio counterparts of gamma ray bursters - HETE followup. 20 cm |
| AK425 | Kollgaard, R. (Penn State)<br>Ghisellini, G. (Torino)<br>Maraschi, L. (Genova U.)<br>Pesce, J. (STScI)<br>Sambruna, R. (STScI)<br>Urry, C. M. (STScI) | Multi-frequency monitoring of blazars. 1.3, 2, 3.6, 6, 20 cm |
| AK431 | Kovo, O. (Tel-Aviv U.)<br>Turner, J. (UCLA)<br>Beck, S. (Tel-Aviv U.) | Multi-frequency continuum maps of Wolf-Rayet dwarf galaxies. 20 cm |
| AK432 | Knapp, G. (Princeton)<br>Rupen, M.<br>Gunn, J. (Princeton) | Mapping evolved stars. 0.7, 1.3 cm |
| AK434 | Kenny, H. (Canadian Military)<br>Dougherty, S. (DRAO)<br>Eyres, S. (Keele)<br>Taylor, A. (Calgary)<br>Davis, R. (Manchester) | Stellar orbital motion in two symbiotic novae. 1.3 cm |
| AK435 | Karovska, M. (CFA)<br>Mattei, J. (AAVSO) | Jet formation in CH Cyg symbiotic system. 3.6, 2 cm |
| AL395 | Lim, J. (SA/IAA, Taiwan) | Imaging the circumstellar envelopes of Be Stars. 0.7, 1.3 cm |
| AL396 | Lockley, J. (Keele)<br>Eyres, S. (Keele)<br>Wood, J. (Keele) | Peculiar binary V Sge: cataclysmic variable or colliding wind. 6 cm |
| AL397 | Longair, M. (Cambridge)<br>Best, P. (Cambridge)<br>Eales, S. (Wales)<br>Rawlings, S. (Oxford)<br>Rottgering, H. (Leiden) | 6C radio glaxies at z ~ 1. 3.6, 6 cm |
| AL398 | Lim, J. (SA/IAA, Taiwan)<br>White, S. (Maryland) | The chromosphere of the M supergiant Betelgeuse. 0.7, 1.3, 2, 3.6, 6 cm |

| No. | Observer(s) | Program |
|---|---|---|
| AL400 | Ledlow, M. (New Mexico State)<br>Owen, F.<br>Keel, W. (Alabama) | A powerful radio galaxy in a spiral host. 3.6, 20 cm |
| AL401 | Lacy, M. (Oxford)<br>Ridgway, S. (Oxford)<br>Rawlings, S. (Oxford)<br>King, L. (Oxford) | Rotation measures of z ~ 1 radio sources. 6, 20 cm |
| AL402 | Lucas, P. (Oxford)<br>Roche, P. (Oxford)<br>Blundell, K. (Oxford) | Low mass young stellar objects. 2, 3.6 cm |
| AL403 | Leitch, E. (Caltech)<br>Pearson, T. (Caltech)<br>Readhead, A. (Caltech) | Monitoring of point sources in the OVRO microwave background fields. 1.3, 2, 3.6 cm |
| AL404 | Lazio, J. (Cornell)<br>Cordes, J. (Cornell)<br>Kassim, N. (NRL)<br>Arzoumanian, Z. (Cornell) | Search for heavily scattered pulsars in and beyond the galactic center. 20, 90 cm |
| AL405 | Laing, R. (RGO)<br>Bridle, A.<br>Feretti, L. (Bologna)<br>Giovannini, G. (Bologna)<br>Parma, P. (Bologna)<br>Perley, R. | Imaging and polarimetry of 3C 31. 3.6 cm |
| AL406 | Lo, K. (Illinois)<br>Goss, W. M. | 1720 OH maser in V1057 Cygni. 20 cm line |
| AL414 | Laine, S. (Florida)<br>Gottesman, S. (Florida) | Nucleus of NGC 7479. 2, 3.6, 6 cm |
| AM533 | Miranda, L. (Madrid Obs)<br>Torrelles, J. (IAA, Andalucia)<br>Eiroa, C. (Madrid Obs) | Young double-shell planetary nebula IC 4997. 1.3, 2, 3.6 cm |
| AM534 | Marti, J. (CNRS, France)<br>Rodriguez, L. (Mexico/UNAM)<br>Reipurth, B. (ESO) | Monitoring the high proper motion thermal radio jet in HH 80-81. 3.6 cm |
| AM540 | Mirabel, I. F. (CNRS, France)<br>Rodriguez, L. (Mexico/UNAM) | Proper motions in the superluminal source GRS 1915+105. 3.6 cm |
| AM543 | Menten, K. (CFA)<br>Reid, M. (CFA) | Resolving the power source in the Orion BN/KL region. 0.7, 3.6 cm line |

| No. | Observer(s) | Program |
|---|---|---|
| AM544 | Moore, C. (MIT)<br>Rutledge, R. (MIT)<br>Lewin, W. (MIT)<br>van Paradijs, J. (Amsterdam) | Parallel x-ray and VLA observations of the rapid burster 1733-335. 3.6, 20 cm |
| AM545 | Menten, K. (CFA)<br>Reid, M. (CFA) | Formaldehyde and ammonia absorption toward lens 0218+357. 0.7, 1.3 cm line |
| AM546 | McCarthy, P. (Mt. Wilson)<br>Rush, B. (Mt. Wilson)<br>Kapahi, V. (NCRA, India)<br>van Breugel, W. (LLNL)<br>Athreya, R. (NCRA, India)<br>Lawrence, C. (JPL) | Mapping the gravitational lens candidate MRC 0406-244. 3.6 cm |
| AM548 | Morganti, R. (CSIRO)<br>Tadhunter, C. (Sheffield)<br>Oosterloo, T. (CSIRO) | Radio morphology of 2-Jy radio galaxies. 6 cm |
| AM557 | Mirabel, I. F. (CNRS, France)<br>Goss, W. M. | Search for 1720 maser emission near GRS 1915+105. 20 cm line |
| AO127 | O'Dea, C. (STScI)<br>Baum, S. (STScI)<br>DeVries, W. (STScI)<br>Biretta, J. (STScI)<br>Macchetto, D. (STScI) | High resolution observations of optical synchrotron jets. 0.7, 1.3, 2 cm |
| AO129 | Ojha, R. (Brandeis)<br>Wardle, J. (Brandeis)<br>Roberts, D. (Brandeis) | Flat spectrum structures in the CSS source 3C48. 0.7, 1.3 cm |
| AP331 | Pooley, G. (Cambridge)<br>Hardcastle, M. (Cambridge)<br>Riley, J. (Cambridge)<br>Alexander, P. (Cambridge) | Constraining the luminosity function of jets in FRII radio galaxies. 3.6, 6 cm |
| AP334 | Perley, R.<br>Carilli, C.<br>Dreher, J. (SETI Institute) | VLA Observations of Cygnus A at 43 GHz. 0.7 cm |
| AP337 | Pedlar, A. (Manchester)<br>Thean, A. (Manchester)<br>Kukula, M. (Royal Obs)<br>Baum, S. (STScI)<br>O'Dea, C. (STScI) | Seyferts from the 12-micron Galaxy sample. 3.6 cm |

| No. | Observer(s) | Program |
|---|---|---|
| AP338 | Paredes, J. (Barcelona)<br>Marti, J. (CNRS, France)<br>Tavani, M. (Columbia)<br>Peracaula, M. (Barcelona)<br>Kniffen, D. (Hampden-Sydney)<br>Mattox, J. (Maryland) | Simultaneous radio and gamma ray observations. 2, 3.6 cm |
| AP341 | Pentericci, L. (Leiden)<br>Rottgering, H. (Leiden)<br>Miley, G. (Leiden)<br>Carilli, C. | Distorted, high rotation measure, radio galaxy PKS 1138-262. 3.6, 6 cm |
| AP344 | Perley, R.<br>Roser, H-J. (MPIA, Heidelberg) | Low frequency observations of Pictor A. 90 cm |
| AR277 | Rodriguez, L. (Mexico/UNAM)<br>Gomez, Y. (Mexico/UNAM)<br>Canto, J. (Mexico/UNAM)<br>Lizano, S. (Mexico/UNAM)<br>Escalante, V. (Mexico/UNAM) | First images of protoplanetary disks. 0.7, 3.6 cm |
| AR361 | Rodriguez, L. (Mexico/UNAM)<br>Gomez, Y. (Mexico/UNAM) | Mapping MWC 349A at the highest VLA angular resolution. 0.7, 1.3 cm |
| AR362 | Reid, M. (CFA)<br>Menten, K. (CFA) | VLA Observations of the 43 GHz SiO masers and stellar size of red giants. 0.7 cm line |
| AR363 | Reid, M. (CFA)<br>Masson, C. (CFA)<br>Menten, K. (CFA)<br>Moran, J. (CFA)<br>Wilner, D. (CFA) | Synchrotron emission from the $H_20$ maser source in W3OH. 3.6 cm |
| AR365 | Rawlings, S. (Oxford)<br>Blundell, K. (Oxford)<br>Lacy, M. (Oxford)<br>Willott, C. (Oxford) | Radiogalaxies at redshifts above 5. 20 cm |
| AR368 | Richards, E. (Virginia)<br>Fomalont, E.<br>Kellermann, K.<br>Partridge, R. B. (Haverford College)<br>Windhorst, R. (Arizona State) | The Hubble deep field. 3.6 cm |
| AR369 | Rizza, E. (New Mexico State)<br>Burns, J. (New Mexico State)<br>Ledlow, M. (New Mexico State)<br>Owen, F. | Radio galaxies in distant Abell clusters. 20 cm |

