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N A T I O N A L R A D I O A S T R O N O M Y O B S E R V A T O R Y

FOURTH QUARTER REPORT

October 1, 1984 - December 31, 1984

PROPERTY OF THE U. S. GOVERNMENT
RADIO ASTRONOMY OBSERVATORY
CHARLOTTESVILLE, VA.

JAN 28 1985

OBSERVING PROGRAM

<u>140-foot Telescope</u>	<u>Hours</u>
Scheduled observing	1739.00
Scheduled maintenance and equipment changes	185.25
Scheduled tests and calibration	190.75
Time lost due to: equipment failure	31.50
power	3.25
weather	40.75
interference	0.75

The following continuum programs were conducted during this quarter.

<u>No.</u>	<u>Observer</u>	<u>Program</u>
S279	D. Stinebring A. Wolszczan (NAIC)	Observations at 10.65 GHz to search for steep spectrum, galactic sources near $l = 23.5^\circ$.
U19	J. Uson (Princeton) D. Wilkinson (Princeton)	Continued search at 19.5 GHz for small-scale anisotropy of the microwave background.
U20	J. Uson (Princeton) D. Wilkinson (Princeton)	Observations of the Sunyaev-Zeldovich effect at 19.5 GHz.

The following line programs were conducted during this quarter.

<u>No.</u>	<u>Observer</u>	<u>Program</u>
B428	L. Blitz (Maryland) L. Armus (Maryland) V. Escalante-Ramirez (CFA) T. Hartquist (Maryland) S. Lepp (CFA) T. Hewagama (Maryland)	Observations at 327 MHz to search for interstellar deuterium and at 310 MHz to search for the deuterated OH molecule OD.
C220	F. Clark (Kentucky) S. Miller (Kentucky) A. Bridle H. Martin	Observations at the 4 mainline frequencies of OH emission/absorption in bi-polar flows.
I3	W. Irvine (Massachusetts) S. Madden (Massachusetts) H. Matthews (Herzberg) D. Swade (Massachusetts)	Search at 1.7 cm for interstellar ethylamine (NH_2CCH).
M231	I. Mirabel (Puerto Rico) L. Rodriguez (Mexico) A. Ruiz (Puerto Rico)	Observations at 6 and 18 cm of high-velocity H_2CO and OH in regions of star formation.

<u>No.</u>	<u>Observer</u>	<u>Program</u>
P128	H. Payne Y. Terzian (Cornell)	Search at 18 cm for OH in planetary nebulae.
T158	T. Thuan (Virginia) E. J. Wadiak (Virginia)	Observations at 21 cm to measure the neutral hydrogen content of active galaxies.
W186	T. Wilson (MPIR, Bonn) R. Rood (Virginia) E. J. Wadiak (Virginia)	Observations at 2 cm of H ₂ densities in giant molecular clouds.
W188	T. Wilson (MPIR, Bonn) R. Rood (Virginia) E. J. Wadiak (Virginia) W. Batrla	Observations at 2 cm of H ₂ CO emission from giant molecular clouds.

The following Very Long Baseline programs were conducted, and the stations used in the observations are coded as follows:

	A - Arecibo 1000-ft B - Effelsberg MPIR 100-m C - Algonquin 150-ft F - Fort Davis 85-ft G - Green Bank 140-ft H - Hat Creek 85-ft I - Iowa 60-ft Jb - Jodrell Bank Mk II Jm - Jodrell Bank 120-ft Km - Haystack 120-ft Lb - Bologna 25-m	Lm - Medicina 32-m N - NRL Maryland Point 85-ft O - Owens Valley 130-ft R - Crimea USSR 30-m Sk - Kirunda Sweden 60-ft Sn - Onsala 20-m So - Onsala 25-m T - Torun 15-m Wn - Westerbork n=1-14x26 m Yn - Socorro n=1-27x25 m
AV6	W. Alef (MPIR, Bonn) E. Preuss (MPIR, Bonn) K. Kellermann	Observations at 6 cm of the milli-arcsecond core of 3C 147, with telescopes B, F, G, Km, Lb, O, and Yn.
B55V	P. Barthel (Leiden) G. Miley (Leiden) E. Preuss (MPIR, Bonn) R. Schilizzi (NFRA)	Survey at 6 cm for compact cores in extended quasars, with telescopes B, G, Km, Lm, O, and So.
B382V	L. Baath (Manchester) F. Briggs (Pittsburgh) M. Davis (NAIC) K. Johnston (NRL) D. Jones (Caltech) B. Ronnang (Chalmers) S. Unwin (Caltech) A. Wolfe (Princeton) J. Romney	Monitoring of the 932-MHz redshifted HI absorption line in AO 0235+164, with telescopes A, G, Jm, O, and Sk.

<u>No.</u>	<u>Observer</u>	<u>Program</u>
B385V	L. Baath (Manchester) F. Briggs (Pittsburgh) M. Davis (NAIC) K. Johnston (NRL) D. Jones (Caltech) B. Ronnang (Chalmers) S. Unwin (Caltech) A. Wolfe (Pittsburgh) J. Romney	Monitoring of low-frequency variables at 932 MHz, with telescopes A, G, Jm, O, and Sk.
C33V	M. Claussen (Caltech) M. Heiligman (Caltech) K. Lo (Caltech) M. Schneps (CFA) M. Reid (CFA)	Observations at 1.3 cm of the small-scale structure of the water-vapor masers in the nucleus of NGC 4258, with telescopes B, G, Km, O, and Yn.
C34V	M. Cohen (Caltech) J. Biretta (Caltech) R. Moore (Caltech) A. Readhead (Caltech) S. Unwin (Caltech)	Observations at 1.3 and 2.8 cm of the compact structures in 3C 273, 3C 279, and 3C 345, with telescopes B, F, G, H, Km, Lm, N, Sn, and Yn.
C35V	W. Cotton F. Owen	Observations at 18 cm for inverse Compton emission, with telescopes B, G, Jm, O, and Yn.
D8V	P. Diamond (Chalmers) R. Booth (Chalmers) D. Graham (MPIR, Bonn) R. Norris (Manchester) T. Perry (Manchester)	Observations at 18 cm of the OH maser OH 104.9+2.4, with telescopes B, G, Jm, O, So, and Wn.
E8V	A. Eckart (MPIR, Bonn) K. Johnston (NRL) A. Witzel (MPIR, Bonn)	Investigation at 18 cm of the milli-arcsecond structure of the BL Lac object 0716+71, with telescopes B, G, Jm, Km, O, R, So, T, Wn, and Yn.
E10V	A. Eckart (MPIR, Bonn) P. Biermann (MPIR, Bonn) K. Fricke (MPIR, Bonn) K. Johnston (NRL) C. Schalinski (MPIR, Bonn) A. Witzel (MPIR, Bonn)	Observations at 18 cm of OSO 1928+73, with telescopes B, G, Jb, Km, Lm, O, So, and Wn.
H15V	D. Hough (Caltech) A. Readhead (Caltech)	Observations at 2.8 cm of the central component of the extended quasar 3C 245, with telescopes B, F, G, H, and O.

<u>No.</u>	<u>Observer</u>	<u>Program</u>
H201V	M. Hodges (Caltech)	Observations at 932 MHz of compact doubles, with telescopes G, Jb, and O.
J33V	D. Jones (Caltech)	Second-epoch observations at 1.3 cm of AO 0235+164, with telescopes B, G, Km, O, and Yn.
J34V	D. Jones (Caltech) R. Sramek	Quick-look observations at 6 cm of NGC 3690, with telescopes G, Km, O, and Yn.
L30V	J. Lestrade (JPL) R. Mutel (Iowa) A. Niell (JPL) R. Preston	Observations at 6 cm of RS CVn binaries, with telescopes B, G, Km, O, and Yn.
L31V	C. Lawrence (Caltech) B. Burke (MIT) R. Booth (Chalmers) R. Linfield (NFRA) D. Payne (JPL) R. Preston (JPL) R. Porcas (MPIR, Bonn) A. Readhead (Caltech) R. Schilizzi (NFRA)	Survey at 1.3 cm of selected, strong sources, with telescopes B, G, Km, O, Sn, and Yn.
M56V	R. Mutel (Iowa) M. Hodges (Caltech)	Observations at 2.8 cm to monitor the outbursts of BL Lac, with telescopes B, F, G, H, Km, and O.
M57V	F. Mantovani (Bologna) I. Browne (Manchester) A. Ficarra (Bologna) T. Muxlow (Manchester) L. Padrielli (Bologna) J. Romney	Observations at 18 cm of 3C 99, with telescopes B, G, Jm, O, So, and Wn.
M58V	R. Mutel (Iowa) T. Muxlow (Jodrell Bank) R. Phillips (Haystack)	Observations at 2.8 and 18 cm of quasar compact doubles, with telescopes B, F, G, H, I, Km, O, and Yn.
M59V	J. Moran (CFA) L. Rodriguez (Mexico)	Observations at 6 cm for high-brightness temperature, nonthermal emission from early-type stars, with telescopes F, G, O, and Yn.

