NATIONAL RADIO ASTRONOMY OBSERVATORY

Quarterly Report

July 1, 1992 - September 30, 1992

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A. TELESCOPE USAGE

The following telescopes have been scheduled for research and maintenance in the following manner during the third quarter of 1992.

	140 Foot	12 Meter	VLA
Scheduled observing (hours)	1852.00	304.00	1720.7
Scheduled tests and calibration	159.50	240.00	274.6
Scheduled maintenance and equipment changes	196.50	1664.00	228.8
Time lost due to equipment, power, interference, weather	66.00	33.75	86.0

B. 140 FOOT TELESCOPE

The following line programs were conducted during this quarter.

No.	Observer(s)	Program
B493	Rood, R. (Virginia) Bania, T. (Boston) Wilson, T. (MPIR, Bonn) Balser, D. (Boston)	$^3He^+$ measurements at 8.666 GHz toward galactic HII regions.
B554	Brown, R.	Observations between 4.8 and 5.0 GHz for recombination lines from QSO's and AGN sources.
B558	Brown, R. Fisher, J. R.	Complete survey for HI absorption in the redshift interval $0.4 < z > 0.9$.
D178	Dickey, J. (Minnesota) Kobulnicky, H. (Minnesota) Garwood, R.	21 cm observations of compact extragalactic radio sources.
L254	Lockman, F. J. Savage, B. (Wisconsin)	Search at 1420 MHz for HI "worms."
L271	Lockman, F. J. Savage, B. (Wisconsin)	Search at 1.4204 GHz for high-velocity HI toward QSO'S.
T313	Tifft, W. (Arizona)	A fundamental test at 21 cm for redshift variability.

The following pulsar programs were conducted during this quarter.

No.	Observer(s)	Program
A113	Arzoumanian, Z. (Princeton) Kaspi, V. (Princeton) Nice, D. (Princeton) Taylor, J. (Princeton)	Observations at 400, 800, and 1660 MHz of the eclipsing binary pulsar in NGC 6342.
B550	Backer, D. (Calif., Berkeley) Van Hook, S. (Calif., Berkeley) Foster, R. (NRL)	Measurements at 800 and 1330 MHz of the timing of an array of pulsars.
B559	Biggs, J. (NASA/GSFC) Salter, C. Foster, R. (NRL)	Observations at 1420 MHz to monitor pulsar HI absorption spectra.
C274	Clegg, A. (NRL) Fiedler, R. (NRL) Cordes, J. (Cornell)	Observations at 800 MHz of strong interstellar refraction of the pulsar 0823+26.
F105	Foster, R. (NRL) Fiedler, R. (NRL) Cordes, J. (Cornell)	Observations at 800-840 and 1330 MHz to obtain the dynamic spectra of strong radio pulsars.
T302	Taylor, J. (Princeton) Nice, D. (Princeton) Thorsett, S. (Caltech) Arzoumanian, Z. (Princeton) Shrauner, J. (Princeton) Wan, L. (Princeton) Sayer, R. (Princeton) Camilo, F. (Princeton)	Pulsar timing observations over the range 780-820 and 1300-1350 MHz.
T312	Taylor, J. (Princeton) Arzoumanian, Z. (Princeton)	Extended timing observations of particular pulsars at 400 and 800 MHz.

The following very long baseline programs were conducted and the NRAO stations used are coded as follows.

G - Green Bank 140 Foot VLBA - All available VLBA 25 m Yn - Socorro n=1-27x25 m

No.	Observer(s)	Program
BF7	Feigelson, E. (Penn State) Phillips, R. (Haystack) Lonsdale, C. (Haystack)	3.6 cm observations of active WTT star HD 283447, with telescopes G, Y_{27}, and VLBA.
BG7	Greenhill, L. (CFA) Moran, J. (CFA) Phillips, R. (Haystack) Townes, C. (Calif., Berkeley)	3.6, 6, and 18 cm observations of the compact core of NGC 3079, with telescopes G, Y_{27}, and VLBA.

No.	Observer(s)	Program
BV4	Venturi, T. (Bologna) Wehrle, A. (JPL) Jones, D. (JPL)	6 cm observations of two candidate compact double radio sources, with telescopes G, Y_{27}, and VLBA.
GB8	Bloom, S. (Boston) Marscher, A. (Boston) Gear, W. (Edinburgh)	3.6 cm VLBI-JCMT-ROSAT-GRO observations of strong millimeter sources, with telescopes G, Y_1, and VLBA.
GB16	de Bruyn, A. (NFRA) Schilizzi, R. (NFRA) Miley, G. (Leiden) Pedlar, A. (NRAL)	Observations at 6 and 18 cm of the radio core of the face-on Seyfert galaxy Mkn 348, with telescopes G, Y_{27}, and VLBA.
GC9	Conway, J.	3.6 cm observations of bright nuclei of powerful double-lobed radio galaxies, with telescopes G, Y_{27}, and VLBA.
GC11	Cawthorne, T. (CFA)	3.6 and 6 cm search for Faraday rotation in the parsec-scale structure of two quasars, with telescopes G, Y_{27}, and VLBA.
GG14	Gurvits, L. (NAIC) Schilizzi, R. (NFRA) Kellermann, K. Barthel, P. (Groningen/Kapteyn) Pauliny-Toth, I. (MPIR, Bonn) Popov, M. (Lebedev) Kardashev, N. (Lebedev)	6 cm observations of quasars at redshift > 3, with telescopes G and Y_{27}.
GL8	Lara, L. (IAA, Granada) Alberdi, A. (IAA, Granada) Marcaide, J. (IAA, Granada)	Observations at 8.4 GHz of the quasar 3C 395, with telescopes G and VLBA.
GL11	Lonsdale, Colin (Haystack) Lonsdale, Carol (Caltech) Smith, H. (Calif.,San Diego)	18 cm observations of starburst galaxies with telescopes G and Y_{27}.
GM12	Mantovani, F. (Bologna) Bondi, M. (Bologna) Junor, W. Padrielli, L. (Bologna)	Observations at 18 cm of steep-spectrum, low-frequency, variable sources, with telescopes G and VLBA.
GP11	Porcas, R. (MPIR, Bonn)	3.6 cm observations of 3C 179, with telescopes G, Y_{27}, and VLBA.

No.	Observer(s)	Program
GW7	Wilkinson, P. (Manchester) Henstock, D. (Manchester) Browne, I. (Manchester) Patnaik, A. (Manchester) Vermeulen, R. (Caltech) Pearson, T. (Caltech) Readhead, A. (Caltech) Cohen, M. (Caltech)	A 6 cm snapshot survey of flat spectrum sources, with telescopes G, Y_1, and VLBA.
GX3	Xu, W. (Caltech) Readhead, A. (Caltech) Pearson, T. (Caltech) Conway, J. Unwin, S. (Caltech) Wilkinson, P. (Manchester) Polatidis, A. (Manchester)	18 cm observations to study a possible new class of active galaxy with S-shaped symmetry, with telescopes G and VLBA.
GZ8	Zensus, A. Unwin, S. (Caltech) Wehrle, A. (JPL)	3.6 cm observations of the evolution of the parsec-scale structure of 3C 345, with telescopes G, Y_1, and VLBA.

C. 12 METER TELESCOPE

The following line programs were conducted during this quarter.

No.	Observer(s)	Program
B571	Bieging, J. (Arizona) Latter, W.	A survey of S stars for mass loss.
B577	Barnes, P. (CFA) Myers, P. (CFA)	Mapping of dense cores associated with intermediate-mass IRAS sources.
D171	Dickel, J. (Illinois) Milne, D. (ATF, Australia)	Study of CO emission associated with SNRs in spiral galaxies.
T311	Thompson, R. (Penn State)	CO observations of ultrasoft X-ray emitting active galactic nuclei.
W312	Wootten, H. A. Turner, B.	A search for CH_2D^+ in interstellar space.

D. VERY LARGE ARRAY

This quarter was spent in the following configurations DnC configuration from July 1 to July 7; D configuration from July 7 to September 28; D → A configuration from September 28 to September 30.