| No. | Observer(s) | Program |
|---|---|---|
| AS568 | Sramek, R.<br>Weiler, K. (NRL)<br>Van Dyk, S. (UC, Berkeley)<br>Panagia, N. (STScI) | Properties of radio supernovae. 1.3, 2, 3.6, 6, 20 cm |
| AS594 | Seaquist, E. (Toronto)<br>Frail, D.<br>Frayer, D. (Toronto) | Search for 1720 MHz and 1612 MHz masers in M82 and NGC 253. 20 cm line |
| AS596 | Stocke, J. (Colorado/JILA)<br>Rector, T. (Colorado/JILA)<br>Perlman, E. (Maryland) | High dynamic range mapping of EMSS BL Lac objects. 3.6, 20 cm |
| AS598 | Serjeant, S. (Imperial College)<br>Lacy, M. (Oxford)<br>King, L. (Oxford)<br>Rawlings, S. (Oxford)<br>Blundell, K. (Oxford) | Are damped Ly absorbers gravitational lenses? 1.3, 2 cm |
| AS599 | Stockton, A. (Hawaii)<br>Ridgway, S. (Oxford) | Radio optical alignment in z~1 quasars. 3.6, 20 cm |
| AT198 | Torrelles, J. (IAA, Andalucia)<br>Gomez, J. (IAA, Andalucia)<br>Rodriguez, L. (Mexico/UNAM)<br>Curiel, S. (Mexico/UNAM)<br>Ho, P. (CFA) | Radio jet $H_2O$ maser systems around YSOs. 1.3 cm line |
| AT200 | vander Tak, F. (UC, Berkeley)<br>Welch, W. J. (UC, Berkeley)<br>van Dishoeck, E. (Leiden)<br>van Langevelde, H. (NFRA) | Nature of W3 IRS5: cluster or cavity? 0.7, 1.3 cm |
| AW362 | White, S. (Maryland) | The stellar activity cycle on active stars. 3.6, 6, 20 cm |
| AW419 | Watson, A. (Lowell Obs)<br>Cox, A. (Wisconsin)<br>Wilcots, E. (Wisconsin) | Sub-arcsecond imaging of nuclear starbursts at 2cm and 6cm. 6 cm |
| AW444 | Wills, K. (Manchester)<br>Pedlar, A. (Manchester)<br>Muxlow, T. (Manchester)<br>Gallimore, J. (MPIfEP, Garching) | HI absorption against the starburst in M82. 20 cm line |
| AW446 | Wilson, A. (Maryland)<br>Falcke, H. (Maryland) | Radio outflows and the narrow line region in Seyfert galaxies. 2, 3.6 cm |
| AW447 | Walker, R. C.<br>Benson, J. | Superluminal motion on kiloparsec scales in 3C120. 6 cm |
| AW461 | Winnberg, A. (Chalmers, Onsala)<br>Engels, D. (Hamburg Univ.) | OH/IR star OH26.5+0.6. 1.3 cm line |

| No. | Observer(s) | Program |
|---|---|---|
| AY074 | Yun, M. | Spin temperature of HI tidal debris in M81 group. 20 cm line |
| AY076 | Yusef-Zadeh, F. (Northwestern)<br>Roberts, D. (Illinois)<br>Goss, W. M.<br>Frail, D.<br>Green, A. (Sydney) | Follow up observation of shock excited OH masers in Sgr A. 20 cm line |
| AY078 | Yusef-Zadeh, F. (Northwestern)<br>Roberts, D. (Illinois)<br>Wardle, M. (Sydney) | Radio continuum study of WR/WN and OH/IR stars in galactic center. 0.7 cm line |
| AZ083 | Zhao, J-H. (SA/IAA, Taiwan)<br>Chen, H. (CFA) | L1641N: a newly discovered protobinary. 0.7, 3.6 cm |
| AZ087 | Zhao, J-H. (SA/IAA, Taiwan)<br>Goss, W. M.<br>Yusef-Zadeh, F. (Northwestern)<br>Falcke, H. (Maryland)<br>Sjouwerman, L. (Chalmers, Onsala) | Sgr A* and its nearby sources. 0.7, 1.3 cm |
| BB062 | Boboltz, D. (VPI & SU) *et al.* | Polarization observations of OH masers in envelopes of OH/IR stars. 20 cm |
| BP031 | Preuss, E. (MPIR, Bonn)<br>Alef, W. (MPIR, Bonn)<br>Pauliny-Toth, I. (MPIR, Bonn)<br>Kellermann, K.<br>Gabuzda, D. (Lebedev) | Polarimetry of the FRII radio galaxy 3C111. 0.7, 3.6 cm |
| BS051 | Shaffer, D. (Interferometrics) et al. | CTD93-CD or CSO: Where is the nucleus? 0.7 cm |

## E. VERY LONG BASELINE ARRAY OBSERVING PROGRAMS

The following 55 research programs were conducted with the VLBA this quarter:

| No. | Observer(s) | Program |
|---|---|---|
| BA018 | Attridge, J. (Brandeis)<br>Homan, D. (Brandeis)<br>Roberts, D. (Brandeis)<br>Wardle, J. (Brandeis) | Second epoch imaging of a blazar sample. 6 cm |
| BA020 | Aaron, S. (Brandeis)<br>Wardle, J. (Brandeis)<br>Roberts, D. (Brandeis) | Twisted jet of Mk501. 3.6 cm |
| BA022 | Aaron, S. (Brandeis)<br>Roberts, D. (Brandeis)<br>Wardle, J. (Brandeis) | Continuing polarization study of the CSS quasar 3C309.1. 18 cm |

| No. | Observer(s) | Program |
|---|---|---|
| BB041 | Beasley, A.<br>Fomalont, E. | Phased-referenced superluminals. 3.6, 13 cm |
| BB062 | Boboltz, D. (VPI & SU)<br>Diamond, P.<br>Kemball, A.<br>Claussen, M.<br>Kogan, L. | Polarization observations of OH masers in envelopes of OH/IR stars. 18 cm with VLA single antenna. |
| BB064 | Benz, A. (SFIT, ETH)<br>Conway, J. (Chalmers, Onsala)<br>Alef, W. (MPIR, Bonn)<br>Gudel, M. (SFIT, ETH) | Planet search via astrometry of dMe stars. 3.6 cm with phased VLA |
| BB067 | Bower, G. (UC, Berkeley)<br>Backer, D. (UC, Berkeley)<br>Wright, M. (UC, Berkeley) | Monitoring gamma-ray blazar NRAO 530. 1.3, 3.6 cm |
| BC051 | Cotton, W.<br>Feretti, L. (Bologna)<br>Giovannini, G. (Bologna)<br>Lara, L. (Bologna)<br>Ventura, T. (Bologna)<br>Marcaide, J. (Valencia) | VLBA polarization observations of NGC 315. 6 cm |
| BC053 | Clark, T. (NASA/GSFC)<br>Ryan, J. (NASA/GSFC)<br>Himwich, W. (Interferometrics)<br>MacMillian, D. (Interferometrics)<br>Gordon, D. (NASA/GSFC)<br>Niell, A. (Haystack)<br>Corey, B. (Haystack)<br>Rogers, A. (Haystack)<br>Eubanks, T. (USNO)<br>Fomalont, E.<br>Walker, C. | NASA Space Geodesy Program: Geodetic observations for 1996. 3.6 cm |
| BC057 | Carrara, E.<br>Zensus, J. A.<br>Abraham, Z. (Sao Paulo)<br>Lobanov, A. (MPIR, Bonn) | Parsec-scale structure of the 3C273 jet: multi-frequency monitoring. 1.3, 3.6, 6 cm |