<u>No.</u>	<u>Observer</u>	<u>Program</u>
M61V	A. Marscher (Boston)	Observations at 1.3 and 2.8 cm of the "naked" core of NRAO 140, with telescopes B, F, G, H, Km, N, O, Sn, and Yn.
P58V	T. Pearson (Caltech) A. Readhead (Caltech)	Second-epoch observations at 6 cm of a complete sample of 20 sources, with telescopes B, G, I, Km, O, and Yn.
P60V	I. Pauliny-Toth (MPIR, Bonn) R. Porcas (MPIR, Bonn) W. Sheng-Yin (MPIR, Bonn) A. Zensus (MPIR, Bonn) K. Kellermann	Continued monitoring at 2.8 cm of 3C 454.3, with telescopes B, F, G, H, Km, and O.
P61V	R. Porcas (MPIR, Bonn)	Observations at 2.8 cm of the superluminal quasar 3C 179, with telescopes B, G, Km, and O.
P62V	G. Pilbratt (Onsala) R. Booth (Onsala) G. Nicolson (Hartebeesthoek) R. Porcas (MPIR, Bonn)	Observations at 6 cm of structural variations in 3C 279, with telescopes B, G, Jb, Km, Lm, O, So, T, Wn, and Yn.
R30V	J. Romney W. Alef (MPIR, Bonn) N. Broten (Herzberg) I. Pauliny-Toth (MPIR, Bonn) K. Kellermann	Studies at 2.8 cm of the structural evolution of 3C 84, with telescopes B, F, G, H, Km, Lm, and O.
R32V	D. Roberts (Brandeis) L. Brown (Brandeis) B. Burke (MIT) D. Gabuzda (Brandeis) R. Potash (Interferometrics) A. Rogers (Haystack) J. Wardle (Brandeis)	Polarization-sensitive observations and polarization synthesis observations of 3C 345 at 2.8 cm, with telescopes B, F, G, Km, and O.
R33V	D. Roberts (Brandeis) L. Brown (Brandeis) B. Burke (MIT) D. Gabuzda (Brandeis) R. Potash (Interferometrics) A. Rogers (Haystack) J. Wardle (Brandeis)	Observations at 6 cm to survey and monitor selected sources for linear polarization, with telescopes B, F, G, Km, O, and Yn.

<u>No.</u>	<u>Observer</u>	<u>Program</u>
S40V	R. Schilizzi (NFRA) R. Hunstead (Sydney) K. Johnston (NRL) R. Laing (RGO) H. Murdoch (Sydney)	Observations at 6 and 18 cm of 0215+015, with telescopes B, G, Jb, Lm, N, O, So, Wn, and Yn.
S41V	S. Spangler (Iowa) J. Cordes (Cornell) D. Morris (Iowa) R. Mutel (Iowa) J. Benson	Observations at 6 and 18 cm to search for cosmic ray induced turbulence near supernova remnants, with telescopes B, G, I, Km, O, and Yn.
T4V	R. Taylor (Toronto) E. Seaquist (Toronto)	Observations at 6 cm of rapidly variable radio sources, with telescopes G, F, Km, O, and Yn.
U14V	S. Unwin (Caltech) J. Halpern (Caltech) K. Pounds (Leicester) J. Benson R. C. Walker	Observations at 1.3 cm of 3C 120, with telescopes B, G, Km, O, and Yn, simultaneous with X-ray observations.
W23V	R. C. Walker S. Unwin (Caltech) J. Benson G. Seielstad	Continued monitoring at 6 cm of 3C 120, with telescopes B, F, G, H, I, Km, O, So, and Yn.
W32V	G. de Waard (Leiden) G. Miley (Leiden) R. Schilizzi (NFRA)	Observations at 6 cm of jet inter- actions with the broad-line region in active nuclei of Fe II quasars, with telescopes B, G, Jb, Lm, O, So, and Yn.
W35V	J. Wrobel (Caltech) J. Biretta (Caltech) M. Cohen (Caltech) D. Roberts (Brandeis) S. Unwin (Caltech)	Studies of kinematics, strengths, and linear polarization of the components of 3C 345 at 2.8 cm, with telescopes B, C, F, G, H, Km, Lm, and O.
W36V	A. Witzel (MPIR, Bonn) A. Eckart (MPIR, Bonn) K. Johnston (NRL) C. Schalinski (MPIR, Bonn)	Observations at 18 cm of 0153+74, with telescopes B, F, G, Jm, O, R, So, T, and Wn.
X25V	A. Haschick (Haystack) J. Moran (CFA) M. Reid (CFA) M. Schneps (CFA)	Observations at 1.3 cm of NGC 3079, with telescopes G, Km, O, and Yn.

<u>No.</u>	<u>Observer</u>	<u>Program</u>
X26V	T. Simon (Hawaii)	Observations at 6 cm of T Tauri, with telescopes G, O, and Yn.
X27V	R. Simon (NRL)	Observations at 1.3 cm of 3C 446, with telescopes G, Km, N, and O.
X28V	P. Diamond (Chalmers)	Observations at 18 cm of OH masers, with telescopes G, O, Yn, and telescopes of the European VLB network.
X29V	M. Sanroma (Barcelona)	Observations at 1661 MHz of 1858+171, with G and telescopes of the European VLB network.
X30V	P. Biermann (MPIR, Bonn) A. Eckart (MPIR, Bonn) K. Fricke (MPIR, Bonn) K. Johnston (NRL) C. Schalinski (MPIR, Bonn) A. Witzel (MPIR, Bonn)	Observations at 18 cm of the OSO 1928+73, with telescopes G, Jm, Km, O, So, and W.
Z8V	A. Zensus (MPIR, Bonn) D. Hough (Caltech) R. Porcas (MPIR, Bonn)	Mapping at 2.8 cm of the central component of the extended quasar 3C 263, with telescopes B, G, Km, and O.

300-foot Telescope

	<u>Hours</u>
Scheduled observing	1923.75
Scheduled maintenance and equipment changes	151.75
Scheduled tests and calibration	0.00
Time lost due to: equipment failure	28.00
power	0.00
weather	9.00
interference	2.50

The following continuum programs were conducted during this quarter.

<u>No.</u>	<u>Observer</u>	<u>Program</u>
A59	H. Aller (Michigan) M. Aller (Michigan) R. Fanti (Bologna) A. Ficarra (Bologna) F. Mantovani (Bologna) L. Padrielli (Bologna)	Observations at 1400 and 2695 MHz of low-frequency variable sources selected from the Bologna-Michigan program.

<u>No.</u>	<u>Observer</u>	<u>Program</u>
B415	J. Broderick (VPI & SU) D. Altschuler (Puerto Rico) B. Dennison (VPI & SU) K. Mitchell (VPI & SU) S. O'Dell (VPI & SU) J. Condon H. Payne	Monitor of low-frequency variable sources at 611, 800, and 1400 MHz.
E43	W. Erickson (Maryland) S. Ananthakrishnan (Tata) W. Dent (Massachusetts) W. Kinzel (Massachusetts)	Observations over the range 100-300 MHz to study the polarization and flux of low-frequency variable sources.
032	C. O'Dea T. Balonek (Williams College) W. Dent (Massachusetts) W. Kinzel (Massachusetts)	Polarization and flux-density measurements of variable sources at 2695 MHz.

The following line programs were conducted during this quarter.

<u>No.</u>	<u>Observer</u>	<u>Program</u>
A75	K. Anantharamaiah (Raman) W. Erickson (Maryland)	Observations of low-frequency recombination lines over the range 25-300 MHz.
G271	R. Giovanelli (NAIC) M. Haynes (Cornell)	Observations at 21 cm of HI in neutral hydrogen galaxies found in clusters and superclusters.
H198	D. Heeschen M. Kaftan-Kassim (unaffiliated) H. Lehto (Virginia)	Observations at 9 cm to study the variability of extragalactic radio source.
P131	H. Payne	Observations over the range 30-300 MHz of the extragalactic source 3C 123 for low-frequency recombination lines.
R214	O. Richter (STSI) W. Huchtmeier (MPIR, Bonn) J. Materne (T.U., Berlin)	Observations of the HI spectra of galaxies lying between the Virgo and Hydra/Centaurus superclusters.
W194	H. A. Wootten J. Armstrong	Observations of neutral hydrogen to investigate the gas content of dusty galaxies.

The following pulsar programs were conducted during this quarter.

<u>No.</u>	<u>Observer</u>	<u>Program</u>
T178	J. Taylor (Princeton) R. Dewey (Cornell) G. Stokes (Princeton) J. Weisberg (Princeton)	Continuation of the northern hemisphere pulsar survey at 390 MHz.
H193	J. Hollis (NASA-Goddard) M. Damashek (STSI) C. Jarrett (Florida State) M. Kafatos (George Mason) A. Michalitsianos (NASA-Goddard)	Observations at 390 and 880 MHz to search for short-term emission in the R Aquarii binary system.

<u>12-meter Telescope</u>	<u>Hours</u>
Scheduled observing	1655.00
Time not scheduled	48.50
Scheduled maintenance & equipment changes	130.25
Scheduled tests and calibration	374.25
Time lost due to: equipment	113.00
weather	286.00
power	0.00
interference	0.00

The following line programs were conducted during this quarter.