No.	Observer(s)	Program
AA133	Alexander, P. (Cambridge) Blundell, K. (Cambridge) Pooley, G. (Cambridge) Riley, J. (Cambridge) Liu, R. (Cambridge)	ENLRs and asymmetries in radio sources. 2, 3.6, 6 cm
AA145	Anglada, G. (Barcelona) Estalella, R. (Barcelona) Torrelles, J. (IAA, Granada) Rodriguez, L. (Mexico/UNAM)	Ammonia toward double radio source in L723. 1.3 cm line
AA146	Appleton, P. (Iowa State) Ghigo, F.	Star formation in ring galaxies. 3.6, 6, 20 cm
AA147	Aschwanden, M. (NASA/GSFC) Bastian, T. Benz, A. (ETH, Zurich) White, S. (Maryland)	3D-reconstruction and HTR imaging of solar bursts. 6, 20, 90 cm
AB414	Becker, R. (Calif., Davis) White, R. (STScI)	Monitoring radio stars HD193793 and P Cygni. 2, 6 cm
AB456	Burke, B. (MIT) Hewitt, J. (MIT) Roberts, D. (Brandeis)	Monitoring 0957+561 A,B. 6 cm
AB635	Berkhuijsen, E. (MPIfR, Bonn) Beck, R. (MPIR, Bonn) Hummel, E. (Royal Obs)	Structure of the magnetic field in the central region of M31. 6 cm
AB638	Buckley, D. (Stroudsburg) Schneider, S. (Massachusetts)	Planetary nebulae with faint optical halos. 3.8 cm
AB639	Bregman, J. (Michigan) Schulman, E. (Michigan) Brinks, E. Roberts, M.	High velocity clouds in external galaxies. 20 cm line
AB642	Balser, D. (Boston) Bania, T. (Boston) Rood, R. (Virginia) Wilson, T. (MPIR, Bonn)	Measuring continuum structure of $^3He^+$ sources. 3.5 cm

No.	Observer(s)	Program
AB644	Bastian, T. Vilmer, N. (Paris Obs) Kerdraon, A. (Paris Obs) Klein, K.-L. (Paris Obs)	Solar radio microbursts and relation to hard X-ray microflares. 6, 20, 90 cm
AB645	Bastian, T. Dulk, G. (Colorado) Gary, D. (Caltech) Nitta, N. (Lockheed) Kiplinger, A. (Colorado)	Solar flares: Microwave imaging with high time resolution. 1.3, 2, 3.6, 6 cm
AB646	Beck, R. (MPIR, Bonn) Ehle, M. (MPIR, Bonn) Dettmar, R. (Bonn U.)	Interstellar medium in NGC 55. 20 cm
AB647	Beck, R. (MPIR, Bonn) Berkhuijsen, E. (MPIR, Bonn) Hummel, E. (Royal Obs)	Structure of magnetic field in M31. 20 cm
AB650	Borkowski, K. (Maryland) White, S. (Maryland) Harrington, J. (Maryland)	Hydrogen deficient planetary nebulae. 6, 20 cm
AB651	Bosma, A. (Marseille Obs) Knapp, G. (Princeton) Athanassoula, L. (Marseille Obs) van Gorkom, J. (Columbia) Gunn, J. (Princeton)	Disk/halo ratio and spiral structure. 20 cm line
AB652	Briggs, F. (Pittsburgh) Turnshek, D. (Pittsburgh) Hazard, C. (Pittsburgh)	Search for extended neutral H in galaxies at z=3.4. 90 cm line
AB654	Brown, R. Low, F. (Arizona) Vanden Bout, P.	Warm faint IRAS sources. 3.6 cm
AB669	Bookbinder, J. (CFA) Guedel, M. (Colorado) Saar, S. (CFA)	M dwarfs. 2, 3.6, 6, 20 cm line
AC323	Curiel, S. (CFA) Rodriguez, L. (Mexico/UNAM)	Emission associated with HH 12. 2 cm
AC324	Carilli, C. Holdaway, M. Ho, P. (CFA)	Halo of NGC 253. 3.6, 6 cm
AC325	Claussen, M. Johnston, K. (NRL)	AGB stars. 1.3 cm line

No.	Observer(s)	Program
AC326	Condon, J. Broderick, J. (VPI & SU)	Radio ID's of extragalactic IRAS sources. 20 cm
AD275	Dwarakanath, K.	GEETEE sources. 20, 90 cm
AD286	Deeg, H.-J. (New Mexico) Brinks, E. Duric, N. (New Mexico) Klein, U. (MPIR, Bonn) Skillman, E. (Minnesota)	Radio spectra of blue compact dwarf galaxies. 1.3, 2, 3.5, 90 cm
AD289	Dubner, G. (IAFE, Argentina) Giacani, E. (IAR, Argentina) Winkler, P. F. (Middlebury) Goss, W. M.	Imaging of the SNR 3C 400.2. 20 cm
AD291	de Pater, I. (Calif., Berkeley) Palmer, P. (Chicago) Snyder, L. (Illinois)	H_2CO emission from comet Shoemaker-Levy. 6 cm line
AD303	Dwarakanath, K. van Gorkom, J. (Columbia)	HI in Abel 154. 20 cm line
AF211	Fiedler, R. (NRL) Dennison, B. (VPI & SU) Johnston, K. (NRL)	Extreme scattering events/target of opportunity. 1.3, 2, 3.8, 6, 20 cm
AF217	Frail, D. Kulkarni, S. (Caltech) Thorsett, S. (Caltech)	Young pulsar in G5.4-1.2. 20 cm
AF221	Frail, D. Kulkarni, S. (Caltech) Vasisht, G. (Caltech)	Search for pulsars in crab-like SNR. 20 cm
AF229	Freudling, W. (ESO) Prieto, A. (ESO)	HI in biconical Seyfert galaxy NGC 5252. 20 cm line
AF239	Frail, D. Whiteoak, J. (Sydney) Goss, W. M.	Search for extended emission near two young pulsars. 20, 90 cm
AG339	Giovanardi, C. (Arcetri) Rodriguez, L. (Mexico/UNAM) Lizano, S. (Mexico/UNAM) Canto, J. (Mexico/UNAM)	High-velocity HI in L1551. 20 cm line

No.	Observer(s)	Program
AG343	Giovannini, G. (IdR, Bologna) Feretti, L. (IdR, Bologna) Boehringer, H. (MPIfEP, Garching) Schwartz, R. (MPIfEP, Garching)	Halo sources in A2255 and A2319. 20 cm
AG344	Giovannini, G. (IdR, Bologna) Feretti, L. (IdR, Bologna) Boehringer, H. (MPIfEP, Garching) Schwartz, R. (MPIR, Bonn)	Cluster radio halo candidates. 20, 90 cm
AG346	Garay, G. (Chile) Rodriguez, L. (Mexico/UNAM) Mardones, D. (Harvard)	Warm molecular gas associated with compact HII regions. 1.3 cm line
AG350	Ge, J.-P. (Brandeis) Owen, F.	Super-high dynamic-range polarimetry of NGC 1275. 6 cm
AG352	Gaume, R. (NRL) Johnston, K. (NRL) Wilson, T. (MPIR, Bonn)	W3(OH) region. 2, 6 cm
AG353	Goss, W. M. Uson, J.	Pilot observations of ^{3}He. 3.5 cm
AH390	Hjellming, R. Gehrz, R. (Minnesota) Taylor, A. (Calgary) Seaquist, E. (Toronto)	Monitoring radio novae. 3.8, 6, 20 cm
AH456	Henning, P. (NFRA) Sancisi, R. (Groningen/Kapteyn)	HI near the elliptical galaxy NGC 4472. 20 cm line
AH457	Heikkila, B. (New Mexico State) Webber, W. (New Mexico State) Burns, J. (New Mexico State) Walterbos, R. (New Mexico State) Duric, N. (New Mexico)	Survey of edge-on spiral galaxies at 90 and 20 cm.
AH461	Hibbard, J. (Columbia) van Gorkom, J. (Columbia)	The fate of gas in interacting/merging galaxies. 20 cm line
AH463	Habbal, S. (CFA) Esser, R. (CFA) Coles, W. (Calif., San Diego) Groll, R. (Calif., San Diego) Gonzalez, R. Lovhaug, U. (EISCAT, Norway) Ronan, R. (Hawaii)	Study of the inner solar wind region. 3.8, 6, 20 cm

No.	Observer(s)	Program
AH465	Hankins, T. (NMIMT) McKinnon, M. Moffett, D. (NMIMT)	Development of pulsar polarimetry at 90 cm.
AH466	Herbig, T. (Caltech) Readhead, A. (Caltech)	Radio sources in Sunyaev-Zeldovich clusters. 6, 20 cm
AH467	Hoffman, L. (Lafayette) Salpeter, E. (Cornell)	HI mapping of NGC 4532/DDO 137 galaxy pair and gas cloud. 20 cm line
AJ217	Johnston, H. (Caltech) Deich, W. (Caltech) Kulkarni, S. (Caltech) Middleditch, J. (Los Alamos)	Deep pulse searches towards globular clusters. 6, 20 cm
AJ218	Johnston, K. (NRL) Gaume, R. (NRL) Wilson, T. (MPIR, Bonn) Lemme, C. (MPIR, Bonn)	DR21/W75 region. 1.3 cm line
AJ219	Joncas, G. (Laval) Green, D. (Cambridge)	Investigation of promising sources from the DRAO galactic plane survey. 3.6, 6 cm
AJ220	Jones, M. (Cambridge) Saunders, R. (Cambridge)	Candidate clusters for Sunyaev-Zeldovich effect. 2 cm
AK294	Katz-Stone, D. (Minnesota) Rudnick, L. (Minnesota) Anderson, M. (Minnesota) Leahy, J. (Manchester) Lonsdale, C. (Haystack) O'Donoghue, A. (St. Lawrence)	Evolution of the relativistic electrons in extragalactic radio sources. 3.6, 6 cm
AK301	Koo, B.-C. (Seoul National U.) Heiles, C. (Calif., Berkeley) Seward, F. (CFA)	The supernova remnant in the W51 complex. 20 cm line
AK303	Kundu, M. (Maryland) White, S. (Maryland) Gopalswamy, N. (Maryland)	Multiple structures in the onset of solar flares. 2, 3.5, 6 cm
AK304	Kundu, M. (Maryland) Woodgate, B. (NASA/GSFC) Maran, S. (NASA/GSFC) White, S. (Maryland) Lim, J. (Caltech)	AU Mic: the radio/Lyα relation (with HST). 2, 3.6 cm
AL150	Lestrade, J.-F. (JPL) Preston, R. (JPL)	Statistical properties of RSCVn stars. 6 cm