| No. | Observer(s) | Program |
|---|---|---|
| BC058 | Clark, T. (NASA/GSFC)<br>Ryan, J. (NASA/GSFC)<br>Ma, C. (NASA/GSFC)<br>Vandenberg, N. (Interferometrics)<br>Gipson, J. (Interferometrics)<br>MacMillan, D. (Interferometrics)<br>Himwich, W. (Interferometrics)<br>Gordon, D. (NASA/GSFC)<br>Niell, A. (Haystack)<br>Corey, B. (Haystack)<br>Rogers, A. (Haystack)<br>Eubanks, T. M. (USNO)<br>Fomalont, E.<br>Walker, C. | CONT96: intensive geodetic VLBI observing. 3.6 cm |
| BC059 | Coles, W. (UC, San Diego)<br>Rickett, B. (UC, San Diego)<br>Ye, S. (UC, San Diego)<br>Massey, W. (UC, San Diego) | Measurement of the solar wind speed near the sun using IPS. 2, 3.6 cm |
| BC060 | Combes, F. (Paris Obs)<br>Baudry, A. (Bordeaux)<br>Wiklind, T. (Chalmers, Onsala)<br>Desmurs, J. (Bordeaux) | Mapping the absorption in the gravitational lens PKS 1830-211. 13 cm line |
| BC061 | Conway, J. (Chalmers, Onsala)<br>Booth, R. (Chalmers, Onsala)<br>Diamond, P.<br>Koribalski, B. (CSIRO) | HI absorption observations of NGC 5793. 20 cm line |
| BD037 | Denn, G. (Iowa)<br>Mutel, R. (Iowa) | Polarized VLB jet of BL Lac. 1.3, 2, 6 cm |
| BD038 | Desai, K.<br>Anantharamaiah, K. (Raman Institute)<br>Dhawan, V.<br>Gothaskar, P. (NCRA, India) | Scattering of 3C279 in the solar wind. 1.3, 2 cm with phased VLA |
| BE011 | Edge, A. (Cambridge)<br>Jones, M. (Cambridge)<br>Grainge, K. (Cambridge)<br>Saunders, R. (Cambridge) | RXJ1459+3337—an extreme GPS quasar. 1.3, 2, 6 cm |
| BE012 | Edwards, P. (ISAS, Japan)<br>Unwin, S. (Caltech)<br>Wehrle, A. (JPL)<br>Weekes, T. (CFA) | MKN 421—radio imaging of a TeV gamma-ray blazar. 1.3, 2, 6 cm |
| BG053 | Gwinn, C. (UC, Santa Barbara)<br>Britton, M. (UC, Santa Barbara)<br>Bloemhof, E. (Arizona) | Angular broadening of a nearby, high latitude pulsar. 90 cm |

| No. | Observer(s) | Program |
|---|---|---|
| BG061 | Gomez, J. (IAA, Andalucia)<br>Marscher, A. (Boston)<br>Alberdi, A. (ESA, Spain)<br>Guirado, J. (JPL)<br>Marcaide, J. (Valencia) | The relativistic jet in 3C 120. 1.3 cm |
| BH023 | Hagiwara, Y. (Nobeyama)<br>Kawabe, R. (NAO, Japan)<br>Diamond, P.<br>Kameno, S. (NAO, Japan)<br>Nakai, N. (NAO, Japan)<br>Inoue, M. (NAO, Japan)<br>Kohno, K. (NAO, Japan)<br>Katagiri, S. (NAO, Japan) | The nuclear region of NGC 5793. 18 cm |
| BK037 | Kellermann, K.<br>Zensus, J. A.<br>Cohen, M. (Caltech)<br>Vermeulen, R. (Caltech) | Monitoring superluminal sources. 2 cm |
| BK043 | Koopmans, L. (Groningen/Kapteyn)<br>deBruyn, G. (NFRA)<br>Jackson, N. (Manchester)<br>Fassnacht, C. (Caltech)<br>Myers, S. (Pennsylvania) | Structure of the gravitational lenses 1600+434. 3.6 cm |
| BL040 | Liljestrom, T. (Helsinki)<br>Leppanen, K. (NFRA)<br>Diamond, P.<br>Gwinn, C. (UC, Santa Barbara) | High temperature maser sources W44, W51M, W51N, W75N. 1.3 cm |
| BL041 | van Langevelde, H. (NFRA)<br>Beasley, A. | Formaldehyde absorption in Centaurus A. 2, 6 cm line |
| BL044 | Lobanov, A. (MPIR, Bonn) | Spectral imaging of 3C120. 1.3, 2, 3.6, 6, 18 cm |
| BL045 | Lister, M. (Boston)<br>Marscher, A. (Boston)<br>Gear, W. (Hawaii) | Magnetic field properties near the cores of blazars. 7 cm |
| BM049 | Mioduszewski, A. (Michigan)<br>Gabuzda, D. (Lebedev)<br>Aller, H. (Michigan) | Monitoring of six highly variable BL Lacertae objects. 1.3, 3.6 cm |
| BM067 | Mattox, J. (Maryland)<br>Marscher, A. (Boston)<br>Wagner, S. (Heidelberg Obs) | Gamma ray blazar 1622-297. 1.3, 2 cm |

| No. | Observer(s) | Program |
|---|---|---|
| BM072 | Marscher, A. (Boston)<br>Wehrle, A. (JPL)<br>Xu, W. (JPL) | Coordinated multi-band observations of gamma-ray blazars. 1.3 cm |
| BN004 | Nakai, N. (NAO, Japan)<br>Inoue, M. (NAO, Japan)<br>Hagiwara, Y. (Nobeyama)<br>Diamond, P. | $H_20$ megamaser in the LINER galaxy IC 1481. 1.3 cm line with phased VLA |
| BR034 | Roberts, D. (Brandeis)<br>Wardle, J. (Brandeis)<br>Ojha, R. (Brandeis)<br>Homan, D. (Brandeis)<br>Aller, H. (Michigan)<br>Aller, M. (Michigan)<br>Hughes, P. (Michigan) | Sources with rapidly varying polarization. 1.3, 2 cm |
| BR044 | Rupen, M.<br>Bartel, N. (York U.)<br>Beasley, A.<br>Conway, J. (Chalmers, Onsala)<br>Bietenholz, M. (York U.)<br>Rius, A. (Barcelona)<br>Altunin, V. (JPL)<br>Jones, D. (JPL)<br>Graham, D. (MPIR, Bonn)<br>Venturi, T. (Bologna)<br>Umana, G. (Bologna) | VLBI imaging of supernova 1993J in M81. 3.6, 6, 18 cm with phased VLA |
| BR045 | Romney, J.<br>Dhawan, V.<br>Kellermann, K.<br>Alef, W. (MPIR, Bonn)<br>Inoue, M. (NAO, Japan)<br>Kameno, S. (NAO, Japan)<br>Horiuchi, S. (NAO, Japan)<br>Gabuzda, D. (Lebedev) | Structural monitoring of 3C 84. 2 cm with phased VLA |
| BS037 | Slysh, V. (Lebedev)<br>Kogan, L.<br>Kalenski, S. (Lebedev)<br>Valtts, I. (Lebedev)<br>Dzura, A. (Lebedev) | Class I methanol masers. 2 cm |
| BS043 | Swain, M. (Cornell)<br>Lobanov, A. (MPIR, Bonn) | VLBA observation of the core of 3C353. 18 cm with phased VLA |

| No. | Observer(s) | Program |
|---|---|---|
| BS044 | Satoh, S. (NAO, Japan)<br>Inoue, M. (NAO, Japan)<br>Nakai, N. (NAO, Japan)<br>Shibata, K. (NAO, Japan)<br>Migenes, V. (NAO, Japan)<br>Kameno, S. (NAO, Japan)<br>Fujisawa, K. (ISAS, Japan) | Monitoring of the continuum and $H_20$ maser emission in NGC 3079. 1.3, 2 cm |
| BS051 | Shaffer, D.(Interferometrics)<br>Kellermann, K. | CTD93-CD or CSO: Where is the nucleus? 1.3, 2 cm with VLA single antenna |
| BT024 | Taylor, G.<br>O'Dea, C. (STScI) | HI absorption in PKS 2322-123. 6, 18 cm with phased VLA |
| BT026 | Trotter, A. (CFA)<br>Greenhill, L. (CFA)<br>Moran, J. (CFA) | Multi-wavelength continuum properties of nucleus of NGC 3079. 2, 3.6, 6 cm with phased VLA |
| BU007 | Ulvestad, J.<br>Hirabayashi, H. (ISAS, Japan)<br>Kobayashi, H. (ISAS, Japan)<br>Fujisawa, K. (ISAS, Japan)<br>Edwards, P. (ISAS, Japan)<br>Preston, R. (JPL)<br>Wiercigroch, A. (JPL)<br>Murphy, D. (JPL)<br>Wietfeldt, R. (JPL)<br>Gurvits, L. (NFRA)<br>Fomalont, E.<br>Ghosh, T. (NAIC)<br>Salter, C. (NAIC)<br>Altschuler, D. (NAIC)<br>Patnaik, A. (MPIR, Bonn)<br>Dewdney, P. (DRAO) | Flat spectrum FIRST sources: snapshot VLBA and VLA survey. 6 cm |
| BV022 | Vermeulen, R. (Caltech)<br>Cohen, M. (Caltech)<br>Kellermann, K.<br>Zensus, J. | Two sided jets in the nearby elliptical NGC 1052. 2, 6, 18 cm |
| BV023 | Venturi, T. (Bologna)<br>Taylor, G. | Parsec-scale Faraday rotation measure structure of 3C216. 6, 18 cm |
| BW026 | Wehrle, A. (JPL)<br>Unwin, S. (JPL)<br>Zook, A. (Pomona College)<br>Xu, W. (JPL) | 3C279: coordinated multiwavelength observations and evolution. 1.3, 2 cm |
| BW028 | Wiklind, T. (Chalmers, Onsala)<br>Combes, F. (Paris Obs)<br>Conway, J. (Chalmers, Onsala) | Molecular absorption observations in gravitaional lens 0218+357. 3.6 cm line |