<u>No.</u>	<u>Observer</u>	<u>Program</u>
C211	E. Churchwell (Wisconsin) R. Crutcher (Illinois)	Relative abundance of CO and CN in dark clouds.
D133	W. Dent (Massachusetts) T. Balonek (Williams College) R. Hobbs (CTA, Inc.)	Evolution of extragalactic radio sources at millimeter wavelengths.
H191	C. Lada (Arizona) P. Hartigan (Arizona)	Maps of molecular outflows around RCRA and CRL 2591.
H196	R. Hobbs (CTA, Inc.) W. Webster (NASA-GSFC)	Observations of asteroids at 3-mm wavelengths.
H202	P. Huggins (New York) A. Healy (New York)	Studies of CO (2-1) circumstellar envelopes.
J109	P. Jewell L. Snyder (Illinois) M. Schenewerk (Illinois)	Methyl-group chemistry in the CSM and ISM: A study of CH ₂ NH.

<u>No.</u>	<u>Observer</u>	<u>Program</u>
L186	C. Leung (Rensselaer) M. Kutner (Rensselaer) N. Evans II (Texas)	Study of radiative transfer effects in CO isotopes.
L190	R. Loren (Texas) B. Wilking (Texas) H. A. Wootten	Propagation of star formation through Rho Oph.
L191	H. Liszt	Search for extragalactic O ₂ .
M228	R. Padman (Berkeley) H. Martin	Investigation of fragmentary structure in molecular clouds.
M232	W. McCutcheon (British Columbia) R. Nordal (British Columbia)	CO observations of S211/212.
P129	J. Payne C. Salter E. Stobie S. Shaklin (Arizona)	90 and 230-GHz observations of Cas A and Tau A.
P130	J. Payne P. Rhodes C. Salter S. Reynolds	Observations of crab-like supernova remnants at 90 GHz.
R211	L. Rudnick (Minnesota) T. Jones (Minnesota) J. Pedelty (Minnesota)	Broader perspectives on nuclei of extended extragalactic sources.
R217	L. Blitz (Maryland) L. Rickard (NRL)	Study of CO emission in galaxies.
S270	M. Schenewerk (Illinois) L. Snyder (Illinois) J. Hollis (NASA-GSFC)	Search for interstellar hypochlorous acid.
S273	A. Sandqvist (Stockholm) T. Elfhag (Stockholm) S. Jorsater (Stockholm) P. Lindblad (Stockholm)	Search for 1-mm and 3-mm CO lines in NGC 1365.
T171	L. Ziurys (Berkeley) B. Turner	Search for NH ₂ at 1.2 mm.
T173	B. Turner L. Ziurys (Berkeley)	Search for vibrationally excited diacetylene.
T185	H. Thronson, Jr. (Wyoming)	Advanced stellar evolution and milli- meter-wave emission.

<u>No.</u>	<u>Observer</u>	<u>Program</u>
T189	H. Thronson, Jr. (Wyoming)	The study of $^{33}\text{S}/^{32}\text{S}$ ratio in the galaxy.
W189	W. Welch (Berkeley) S. Vogel (Berkeley) M. Wright (Berkeley) D. Backer (Berkeley) R. Plambeck (Berkeley) T. Kuiper (JPL) E. Kuiper (JPL) H. Dickel (Illinois) J. Bieging (Berkeley) R. Padman (Berkeley)	High-resolution mapping of large fields.
Z43	B. Zuckerman (UCLA)	CO and HNC in evolved stars and a search for CCL.
Z44	L. Ziurys (Berkeley) B. Turner R. Saykally (Berkeley)	Study of vibrationally excited HCN and HNC.

Very Large Array

The quarter was scheduled 97.2 percent of the time.

Astronomical	1627.0 hours (73.7 percent)
Scheduled maintenance	220.2 hours (10.0 percent)
Scheduled test/calibration	298.3 hours (13.5 percent)

The average downtime was 6.9 percent.

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

<u>No.</u>	<u>Observer</u>	<u>Program</u>
AA-30	H. Aller (Michigan) S. Reynolds	Mapping and polarimetry of 3C 58. 20 cm.
AA-36	R. Antonucci E. Olszewski (DAO, Canada)	IRAS extreme infrared galaxies. 6 cm.
AA-38	D. Axon (NRAL, UK) S. Unger (NRAL, UK) A. Pedlar (NRAL, UK)	The double radio source in the Seyfert galaxy NGC 5252. 1.3, 2, 6 and 20 cm.
AA-39	R. Antonucci J. Ulvestad (JPL)	Radio structure of OI 287. 2 and 6 cm.

<u>No.</u>	<u>Observer</u>	<u>Program</u>
AB-129	B. Burke (MIT) J. Hewitt (MIT) D. Roberts (Brandeis)	Monitoring time variations in 0957+561. 6 cm.
AB-167	R. C. Bignell E. Seaquist (Toronto)	Monitoring SNR in the galaxy NGC 4449. 6 and 20 cm.
AB-182	J. Burns (New Mexico) T. Balonek (Williams College) E. Hummel (MPIR, Bonn)	Monitoring the cores of extended radio sources and spiral galaxies. 2, 6, and 20 cm.
AB-276	C. Bennett (MIT) C. Lawrence (Caltech) J. Hewitt (MIT) B. Burke (MIT) E. Turner (Princeton)	Variability monitoring of the new gravitational lens 2016+112. 2 and 6 cm.
AB-289	M. Birkinshaw (Cambridge) R. Davies (KPNO)	Structures of radio sources as- sociated with bright elliptical galaxies with known stellar dynamics. 6 cm.
AB-298	F. Briggs (Pittsburgh)	HI observations of interacting dwarf galaxies UGC 1171/1176. 21-cm line.
AB-299	F. Briggs (Pittsburgh)	Extended HI distribution around NGC 628. 21-cm line.
AB-300	F. Briggs (Pittsburgh)	Extended HI near NGC 2146. 21-cm line.
AB-303	R. Becker (California, Davis) D. Helfand (Columbia)	Supernova remnants far inside the solar circle. 20 cm.
AB-305	D. Branch (Oklahoma) J. Cowan (Oklahoma)	Search for 20-cm emission from the Type I supernova 1972e in NGC 5253. 20 cm.
AB-307	C. Benn (Cambridge) J. Wall (RGO, UK) G. Grueff (Bologna) M. Vigotti (Bologna)	5C 12 sources. 6 and 20 cm.
AB-309	G. Bothun (Caltech) E. Skillman (Washington)	HI in extremely low-surface bright- ness and gas-rich dwarf galaxies. 21-cm line.
AB-310	I. Browne (Caltech/NRAL, UK) D. Murphy (NRAL, UK) R. Perley	Extended structure around core- dominated quasars. 20 cm.

<u>No.</u>	<u>Observer</u>	<u>Program</u>
AB-311	J. Burns (New Mexico) J. Eilek (NMIMT) W. Christiansen (North Carolina)	A quantitative investigation of turbulence in the radio galaxy 0816+526. 2 and 6 cm.
AC-101	J. Condon	Survey of bright spiral galaxies. 20 cm.
AC-104	T. Cornwell W. van Breugel (Berkeley) R. Ekers L. Smarr (Illinois)	The db system NGC 4782/4783. 6 and 20 cm.
AC-105	R. Cameron (Mt. Stromlo) C. Bicknell (Mt. Stromlo) R. Ekers	Jet radio sources in southern clusters.
AC-106	R. Crutcher (Illinois) C. Heiles (Berkeley) M. Stevens (Berkeley) W. M. Goss (Groningen) T. Troland (Kentucky) I. Kazes (Obs. de Paris)	Mapping of magnetic fields in molecular clouds. 18-cm line.
AC-110	B. Campbell (Arizona)	Continuum sources in regions of high-velocity molecular gas. 1.3, 2, and 6 cm.
AC-111	J. Cordes (Cornell) D. Heeschen J. Simonetti (Cornell)	Search for flickering in extragalactic sources. 20 cm.
AC-112	D. Branch (Oklahoma) J. Cowan (Oklahoma)	Search for 20-cm emission from the extraordinary supernova 1961V in NGC 1058. 20 cm.
AC-113	B. Cooke (Leicester, UK) M. Turner (Leicester, UK) I. McHardy (Leicester, UK) T. Ponman (Birmingham, UK)	Search for radio emission from the galactic X-ray source GX 349+2. 20 cm.
AC-114	B. Clark R. Perley	High-resolution source structure survey. 2 and 6 cm.
AC-115	S. Catalano (Catania, Italy) D. Gibson (NMIMT) M. Rodono (Catania, Italy)	Flux and luminosity limited surveys of Algol binaries. 6 cm.
AC-116	E. Churchwell (Wisconsin) D. Abbott (Colorado) J. Bieging (Berkeley)	Stellar nonthermal emitters. 2, 6, and 20 cm.