No.	Observer(s)	Program
AL252	Ledlow, M. (New Mexico) Owen, F.	Radio galaxies in rich clusters. 20 cm
AL258	Lo, K. (Illinois) Sargent, W. (Caltech) Engargiola, G. (Illinois)	HI mapping of faint dwarf irregular galaxies. 20 cm line
AL262	Lehnert, M. (Johns Hopkins) Baum, S. (STScI) O'Dea, C. (STScI) Armus, L. (Johns Hopkins) Caganoff, S. (Johns Hopkins)	Galactic superwinds: 3 starburst galaxies. 6 cm
AL266	Liang, H. (Mt. Stromlo) Subrahmanyan, R. (AT, Australia) Ekers, R. (AT, Australia) Silk, J. (Calif., Berkeley)	Sunyeav-Zeldovich effect in distant clusters. 3.6 cm
AM345	Mirabel, I. (CNRS, France) Rodriguez, L. (Mexico/UNAM) Cordier, B. (CNRS, France) Paul, J. (CNRS, France) Lebrun, F. (CNRS, France)	1E 1740.7-2942. 6, 3.6 cm
AM353	Moffett, D. (NMIMT) Goss, W. M. Reynolds, S. (North Carolina St.)	SN 1006 - expansion. 20 cm
AM359	Muhleman, D. (Caltech) Grossman, A. (Maryland) Slade, M. (JPL) Butler, B. (Caltech)	Radar measurements of Titan reflectivities and rotation rate. 3.5 cm line
AM364	Morganti, R. (IdR, Bologna) Parma, P. (IdR, Bologna) Fanti, R. (IdR, Bologna) de Ruiter, H. (IdR, Bologna) Capetti, A. (IdF, Torino)	Polarization study of B2 radio galaxies. 6 cm
AM365	McMahon, P. (Columbia) Richter, O.-G. (STScI) van Gorkom, J. (Columbia) Ferguson, H. (Cambridge)	HI survey of the Hydra I cluster. 20 cm line
AM367	Mehringer, D. (Chicago) Palmer, P. (Chicago) Goss, W. M. Yusef-Zadeh, F. (Northwestern)	W51 star-forming region. 3.6, 6, 20 cm line

No.	Observer(s)	Program
AM368	Mehringer, D. (Chicago) Palmer, P. (Chicago) Goss, W. M. Yusef-Zadeh, F. (Northwestern)	Sgr D star-forming region. 6, 20 cm line
AM369	Mehringer, D. (Chicago) Palmer, P. (Chicago) Yusef-Zadeh, F. (Northwestern) Goss, W. M.	Reproposal for search for H_2O masers in Sgr B1 and G0.6-0.0. 1.3 cm line
AM370	Mangum, J. (Texas) Wootten, H. A.	Dense core structure in DR21(OH). 2 cm line
AM371	Mikami, H. (Nagoya) Umemoto, T. (Nobeyama Obs) Yamamoto, S. (Nagoya) Saito, S. (IMS, Japan)	Distribution of high-temperature gas in the L1157 dark cloud. 1.3 cm line
AM372	Myers, S. (Toronto) Lawrence, C. (Caltech)	Survey of microwave background fields. 1.3, 2, 3.6 cm
AM385	Mirabel, I. (CNRS, France) Rodriguez, L. (Mexico/UNAM)	Gamma ray source 1758-258. 6 cm
AO109	Olling, R. (Columbia) van Gorkom, J. (Columbia)	Mass distribution of NGC 4244. 20 cm line
AO110	Onello, J. (SUNY) Phillips, J. (Caltech) Terzian, Y. (Cornell) Goss, W. M.	Radio recombination lines of partially ionized gas in W48. 20 cm line
AP217	Puche, D. (CFA) Westpfahl, D. (NMIMT) Brinks, E.	Nearby dwarf galaxies. 20 cm line
AP223	Plante, R. (Illinois) Lo, K. (Illinois) Crutcher, R. (Illinois) Killeen, N. (AT, Australia)	HI Zeeman measurement against the galactic center's arc and arch sources. 20 cm line
AP225	Phookun, B. (Maryland) Mundy, L. (Maryland)	NGC 5713, NGC 3162, and NGC 3675: HI observations of one-armed spiral galaxies. 20 cm line
AP228	Puche, D. (CFA) Westpfahl, D. (New Mexico Tech) Brinks, E. Deeg, H.-J. (New Mexico)	The energy balance in two nearby dwarf galaxies. 2, 3.6, 6, 20 cm

No.	Observer(s)	Program
AP229	Porter, A. (KPNO-NOAO) Green, R. (KPNO-NOAO) Osmer, P. (KPNO-NOAO) Biretta, J. (STScI)	X-band survey of the highest redshift quasars. 3.8 cm
AP237	Phillips, J. (Caltech) Frail, D. Thorsett, S. (Caltech)	Search non-pulsed emission around millisecond pulsars. 20 cm
AP238	Palmer, P. (Chicago) Gonatas, D. (Pennsylvania)	Recombination line and continuum studies of Mon R2 and M17 SW. 3.6, 6, 20 cm line
AR251	Rupen, M. Lees, J. (Princeton) Knapp, G. (Princeton) van Gorkom, J. (Columbia)	HI emission from elliptical galaxies. 20 cm line
AR262	Rowan-Robinson, M. (Queen Mary) Sopp, H. (Queen Mary) Lawrence, A. (Queen Mary) McMahon, R. (Cambridge)	The nature of ultra-luminous infrared galaxies. 20, 6, 2 cm
AR263	Rudolph, A. (Maryland) de Geus, E. (Maryland) Brand, J. (Arcetri) Wouterloot, J. (Cologne)	Radio continuum observations of outer galaxy massive star-forming clouds. 2 cm
AR266	Richter, O.-G. (STScI) Saha, A. (STScI) Hoessel, J. (Wisconsin)	UGC-A86 and UGC-A92: Local group galaxies or companions of IC 342. 20 cm line
AR270	Rodriguez, L. (Mexico/UNAM) Canto, J. (Mexico/UNAM) Anglada, G. (Barcelona) Estalella, R. (Barcelona) Torrelles, J. (IAA, Granada)	Exciting source of selected new bipolar outflows. 2, 3.8 cm
AR271	Rood, R. (Virginia) Bania, T. (Boston) Balser, D. (Boston) Wilson, T. (MPIR, Bonn)	Mapping of the planetary nebula NGC 3242 in ^{3}He+. 3.5 cm line
AR272	Rowan-Robinson, M. (Queen Mary) Sopp, H. (Queen Mary) Lawrence, A. (Queen Mary) McMahon, R. (Cambridge)	Nature of ultra-luminous infrared galaxies. 3.6, 20 cm
AR273	Rucinski, S. (York U.)	High-latitude T Tauri stars. 3.6, 6, 20 cm

No.	Observer(s)	Program
AR274	Rupen, M. Lees, J. (Princeton) Knapp, G. (Princeton)	Imaging the HI in the peculiar elliptical NGC 3928. 20 cm line
AR288	Rucinski, S. (York U.)	Is there thermal emission from YZ CMi? 1.3, 2, 6 cm
AS333	Sramek, R. Weiler, K. (NRL) van der Hulst, J. (Groningen/Kapteyn) van Dyk, S. (NRL) Panagia, N. (STScI)	Statistical properties of radio supernovae. 2, 6 cm
AS437	Seaquist, E. (Toronto) Odegard, N. (GSC/GSFC)	Synchrotron emission from galactic superwinds. 6 cm
AS465	Sarazin, C. (Virginia) O'Dea, C. (STScI) Baum, S. (STScI)	Radio imaging of the complex X-ray source 2A 0335+096. 6, 20 cm
AS475	Simpson, C. (Florida) Gottesman, S. (Florida)	Dwarf galaxies out to 50 Mpc. 20 cm line
AS478	Subrahmanyan, R. (AT, Australia) Goss, W. M.	Electron temperatures in HII regions. 90 cm
AS479	Swain, M. (Rochester) Bridle, A. Baum, S. (STScI)	3C 353. 3.6 cm
AS480	Szomoru, A. (Groningen/Kapteyn) van Gorkom, J. (Columbia) Gregg, M. (Mt. Stromlo)	HI survey of the Bootes void. 20 cm line
AT127	Thorsett, S. (Caltech) Taylor, J. (Princeton) Hankins, T. (NMIMT) Stinebring, D. (Oberlin College)	Timing fast pulsars. 6, 20, 90 cm
AT134	Taylor, A. (Calgary) Dougherty, S. (Calgary)	Monitoring of radio variable Be stars. 3.8 cm
AT135	Taylor, A. (Calgary) Kenny, H. (Calgary)	Concurrent ROSAT/VLA observations of LSI 61°303. 6 cm
AT138	Tafalla, M. (Calif., Berkeley) Bachiller, R. (Yebes Obs) Martin-Pintado, J. (Yebes Obs)	NH_3 imaging of central sources of two conspicuous molecular jets. 1.3 cm line