| No. | Observer(s) | Program |
|---|---|---|
| BW029 | Wrobel, J.<br>Ulvestad, J.<br>Carilli, C. | Inner 30 pc of Mrk 231. 1.3, 2, 3.6, 6, 18 cm with phased VLA or VLA single antenna |
| BZ017 | Zensus, J.<br>Lobanov, A. (MPIR, Bonn)<br>Leppanen, K. (NFRA) | Monitoring the parsec-scale jet structure of 3C345. 1.3, 2, 3.6, 6 cm |
| GG028 | Gabuzda, D. (Lebedev)<br>Kollgaard, R. (Penn State)<br>McHardy, I. (Southampton) | BL Lac object spirals-true host galaxies or intervening systems. 6 cm |
| GM027 | Marcaide, J. (Valencia)<br>Ros, E. (Valencia)<br>Alberdi, A. (ESA, Spain)<br>Diamond, P.<br>Shapiro, I. (CFA)<br>Guirado, J. (JPL)<br>Preston, R. (JPL)<br>Jones, D. (JPL)<br>Witzel, A. (MPIR, Bonn)<br>Krichbaum, T. (MPIR, Bonn)<br>Schilizzi, R. (NFRA)<br>Mantovani, F. (Bologna)<br>Trigilio, C. (Bologna)<br>Whitney, A. (Haystack) | Monitoring the expansion of SN 1993J. 6 cm |
| GM028 | Marcaide, J. (Valencia)<br>Ros, E. (Valencia)<br>Alberdi, A. (ESA, Spain)<br>Diamond, P.<br>Shapiro, I. (CFA)<br>Guirado, J. (JPL)<br>Preston, R. (JPL)<br>Jones, D. (JPL)<br>Witzel, A. (MPIR, Bonn)<br>Krichbaum, T. (MPIR, Bonn)<br>Schilizzi, R. (NFRA)<br>Mantovani, F. (Bologna)<br>Trigilio, C. (Bologna)<br>Whitney, A. (Haystack) | Monitoring the expansion of SN 1993J. 13 cm |
| GO002 | Otterbein, K. (MPIR, Bonn)<br>Krichbaum, T. (MPIR, Bonn)<br>Witzel, A. (MPIR, Bonn)<br>Wagner, S. (Heidelberg Obs) | Second epoch observation of the ultraluminous quasar S2 0836+710. 1.3 cm |

| No. | Observer(s) | Program |
|---|---|---|
| GW014 | Leppanen, K. (MPIR, Bonn)<br>Valtaoja, E. (Helsinki)<br>Wiik, K. (Helsinki)<br>Schilizzi, R. (NFRA)<br>Pilbratt, G. (ESTEC) | Sample of 15 AGN. 1.3 cm |
| VT004 | Edwards, P. (ISAS, Japan) | Ground Radio Telescope tests for VSOP. 1.3, 6 cm |
| VT005 | Gurvits, L. (NFRA) | Ground telescope qualification for VSOP observing. 1.3, 6, 18 cm |
| VT006 | Gurvits, L. (NFRA) | Qualification tests for VSOP ground telescopes. |

## F. SCIENCE HIGHLIGHTS

Socorro

VLA Observations Help Confirm "Quasar Cutoff" - Optical studies have indicated that the space density of quasars decreases rapidly at distances beyond redshift z=3. However, this was not an unambiguous result, because the optical cutoff could be caused by obscuration of more distant quasars by dust in intervening galaxies. A study of radio emission from quasars was undertaken, using the VLA and the Australia Telescope, to see if the decline in space density occurs when quasars are observed at wavelengths unaffected by dust. The result was similar to the optical studies, showing a strong decrease in quasars at redshifts greater than z=3. The radio studies strengthen the case for the "cutoff" applying to all quasars. If this is the case, the observations provide a measure of the timescale for processes such as galaxy formation and interactions, thought to be associated with quasars.

*Investigators:* *P.A. Shaver (ESO); J.V. Wall (Greenwich); K.I. Kellermann; C.A. Jackson (Cambridge); and M.R.S. Hawkins (Royal Observatory, Edinburgh).*

Tucson

A number of experiments designed to measure the spectral line emission from comet Hale-Bopp have been conducted at the 12 Meter during the past several months. A monitoring program has been conducted to study the changes in the CO emission production rate toward comet C/Hale-Bopp. This program has found that Comet Hale-Bopp (1995 O1) appears to be an object similar to Chiron, yet is presently a long-period comet that has evolved from an Oort cloud quasi-parabolic trajectory. Carbon monoxide is thought to be the dominant outgassing agent in this comet and the group has observed CO via both the J=1 and J=2-1 transitions. A main goal of this proposal is to measure for the first time the evolution of the production rate of CO with heliocentric distance and to compare it to the rate of water. A number of other research teams are studying the characteristics and properties of C/Hale-Bopp through its $CH_{30}OH$, $H_2O$, and HCN emission.

*Investigators:* *M. Womack (Penn State); M. Festou (Midi-Pyrenees Obs.); J. Mangum; and A. Stern (SWRI)*

The interaction of supernova remnants (SNRs) with dense molecular clouds is of considerable interest because it provides an opportunity to study the complex physical and chemical processes associated with shocks. Measurements have been made of the CO 2-1 emission from the W51 SN using the On-The-Fly (OTF) observing technique. These measurements will yield information on the association between the shocked CO and HI in this region. By further combining these CO 2-1 measurements with comparable resolution CO 1-0 and 3-2 observations of W51, the researchers will be able to derive the physical conditions within the shock region, providing information that can be used to constrain shock excitation models of SNRs.

*Investigators:* *B-C. Koo (Seoul National U.); D-S. Moon (Seoul National U.); and B.E. Turner*

Green Bank

Precise analysis of pulse arrival times from pulsars shows that there are often perturbations in the apparent pulsar period. One source of this timing noise is variation in the pulsar's dispersion measure caused by its motion through the ISM. Multifrequency timing observations on the 140 Foot telescope, however, show that the perturbations do not scale with wavelength squared, as would be expected from dispersive changes, but rather as wavelength to the fourth power. This implies that, because of interstellar scattering, a different volume of the ISM is being sampled by pulses at different frequencies. Precision timing in the presence of this unstable "interstellar weather" is thus difficult, and requires multi-frequency observation at the highest possible frequencies.

*Investigators: D. C. Backer and T. Wong (UC, Berkeley)*

## G. PUBLICATIONS

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

## H. CHARLOTTESVILLE ELECTRONICS

Amplifier Development, Design and Production

Outside the MAP project, the following regular amplifiers were built:

- twelve 1.2-1.8 GHz built and delivered (various users)
- retested one 8-10 GHz amp and delivered
- five new KH amps, plus one retested KH amp, sold to Jet Propulsion Laboratory
- built four 4-6 GHz amps—delivered to Smithsonian Astrophysical Observatory
- upgrading five KH and KL amps from GB—in process for adding InP first stages to improve noise figure

Development and construction of new low-frequency amplifiers for the GBT continued:

- one prototype 385-520 MHz amp built—in testing stage
- two 1.7-2.7 amps built—awaiting test

In the MAP project, the following developments occurred:

The new 40 GHz amplifier design was completed and a prototype was built using NRAO devices. It required only minor tweaking to perform in accordance with the model predictions. The first quarter of the MAP wafer was delivered by Hughes and the 40 GHz prototype had all its devices replaced with the new passivated ones. There was a moderate degradation in performance, particularly at the high frequency end, which may be due to one of several causes:

(1) Poor device quality—not considered likely

(2) Slight change in geometry due to reduced size of new devices—easily corrected

(3) Slight increase in capacitance of device—easily corrected

Final machining of the next four prototypes, needed by Princeton for radiometer testing, is pending fine tuning, and should be complete by the middle of January.

The design of the 30 GHz amplifier is essentially complete and construction will begin in about two weeks.

It has been determined that the existing 90 GHz design is probably OK for MAP use. Four new amplifiers will be populated with MAP devices and tuned for optimum performance.

The HP Vector Network Analyzer was delivered and works well. Tests are in progress on the rest of the test components for all five frequency bands.

The clean-room construction was begun and is expected to be complete by the middle of January. Components for moving all darkroom operations to Edgemont Road have been ordered.

Multiple versions of the project schedule were generated and coordinated with Princeton and Goddard. We are converging on a master plan with which everyone should be happy.