<u>No.</u>	<u>Observer</u>	<u>Program</u>
AD-94	I. de Pater (Berkeley) K. Weiler (NSF) R. Fanti (Bologna) C. Fanti (Bologna)	Monitoring polarization characteristics in variable radio sources. 2, 6 and 20 cm.
AD-119	N. Duric (Toronto) E. Seaquist (Toronto) P. Crane R. C. Bignell L. Davis (KPNO)	Edge-on spiral galaxy NGC 3079. 6 and 20 cm.
AD-141	S. Drake (Colorado) J. Linsky (Colorado)	Chromospheric radio emission and temperatures in nearby cool giant stars. 2 and 6 cm.
AD-145	N. Duric (Toronto) E. Seaquist (Toronto) P. Crane L. Davis (KPNO)	Scaled array observations of the spiral galaxy NGC 4736. 20 cm.
AD-151	S. Drake (Colorado) D. Gibson (NMIMT) J. Linsky (Colorado)	Radio survey of long-period RS CVn binaries. 6 cm.
AE-38	A. Eckart (MPIR, Bonn) A. Witzel (MPIR, Bonn) K. Johnston (NRL) R. Simon (NRL)	Quasar 1928+73. 1.3, 2, 6, and 20 cm.
AE-39	N. Evans (Texas) R. Levreault (Texas) S. Beckwith (Cornell) M. Skrutskie (Cornell)	Pre-main-sequence stars driving molecular outflows. 6 cm.
AF-90	M. Fich (Washington)	Galactic plane continuum sources. 2 cm.
AF-91	C. Fanti (Bologna) R. Fanti (Bologna) P. Parma (Bologna) H. de Ruiter (Bologna)	A selection of radio galaxies from the B2 catalog. 6 and 20 cm.
AF-93	J. Fix (Iowa) R. Mutel (Iowa)	Time variations in maps of hydroxyl masers. 18-cm line.
AF-94	J. Fix (Iowa) J. Neff (Iowa)	Sizes and temperatures of asteroids. 2 cm.
AF-96	D. Florkowski (USNO)	A ring around RY Scuti. 6 and 20 cm.

<u>No.</u>	<u>Observer</u>	<u>Program</u>
AF-97	E. Fomalont B. Geldzahler (NRL)	Sco X-1. 6 and 20 cm.
AF-98	E. Fomalont W. M. Goss (Gronigen) A. Lyne (NRAL, UK) R. Manchester (CSIRO)	Pulsar positions and proper motions. 20-cm line.
AF-100	G. Fuller (Berkeley) C. Heiles (Berkeley)	Ionized helium in galactic HII regions. 6-cm line.
AG-116	D. Gibson (NMIMT) W. Priedhorsky (LANL)	Search for a 300-day periodicity in Cyg X-1. 2, 6, and 20 cm.
AG-145	B. Geldzahler (NRL) P. Schwartz (NRL)	Simultaneous multifrequency observa- tions of blazars. 1.3, 2, 6, 20, and 90 cm.
AG-157	D. Gibson (NMIMT) T. Ayres (Colorado)	Radio, UV, and X-ray observations of the limb crossing of an active region on Sigma Geminorum. 2, 6, and 20 cm.
AG-160	D. Gary (Caltech) J. Linsky (Colorado) B. Haisch (Lockheed)	Coordinated microwave, X-ray, optical and ultraviolet observations of the eclipsing binary YY Gem. 2, 6, and 20 cm.
AG-163	W. M. Goss (Groningen) R. Ekers R. Sramek D. Branch (Oklahoma) J. Cowan (Oklahoma)	Search for very young SNR in our galaxy. 20 cm.
AG-164	A. Gower (Victoria, Canada) J. Hutching (DAO, Canada)	Low redshift quasars. 1.3 and 2 cm.
AG-165	D. Green (Cambridge) A. Downes (Cambridge)	HI absorption toward a probable young galactic SNR. 20-cm line.
AG-166	P. Gregory (British Columbia)	Observational test of a jet model for SNR G109.1-1.0. 6 and 20 cm.
AG-167	P. Gregory (British Columbia) A. Taylor (Toronto)	"Short-term" variable sources. 6 and 20 cm.
AG-168	J. Garcia-Barreto (Mexico) P. Pismis (Mexico)	Search for continuum radiation from the nuclei and bars of SB galaxies. 6 and 20 cm.

<u>No.</u>	<u>Observer</u>	<u>Program</u>
AC-169	G. Garay (ESO) L. Rodriguez (Mexico)	Radio recombination lines from planetary nebulae. 2 and 6-cm lines.
AH-143	E. Hummel (MPIR, Bonn) J. van der Hulst (NFRA) R. Sramek	Monitoring central radio sources to search for supernovae. 6 cm.
AH-163	W. Hermson (MPIR, Bonn) T. Wilson (MPIR, Bonn) C. Walmsley (MPIR, Bonn) C. Henkel (MPIR, Bonn) K. Johnston (NRL)	Hot ammonia sources in Orion, the (8,7) transition. 1.3-cm line.
AH-167	J. Hewitt (MIT) C. Bennett (MIT) B. Burke (MIT) C. Lawrence (Caltech) E. Turner (Princeton)	Search for gravitaitonal lenses. 6 cm.
AH-168	C. Heiles (Berkeley) S. Kulkarni (Berkeley)	Comparison of HI spin temperatures and H ₂ rotational temperatures. 21-cm line.
AH-170	P. Hintzen (NASA-GSFC) F. Owen	Distorted radio QSOs. 6 and 20 cm.
AH-172	R. Hjellming K. Johnston (NRL)	SS433. 2 and 6 cm.
AH-173	D. Hogg	Emission-line galaxy H _e 2-10. 2, 6 and 20 cm.
AH-176	V. Hughes (Queen's, Canada) B. McLean (STSI)	Globular cluster object M3A. 2 cm.
AH-179	R. Hjellming G. Hennessy (NMIMT)	Nova Vulpeculae 1984. 2 and 6 cm.
AJ-104	K. Johnston (NRL) D. Florkowski (USNO) C. Wade G. Gatewood (Pittsburgh) G. de Vegt (Hamburg Obs.) M. Shao (NRL)	Precise optical/radio positions of the stars Algol, HR1099, and UX Ari. 6 cm.
AJ-115	J. Jackson (MIT) A. Barrett (MIT) P. Ho (Harvard)	Continuum survey of starburst galaxies detected in CO. 6 cm.

<u>No.</u>	<u>Observer</u>	<u>Program</u>
AJ-116	J. Jackson (MIT) A. Barrett (MIT) P. Ho (CFA) S. Dynes (MIT)	Ammonia near Sgr A West. 1.3-cm line.
AJ-117	K. Johnston (NRL) C. Wade P. Seidelmann (USNO) G. Kaplan (USNO) W. Webster (NASA/GSFC) R. Hobbs (CTA, Inc.)	The spatial distribution of 2-cm emission from 1 Ceres. 2 cm.
AK-103	S. Kulkarni (Berkeley) C. Heiles (Berkeley) J. van Gorkom	Absorption distances to low-latitude variable sources. 21-cm line.
AK-113	S. Kwok (Calgary)	Radio survey of compact planetary nebulae. 2 and 6 cm.
AK-118	M. Kutner (RPI) N. Evans (Texas)	H ₂ CO emission as a probe of high-density clumping in molecular clouds. 6-cm line.
AL-78	K. Lang (Tufts) R. Willson (Tufts)	Joint VLA-IUE observations of flare stars. 20 cm.
AL-88	L. Little (Kent, UK) S. Davies (Kent, UK) W. Dent (Kent, UK) N. Matthews (Kent, UK) G. White (Queen Mary College)	Ammonia maps of massive molecular cloud cores. 1.3-cm line.
AL-89	S. Lakshmi (IISc/TIFR, India) Gopal-Krishna (TIFR, India) A. Singal (TIFR, India) K. Joshi (TIFR, India)	Three extended radio sources in chains of galaxies. 6 and 20 cm.
AL-90	C. Lawrence (Caltech) J. Hewitt (MIT) C. Bennett (MIT) B. Burke (MIT) E. Turner (Princeton)	Observations of gravitational lens 2016+112. 6, 18, and 20 cm.
AL-91	C. Lake (Bell Labs) R. Schommer (Rutgers) J. van Gorkom	Rotation curves of dwarf galaxies exploring the phase-density of dark matter. 21-cm line.
AM-124	I. McHardy (Leicester, UK) R. Warwick (Leicester, UK) A. Smith (ESTEC, Netherlands)	Monitoring OVVs. 2, 6 and 20 cm.

<u>No.</u>	<u>Observer</u>	<u>Program</u>
AM-130	J. Machalski (Jagiellonian) J. Condon	Possible primordial clusters. 20 cm.
AM-132	U. Mebold (Bonn) P. Kalberla (Bonn)	High-velocity cloud interacting with galactic gas. 21-cm line.
AM-133	T. Menon (British Columbia)	Radio sources in compact groups of galaxies. 6 cm.
AM-134	S. Mufson (Indiana) M. McCullough (Indiana) J. Dickel (Illinois)	Large and small-scale radio structure in SNR IC 443. 20 cm.
AM-135	R. Mutel (Iowa) J. Lestrade (Bureau of Longitude, Paris)	Radio activity in RS CVn binaries: correlation with period. 2, 6, and 20 cm.
AM-136	R. Mutel (Iowa) J. Lestrade (Bureau of Longitude, Paris)	Radio activity in RS CVn binaries II. Investigation of short-period systems. 6 cm.
AN-29	R. Norris (CSIRO) J. Forster (CSIRO) W. Baan (Arecibo)	Active galactic nucleus IC 4553. 1.3, 2 and 6 cm.
AO-47	C. O'Dea F. Owen	Constraints on the properties of bent beams. 20 cm.
AO-53	C. O'Dea A. Patnaik (TIFR, India) Gopal-Krishna (TIFR, India)	Gigahertz peaked spectrum sources. 1.3, 6 and 20 cm.
AO-56	R. Olowin (Oklahoma) T. Herczeg (Oklahoma)	Search for radio variability in white dwarf pulsar AE Aqr. 6 cm.
AP-89	L. Padrielli (Bologna) A. Rogora (Bologna) H. de Ruiter (Bologna)	Twenty-five compact quasars selected from the B2 catalogue. 6 and 20 cm.
AP-90	P. Parma (Bologna) R. Fanti (Bologna) C. Lari (Bologna) E. Fomalont R. Ekers	The unusual morphology of NGC 326. 18 and 20 cm.
AR-102	L. Rudnick (Minnesota) T. Jones (Minnesota) J. Pedelty (Minnesota)	Nuclei of extended extragalactic sources. 2, 6, and 20 cm.
AR-113	G. Robertson (AAO, Australia) D. Harris (CFA)	Abell 84. 6, and 20 cm.