No.	Observer(s)	Program
AT139	Taylor, C. (Minnesota) Brinks, E. Skillman, E. (Minnesota)	BCDs: search for neutral hydrogen companions. 20 cm line
AT142	Torrelles, J. (IAA, Granada) Rodriguez, L. (Mexico/UNAM) Canto, J. (Mexico/UNAM) Ho, P. (CFA) Gomez, J. (CFA)	Excitation of HH1 and HH2. 1.3 cm line
AT143	te Lintel Hekkert, P. (Mt. Stromlo) Habing, H. (Leiden) Blommaert, J. (Leiden) Dejonghe, H. (Gent Obs) Rich, M. (Columbia) Winnberg, A. (Chalmers/Onsala)	OH/IR stars: 1612 MHz survey of galactic plane. 18 cm line
AU051	Uson, J. Bagri, D. Cornwell, T.	Search for redshifted 21 cm emission from Zeldovich pancakes. 90 cm line
AU052	Uson, J. Bagri, D. Cornwell, T.	Confirmation of a Zeldovich pancake. 90 cm line
AV191	Viallefond, F. (Meudon) Lequeux, J. (Meudon)	Small-scale structure in the extinction. 3.6 cm
AV192	van Langevelde, H. (Leiden) van Dishoeck, E. (Leiden) Blake, G. (Caltech)	Molecules in the T Tauri circumstellar disk. 1.3, 6 cm line
AV193	van der Hucht, K. (Utrecht) Williams, P. (Utrecht) Spoelstra, T. (Utrecht)	Wolf-Rayet object WR125. 2, 6, 20 cm
AV196	Verdes-Montenegro, L. (IAA, Granada) Ho, P. (CFA)	HH 25 and HH 26: their associated double peaked NH_3 structure. 1.3 cm line
AV197	Verdes-Montenegro, L. (IAA, Granada) Ho, P. (CFA)	Dynamics of the core associated with exciting source of Cepheus A. 1.3 cm line
AW298	Wallin, J. (NRL) Higdon, J. (Texas) Appleton, P. (Iowa State)	Ring galaxy AM1354-250 HI. 20 cm line
AW312	Wilson, C. (Maryland) Skillman, E. (Minnesota)	Atomic hydrogen clouds in the irregular galaxy NGC 6822. 20 cm line

No.	Observer(s)	Program
AW321	Wood, D. Adler, D. Goss, W. M.	High-resolution study of anomalous helium abundance variations in W3. 3.6 cm line
AW325	Waller, W. (NASA/GSFC) Westpfahl, D. (NMIMT) Puche, D. (CFA) Wilcots, E. (Washington)	HI morphology and kinematics of NGC 1569. 20 cm line
AW326	Westpfahl, D. (NMIMT) Adler, D.	Interarm HI in M81. 20 cm line
AW327	White, S. (Maryland) Lim, J. (Caltech) Pallavicini, R. (Arcetri)	Search for polarization inversion on weak-line T Tauri stars. 2, 6 cm
AW328	White, S. (Maryland)	Densities in the solar corona. 1.3, 2 cm
AW330	Wills, B. (Texas) Shastri, P. (Calif., Berkeley)	Core variability in lobe dominated quasars. 3.8 cm
AW331	Willson, R. (Tufts) Lang, K. (Tufts) Kile, J. (Tufts)	Solar bursts during Max 91. 2, 3.8, 6 cm
AW333	Wilson, T. (MPIR, Bonn) Gaume, R. (NRL) Johnston, K. (NRL)	H_2 density and kinetic temperature of clouds toward Cas A. 1.3 cm line
AW335	Wootten, H. A. Mangum, J. (Texas)	NGC 1333: dense gas accreting onto a binary protostar. 1.3 cm line
AW336	Wootten, H. A. Sahai, R. (Chalmers, Onsala)	Circumstellar chemistry of cyanopolyynes. 1.3, 2 cm line
AW337	Wootten, H. A. Benson, P. (Wellesley)	Water maser location in the young, low-luminosity star 16234-2417. 1.3 cm line
AY043	Yusef-Zadeh, F. (Northwestern)	High-resolution mosaic of the Sgr A complex. 3.6 cm
AY045	Yin, Q. Heeschen, D.	Supernovae in MKN 297. 3.6, 6, 20 cm
AY048	Yun, M. (Harvard) Ho, P. (CFA) Lo, K. (Illinois)	Large HI tidal remnants around M81. 20 cm line

No.	Observer(s)	Program
AZ044	Zhao, J. Ekers, R. (AT, Australia) Goss, W. M. Lo, K. (Illinois) Narayan, R. (CFA)	Flux density variations in Sgr A. 1.3, 2 cm
AZ053	Zhao, J. Carilli, C. Anantharamaiah, K. (Raman Institute) van Gorkom, J. (Columbia)	Seyfert NGC 1068. 3.6, 6, 20 cm

E. VERY LONG BASELINE ARRAY

No.	Observer(s)	Program
BB002	Brown, R. Benson, J.	The apparent structure of Sgr A. 6 cm
BG006	Greenhill, L. (CFA) Moran, J. (CFA) Phillips, R. (Haystack) Townes, C. (Calif., Berkeley)	Water masers from SiO stars. 1.3 cm line
BR001	Reid, M. (CFA) Readhead, A. (Caltech)	Trigonometric parallax of the galactic center: choosing reference sources. 3.8 cm
BZ002	Zheng, X. (Nanjing) Moran, J. (CFA) Reid, M. (CFA) Haschick, A. (Haystack)	Megamaser galaxy IRAS 17208-0014. 20 cm
GL009	Lestrade, J. (JPL/Meudon) Phillips, R. (Haystack) Jones, D. (JPL) Preston, R. (JPL)	Astrometric observations of stars to tie in HIPPARCOS. 3.6 cm
GW004	Wegner, R. (MPIR, Bonn) Krichbaum, T. (MPIR, Bonn) Standke, K. (MPIR, Bonn) Schalinski, C. (MPIR, Bonn) Britzen, S. (MPIR, Bonn)	VLBI imaging of the most violently intraday variable source 0804+49. 3.6 cm
US003	Skinner, S. (Colorado) Linsky, J. (Colorado) Phillips, R. (Haystack)	VLBI observations of the unusual PMS stars Z CMa and MWC297. 3.6 cm

F. SCIENTIFIC HIGHLIGHTS

Green Bank

High-quality 21 cm HI spectra obtained on the 140 Foot Telescope has been used to calibrate precisely the wavelength scale of QSO absorption spectra taken with the Faint Object Spectrograph of the Hubble Space Telescope. The corrected UV spectra, together with the 21 cm spectra, are used to determine the metal abundance in high-velocity galactic clouds; for magnesium, the clouds have gas-phase abundances > 0.05 to > 0.28 of solar.

Observers: Blair D. Savage (U. Wisconsin) and Felix J. Lockman (NRAO)

Socorro

Counter-Rotating Gaseous Disks Found in the "Evil-Eye" Galaxy

As part of a program to study nearby galaxies at high spatial and velocity resolution, the type Sab spiral NGC 4826 (M64), also known as the "Evil-Eye" Galaxy because of its distinctive optical appearance, was observed at 21 cm using the VLA in the B, C, and D configurations. The resulting data were used to produce a high-resolution map of neutral-hydrogen velocities in the galaxy. This map reveals two distinct disks of gas in the system, with one in the central two kiloparsecs counter-rotating with respect to the rest of the galaxy. This inner disk, inclined by 45 degrees to the outer disk, contains about half of the galaxy's total gas mass, based on both radio and optical observations. This is the first galaxy observed with counter-rotating gaseous disks. Previously, kinematically distinct subsystems have been found in elliptical and spheroidal galaxies, but these consist of either two stellar components or a stellar and a gaseous component.

The most plausible explanation for these two counter-rotating gas disks seems to be that they are the result of a galactic merger. Indeed, the situation in NGC 4826 seems quite consistent with the results of recent supercomputer simulations of merger events. This compelling evidence for a relatively recent merger event within a spiral of this type raises a number of interesting questions about the frequency of mergers, the extent to which mergers may be responsible for shaping the Hubble sequence of galaxy types, and how long-lived the observable signatures of galactic mergers may be.

Investigators: R. Braun (Netherlands), R.A.M. Walterbos (NM State), R.C. Kennicutt, Jr. (Arizona)

VLBA Observations Reveal New Details of Circumstellar SiO Masers

The VLBA has been used to produce the first synthesis maps of SiO masers at 43 GHz, revealing new details of this type of activity surrounding cool red stars. U Herculis, an M5e-M8e giant some 460 pc distant, has a circumstellar shell containing OH, H_2O, and SiO masers. Observations of this star with four stations (PT, LA, KP, NL) of the VLBA show a very clear ring of SiO maser emission with a diameter of 16 milliarcseconds, or about 7.4 AU at the assumed distance of the star. Since the diameter of the star itself is estimated to be between 10 and 20 milliarcseconds, this is the first demonstration that SiO masers are very close to, and possibly within, the tenuous outer layers of a star. (The synthesized VLBA beam was approximately one milliarcsecond in this observation.)