Superconducting (SIS) Millimeter-Wave Mixer Development

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

SIS373—A broadband tunerless SIS mixer for 200-300 GHz. This mixer requires no anodization, and is compatible with both the UVA and JPL SIS fabrication processes. It has low capacitance in the IF circuit to allow wide IF bandwidth, a problem with some present SIS mixer designs. These mixers are now being fabricated at UVA.

ISM371—A 200-300 GHz SIS image-separating mixer on a single quartz chip. The 2 x 1 millimeter quartz chip is mounted in a waveguide block with separate RF and LO waveguide ports. A modest image-rejection of 10-15 dB across the band will be adequate to suppress atmospheric noise in the image band, which otherwise seriously degrades the system sensitivity of broadband SIS receivers. Substrates for this mixer are at present being fabricated at JPL, and the mixer blocks are being made in the CDL shop.

SIS302—This 260-300 GHz SIS mixer will be made in both tunerless and tunable versions, the latter to allow receivers to be tuned for single-sideband operation on the 12 Meter Telescope. Because only two junctions are used, the LO power required will be lower than for the older SIS301 and SIS371 mixers (which have four or six junctions). The design and the mask layout have been completed and it will be ready for fabrication at UVA once the masks are made.

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

Work continues on adapting a 4 K test station for evaluating image separating SIS mixers (see above). IF quadrature hybrids and ferrite isolators have been tested at 4 K and suitable ones selected for the test receiver. Two new SIS bias supplies have been constructed for this system.

For use at the input of HEMT receivers, and for the LO circuits of SIS receivers, we are designing a new broadband waveguide vacuum window consisting of layers of fused quartz and PTFE glued into a waveguide flange. Over almost the whole WR-10 band (75-110 GHz) the insertion loss of a prototype was less than 0.1 dB and the return loss greater than 25 dB. A narrow resonance near 104 GHz will be eliminated in the next design iteration.

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

During this quarter we have assembled and tested seven SIS mixers, and mounted and DC-tested seven SIS chips from four UVA wafers.

Electromagnetic Support

GBT. Main reflector panels fabricated so far have been measured and are found to have rms accuracy varying between 0.002" and 0.006". A study was done to analyze the effects of panel distribution. The intention was to install the good panels near the plane of symmetry while moving the not-so-good panels to the outside where the illumination by the feed is weak. Aperture efficiency was calculated for different panel distributions at 15 and 22 GHz. From the efficiency, an equivalent rms value for the distributions was calculated. Using panels with lower rms values in the center yielded the lowest equivalent rms.

Input return loss on the L-band feed was measured and was found to be better than -25 dB in the 1.15 to 1.73 GHz range. Measurements were done at different elevations in order to check if there was any deflection of the feed after the outside was reinforced with fiberglass. There was no indication of any bending. Pattern measurements were done on the feed. There is good symmetry between the E- and H-plane patterns and the illumination taper is around -15 dB in the frequency range of operation.

VLA. The K-band feed for the 18-26.5 GHz band was designed and fabricated in the Green Bank machine shop. Far-field patterns were measured and the feed possesses a circularly symmetric beam within the band of operation.

GBT Spectrometer

During the last quarter, system testing of the GBT spectrometer has continued. As of late December, the first three quadrants of the system are error free after 30 minute integrations. The last quadrant still makes errors which are probably due to backplane wiring errors (such as those found when testing the first three quadrants).

The test being run on the system substitutes bits from a pseudo-random data generator for the sampler A/D result at the 100 MHz sampler output stage. This test data is run through the system to produce exactly predictable results in the long-term accumulator.

The only part of the GBT spectrometer still in question is the design of the long-term accumulator. This card still exhibits erroneous operation on overnight tests.

Early problems in the system, expressing themselves as erratic errors at various points in the 100 MHz data stream, were due to power supply instability. After several partially successfully attempts to solve this problem, a final fix was found to be local sensing all power supplies in the system.

The possibility of NRAO supplying GBT-like spectrometer systems or cards for several other instruments (i.e., the 12 Meter telescope, the JCMT, and a South Korean telescope) has been studied in the last few months. A formal proposal was prepared for the Seoul National University for one of the systems.

Several of the applications above would like to run with a clock rate of 125 MHz instead of 100 MHz as in the GBT system. Hence, a test fixture was constructed that could test GBT memory and correlator cards up to at least 150 MHz to see if there was sufficient performance margin in the cards to permit the increased clock rate.

Frequency Coordination

A meeting of WG7D in Geneva, October 8-16, was attended by Dick Thompson. Two major topics discussed were potential interference from a proposed cloud profiling radar satellite at a frequency near 94 GHz and interference from stations of the MSS (mobile satellite service). He also attended the final meeting of Task Group 1-3 on Spurious Emission Limits held in Santa Rosa, October 24-30. As at earlier meetings of TG1-3, strong opposition to limits by representatives of the space services prevented the adoption of any results that would provide meaningful protection to radio astronomy from spurious emissions from satellites.

MMA

The MMA system working group met during the quarter and continued the discussion of the interconnection of the antennas for a proposed joint configuration containing the 40 MMA antennas with the 50 antennas of the LMSA (the proposed Japanese Large Millimeter and Submillimeter Array). This is in preparation for the workshop to be held on the combined array in March 1997.

## I. GREEN BANK ELECTRONICS

GBT IF System

The testing of the 1.6 GHz sampler/filter modules is still on hold, testing should resume in early Spring. The construction of the 100 MHz converter/filter modules was completed this quarter and testing is on hold until early Spring.

All seventeen 1-8 GHz converter modules were module tested and await integration and system test.

Extensive research has been done to determine how to fix the GBT IF fiber optic distribution system problems. Namely, the fiber optic system is phase sensitive to the light. As the cable flexes the amplitude of the received signal changes due to polarization affects. Below describes briefly our work over this period.

- Installed polarization maintaining (PM) fiber on the 140 Foot telescope and the tests showed that the improvement would be about ten times better than the normal single-mode fiber. This would still leave us about two orders of magnitude to go.

- Received and evaluated an Ortel 2515A fiber optic receiver. We had hoped that it would significantly be less susceptible to polarization changes. In fact it was not as good as other receivers we have evaluated. Our best fiber optic receiver is an Ortel 4510, which is similar in design to the 2515A. The 4510 is no longer manufactured.

- Designed a fiber optic attenuator system. With this system we will attempt to close a loop on a tone that we can then use to AGC the system with.

We expect to have more definite plans on how to solve the problems by the end of February.

GBT Receivers

The L-band feed modifications are now complete with the radome material installed. S. Srikanth did extensive testing of the feed both in the receiver test building and on the antenna test range. The results looked very good. Sri has created a notebook with the test results and is in the process of generating a memo on the results.

The four-band prime focus receiver was installed on the 140 Foot telescope with good results. We had some problems with the HEMTs, which have been returned to Charlottesville for evaluation. Ron Maddalena is presently generating a report on these tests.

The design and fabrication drawings for the 910 MHz - 1230 MHz prime focus receiver ortho-mode transducer (OMT) was completed last year. Changes which we made in the L-Band OMT will be incorporated into its drawings then the shop will proceed with fabrication, probably sometime in the second quarter of 1997.

The C-band receiver is built and awaiting testing. Due to limited staffing very limited progress has been made in this area. Engineers will complete the testing and fit it on the 140 Foot for use this spring.

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

We have spent considerable time evaluating the K-band cryogenic system in the lab over the past quarter. The system performed flawlessly in the lab but recent tests at the 140 Foot show that it is again performing poorly there. We hope to solve this mystery in the near future.

GBT Servo System

We have been working closely with the Comsat/RSI servo division on the GBT Servo system. We are monitoring their progress, working out technical details, and reviewing their test procedures and documentation. Over the past quarter very little progress has taken place. A technician is scheduled to come to the site mid-January to finish up various tasks. Testing is scheduled to start on the Feed-Arm servo system in late January to early February.

Site Operations

Interferometer Telescopes. Over the past quarter we have spent time getting the interferometer telescopes back on-line. This required various digital tasks as well as refurbishing the receiver cryogenic systems.

Project Phoenix (SETI). The Electronics Division has assisted the SETI Institute in preparing for observations with the 140 Foot Telescope. Our present role is primarily to support the receiver system.

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

OVLBI. We have hired a new technician (Timothy Glaser) and a new engineer (Dan Pedtke) for the OVLBI project.

IRIDIUM. The standard 140 Foot L-band receiver was modified to use special front end filters for test observations of the Iridium satellites. Each time we do testing for Iridium we need to modify the receiver, test it, and install it on the 140 Foot. When the receiver is used for astronomy then we unmodify it and retest the system before re-installing it on the 140 Foot.

As usual, maintenance, repair, and installation support was supplied to the 140 Foot, USNO 20 Meter and the OVLBI earth-station telescopes. This includes electronic maintenance, electronic design projects to assist users for special projects, and cryogenic support for virtually every receiver in Green Bank. In addition we have been preparing for outfitting the new Jansky Lab.