<u>No.</u>	<u>Observer</u>	<u>Program</u>
AR-114	L. Rodriguez (Mexico) J. Canto (Mexico) S. Curiel (Mexico)	Search for faint, extended continuum emission in regions of molecular outflows without associated point sources. 6 cm.
AR-115	L. Rudnick (Minnesota) J. Pedelty (Minnesota)	Equal linear resolution study of extragalactic radio source luminosity effects. 2 and 6 cm.
AS-79	S. Spangler (Iowa) W. Cotton S. Allendorf (Iowa)	Monitoring low-frequency variables. 1.3, 2, 6, and 20 cm.
AS-80	R. Sramek J. van der Hulst (NFRA, Neth.) K. Weiler (NSF)	Monitoring supernovae SN1980 in NGC 6946 and SN 1979c in M100. 6 and 20 cm.
AS-156	M. Stevens (Berkeley) C. Heiles (Berkeley)	OH mapping of Orion B. 18-cm line.
AS-183	G. Swarup (TIFR, India)	QSOs with absorption lines. 6 cm.
AS-200	S. Simkin (Michigan State) H. Su (Purple Mt. Obs.) J. van Gorkom	HI observations of Seyferts of different morphological type. 21-cm line.
AS-203	S. Schneider (Cornell) E. Salpeter (Cornell) Y. Terzian (Cornell)	HI study of the intergalactic cloud in Leo. 21-cm line.
AS-206	R. Snell (Massachusetts) J. Bally (Bell Labs) P. Schwartz (NRL)	Radio jets associated with L1551 IRS-5. 20 cm.
AS-209	E. Seaquist (Toronto) A. Taylor (Toronto)	Radio emission from symbiotic stars. 6 cm.
AS-210	W. Sullivan (Washington)	Sizes and offsets of the HI distribution in the central spiral galaxies of the Coma cluster. 21-cm line.
AT-53	A. Taylor (Toronto) E. Seaquist (Toronto) S. Kenyon (CFA)	The symbiotic star HI-36. 2, 6, and 20 cm.
AT-54	A. Taylor (Toronto) E. Seaquist (Toronto)	Absorption distances to galactic plane variables. 21-cm line.

<u>No.</u>	<u>Observer</u>	<u>Program</u>
AT-55	A. Taylor (Toronto) F. Seaquist (Toronto) S. Kenyon (CFA)	Radio spectra of symbiotic stars. 1.3, 2, 6, and 20 cm.
AT-56	L. Tacconi (Massachusetts) J. Young (Massachusetts)	Cycling of the ISM in the luminous Sed galaxy NGC 6946. 21-cm line.
AU-20	J. Ulvestad A. Wilson (Maryland)	Seyfert 1.9 galaxies. 6 and 20 cm.
AV-96	J. van der Hulst (NFRA) R. Sramek K. Weiler (NSF)	Monitoring radio supernova in NGC 4258. 6 and 20 cm.
AW-48	C. Wade K. Johnston (NRL) P. Seidelmann (USNO) G. Kaplan (USNO)	Astrometric observations of minor planets.
AW-78	J. Wardle (Brandeis) R. Laing (RGO, UK)	Monitoring variability of the central components of extended radio sources. 2 and 6 cm.
A-116	T. Wilson (MPIR, Bonn) K. Johnston (NRL) P. Jewell (MPIR, Bonn) C. Walmsley (MPIR, Bonn) K. Menten (MPIR, Bonn)	A newly discovered methanol maser line. 1.3-cm line.
AW-118	J. Wink (MPIR, Bonn)	Helium Stromgren spheres. 2-cm line.
AW-120	W. Webster (NASA-GSFC) R. Hobbs (CTA, Inc.) P. Lowman (NASA-GSFC)	Microwave spectra of the major asteroids. 2 and 20 cm.
AW-121	R. C. Walker J. Benson	3C 120. 20 cm.
AW-122	A. Wehrle (UCLA) M. Morris (UCLA)	Vertical radio structure in the nuclei of normal spiral galaxies. 2 and 6 cm.
AZ-24	X. Zheng (Nanking, China) P. Ho (CFA) J. Moran (CFA)	Clumping and rotation in the molecular cloud OMCl. 1.3 cm-line.
VAH-30	A. Haschick (Haystack)	NGC 3079. 1.3 cm.
VAH-31	T. Simon (Hawaii)	T Tauri. 6 cm.

<u>No.</u>	<u>Observer</u>	<u>Program</u>
VAH-32	R. Simon (NRL)	3C 446. 1.3 cm.
VD-1	B. Dennison (VPI & SU) P. Diamond (MPIR, Bonn)	(EVN84-35). 18 cm.
VL-32	C. Lawrence (Caltech) A. Readhead (Caltech) R. Linfield (NFRA, Netherlands) R. Schilizzi (NFRA, Netherlands)	Maps of sources with 1.3 cm structure. 1.3 cm.

RESEARCH PROGRAMS

Scientific Highlights

Although there have been many ground-breaking discoveries made with the VLA during the quarter, the following NRAO news release highlights one particularly enigmatic observation.

Abell 400 and the 3C 75 Radio Jets

Astronomers today reported the discovery of a spectacular new radio jet in space. Four enormous radio "jets" have been found to be exploding out from a galaxy lying in the center of a dense cluster of galaxies about 300 million light years from Earth. The discovery was reported by scientists from the United States and Japan who used the Very Large Array (VLA) radio telescope of the National Radio Astronomy Observatory to make their observations.

The strange galaxy possesses two bright centers located about 20,000 light years apart, each of which is the source of twin radio jets which appear twisted and tangled as they splay out into space. The entire object, known as 3C 75, is about one million light years across. The phenomenal power associated with these jets is equivalent to one hundred million times the energy radiated by the sun.

The discovery was reported by Frazer Owen and Christopher O'Dea of the NRAO, Makoto Inoue (Nobeyama Radio Observatory), Jean Eilek (New Mexico Tech), and Richard White (Computer Science Corporation).

The four jets, looking much like gigantic smoke clouds billowing into space, are indicative of awesome forces at work. Radio jets, also observed in other active galaxies, are believed to be made of high energy particles and magnetic fields violently ejected from a compact object such as a black hole.

Over the past decade, X-ray observations of clusters of galaxies have revealed the existence of very hot gas between galaxies. The bending of the jets in 3C 75 may result from the sweeping back of the ejected material as the object moves through space, much as a wake streams behind a speed boat.

The astronomers report that the enormous extent of the jets suggests that the energy for powering the radio emission may be coming from the hot gas in the cluster as well as from the center of the galaxy. The discovery of this remarkable object will allow the astronomers to learn more about intergalactic space, which, in turn, will enhance our understanding of the evolution of the universe.

Publications

Appendix I contains a tabulation of all preprints received in the NRAO Charlottesville library authored by NRAO staff members or based on observations obtained on NRAO telescopes during 1984.

ENGINEERING DIVISION

Design of modifications to the focal point enclosure and structure of the 300-ft telescope continued.

The new deformable subreflector was placed in service on the 140-ft telescope. Design and study continued on the splitter for the new feed systems on the 140-ft, and a contract was awarded for a low-frequency reflector to be used in the new feed system.

Negotiations with the VLBA antenna proposers were completed.

Refinements to the in house VLBA antenna design were made.

Negotiations with the A/E for design of the Pie Town site building and facilities were completed.

All VLBA sites continued to be reviewed for acceptability and availability.

Conceptual design studies for a 72-MHz antenna for use in an array were started.

ELECTRONICS DIVISION

Charlottesville

Assembly of a second 8.4 GHz front-end has begun. Shipment of the front-end for Voyager testing at the VLA by April is expected.

A low-noise HEMT device manufactured by General Electric has produced a noise temperature of 8.5 ± 1.5 K at 8.4 GHz. This figure is the lowest noise ever reported for a transistor amplifier at that frequency. Testing of additional developmental devices from General Electric and Cornell at 8 and 23 GHz continues.

The 115-GHz SIS (superconductor-insulator-superconductor) receiver has been completed and will be shipped to the 12-m telescope in January for telescope testing and system integration. Development of Schottky diode mixers for 270 and 350 GHz continues.

Prototyping of circuits for the millimeter-wave, 1536-channel, hybrid spectrometer has begun. An intermediate goal is completion and testing of one-eighth of the system by the fall of 1985.