VY Canis Majoris, an M supergiant at a distance of about 1,500 pc, has a much more complex shell, with strong OH, H_2O and SiO masers as well as prominent dust content. The VLBA maps (made using the above four stations plus FD) reveal three apparent concentrations of SiO maser activity in the vicinity of this star. This information is still being analyzed, but the observations raise the possibility that this may be a previously unresolved multiple star system. SiO maser activity also has been observed around five other stars in this VLBA monitoring program.

Investigators: P. Diamond, J. Benson, B. Junor, A. Zensus, A. Kemball, V. Dhawan (all NRAO)

G. PUBLICATIONS

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

H. CENTRAL DEVELOPMENT LABORATORY

Amplifier Development, Design, and Production

Two 38-45 GHz amplifiers (A28 and A29) were constructed and are being used for the evaluation of millimeter-wave transistors from TRW, Martin-Marietta and Hughes. Excellent results were obtained with lattice-matched HFET's from TRW, indicating the possibility of under 50 K receivers in the 65 to 90 GHz range. The WR12 waveguide-to-microstrip transition, covering the 65-90 GHz band, was developed and a number of quasi-lumped components were tested (d.c. separation structures, capacitors, bond-wire inductors) in a microstrip-on-teflon environment. A prototype 65-90 GHz amplifier was designed and is under construction. The development of a measurement system and necessary dewar modifications continued. MMIC two-stage amplifiers covering the 110-120 GHz range from TRW were tested. A gain of 18 dB and noise temperature of about 350 K were measured at 110 GHz at room temperature.

The designs for two of the GBT amplifiers are underway. This work includes the design of a three-stage 2.6-3.95 GHz amplifier of which a detailed mechanical drawing is currently being done. A bias tee for the 2.6-3.95 GHz band (for SIS receiver tests) has been designed and fabricated. Finally, a 4.0-6.0 GHz amplifier is currently in the electrical design stage.

During this quarter the fabrication and testing of the two previously designed GBT K-band amplifiers commenced. Two prototype units were constructed: 18-22 GHz and 22-26 GHz. The amplifiers use ROHM Research 0.1 micron HFET devices in the first and second stages. The third and fourth stages contain Fujitsu FHR03X devices. Both amplifiers can have either a coaxial or a waveguide input port. Gain was measured to be from 27 to 30 dB. Cryogenic noise measurements and final tuning of the amplifier are currently underway.

An additional 21 L-band amplifiers have been built and tested. This completes the construction for the rest of 1992.

At a lower priority, work is continuing on the construction of a wide bandwidth receiver system for measuring the performance of cryogenically-cooled amplifiers up to 26 GHz. The coaxial dewar feed-through and cold attenuator have been characterized through extensive measurements of RF loss. A thermal model of the coaxial line has also been developed in order to calculate the heat loading on the cold attenuator. The calibration of these lines is important for accurate amplifier noise measurements when using the cold-attenuator method.

Superconducting (SIS) Millimeter-Wave Mixer Development

Work continues on development of better tunerless 200-300 GHz SIS mixers. The initial version exhibited some instability in the lower part of the frequency range. A modification cured the instability and gave 50 K $\leq T_R(DSB) \leq$ 60 K from 200-260 GHz, increasing to 190 K at 300 GHz. We believe we now understand this behavior, and are attempting to design a new version which should cover the full 200-300 GHz band with low noise. Above ~250 GHz, these mixers require magnetic bias to suppress the effects of Josephson noise. A UVa student is working with us to develop a magnetic biasing scheme compact enough for the "rocket" receiver modules–probably a combination of a permanent magnet and a small superconducting coil. Our progress on tunerless mixer development is reported in Electronics Division Internal Report No. 291.

The first two 260-300 GHz SIS receiver inserts ("rockets") for the 12 Meter Telescope are now being tested in the CDL. Initially, magnetic bias for the mixers is being provided by small permanent magnets, which do not allow us to optimize the field.

As mentioned in earlier Quarterly Reports, vacuum windows for receivers on the 12 Meter Telescope became a critical issue when we found we were unable to obtain further supplies of the very low loss extruded polystyrene foam used to support the mylar vacuum barrier in all our vacuum windows. This led to an urgent program of material testing in the CDL, which we believe has resulted in a better broadband vacuum window design. The results of our work are reported in Electronics Division Internal Report No. 292.

During this quarter, we have built (or rebuilt) and tested a total of 10 SIS mixers operating from 90-300 GHz. This includes five 3-mm mixers made to our design at the University of Illinois for the BIMA interferometer. We have also rebuilt a 200-300 GHz Schottky diode frequency tripler damaged in one of the 225 GHz site testing receivers.

OVLBI Earth Station Project

Work continued during the quarter on the detailed design phase, with progress in the various subsystems described in the following paragraphs. The end of the quarter was devoted to preparations for a Critical Design Review of the entire project, scheduled for October 15. This included the preparation of a detailed report on the design ("The Green Bank OVLBI Earth Station Project: Report on the Detailed Design Phase," October 9, 1992; 160 pp. plus appendices.)

In the optics subsystem, most of the design work had already been completed and fabrication is in progress. The Ku-band horn was finished last quarter, and the X-band horn is being fabricated in the Green Bank shop. Bids were received on the ellipsoidal mirror and an order was placed. The specification for the hyperboloidal subreflector was completed and an RFP was issued, with bids due in mid-October. A mirror alignment plan was devised, and the design of mounting structures was started.

Fabrication of the cryogenic front-ends continued in Charlottesville. Intermediate level design of the down converters and their local oscillators was completed.

In the two-way timing subsystem, the transmitter assembly breadboard was completed and successfully tested.

In the wideband data subsystem, design of the Decoder continued and is now at the component level of detail. The subcontract for construction of the VLBA recorders was completed, and tests by NRAO personnel at the contractor's plant were successful. Delivery to Green Bank occurred near the end of the quarter and acceptance tests were in progress.

The computer control subsystem has made significant progress. The real-time computer is installed at the antenna site, and code for the direct control of the antenna pointing has been written and partially tested. A second programmer joined the staff in early August. Formal specifications for interfaces to external elements of the missions have been written and distributed for comments. High level design of the real-time control system and of some of the offline software has been completed.

The 13.7-m antenna pointing study was completed as a summer student project and shows that the pointing accuracy is more than adequate for this project, even in the daytime. Refinements in the measuring technique resulted in more accurate pointing correction coefficients. The upgrading of the main reflector by replacing one-third of its panels and re-aligning the entire surface was completed. Verification of the new surface accuracy by holography will be carried out next quarter.

Electromagnetic Support

Gain/T_{system} optimization for the Green Bank Telescope was done in order to determine the feed taper at the edge of the subreflector. This was done at 1.42 GHz, 5.00 GHz and 15.00 GHz. Based on this analysis, three different designs will be used for the secondary focus feeds.

A prototype linear taper feed was designed at K-band covering 18 to 23.1 GHz. This feed has a taper of -13 dB at the edge of the subreflector, and this design will be used for all the feeds above 8.0 GHz.

The VLBA 12-15.4 GHz polarizer and a prototype OMT for the GBT were analyzed using the HFSS software.

I. GREEN BANK ELECTRONICS

GBT Active Surface

Early production data on GBT panel actuators was evaluated and allowable production tolerances were generated. A printed circuit pattern for mounting lightning protection devices (transorbs), as well as filtered connectors, was designed. The specification generated by Loral for the panel actuator cables was reviewed and commented upon.

GBT Servo System

The testing of the GBT 22-bit encoders was witnessed at the manufacturer's (BEI) facility. A design review of the servo system was held at PCD's facility in Richardson, TX. The meeting covered hardware, software, and dynamics. On the same trip, RFI measurements of part of the NRAO system were made. A report was generated documenting and analyzing the results.

GBT Receivers

Construction of the 18-26.5 GHz, K-band receiver is well under way. Work is also being done to prototype and test a down converter system. The dewar input waveguide windows and thermal transitions have been tested satisfactorily. Polarizers for 18-22 GHz were received. A problem with mode resonances near the high end of the operating band was discovered. The manufacturer has designed and tested a new square-to-circular transition which corrects this problem, and the Polarizers will be returned to be retrofitted. The cardcage has been constructed. The MCB digital interface has been designed and is approximately 80 percent complete. Assembly of the post-dewar microwave components is underway. Critical components that are yet to be received include the polarizers, cryogenic isolators, and cryogenic HFET amplifiers (which are under development at the CDL).

Design of the prime focus receiver no. 1 continues. Much of the dewar layout has been completed and submitted for fabrication. A standard front-end box is being prepared in the machine shop. Details of the receiver block diagram are being reviewed, and revisions considered to support special requests for polarization measurements. The vendor who has contracted to provide a 680-920 MHz orthomode transducer is having difficulty meeting the specified VSWR performance. This situation is being reviewed.