Normal day to day support of UNIX workstations, weather station, time systems, and local area networks continues.

## J. TUCSON ELECTRONICS

68-115 GHz Receiver

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

8-Beam 220-250 GHz Receiver

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

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

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

Planned Wideband Continuum Receiver

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

New Phase Lock Control

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

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

Cryogenics

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

Quadrant Detector and Thermal Sensors

One of the main contributions to pointing changes on the 12 Meter 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

We are planning a new digital spectrometer for the 12 Meter Telescope which will be copied from the GBT design. The new spectrometer will have twice the instantaneous bandwidth currently available for our multibeam systems, and will use a single wideband sampler for each IF channel, so avoiding the persistent platforming problems experienced with our existing hybrid correlator spectrometer.

## K. SOCORRO ELECTRONICS

VLA L-band Image and 1400 MHz Birdie

Recently completed installation of $\lambda/2$ Walsh function phase switching of the 200 MHz reference frequency in the first LO has reduced, by more than 25 dB, image responses which fold about 1600 MHz (VLA Elec. Memo 224). This has nearly eliminated the 1665-1667 MHz image problem for main line OH observations caused by 1533-1535 MHz signals from Inmarsat satellites. It also has considerably reduced spurious signals below 1500 MHz which are caused by Forest Service transmitters emitting above 1700 MHz.

The 200 MHz phase switching combined with suppression of harmonics of the 200 MHz phase detector in the X-band LO have reduced the 1400 MHz internal RFI by more than 30 dB (VLA Test Memo 200). This should allow continuum observations with narrow bandwidths containing 1400 MHz, and also allow spectral line observations around 1400 MHz by excising the channel containing the residual 1400 MHz RFI.

VLA Upgrade Prototype: K-band Front End

Development work continued on a front end covering the full waveguide band in the frequency range of 18 GHz to 26.5 GHz. The Central Development Lab completed a prototype polarizer consisting of a waveguide phase shift section and an OMT section. The phase shifter will be improved. Most components required for two front ends are on hand. The VLA machine shop is fabricating the dewar. Assembly will start early in the first quarter of 1997. One front end will include three sub-band total power system temperature monitors for estimating atmospheric phase variations. The three new F14 modules with front panel cryo controls and analog monitoring are now complete.

VLA, VLBI, and Pulsar Improvements

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

A VLBI Baseband Switch will connect any of 16 inputs to each of the four VLBI IF inputs which up convert to 600 MHz VLBA IF inputs. Four inputs will be from the analog-sums and 12 inputs will be grouped as four IFs from one antenna each on the west, north, and east arms. The switch is being constructed by modifying four surplus Wandel & Goltermann matrix switch boxes. Each box has 24 inputs which allows future expansion. Modifications include an impedance change from 75 to 50 ohms and a new controller card to interface with the DCS system. A network of power dividers interfaces the inputs to the switch boxes. A new patch panel will connect the four IF outputs from the analog-sum buffer to the 2-channel 150 MHz up converter for the 14-channel video converter pulsar system and to the pulsar wideband detectors. It will have power monitoring and computer controlled level setting. Design has begun. A 32-channel baseband level-setting system will maintain ideal signal levels out of the High Time Resolution Processor (HTRP) Multiplying Polarimeter. The HTRP PC will set the levels as well as acquire the high speed data samples.

The VME Timing board design was finished in November and parts were ordered. The prototype board will be ready for testing in January. Design started on the VME Analog board with completion expected in March.

VLA Correlator Controller

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

VLA Virtual Instrument Recorder (VIR)

This computer based system is now complete, although software for long-term and high-speed data logging will continue to evolve. The system replaces the eight channel Digital Data Tap which was retired after 16 years of service.

VLA Atmospheric Phase Monitor

All the significant parts of the former MMA Mauna Kea site testing interferometer are now at the AOC or the VLA. The entire system will be installed at the VLA next quarter as a near-real-time atmospheric phase monitor.

Increasing the VLA Continuum Bandwidth

We began investigating the possibility of increasing the VLA continuum bandwidth from the present 4*50 MHz to 4*80 MHz (VLA Electronics Memo # 148, 227) by increasing the spectrum of the signals going into the existing 100 MHz samplers and delay-multiplier system. Tests of the sampler quadrature network indicate useful performance to about 80 MHz. The conceptual design makes minimum modifications to the existing hardware and tests effects on the present system performance.

VLA Pie Town Interferometer

The Division developed a system block diagram to connect the VLBA Pie Town antenna signals to the VLA correlator for real time correlation with 26 VLA antennas. It is based on using existing optical fiber installed by Western New Mexico Telephone Company between the VLA control building and the PT antenna. This system would require increasing the correlator digital delay to at least four times the present maximum delay of 163 microseconds.

Cryogenics

We have used a variable-speed motor controller to investigate the effects of reduced-speed operation on a CTI 350 refrigerator. The refrigerator operates smoothly to 25 Hz with the controller feeding a Scott T transformer arrangement. Tests of load capacity vs speed will be done.

GPS Receivers

The VLBA Odetics 325 GPS receivers will not function after September 1999 and are not fixable. We are searching for low cost compatible replacements. One possibility is the Radiocode model which has worked well at the VLA and now is at VLBA Pie Town.

VLBA Masers

Masers 8 and 10 have been tested at the AOC to confirm the resonance stability of the 405 kHz IF stage. Both required retuning with selected NPO capacitors. Both masers are being monitored for long term IF level stability. Maser 11 at North Liberty continues stable levels after the same repair was made last quarter.

VLBA Prototype 3-mm Receiver

A prototype 80-90 GHz HFET receiver, assembled by the Central Development Lab, was installed in the Pie Town antenna in December. Initial single dish tests show aperture efficiency of ten percent, a reasonable beam shape and zenith system temperature of about 130 K. Interferometric tests will be made in January. A second receiver will be installed at VLBA Los Alamos in 1997.

VLBA Correlator

There still have been no failures of any new ASICs since they were installed a year ago. Four old ASICs have failed in the fourth quarter (as of Dec 10).

Changes in the Playback Interface firmware have been implemented that should reduce the occurrence of lost syncs. Tests with a specific job that was prone to lost syncs indicate a reduction of approximately 20 to 1.

System tests of the FIR (data filter) card for all possible numbers of tapes have been completed. The FIR is now thought to be working properly for use with Space VLBI.

Work continues on a correlator overview manual. This introductory manual will be followed by detailed manuals for each sub-system in the correlator.

VLBA Data Acquisition and Playback

Work on high density recording and playback continues. The system is more sensitive to record write voltages, which have been adjusted at the stations. We have noticed some effect of thick tape changing the contour of the heads. Thick tape vacuum was increased in the playback drives. Oscillations in the reproduce system were greatly reduced by modifying all of the Parallel Reproduce Modules to improve grounding. Study of signal-to-noise ratios and spectral performance of all playback drives continues. We discovered and fixed a number of problems with head amplifier circuits. Development began on a jig to test head assemblies in the lab before headstacks are plugged in.

Engineering Services has delivered a prototype heater assembly to further test reduction of relative humidity in the headstack area.

Interference Protection

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

A co-op student has developed user interface and data display software for the digital auto-correlator spectrometer. It will initially be used as the primary back-end for the IRIDIUM satellite emissions tests. Later, we will monitor the four baseband IFs of the antenna at W8. Eventually a frequency down converter will allow the auto-correlator to replace the spectrum analyzer in the W8 P- and L-band RFI monitor.

Normal protection efforts are minimal pending recruitment of an RFI Protection Engineer.

IRIDIUM Satellite Tests

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

Our test plan for objective A) calls for measurements with two subarrays, three antennas with special 1612 MHz bandpass filters to minimize gain compression from the satellite's main emissions at 1621.35 - 1626.50 MHz, and 24 antennas in normal mode to determine the effects of gain compression.

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

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

Parts have been ordered to build a signal source emulating the IRIDIUM satellite's multichannel emissions. This will allow us to determine intermodulation levels within our own equipment.

## L. COMPUTING AND AIPS

### General

The quarter just ended was a positive one for computing at NRAO, with significant progress in ongoing efforts to keep computing facilities at the Observatory capable and effective for research. Despite that, there are still significant problems remaining in computing. In particular, the growing obsolescence of the standard workstations which most scientists and engineers have at NRAO is a problem which must be addressed. The usual IPX or IPC machines which NRAO staff have on their desks run AIPS more slowly than a $1500 PC running AIPS and Linux. It is difficult to buy machines as slow as the Observatory's standard issue machine, but if you dip into the nether regions of the refurbished computer market, you might be able to buy an IPX similar to the Observatory's standard issue machine for around $500, as Green Bank was able to do this past quarter. During the coming year planning will proceed on a strategy to replace or upgrade the typical user's desktop machine over the next 2 to 3 years, working within the expected funding constraints. Other issues to be faced include networking and server upgrades in Socorro and Charlottesville, and issues associated with dealing with large data volumes at all NRAO sites.