Green Bank

Spectral processor design continued in system definition, simulation and RAM, ROM, and ALU evaluation for the FFT butterfly boards. Testing continued on the data acquisition and control processor of the MASSCOMP 300-ft control system.

The 2.0 to 3.5-GHz cooled FET amplifier was completed and installed in the 2-5 GHz receiver. It was debugged in the test stand and will be tested on the 140-ft telescope next quarter. Assembly of the 5 GHz, 7-feed receiver continued. Tests of feed and cooled upconverter demonstrated that the 0.3-1 GHz receiver is usable down to 280 MHz. A new feed filled the 450 to 500 MHz portion of the 400 to 500-MHz gap in frequency coverage. Scale models of several low-frequency feeds for the 300-ft were tested.

The deforming control servo for the new 140-ft subreflector was re-optimized. Theoretical investigations began on a subreflector vertex plate to reduce multiple reflections between feeds and subreflector. The 4.7-7.2 GHz polarization splitter design was given to the Engineering Division for detailed mechanical design. Minimum K-band system temperature of 31 K was achieved by removing up-converters and switch from one of the two maser receivers. Design of nutator modifications to provide lateral offset tracking of the best-fit surface continued.

VLBA designing and prototyping continued for the LO synthesizer, L-band front-end and 6-cm FET amplifiers. Stress testing of four cryogenic refrigerators continued.

Report EDIR No. 251, "Interferometer 14.2-m Digital Data Link," was issued.

Routine and unscheduled maintenance and RFI suppression at the telescope, lab and site continued.

Tucson

During this quarter work has progressed on the new 70-120 GHz receiver. This receiver is scheduled for telescope tests in February. Initially this receiver will be used with two channels covering the 90-120 GHz band; two additional channels covering 70-90 GHz will be added at a later date.

The dual-channel SIS mixer dewar assembly has been completed in the Central Development Laboratory and will be shipped to Tucson in early 1985. Plans are to test this prototype system on the 12-m telescope as soon as possible.

All machine shop work on the 345-GHz cooled mixer receiver is complete and laboratory tests will begin in the next couple of months.

Work on the dual-channel, 130-170 GHz receiver is at a standstill owing to lack of manpower.

Work on the new optical system incorporating fast beams switcher and various calibration systems is moving along very slowly owing to the lack of manpower.

Very Large Array

Fourteen antennas now have insulation installed to improve their pointing.

Five antennas now have 327-MHz receivers installed, and this system is undergoing test and evaluation. Modification to some modules is being considered to reduce local RFI.

Three antennas now have a simple 75-MHz receiver and a log-periodic antenna outrigger on the side of the 25-m reflector.

The prototype, 8-GHz receiver subsystem is now installed on Antenna 20 and is undergoing single-dish testing. The measured system temperature is 43°K.

To improve the reliability of the A/C side of the correlator, half of the power supplies have been replaced with a newer type. The remaining supplies are scheduled to be replaced the first quarter of next year.

The RFI measurement trailer is making RFI measurements at selected VLBI sites in the Tucson area.

COMPUTER DIVISION

General

During October 1984 a Lasergrafix 800 printer manufactured by QMS, Inc., of Mobile, Alabama, was installed and connected to a terminal port on the Charlottesville VAX. The laser printing engine of this printer was manufactured by Canon and is very similar to their "personal copiers" (e.g., it uses user-replaceable drum and toner assemblies). The resolution is 300 dots per inch, and the machine prints on plain 8.5x11 inch paper.

Supercomputer Access. The NRAO has applied for Class VI computer time under the NSF Supercomputer Access Program. This is in accordance with our long-term computer plan and was recommended by the Computer Advisory Group. The preferred computer system is the Cray X-MP supercomputer of Vector Productions in Los Angeles. Forty CPU hours have been requested, to be used in early 1985. (Note: About 30 of the billing hours are needed to pay for auxiliary costs, including I/O, mass storage, interactive priority, and image display charges.)

In anticipation of access to the Vector Productions computer, the VLA staff has carried out initial experimentation with the Cray-1 computer at Los Alamos National Laboratory. An existing maximum entropy deconvolution algorithm has been adapted to the Cray-1, but the attempt to process a 4096x4096 pixel image has not yet been successful.

The computer time shall be used to adapt the NRAO's portable synthesis mapping software, AIPS, to the Cray X-MP.

Intersite Digital Communication Systems. Testing was done with the goal to improve the reliability of the intersite Digital communications system. Reliability has been a problem in late 1984. Also, some network expansion is planned. In early 1985, the network will be extended to the California Institute of Technology to aid in coordinating the development of VLBA correlator/fringe processor software. Tentative plans also call for extending the network to Vector Productions, a California-based company which will be involved with the NSF in the Supercomputer Access Program.

AIPS

AIPS Software Development. In the fourth quarter of 1984, the AIPS array processor interface routines were extensively modified to run more efficiently using the software array processor. Include files were added which allow insertion of compiler directives to improve the vectorization of the code. This change was done in anticipation of installing AIPS on a CRAY in early 1985. Preliminary, system level work was done for the calibration and editing software to be implemented in 1985. Work was begun on a suite of validation and benchmark tests of AIPS programs.

Very Large Array

The definition of the system data structures for the new on-line computers was completed. Work is now in progress to define the operator interface to the new system.

In order to enhance the capability of data calibration and editing and of observing source list preparation for observers who make use of the dial-in facility, two additional lines have been added to the DEC-10. These are on a rotary hunt group with the normal number and will be switched to automatically if the printer dial-in extension is in use.

In order to increase the reliability of the pipeline, it was taken out of service for the month of November. All existing programs were installed and tested with the new operating system (RSX-11M+). In addition, some outstanding hardware problems with the array processors and the shared disk units were diagnosed and corrected.

A large disk storage unit containing space for 1.3 Gbyte has now been added to the second VAX computer at the VLA site. Mapping problems requiring large amounts of disc storage can now be performed on both VAX computers.

THE VERY LONG BASELINE ARRAY PROGRAM

The 4th quarter of 1984 has seen progress in all areas of VLBA development.

In the area of site selection, a major activity has been the evaluation of possible RFI problems at the various tentatively chosen antenna sites. The Pie Town site has been judged acceptable. Measurements at the Los Alamos site are complete, but the results raise some concern about RFI at L-band. Measurements at Kitt Peak are in progress, as are preliminary checks at Quabbin (Massachusetts). A site near Haystack Observatory has been ruled out because of probable RFI from the Haystack (X-band) and Millstar (UHF and V-band) radars.

The firm of Stevens, Mallory, Pearl and Campbell of Albuquerque, New Mexico has been selected as the Architect/Engineer (A/E) subcontractor for design and construction of the Array Operations Center and the VLBA Station buildings. Negotiations are complete and the contract is being prepared.

In the antenna area, negotiations were conducted with TIW Systems, Inc. and Radiation Systems, Inc. at the vendors' plants leading to "best and final" revised proposals and prices from each. Each was asked to submit prices that included the manufacture and installation of surface panels having an RMS deviation of 0.13 mm. Each firm was judged capable of producing acceptable antennas. RSI's proposal was selected, largely on the basis of a price advantage of about one million dollars. Contracts covering manufacturing and installation were signed and approved in late December 1984.

In electronics, a cooled-FET front-end prototype for ~ 8.4 GHz has been developed and installed for test on one of the VLA antennas. It provides system temperatures of about 43 K on both channels, a highly satisfactory result. In a sense, this assembly is a generic prototype for most of the VLBA front-end packages, since most of the frequency-independent design features will be the same from L-band to about 20 GHz.

The L-band front-end development model tests at Green Bank yielded receiver temperatures averaging 12.5 K over the range 1.35 to 1.75 GHz--within about 2 K of the best Green Bank system. Slow cool-down seems to show the need for more reserve cooling capacity for the L-band assembly, in which the polarizer and other cooled components are relatively large. It has been decided to modify the design to accommodate a Model 350 refrigerator instead of the smaller Model 22 now in use.

For 22.2-24.6 GHz, the plan is to use a HEMT (high electron mobility transistor) amplifier cooled to 15 K. A receiver temperature of 45 K ($T_{\text{sys}} \sim 70$ K under good conditions) is estimated for such a unit, based upon tests of HEMT's obtained under development contracts with Cornell and General Electric. Since HEMT's have not yet been made in production quantities, a fallback position would be to use GASFET's, though this would result in a receiver temperature some 25 K higher.

In the range 42.3-43.5 GHz, it is now proposed to develop an SIS (superconductor/insulator/superconductor) junction mixer, for which a receiver temperature of 40 K may be predicted ($T_{\text{sys}} \sim 75$ K under good conditions), as compared to ~ 150 K for a cooled GASFET amplifier. Various junction materials will be investigated.

Cryogenics Technology, Inc. Model 22 refrigerators (1-watt capacity) have been chosen to cool most of the front-ends for the VLBA receivers because of their small size and weight. Four such units are under test at Green Bank to establish reliability figures for these units. One of these units has accumulated about 3500 hours thus far. Some past failures at NRAO have cast doubt that these units are as reliable as the older CTI 350 (3-watt capacity), but CTI expects to achieve 10,000 hours MTBF by improving tolerances and inspections. CTI maintenance experience with units in their West Coast area seems to show this figure can be achieved.