Several of the long-lead items needed for the 8-10 GHz and 12-15.4 GHz receivers have been ordered. Work on development of a quad-ridged OMT for the Gregorian receivers below 8 GHz continues. A prototype unit having a non-tapered cylindrical outer shell was found to have good isolation but poor return loss performance. The quad ridged taper section appears to be the major cause of this problem, and analytical and experimental work continues. This development is a critical item as receiver development cannot proceed far without a firm size for the OMT.

GBT Local Oscillator System

Interfaces were worked out with Loral concerning electronics racks that attach to the feed turret. Fabrication drawings of the racks and LO and Test Tone routers were done and submitted for fabrication. Additional interfaces concerning cable entrances to the Receiver Room were finalized.

The frames for the electronic racks which attach to the feed turret have been fabricated. Fabrication of component mounting plates and covers for the LO and Test Tone routers continues in the shop. The MCB digital interface and switch driver circuitry for these routers have been designed and the necessary circuit cards are being prepared. All purchased components, including the VLBA style Phase Cal Generator, have been received.

GBT Feeds

Testing of a prime focus feed prototype was done, and the patterns were satisfactory. A fabrication drawing for the full-size L-Band profile horn was generated. The machine shop will shortly begin work to develop the details of how to fabricate and assemble this feed. Several options are being considered.

Fabrication drawings for the 18-22 GHz feed have been submitted to the shop.

The 24-inch feed rotator mechanism has been fabricated and assembled. A problem was identified with the motor previously selected, and a higher torque unit was ordered. The servo drive for this mechanism has been contracted out; delivery is expected before the end of the year.

GBT Autocollimator

Progress has been slowed due to failure of the ceramic stack on the piezo-controlled mirror positioning platform. The device has been returned to the manufacturer for repair and re-calibration. Results obtained before failure indicated stability and response time within specifications.

Cassegrain Receivers

Receivers using HFET amplifiers have replaced one of the two upconverter-maser receivers at X band (7.5-12.5 GHz) and Ku band (12-18 GHz). Advantages of the HFET receivers are improved reliability, lower average noise temperature over the full band, less complexity, and no RF tuning. Spectral line observations using both receiver types simultaneously indicate little, if any, difference in baseline quality. Baselines also appear equivalent whether vertex to control room IF transmission is by coaxial cable or a fiber optic link. Work continues on the second HFET receiver LO system. Delivery of the HFET amplifiers is expected by the end of 1992.

Spectral Processor

Two features were added to enhance the Spectral Processor's software. First, the ability to do a quick test of the health of a significant part of the system was implemented by running pseudo-random data through the digital hardware. Second, software to diagnose faults in some of the electronics to the card level was implemented and debugged.

Site Computing

The "Thin-net" Ethernet LAN was extended to include the first floor of the Jansky lab.

USNO Operations

A communications adapter was designed, built, and tested for the Hawaii system. The adapter allows the control computer to talk to the receiver via fiber optic cables and to the VLBI back-end via copper pairs.

Assembly of the Hawaii S/X front-end box is complete. Initial tests on the receiver have yielded a system noise temperature of about 27 K at S-band and 32 K at X-band. Spurious mixer products were found to be at least 24 dB down at S-band and 20 dB down at X-band. Modifications to the link receiver to provide Mark III IF outputs is also complete. Work is continuing on the monitor/control software. Future plans include mounting the receiver on 85-1 in Green Bank and doing coordinated VLBI runs with 85-3 in October of this year. Hardware will be shipped to the site in Kauai following those tests.

VLBA

The last two 7 mm (43 GHz) front-ends were completed and shipped. The remaining eleven baseband converters have been constructed; testing will be completed early in the next quarter.

J. SOCORRO ELECTRONICS

RFI Improvements

Radio frequency interference (RFI) locally generated at each VLA antenna partially limits the sensitivity of the 74 MHz and 327 MHz receivers. Twelve antennas outfitted with RFI shielded enclosures over the B-rack in the vertex room produce no RFI at 327 MHz and reduced RFI at 74 MHz. Outfitting additional antennas awaits funding.

Several VLBA sites appear to have strong RFI in the 1.5 GHz and 2.3 GHz receiving bands. Investigations of the sources and possible mitigation measures, such as additional filtering, began this quarter.

Frequency Coordination

Frequency coordination attempts to prevent or at least minimize interference to VLA and VLBA observations from government and non-government transmitters before and after their initial installation. The National Science Foundation's Electromagnetic Spectrum Manager alerts us to government installations and operations. However, unlike the notification by non-government users required within the National Radio Quiet Zone, the VLA-VLBA frequency coordinator must maintain an informal network and use commercial sources to obtain timely information on non-government transmitters. Mitigation involves negotiations with operator/owners and/or with the FCC. In June we petitioned the FCC to deny applications for four TV transmitters to protect 611 MHz observing at the Los Alamos, North Liberty, and Owens Valley VLBA sites. This quarter, one applicant withdrew its application, two modified their application to meet our requirement, and one continues to work on mitigation measures.

1.3 - 1.7 GHz T_{sys} Improvements

At the end of this quarter sixteen VLA antennas have the improved (30 K vs 55 K T_{sys}) VLBA style 20 cm front ends. With 1992 funds, construction continues on nine more front ends, the last of which will be installed in the second quarter of 1993. With 1993 funds, we expect to complete the front ends for the remaining three antennas plus two spares.

43 GHz Tests of VLA Antenna

Antenna aperture efficiency and pointing errors are the critical factors to determine whether to add 43 GHz receiving systems to the VLA. In May, electronics and engineering services divisions installed on antenna 14 a VLBA 43 GHz front end with a VLBA feed modified for the VLA antenna optics. Tests by the scientific and engineering staff during this quarter determined the on-line system parameters such as focus, sub-reflector rotation, and pointing offsets with observations of the SiO masers in R Leo. This work began shortly after the receiver was installed. Much of the work was hampered by early monsoons which made observations impossible on many days. SiO maser emission was seen in autocorrelation spectra of the evolved star R Leo. Pointing corrections were determined from raster scans using the new //OF observing mode. Jupiter was detected in total power mode. Pointing to an arbitrary source using the current pointing model appears to be good to 20" or better. On-source, the pointing appears to be much better, probably better than 5". The atmospheric opacity at the zenith is 0.1 on a typical day, the best was 0.04. Considering that we began to fine-tune the system, it is likely that we will achieve an aperture efficiency of 17 percent at 43 GHz, but this will have to await further tests.

A second VLA 43 GHz front end will be installed on antenna 8 early in the next quarter. Some of the future testing will measure efficiency changes with frequency and elevation.

VLA Wye Monitor

Cable of nineteen copper-wire-pairs, buried along each arm of the wye and one to the technical service area, provide the VLA operator with basic telephone and monitor/control functions of the antennas and electrical power generators. Reliability has declined as leakage between wires has increased. Many functions serve all antennas on an arm instead of individual antennas because of the limited number of pairs. This quarter we completed the design and prototype testing of a new digital monitor and control system which operates on only four pairs of wires. Besides much greater immunity to leakage, the system will provide many functions to each antenna, to the electrical power generators, to the computer and correlator uninterruptible power supplies, and to the online computers.

K. TUCSON ELECTRONICS

Spectrometer Upgrades

The IF filter modules of the Hybrid Spectrometer have been upgraded with "mil-spec" components that should make the modules more gain-stable and more resistant to failure. Work on the fully-tunable IF section of the Hybrid Spectrometer is proceeding nicely and should be completed within the next few months. This enhancement will allow observers to center up to eight IF bands at independent frequencies, so long as they all fall within the front-end bandpass.

A project to make filter bank configuration faster and easier is also well-along. This project consists of the construction of an additional "switcher" unit that allows the routing of any two filter banks into the 512-channel multiplexor. This project will eventually lead to computer automation of all filter bank setups. The 25 kHz spectrum expander, which has been superseded completely by the 24 kHz mode of the Hybrid Spectrometer, has been removed from service.

Control Software Changes

A significant upgrade of the telescope control system has occurred this summer. The aim of these projects was to replace some old hardware, to modify some of the software modules in light of experience gained in the first two years of operation of the new control system, and to enhance the observing capabilities of the system. First, the Sun 3 used for control coordination has been replaced with a Sun SparcStation IPX. This change eliminated a piece of obsolete hardware and has also increased the speed of the system considerably. In addition, a data and control bus (GPIB) that was failure-prone in the past has been largely eliminated. Where it continues to exist to interface commercial instruments, it has been isolated so that it cannot hang up the rest of the system. The digital continuum backend and the computer that controls frequency synthesizers have been replaced with more flexible VxWorks systems.

In other software areas, the module that controls the execution of high-level observing procedures was rewritten to allow more flexibility and greater ease of use. In addition, the operator's interface to the control system, which has used a screen system running under Sunview, has been replaced with an X-windows interface. We expect to make this interface available to observers in the near future. We have also installed a "passive and active" field capability into the system so that an upcoming observation can be configured while the current observation is still in progress. In another project, we have developed a new real-time data monitoring system. On a dedicated workstation console, this system automatically displays the data from the last scan taken, automatically reduces pointing and focus observations, and can display auxiliary information such as site weather data and satellite weather images available over the network.