### 1996 RE Budget:

The $117,000 allocated from the 1996 RE budget was augmented with significant savings in certain maintenance contracts and a modest amount of funds from other sources (including two NASA grants). As a result, NRAO has acquired a number of advanced workstations to augment and replace the Observatory's aging public workstations. The primary function of these new machines will be to support data reduction by visitors to NRAO sites. The new hardware being purchased includes eleven Sun Microsystems Sparc Ultra 2's and one Digital Alpha workstation. Two of the machines will go to Tucson and the 12 Meter, one to Green Bank, two (including the Alpha) to Charlottesville, and seven to Socorro. The Sun machines have dual processors with a clock speed of 167 MHz; the AIPSMark93 for a single AIPS process on the Sun machines is above 8. The Dec Alpha has a single 400 MHz processor, and is estimated to have an AIPSMark93 of about 11. Each of the machines will have at least 384 MBytes of memory, and 24 GBytes of disk space available to users. These eleven machines represent a very substantial increase in the computing facilities for visitors at the Observatory, and should help ease access to computing facilities for NRAO users and visitors. Final delivery is in January; the new hardware is likely to become available for visitors starting in February. As part of this procurement, most of the Observatory's older IBM RS/6000 workstations are being retired, due to their high maintenance costs. Procedures for reserving workstations will remain the same at each NRAO site. Details of the AIPS DDT and bench-marking information on various computers may be found at http://www.cv.nrao.edu/aips/ddt.html.

### Software

The Observatory is acquiring a few licenses for each site to use IDL, a commercial data reduction package used by some segments of the astronomical community.

### NRAO Intranet

We have proceeded with our plans to implement a frame relay intra-net for NRAO's internal computer communications while retaining it's connection via the Internet for outside traffic. The frame relay service provides guaranteed bandwidth between six of the VLBA sites and the AOC. It also provides guaranteed service between the NRAO's four major locations. Further, it provides much improved service from Green Bank to the Internet. In addition, it provides secure service for all traffic between these sites; this is especially important for the Fiscal Division. The single contract for frame relay service replaces seven existing contracts for Internet service for eight locations.

By the end of 1996, the installation of the intra-net was almost complete. The first circuit implemented was to support Project Phoenix between Green Bank and their facility in Woodbury, Georgia. This was finished in November. Shortly thereafter, the NRAO traffic at both Charlottesville and Green Bank were converted to use the new frame relay service. This provided increased performance of access between Green Bank and the Internet. In December, Socorro and Tucson plus five VLBA stations were added.

By and large the conversion was uneventful. Some work still remains—fine tuning of the circuits and access plus operational procedures—but the increased network connectivity between the NRAO sites is very welcome.

NRAO users who access Observatory computers from outside should notice a greatly improved response to Green Bank. Access to other sites may be slightly improved, since the external access no longer competes with internal NRAO traffic.

VLA Archive

The VLA Archive Project is progressing well. Apart from the period 1985 - 1987, all data from the very beginning (1976) to present have been converted and stored on Exabyte tape. Currently antenna files are being retrieved from the older tapes; due to a software problem (which has been fixed in the meantime) this was not done during the original data extraction. As soon as this intermezzo is over, we will return to the last leg: data from the period 1985 - 1987. The whole project is expected to be concluded some time in 1998, when it is our intention to move all data from Exabyte to CD-ROM. By then, we hope that the new DVD (Digital Video Disk) technology will be sufficiently developed and affordable to be acceptable to us. Each disk will be able to hold the contents of two to four of our current Exabyte tapes.

Workstations

Starting in October, Kiowa (an IBM 580 machine) was made available for general use. Previous to this, it had been reserved for VLBA correlator tests. In addition, we plan to upgrade all IBMs to Sparc Ultra-2 class dual-processor machines which, per processor, are capable of an AIPS benchmark speed three times that of the fastest IBMs. After this upgrade we believe we are in a good position to handle very large VLBA and some orbiting VLBI projects. We are currently starting a test to study the suitability of a Pentium Pro 200 machine for the reduction of intermediate sized VLA and VLBA data sets. AIPS DDT tests have shown that an AIPS benchmark close to that of the IBMs is possible. The aim of the current test is to assess the suitability of PCs for AIPS data reduction by using them for a prolonged time for actual data reduction. If these tests are successful, PCs will be an attractive and moderately priced alternative to various intermediate class workstations.

Networking

At the AOC, we are ready to implement our planned network upgrade. These plans call for a switched network, consisting of a very fast backbone, and several supplementary switches designed to considerably lower the load on any part of the network. All necessary equipment has been ordered; the implementation will follow as soon as the equipment arrives.

The NRAO-wide Intranet came in to operation. This Intranet should result in a much better connectivity between NRAO sites; this is especially useful for the various VLBA sites, but is also beneficial to all other NRAO operations. It also will greatly enhance the security of information flowing from one site to the other. Until now, all information transported over the regular Internet was in principle susceptible to interception.

New 28.8 K modems were purchased for the AOC to replace the 14.4 K ones we have been using for the last couple of years.

Other hardware

We have dropped maintenance of the Microvax at the AOC. We plan to leave it running until something serious breaks. When that happens, this will mark the end of VAX/VMS at NRAO/New Mexico after 18 years of continuous presence! Also, the line printer, which relies on the Microvax, will disappear when the Microvax does. We have purchased a high-end PC in order to study the possibility of serving various databases (library, VLA, MAINT) using an Windows NT server. This choice was prompted by the exorbitant prices that were required in order to renew our Ingres license on Unix machines. We have good hopes that licenses

on PCs are priced a lot lower; in addition, for some of the applications (MAINT), there exists ready software with similar functionalities running on the PC platform.

Personnel

Stephane Beland, who for five years has made invaluable contributions to the VLA archive project, had announced that he would leave NRAO late December, 1996. His VLBA online duties will be taken over by Rick Lively, for whom we are in the process of hiring a replacement. We have re-advertised the network analyst position, after prolonged negotiations with one very promising candidate led to nothing. From the fifteen applications, we have currently selected three people. We intend to start the interviews early January 1997, and hope to be able to make an offer shortly thereafter.

AIPS Software

Early November the 15OCT96 version of AIPS was released to the outside world. As usual, the "AIPSletter" describing many of the changes and improvements, was written and distributed.

The AIPS DDT was used extensively to test new architectures considered for purchase by NRAO. A DEC Alpha machine reached the highest AIPS benchmark thus far, namely 12.0. It was decided to purchase six Sparc Ultra-2 dual processor machines. Earlier tests had shown that these machines are capable of an AIPS benchmark of 9 per processor. AIPS benchmarks of multiprocessor systems at NCSA were less successful, partly because AIPS code is not parallelized enough to make use of many processors at once.

Most of the software development of the last three months went into the 15OCT95 release. Since then, the emphasis of software development was on orbiting VLBI, in view of the upcoming launch of the Japanese VSOP satellite. Some highlights:

1) New polarization correction modes DOPOL=2 and DOPOL=3 were implemented. This allows second order polarization corrections when using the linear D-term approximation within AIPS. The mode DOPOL=3 applies more rigorous flagging, removing visibility points with any missing polarization correlation pairs, whereas DOPOL=2 applies the same second-order correction but makes several approximations for any missing polarization correlation pairs when computing the correction matrix. DOPOL=1 makes the same first-order correction as before.

2) Work on the VLB DDT continued, and the following features were added: a) instrumental polarization errors; b) multiplicative gain errors; c) rest frequencies and LSR velocities in the SU table and catalog header; and d) baseline-dependent integration times.

3) Elevation interpolation, which was introduced in 15OCT96 AIPS, was further enhanced by adding the possibility to fit for opacity.

4) As always, numerous smaller improvements were made and bugs were fixed. The designated AIP program continues to allow users worldwide quick access to AIPS support.

Personnel

We hope to be able to hire one new position in the AIPS group in the beginning of 1997 in order to offset recent losses. In the meantime, we are planning to structure the porting of selected routines from AIPS CVX to AIPS TST.

## M. AIPS++

The first meeting of the AIPS++ Scientific and Technical Advisory Group was held in Socorro November 4 - 6, 1996. Presentations were made to the group by members of the AIPS++ Project. The group, chaired by Robert Braun of the Netherlands Foundation for Research in Astronomy, expeditiously produced a report, which is available from http://aips2.nrao.edu/aips++/docs/notes/198/198.html. The advice given by the group was generally very useful, but particularly so in helping decide development strategies for the next few years, and has already been taken into account in revising our plans for the

release strategy. Following their advice, we plan to make two major releases, one in 1997 and one in 1998. The first is designated as a *Limited Public Release* since it will contain only a subset of the functionality expected to be present eventually. The second release, in 1998, is expected to have a more rounded set of capabilities. The limited public release is preceded by an explicit *beta* release. The goals for the various releases are as follows:

- Beta Release Due Mid-February 1997
  - Targeted to consortium sites and a few friendly astronomers.
  - Contains basic environment, tools, synthesis applications (including polarization self-calibration and Briggs NNLS deconvolution algorithm).
  - Will get early exposure for AIPS++.
- Limited Public Release Due Mid-1997
  - Interfaces should be fixed at this point.
  - Open release, targeted to both astronomers and programmers.
  - Contains basic environment, tools, synthesis applications.
  - GUI front ends to major DOs and applications.
  - Will provide environment for code development.
- AIPS++ V2 Due Mid-1998
  - Synthesis package (including some functionality for VLBI).
  - Single dish package.
  - Image Analysis package.
  - General toolkit.
  - Visualization toolkit and applications.
  - Contributed code.