A flexible local oscillator (LO) arrangement is being developed to serve all the VLBA receiver channels. A major element, a synthesizer that provides 2 to 16 GHz in 0.1 GHz steps, has been breadboarded but not fully tested. Phase stability of the comb generator section has been found adequate against variations in temperature and drive level--a preliminary indication of acceptable performance.

Development of frequency converter modules is in progress in the NRAO Central Electronics Lab.

In the data-recording system area, work has ceased on developing a system based upon multiple video cassette recorders. With the longitudinal system, a recording density of over 10 megabits per square inch has been demonstrated in actual VLBI operations, using a 40-micron track width on tape 25 microns thick. Initial laboratory record/playback tests using Haystack-built heads giving 20-micron track width have yielded satisfactory signal-to-noise ratios and bit error rates. To optimize S/N, additional tests are planned in which the number of turns on the fluxor cores is varied. Tests of thinner (20 micron) tape are also promising. Samples of tape 15 microns thick will be received and tested shortly.

Although plans have called for the use of a somewhat modified Mark III recording format, additional features and changes have been proposed by NRAO, and certain design choices remain. Examples include number of levels of quantization, sample encoding method, error detection approach, channel-to-track assignment and switching method, and record and playback speeds. Design goals include acceptably small losses in system sensitivity, reliability, ease of operation and maintenance and acceptably efficient use of tape. A meeting is scheduled for early January at which many, if not all, of these issues will be resolved.

In the correlator area, the subcontract with Caltech was signed and approved early this quarter.

Caltech reports that the review of specifications and architecture are proceeding in parallel and on schedule. In the absence of final specifications, Caltech has assumed a set of working specs in order to make progress on the architecture. An in-depth design review is planned for mid-January during which many questions affecting not only the correlator, but the data recording/playback systems and the post-processing should be resolved.

The original VLSI custom correlator chip design effort at JPL yielded a chip that did not meet performance specs, and the effort was dropped. Five other options were considered, from which it was decided to start the development of a gate array chip based on 3-micron CMOS technology, a standard process that does not press the state of the art. However, a semi-custom chip being developed for the Australia Telescope (AT) will shortly be delivered in prototype quantities. Should it offer adequate capability with some cost savings, the gate array development could be dropped.

Tasks for the near future include analysis of proposed interconnection schemes, finalizing of specs, completing of most of the architectural design, and planning of software development. Two NRAO people will assist in the last area.

In the area of data processing, the bulk of the software needed for the normal processing of astronomical data from the VLBA are currently available and are in routine production use. There are three general areas in which development is needed: (1) the interface to the correlator and monitor data base, (2) calibration and editing of correlator output, and (3) geometric analysis of the data, i.e., for astrometry and geodesy.

(1) The interface between the correlator and the data-processing system will be the archived correlator output medium (magnetic tape or optical disk) with information written in a standard data interchange format (FITS). The information to be written on this tape is now mostly specified. Some details remain to be settled. Significant progress has been made on an improved data averaging scheme which could greatly reduce the bulk of the data archived.

(2) Most of the general system-level features of the calibration and editing package have been specified and work has begun on the database interface routines. Application software must await completion of the system-level hardware.

(3) The requirements of geometric observations are being included in the work described for the previous two sections.

PERSONNEL

New Hires

Neil E.B. Killeen	Research Associate	11/05
Juan M. Uson	Assistant Scientist	11/16
John H. Simonetti	Research Associate	12/05

Rehires

Anthony R. Kerr	Scientist	11/05
Gerritt L. Verschuur	Visiting Associate Scientist	11/13

Terminations

Althea Wilkinson	Visiting Associate Scientist	10/12
Peter N. Wilkinson	Visiting Associate Scientist	10/12
Gustaef van Moorsel	Systems Scientist	11/30
Jerzy Machalski	Visiting Scientist	12/17
Hans R. De Ruiter	Visiting Assistant Scientist	12/07
Franklin H. Briggs	Visiting Associate Scientist	12/31

Changes in Status

Hein Hvatum	to Acting Director	10/01
Morton S. Roberts	to Senior Scientist	10/01

APPENDIX I.

PUBLICATIONS AUTHORED BY NRAO STAFF MEMBERS
OR BASED ON OBSERVATIONS OBTAINED ON NRAO TELESCOPES DURING 1984

AUTHOR (S)	TITLE	AUTHOR (S)	TITLE
ABBOTT, D.C.; BIEGING, J.H. CHURCHWELL, E.	Observations of Nonthermal Radio Emission from Early-Type Stars	BARTHEL, P.D.; WILEY, G.K. SCHILIZZI, R.T.; PREUSS, E.	Compact Radio Corps in Extended Quasars
ALTSCHULER, D.R.; BRODERICK, J.J. CONDON, J.J.; DENNISON, B. ET AL	Multifrequency Light Curves of Low-Frequency Variable Radio Sources	BARVAINIS, R.; CLEMENS, D.P.	A Search for SiO Masers in Orion-Like Regions
ANDREWS, M.D.; BASART, J.P. LAUB, R.C.	Observations of the Radio Source G6.6-0.1 Positionally Coincident with the W28 SNR	BASTIEN, P.; BATRLA, W. HENKEL, C.; PAULS, T. ET AL	Formaldehyde Observations of OMC-1
ANTONUCCI, R.R.J.	Extended Radio Emission Associated with Blazars	BAUD, B.; SARGENT, A.I. WERNER, M.W.; BENVELEY, A.F.	Radio and Infrared Observations of OH/IR Stars at the Tangential Point and Near the Galactic Center
ANTONUCCI, R.R.J.; OLSZEWSKI, R.W.	A Possible Class of Obscured Active Nuclei Among the IRAS Infrared Sources	BELL, M.B.; MATTHEWS, H.E.	HC11N IN TMC1
ANTONUCCI, R.R.J.; ULVESTAD, J.S.	Extended Radio Emission Associated with Blazars	BENSON, J.M.; MUEHL, R.L. GAUME, R.A.	High-Angular-Resolution Observations of the OH Masers in W51 (Main)
ARCHER, J.W.	A High Performance, 2.5K Cryostat Incorporating a 100-120 GHz Dual Polarization Receiver	BIEGING, J.H.; COHEN, M.	Multi-frequency Radio Images of L1551 IRS5
ARCHER, J.W.	An Instrument for the Precision Measurement of Attenuation in a Waveguide Network	BIEGING, J.H.; COHEN, M. SCHWARTZ, P.R.	VLA Observations of T Tauri Stars. II. A Luminosity-Limited Survey of Taurus-Auriga
ARCHER, J.W.; CRAWFORD, M.J. JR	A Synthesised 90-120 GHz Signal Source	BIRD, M.K.; WALMSLEY, M. HUCHTMEIER, W.K.; BATRLA, W.	K-Band Radio Line Observations of Comet P/Crommelin
ARCHER, J.W.; FABER, M.T.	A Very Low-Noise Receiver for 80-120 GHz	BIRKINSHAW, M.; DAVIES, R.L.	The Orientations of the Rotation Axes of Radio Galaxies I. Radio Morphologies of Bright Elliptical Galaxies
ARCHER, J.W.; FABER, M.T.	High Output Power 95-116 GHz Frequency Doublers for a 310-350 GHz 6x Multiplier Chain	BOWERS, P.F.; HAGEN, W.	Luminosities and Mass Loss Rates of OH/H2O Maser Stars
ARCHER, J.W.; FABER, M.T.	Low-Noise, Fixed Tuned, Broadband Mixer for 200-270 GHz	BREGMAN, J.W.	Diffusive Shock Acceleration and Quasar Photospheres
APISTRONE, J.T.; BARRETT, A.H.	High-Resolution Surveys of the Sagittarius A Molecular Cloud Complex in Ammonia, Carbon Monoxide, and Isocyanic Acid	BREGMAN, J.W.; GLASSGOLD, A.E. HUGGINS, P.J.; KINNEY, A.L.	X-ray Emission from Red Quasars
APISTRONE, J.T.; HO, P.T.P. BARRETT, A.H.	VLA Observations of Smooth, Rapidly Rotating M33 in the Sgr A "15 km s-1 Cloud"	BRIDLE, A.H.	Phenomenology of Extragalactic Radio Jets
ARNAUD, K.A.; FABIAN, A.C. HAZARD, C.; CONDON, J.J. SARGENT, W.L.W.	An Optically-Selected Sample of X-ray-Quiet QSOs	BRIDLE, A.H.	Menu for an All-Purpose Source Model
		BRIDLE, A.H.	Sidedness, Field Configuration, and Collimation of Extragalactic Radio Jets
		BRIDLE, A.H.; PERLEY, R.A.	Extragalactic Radio Jets