Several new observing procedures will be available this autumn. For example, a square-spiral mapping algorithm will be available for spectral line mapping. With this algorithm, one can start in the center of the mapping field and work outward rather than scanning in a raster fashion from the edge of the field. In addition, on-the-fly continuum mapping is now available. This technique greatly speeds up continuum mapping compared to the more traditional step and integrate mode, since no time is lost waiting for the telescope to settle into position. Furthermore, data quality is improved since both the receiver and atmosphere will be more stable over the course of the map, the shorter the required observation time.

Actual telescope positions and time stamps are recorded rigorously every 100 millisec. Some work remains to be done on the analysis programs for on-the-fly data.

Analysis Software Change

As promised, UniPops is now the default analysis program at the 12 Meter for both spectral line and continuum data. Numerous improvements were made to UniPops over the summer, many of which were to address comments specifically concerning the 12 Meter implementation. To ease the transition to UniPops, the local staff has constructed procedures that allow UniPops to operate with the same commands as VMS Pops. Of course, UniPops has many new capabilities and numerous bugs in old Pops have been fixed in UniPops.

Since the 12 Meter implementation of UniPops is now mature, the VMS Pops system is being phased out. We will continue to keep the VAX VMS workstation on line for VMS programs not yet ported to Unix, as long as the need is present and as long as we have the resources to support it.

The impending arrival of the upgraded 8-beam receiver has necessitated a minor change in the raw data format to rationalize the scan numbering conventions. Users who have their own programs to read the 12 Meter raw data files should consult with the staff about changes they will need to make.

Antenna Improvements

We have installed a new spillover shield just behind the subreflector on the 12 Meter. Radiation that passes beyond the edge of the subreflector that would have otherwise terminated at ambient temperature on telescope structures or on the ground, is now reflected back onto the primary and then on the sky. This results in a lower system temperature, since the sky has a lower radiation temperature than the telescope or ground. Tests of this system made at the beginning of summer shutdown indicate an improvement in the rear spillover and blockage efficiency, η_b, from ~0.88 to ~0.94 with the λ3 mm SIS receiver. Corresponding improvements in system temperature, and perhaps in standing wave suppression, are also anticipated.

The azimuth inductosyn (angle resolver) mount and cable wrap assembly are being replaced in an effort to improve azimuth pointing. Over the last year or so, we have acquired evidence of hysteresis in azimuth pointing, at the 5-10 arcsec level. Other evidence suggested that the azimuth inductosyn mount was being stressed and might be shifting slightly with respect to the floor of the telescope pedestal, to which it is affixed. A new concrete pedestal and stainless steel mounting plate has been laid in the pedestal. The azimuth shaft mounting is being re-engineered. We are hopeful that these modifications will eliminate the azimuth hysteresis.

Physical Plant

One of the most serious sources of down-time last observing season resulted from site power outages and the failure of backup power systems to respond appropriately. Several steps have been taken this summer to improve this situation. First, we have installed a new 200 kW diesel generator. Second, we have made a number of repairs and renovations to the site uninterruptible power system (UPS). As a final step, we have installed three 5 kW UPS systems as a further backup for critical components such as the UT clocks. These small UPS's are brand new, but were obtained as government surplus.

Receiver Status Update

We expect to have the 270-300 GHz SIS mixers installed in the 1 mm receiver package this autumn. Observers are free to apply for observing time with these mixers. When these mixers are installed, the 12 Meter will have state-of-the-art SIS receivers covering the complete millimeter-wave band from 68 GHz to 300 GHz, excluding atmospheric stop bands. This is accomplished with separate receivers covering the λ3, 2, and 1 mm bands.

Work on the upgraded 230 GHz, 8-beam SIS receiver has been slowed by the press of summer shutdown activities. Although we are still hoping to test the receiver on the telescope next spring, we doubt that it will be ready for observers until the fall of 1993. We ask that you hold your proposals for this receiver until we notify you in these pages.

Holography and Surface Resetting

At the end of July, we made new prime focus holography measurements of the 12 Meter telescope surface, using the LES8 satellite at 38 GHz. This was a most successful holography session; the new "on-the-fly" observing technique increased the data acquisition efficiency, and the staff at Lincoln Labs supplied us with exceptionally precise orbital data. Significant improvements were made to the receiver and digital holography backend. We observed the satellite at night, in stable conditions, between elevations of 30 and 65 degrees, obtaining many complete holography maps. The maximum resolution obtained corresponds to about 10 cm on the surface of the 12 Meter telescope. The quantity and quality of the data are the best we have ever achieved.

The data are still being analyzed in detail, although the first "quick-look" analysis confirms the quality of the data, and that the surface has been relatively stable since the last holographic measurement, in 1990. A shaped sub-reflector is currently in use at the 12 Meter Telescope to compensate for the known distortions of the primary surface. Using the new holography data, we plan to readjust the primary surface of the telescope, and replace the sub-reflector with the original, symmetric version. We had originally planned to reset the surface at the end of this summer shutdown. However, the unanticipated work with the dome door mechanism described above has already lengthened this shutdown period. We have therefore postponed the surface adjustment until next January. We anticipate a worthwhile increase in telescope efficiency above 200 GHz.

L. AIPS

The 15OCT92 version of AIPS will be released shortly. This version of AIPS has major improvements to Workstation display capability and for calibration of VLBA data. New tasks have been written which can combine radio and optical data to produce multi-color (RGB) images. A new system for VLBI polarization calibration has been completed and is being tested and documented by the AIPS group. As usual, a small number of bugs have been found and most have been fixed.

An area where problems still persist is in correction of phase rotations as a function of shifting the phase center of observations. Problems occur because AIPS must work with observations at several different frequencies within the same UV-data. Different corrections are required for each of the different frequencies. New AIPS software generally correctly handles this problem, but older software was written at the time when AIPS data was only single-frequency. Systematic testing of old software with new data formats is needed.

A major concern is documentation and periodic testing of AIPS software. Procedures have been created for testing tasks commonly used to produce images of VLA data, but similar tasks are needed to test VLBI data.

M. SOCORRO COMPUTING

In the online area this summer, work was begun on software development for the new VLA correlator controller being designed and built by engineering. We anticipate that the new system will be in place and in use by the end of 1993. This is a major project requiring the participation of several senior engineers and programmers working as a team.

The single visualization and four high-end computing IBM RS/6000-560's which were ordered at the beginning of the quarter were installed during the summer. They are now available to visitors and in-house staff with larger or more compute-intensive projects than can easily be done on a Sun. Some software development will be required to make the

visualization system useable by the general community. Additional memory and disk space has been ordered for the 4 reservable high-end IBMs to increase the scope of projects they can handle.

A shortage of SPARCstations was evident during the summer visitor rush. Two additional, fully-equipped IPXs have been installed to meet more of the demand. Together with the IBMs, this brings the total number of workstations reservable by visitors to 12, plus two for visitors staying longer than a month.

We now have two working DAT tape drives (DDS format, no compression), with more planned for installation in the next couple of months. This medium is supported by AIPS and visitors may now take data to their home institution, or have it sent to them, on 4 mm DAT tapes. This is in addition to the support already provided for half-inch, 9-track reels and 8 mm Exabyte cartridges.

Current plans for the AOC Convexes are to turn one off around the end of 1992, and keep the other running until at least mid-1993. Maintenance prices on these machines are very high. The C1 models installed at the AOC are no longer powerful enough to compare favorably with the newer machines in terms of processing capacity and the response time that people using them perceive.

N. VERY LONG BASELINE ARRAY PROJECT

Antennas and Site Preparation

The first nine VLBA stations are operational: Pie Town, New Mexico; Kitt Peak, Arizona; Los Alamos, New Mexico; Fort Davis, Texas; North Liberty, Iowa; Brewster, Washington; Owens Valley, California; Hancock, New Hampshire; and St. Croix, Virgin Islands.

The St. Croix site became operational at the end of this quarter. However at the time of this writing, this antenna's Internet connection is currently utilizing a dial-up line to Socorro because of a series of delays by the Puerto Rico Telephone Company in completing a cable installation between a central office and the new CRACIN regional network headquarters in San Juan. At the Mauna Kea site the antenna erection is complete except for antenna painting, which is underway. The control building is also complete. The initial NRAO electrical outfitting of the building was completed in this quarter. Initial NRAO mechanical outfitting of the antenna is scheduled to start in October, and antenna operability is scheduled for the second quarter of 1993.

Electronics

Construction of VLBA front ends is complete except for the spare (eleventh) unit for 8.4, 14, and 23 GHz. These units will be completed by the end of the year. Converter modules are also completed during August except for the spare units for some bands. These units are in the final stages of wiring and testing as the quarter ends.