The project remains very active in a number of different areas, both short-term for the beta release (such as alpha testing of the synthesis code) and longer-term (such as development of an image display library). For more detailed information on the current and planned capabilities of the AIPS++ system, see the latest project report, covering the period 1 July - 30 November 1996, at http://aips2.nrao.edu/aips++/docs/project/1996q3.html.

## N. GREEN BANK TELESCOPE PROJECT

Antenna

The antenna tipping structure has been moved from the 66 degrees position to 78 degrees, which is the telescope access position. The 55x25x13 foot (approx) dual boxes of the horizontal feed arm are being assembled on the structure. Four of the boxes are ready for installation. Once the remaining eight boxes are installed, assembly of the vertical portion of the feed arm will begin.

Progress has been made on the upper 60 feet of the upper vertical feed arm which has been trial erected on the ground. The subreflector panels have been installed on the subreflector backup structure, and the subreflector assembly is mounted in position on the feed arm tip. The prime focus feed positioner mechanism is installed and is currently in a partially retracted position. The access and stairways are also completed. The feed arm tip assembly will be used for setting the subreflector surface and testing and calibrating all the mechanical elements on the upper feed arm.

The main reflector backup structure (BUS) trial assembly is progressing well. By Christmas, the BUS was over 60 percent trial erected. From Hoop 15 to Hoop 33 all trusses are in place. Trusses R1, R1L, R1R, R2L, R2R, R3L and R3R between Hoops 33 and 45 are also in place. All but 30 pieces of the BUS have been delivered to the site. The site crew reports that progress on the BUS trial erection is in "high gear" and completion is scheduled for the summer. Once the trial erection is complete, the BUS will be disassembled into 22 modules for lifting onto the antenna.

Approximately 1,400 of the 2,200 main reflector surface panels have been fabricated and are awaiting final inspection. Painting, and shipment to the site.

Open Loop Active Service and Pointing

Software development continued this period. Most of the effort concentrated on the interface between the active surface master processor and the 3D Surface Designation system. All commands in the interface are being methodically tested. Ten commands were completely tested this month. At this point, the last two commands in the interface are almost completely tested. During the testing, a bug which caused a few actuators not to get a software enable was found. The cause was found and fixed.

Servo

NRAO's primary responsibility with regards to the servo system is to monitor the progress of the servo contractor. No progress was achieved in the feed arm servo this quarter due to the unavailability of a project engineer at PCD.

When the Feed Arm servo tests are run, in early 1997, NRAO will be responsible for conducting RFI tests of the system. Some effort was expended this month in meeting with various experts on site to devise a test plan. Testing to the required levels will require more than the "standard setup". The cost of transmitting signals from the GBT site to the spectral processor at the 140 Foot Telescope was investigated.

GBT Spectrometer

The digital hardware for the complex spectrometer system is being designed. Two days were spent this period debugging and testing the system. In addition, a meeting was held primarily to address software and computer hardware questions that had recently arisen.

Closed Loop Active Surface and Pointing

Mirror assembly and testing is complete with the exception of some modifications to the units in the field, which will be done after they are phased out with production optics and base assemblies. Work continues on the optics assemblies. A prototype of the detector housing is being built and will be evaluated in January. A neutral density filter has been mounted on a 1" retroreflector (for the reference cube), and will be evaluated in January as well. The conduit between the seven GBT monuments that require berms has been completed and is now ready for the earthwork. Work is proceeding on fitting the dual axis inclinometer calibration data for the panel setting tool.

Software

A written procedure has been tested and placed in the archives in order to formalize the software documentation of revisions and source code. Backup procedures have been formalized to insure duplication of source code at the laser lab and Jansky lab.

GBT Architecture

Work continues on the structural-to-RF model. A procedure is being developed to calibrate each retroreflector in the lab.

Electronics

Prime Focus Receiver. The front end box has been installed in indoor/outdoor test building and noise temperature and calibration values have been measured using both the Room Temp Absorber/Cold Sky method and the LN2/Room Temp Load methods.

Tests have been performed on the coax-rectangular waveguide circular waveguide transition to determine its noise contribution and effects on measured noise temperature. Design of prototype SBFA feed for the Receiver has continued.

LAN/Ethernet. A LAN switch has been researched and ordered to connect a high speed (100 Mbit) ethernet from the New Jansky building to the GBT.

L-band Receiver. The L-band feed pattern was measured this period using the outdoor antenna test range. The receive's dewar assembly was completed, and the first cool-down was successful. Receiver noise temperature measurements were performed. Receiver noise temperatures were measured and found to be below the anticipated 8 K.

C-band Receiver. A new feed section was fabricated by the shop. The new section relocates the mounting flange for correct placement of the feeds phase center.

X-band Receiver. The receiver was cooled down on 20 November 1996. The cryogenic temperatures have been cycling since then. The first stage cycles between 37 K and 50 K, and the second stage between 14 K and 20 K.

K-band Receiver. Cryogenic testing continued through the month. A helium leak check was performed and no leaks were found. Long term testing in the lab has not uncovered any problems that could help explain the history of poor reliability at the 140 Foot telescope.

Two cryogenic amplifiers were removed from the dewar and sent to Charlottesville for repair. The LEDs are not working.

A trial fit of the receiver at the GBT receiver room was successful. Holes in the feed rotator must be made bigger, to allow bolts to drop through.

LO Reference Distribution System. The 10 MHz Distributor modules were completed. X5 multipliers, 10 MHz Amp/Filters, 500/10 Receivers, 2 KHz PLL, and optical receiver circuits were completed this quarter.

Component evaluations for the 500 MHz Buffer and the 100 MHz Distributor were completed. Final electrical and mechanical designs were completed and drawings were submitted to the shop.

ULO. Another failure was encountered during long-term testing of the ULO. A bad transistor (Q6 on the 38 MHz Filter/Divider board) was replaced. Long- term testing continues.

Spectral Processor. This system was modified so that it can operate without the TRAK clock.

Feed Defroster. Most of the hardware has been ordered to control the feed defroster. The logic to control the defroster has been designed and is in the process of being entered into Or-Cad. Some RFI testing of the heater control will be performed as soon as practical.

Accelerometers. The hardware to send the accelerometer signals from the elevation bearing to the servo room has been built and is ready for installation. The cable has been run from the elevation bearing to the servo room. The system will be installed on the GBT during the next period. Software to record the data has been tested. The plan is to record one hour worth of data, sampling two channels at 100 Hz.

Switching Signals. The last two chassis for this system have been received from the shop. All wire lists to wire the chassis have been generated. When technician time is available, the chassis will be wired and ready for testing.

Monitor and Control

Work on implementation of LO1A and of the IF Manager whose functionality includes the Observing Frequency Formula specification continues. Work on the remaining GUI component was in progress at the end of the period. Further work on the IF Manager and IF Router will wait until the mockup is set up. Work continues on the astronomical calculations for the LO1.

Work began in earnest last month on finishing up the DCR and creating a production model of the software. Though all of the basic functionality was completed, more remains to be done on installation procedures and integration.

The development work on the monitor system was completed last month and integration testing will start in January prior to its release.

Work on the holography backend stopped because of deficiencies in the hardware design. Work will continue when it is determined whether and how to upgrade the device.

A number of changes to the FITS format for the GBT data and data associated parameter files were implemented.

For the antenna, progress was made on the commanded track definition, but more work remains the Coordinate Processor class and Antenna programs to support user-defined transformations on top of any of the seven supported coordinate systems were revised.

## O. PERSONNEL

New Hires

None this quarter.

Terminations

| | | |
|---|---|---|
| M. Balister (Retired) | Electronics Engineer | 12/31/96 |
| C. Barnbaum | Research Associate | 10/31/96 |
| S. Beland | Sr Sci Programming Analyst | 12/27/96 |
| E. Brinks | Associate Scientist - Socorro Operations | 12/31/96 |
| P. Shannon | Scientific Programming Analyst | 12/13/96 |
| X. Yang | Assistant Scientist - Research Support | 11/22/96 |

Other

| | | |
|---|---|---|
| T. Bastian | Return from Leave for Professional Advancement | 11/04/96 |

Change in Title

| | | |
|---|---|---|
| J. Uphoff | to Scientific Programming Analyst | 11/18/96 |

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