Three of the early filter modules for the 610 MHz band that are in operation at antennas require retrofitting to narrow-band filter units. These narrow-band units have now been completed and will be retrofitted during the next quarter. The design of the Pulse Calibration Insertion Modules is now complete and construction of these modules is now in progress. The last type of module scheduled for installation at the antennas is the Pulse Calibration Monitor module, which is not essential to the start of operation of the array. During this quarter, the design of this module has almost been completed, and construction will be started during the last quarter.

Data Recording

The production of VLBA recorders and playback units continues, with units through serial #35 completed. Five more units, including the project's final unit, #51, are largely completed at the AOC. The production of eleven units in Haystack's

fourth and final production run are also largely completed, with first shipments from this run planned for mid-November. The mechanical upgrades to the tape path to reduce stress on thin tape have been installed at all antenna sites except for St. Croix and Hancock.

The thin tape, accelerated wear, lifetime reliability tests continued through the third quarter, and will also continue in the fourth quarter. The results of these tests on the modified transports have been encouraging enough that a thin tape RFQ was issued in September. An order for approximately one-half the final required tape quantity is expected for release in October, 1992. The remaining initial tape inventory is scheduled to be ordered in the second quarter of 1993, assuming that field performance of the production tapes is equal to or better than the manufacturers' current test samples. Delivery of the first thin tape production quantity is expected late in the fourth quarter. Thick tape will be used as a temporary measure to allow early VLBA operations. Haystack Observatory is arranging the shipping of adequate quantities of thick tapes to the AOC from various VLBI and correlator sites to support this effort.

Monitor and Control

During third quarter 1992 enhancement of the on-line software system continued. A program to utilize the Data Quality Analysis section of the formatter has been written to catch any problems with recordings at an earlier stage.

Work is progressing toward inserting relevant log data into the Ingres database. A Sparc workstation has been purchased to run the database. Work is progressing toward a final format of data on this database. Software currently available is believed to be minimally sufficient to provide data to the correlator.

Work is continuing on the general purpose listing/plotting program for engineering data extracted from the station monitor data. This is currently functional, but needs substantial enhancements.

Correlator

The correlator was moved from the Central Development Laboratory in Charlottesville to its final station in the Array Operations Center in Socorro. The move imposed somewhat more than a month of down time; previously successful test correlations were reproduced on August 6. Relocation of the three remaining correlator group members, of five transferring to Socorro, was also completed. In addition, the four engineers and programmers not transferring continued to make significant contributions toward completion of the correlator during visits to Socorro, totalling some 15 work-weeks.

Upon successful reactivation of the correlator, testing, and integration activities resumed in two main areas. In the first, detailed application of the internal "system test" capability revealed a low level but widespread incidence of errors in transmission of control register and mode table data to locations throughout the correlator. Several remedial measures which were applied succeeded in reducing these errors to about one percent of normally occurring transmissions. Investigation continues into the remaining errors.

The second major activity was to complete the end-to-end signal path through the entire system. Along the entire primary data path, across all playback interfaces, FFT and multiplier/accumulator modules, the parallel data-validity signals were connected and their functionality verified. In the correlator's backend, the digital output filter—the final module in the data path—was installed and integrated into the system. The software which drives the sequence of loading, processing, and extraction of filtered results was substantially completed. At the end of the quarter, the first fringes were obtained at the filter output instead of via the interim link over the integrator's control bus, which had been used for all previous test output. Beyond the filter, a longstanding intermittent hardware failure in the disk drives which buffer the archive output was resolved, and a bug in the file system supported on these disks by the real-time operating system was identified and circumvented. The final procurement of DAT and Exabyte cassette tape drives for the archive and distribution systems was initiated and completed.

Much of the preliminary mechanical and electrical work on the "recorder wall"—between the computer room and the VLBA Operations area—had been completed in advance of the correlator's arrival in Socorro. The five playback drives

accompanying the correlator were installed directly in their final positions in the wall, albeit with the interim cabling used previously. An additional four drives were installed by the end of the quarter, and final cabling completed for all nine. Barcode readers for automatic tape recognition were permanently mounted on seven of these drives.

O. GREEN BANK TELESCOPE PROJECT

During the last quarter, the GBT antenna design and construction activity has continued apace. The review and analysis of the design proceeded, looking toward a major design review in late October. At the construction site, the pintle bearing was installed and grouted. The track sections all have been installed, and the process of leveling the track began. The derrick crane, which will be used to erect the antenna, is under construction. The steel for Level 1 of the alidade structure was delivered to the site. Fabrication of the whiffle beams and the elevation wheel and box structure members continued.

The frames for the electronic racks which attach to the feed turret have been fabricated. Fabrication of component mounting plates and covers for the LO and Test Tone routers continued in the shop. The MCB digital interface and switch driver circuitry for these routers have been designed and the necessary circuit cards are being prepared.

Construction of the 18-26.5 GHz receiver has continued. The dewar input waveguide windows and thermal transitions have been tested satisfactorily. Polarizers for 18-22 GHz have been received. A problem with mode resonances near the high end of the operating band was discovered. The manufacturer has designed and tested a new square-to-circular transition which corrects this problem, and the polarizers have been returned to be retrofitted. The cardcage has been constructed. The MCB digital interface has been designed and is approximately 80 percent complete. Assembly of the post-dewar microwave components is underway.

Design of the prime focus receiver No. 1 continued. Much of the dewar layout has been completed and submitted for fabrication. A standard front-end box is being prepared. Details of the receiver block diagram are being reviewed and revisions considered to support special requests for polarization measurements.

Several of the long-lead items needed for the 8-10 GHz and 12-15.4 GHz receivers have been ordered. Work on development of a quad-ridged OMT for the gregorian receivers below 8 GHz continued. A prototype unit having an untapered cylindrical outer shell was found to have good isolation but poor return loss performance. This quadridged taper section appeared to be the major cause of this problem, and analytical and experimental work continued. A fab drawing for the full-size L-band profile horn was generated. Several options are under consideration for how to fabricate and assemble the L-band feed. Fab drawings for the 18-22 GHz feed has been submitted to the shop.

The 24-inch feed rotator mechanism has been fabricated and assembled. A problem was identified with the motor previously selected, and a higher torque unit ordered. The servo drive for this mechanism has been contracted out, and delivery is expected before the end of the year.

In the GBT active surface development area, the third rangefinder was installed on the 100-foot tower at the panel test site. This completes the hardware installation, and there is now a complete, full-scale model of a portion of the GBT active surface. The computer controlling the three rangefinders has been installed, allowing demonstration of three-dimensional measurement of the nine retroreflectors on the test panels.

The computer controlling the panels has been installed and is working. The commanded panel movements agree closely with the movements measured by the rangefinders. The atmospheric tests for the proposed autocollimator in the precision pointing system have been successfully completed. A precision servo-controlled mirror has been purchases and is being evaluated for use in the system. Initial tests show a positioning accuracy of around one arcsecond.

In the monitor and control area, reviews of the requirements analysis were held both in Green Bank and Charlottesville. Reviews are complete for the sections on control, monitor, electronics, data handling, and antenna. Implementation of classes handling hardware interfaces continued.

The work on the serial interface (Standard Interface Board) neared completion. Work on the classes handling control dependencies were completed. Implementation of the monitor classes is in progress.

P. PERSONNEL

New Hires

M. P. Haynes	Visiting Scientist	06/10
P. E. Palmer	Visiting Scientist	07/01
D. R. Schiebel	Sr. Scientific Programmer	07/13
V. Dhawan	Assistant Scientist - Research Support	07/08
G. A. van Moorsel	Assistant Scientist - Socorro Operations	08/03
E. L. Meinfelder	Sr. Scientific Programmer	08/03
M. J. Claussen	Assistant Scientist - Socorro Operations	08/10
J. Cheng	Structural Engineer I	08/24
J. D. Downes	Electronic Engineer II	08/31
T. J. Balonek	Visiting Scientist	09/21
D. G. Finley	Technical Writer	09/01
S. J. Blachman	Sr. Scientific Programming Analyst	09/14
L. A. Abeyta	Electronics Engineer II	09/22

Terminations

M. P. Haynes	Visiting Scientist	07/10
P. E. Palmer	Visiting Scientist	07/29
C. J. Salter	Associate Scientist - Green Bank Operations	08/31
J. A. Biretta	Research Associate	08/31
D. Puche	Research Associate	09/30

Promotions

N. Maddalena	to Junior Systems Analyst	07/01
R. C. Walker	to Scientist - Continuing Appointment	07/01
J. A. Zensus	to Associate Scientist	07/01
T. Bastian	to Associate Scientist	07/01
J. Wrobel	to Associate Scientist - Socorro Operations	07/01
L. King	to Scientist - Continuing Appointment	07/01
J. Romney	to Scientist - Continuing Appointment	07/01
E. Brinks	to Associate Scientist - Socorro Operations	07/01
J. Benson	To Scientist - Socorro Operations	07/01
P. Diamond	to Associate Scientist - Socorro Operations	07/01
P. Jewell	to Scientist - Tucson Operations	07/01
F. Ghigo	to Associate Scientist - Green Bank Operations	07/01
R. Maddalena	to Associate Scientist - Green Bank Operations	07/01
G. Langston	to Associate Scientist - Research Support	07/01
T. Romero	to Head, Socorro Observatory Services	06/19

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