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BROWN, R.L.; LISZT, H.S.	Sagittarius A and Its Environment	D'ADDARIO, L.R.; THOMPSON, A.R.	Complex Cross Correlators with Three-Level Quantization: Design Tolerances
BURNS, J.O.; BASART, J.P.	Radio Jets in Classical Double	SCHWAB, P.R.; GRANLUND, J.	
DE YOUNG, D.S.; GHIGLIA, D.C.	Radio Sources with Strong Cores	DE RIJTER, H.R.; PARMA, P.	The Correlation Between Distortion of Radio Structure and Linear Size in Low Luminosity Radio Galaxies
BURNS, J.O.; NELSON, E.R.	X-ray Emission Possibly Coincident with the Radio Tail of PKS0301-123	DENNISON, B.; BRODERICK, J.J.	The Spectral Evolution of Low-Frequency Variable Radio Sources
WHITE, R.A.; GREGORY, S.A.		O'DELL, S.L.; MITCHELL, K.J. ET AL	
CAMPBELL, B.	VLA Observations of Collimated Outflow at NGC 7538 IRS 1	DICKEL, J.R.; D'ODORICO, S. SILVERMAN, A.	VLA Observations of Three Extragalactic SNR at 20 cm and 6 cm
CAMPBELL, B.	New Radio Sources at AFGL 2591: Young Cluster or Single Star?	DICKEY, J.M.; SALPETER, E.E.	1.4 GHz Continuum Sources in the Hercules Cluster
CERNICHAPO, J.; GUELIN, M. ASKNE, J.	TMC1-Like Cloudlets in HCL2	DOWNES, A.	Observations of the Remnants of Three Historical(?) Supernovae
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CHIRCHWELL, E.; NASH, A. WALMSLEY, C.M.	The Relative Abundances of Cyanogenated Molecules	DREHER, J.W.; JOHNSTON, K.J. WELCH, W.J.; WALKER, R.C.	Ultracompact Structure in the H II Region W49N
CLARK, P.O.; TROLAND, T.H. MILLER, J.S.	Polarization Properties and Time Variations of the SiO Maser Emission of W Hydrae	ENSMAN, L.M.; ULVESTAD, J.S.	Alternating Ejection in Radio-Loud Quasars?
COHEN, M.; BEIGING, J.H. DREHER, J.W.; WELCH, W.J.	The Binary System MWC 349	FABER, M.T.; ARCHER, J.W.	A Very Low-Noise, Fixed-Tuned Mixer for 240-270 GHz
CONDON, J.J.	Cosmological Evolution of Radio Sources	FABER, M.T.; ARCHER, J.W.	A High Efficiency Frequency Doubler for 100 GHz
CORDES, J.M.; WEISBERG, J.M.	Pulsar Space Velocities from Interstellar Scintillations	FABER, M.T.; ARCHER, J.W.	A High Efficiency Frequency Doubler for 100 GHz
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CRUTCHER, R.M.	Optical and Radio Study of the Taurus Molecular Cloud Toward HD 29647	FEIGELSON, E.D.; ISOBE, T. KEMBHAVI, A.	Radio and X-ray Emission in Radio-Selected Quasars
D'ADDARIO, L.R.	An SIS Mixer for 90-120 GHz with Gain and Wide Bandwidth	FEIGELSON, E.D.; MONTMERLE, T.	An Extremely Variable Radio Star in the Rho Ophiuchi Cloud

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FELLI, M.; STAUDE, R.J. REDDMANN, T.; MASSI, M. ET AL	High Spatial Resolution Observations of S 106 from $\lambda = 0.6$ micron to $\lambda = 1.3$ cm. A Wind Model for the Bipolar Nebula	GREENFIELD, P.E.; ROBERTS, D.H. BURKE, B.P.	The Gravitationally Lensed Quasar 0957+561: VLA Observations and Mass Models
FERRETTI, L.; GIOIA, I.M. GIUVANNINI, G.; GREGORINI, L. PADOIELLI, L.	High Resolution Radio and X-ray Observations of A115	GUSTEN, R.; WALISLEY, C.M. UNGERECHTS, H.; CHURCHWELL, R.	Temperature Determinations in the Galactic Center Molecular Clouds
FEY, A.L.; SPANGLER, S.R. MUTEL, R.L.; BENSON, J.M.	22.2 GHz Observations of the Radio Source 0552 + 398 (DA 193)	HAMILTON, A.J.S.; SASLAW, W.C. THUAN, T.X.	Thermodynamics and Galaxy Clustering: Analysis of the CfA Catalog
FIX, J.D.; MUTEL, R.L.	A Search for 018H Maser Emission from 3351.8 - 0.5	HASCHICK, A.D.; BAAN, W.A.	Extragalactic High Velocity Clouds: VLA Observations of the Broad Neutral Hydrogen Absorption in the Radio Galaxy 3C293
FOMALONT, E.B.; GOSS, W.M. LYNE, A.G.; MANCHESTER, R.N.	Radio and Infrared Observations of Optically Invisible Type II Hydroxyl Masers	HASCHICK, A.D.; BAAN, W.A.	A Superluminous Water Vapour Maser Source in NGC 3079
FOMALONT, E.B.; KELLERMAN, K.I. WALL, J.V.; WEISTROP, D.	Astrometry of 59 Pulsars: A Comparison of Interferometric and Timing Positions	HASCHICK, A.D.; HO, P.T.P.	Formation of OB Clusters: CO, NH ₃ and H ₂ O Observations of the Distant HII Region Complex in S128
FULKERSON, S.A.; CLARK, F.D.	A Deep 6-Centimeter Radio Source Survey	HAYLEN, R.J.	National Radio Astronomy Observatory Annual Report, July 1983-June 1984
GARAY, G.; REID, M.J. MOPAN, J.M.	The Gas Density Gradient for Three Dark Interstellar Clouds	HECKMAN, T.M.; VAN BREUGEL, W.J.M. MILEY, G.K.	Emission-line Gas Associated with the Radio Lobes of the High-Luminosity Radio Source 3C 171
GAZZI, G.; TARENGHI, M. JAFPE, W.; BUTCHER, H. ROSENBERG, A.	Compact H II Regions: Hydrogen Recombination and OH Maser Lines	HEESCHEN, D.S.	Plickering of Extragalactic Radio Sources
GEIDZAHLER, B.J.; FOMALONT, E.B.	Radio and Optical Investigation of UGC 6697 in Abell 1367	HEWKE, C.; WILSON, T.L. JOHNSTON, K.J.	Ammonia Absorption Toward NGC 7533 IRS 1: 2 Arc Second Observations in the (3,3) Line
GIL, J.	Radio Observations of the Jet in Pomax A	HEPMAN, J.; BAUD, B. HABING, R.J.; WINBERG, A.	VLA Line Observations of OH/IR Stars
GIL, J.; RUDNICKI, W.	A Model of Radio Emission from the Millisecond Pulsar PSR 1937+244	HO, P.T.P.; JACKSON, J.M. BARPITT, A.H.; ARMSTRONG, J.T.	Interactions Between the Continuum Sources in the Galactic Center and Their Immediate Molecular Environment
GORDON, M.A.	A Geometrical Depolarization of Pulsar Radiation	HODGES, M.W.; MUTEL, R.L. PHILLIPS, R.B.	A VLBI Survey of Peaked Spectrum Radio Sources
GOTTESMAN, S.T.; BALL, R. HUTTER, J.H.; HUNTLEY, J.M.	The VLBA: A Telescope of Continental Dimensions	HOGG, D.E.	Resolution of the Radio Source gamma 2 Vel
GOPEP, A.C.; HUTCHINS, J.B.	High-Resolution Observations of the H I Content of the Barrel Spiral Galaxies NGC 3992 and NGC 4731	HOLLIS, J.M.; KAFATOS, M. MICHALITSIANOS, A.G.; MCALISTER, H.	The R Aquarii System at Optical and Radio Wavelengths
	Radio and Optical Morphology of Low-Redshift Quasars		

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HUCHRA, J.: GORENSTEIN, M. KENT, S.: SHAPIRO, I. ET AL	2237+0305: A New and Unusual Gravitational Lens	KEEL, W.C.	The Jet of PKS 0521-36: An Aginy Counterpart of M87?
HUMMEL, E.: KOTANYI, C.G.	50 Galaxies and the Influence of the Gas Content on the Radio Continuum Emission from a Disk Component	KELLERMANN, K.I.	Superluminal Radio Sources
HUMMEL, E.: PEDLAR, A. VAN DER HULST, J.R.: DAVIES, R.D.	A Radio Continuum Survey of the Sbc Spiral Galaxies at 1.465 GHz	KNOKE, J.E.: PARTRIDGE, P.B. RATNER, M.I.: SHAPIRO, I.I.	Limits on Arcsecond-Scale Fluctuations in the Cosmic Microwave Background
HUMMEL, E.: SMITH, P. VAN DER HULST, J.M.	The Large-Scale Radio Continuum Structure of the Edge-On Spiral Galaxy NGC 253	KOTANYI, C.	Radio Continuum Emission in the Virgo Cluster
HUTCHINGS, J.B.: GOWER, A.C.	Evidence for Beamed Radiation from QSOs	KRISS, J.A.: BECKER, R.F. HELFRAND, D.J.: CANIZARES, C.P.	G27.4 + 0.0, A Galactic SNR with a Central Compact Core
IRVINE, W.M.: AND 39 OTHERS	Radioastronomical Observations of Comets IRAS-Araki-Alcock (1983d) and Sugano-Saigusa-Fujikawa (1983e)	KRONBERG, P.P.	Discovery of an Entire Population of Radio Supernova Candidates in the Nucleus of Messier 82
IRVINE, W.M.: SCHLOERB, P.P.	Cyanide and Isocyanide Abundances in the Cold, Dark Cloud TMC-1	KRONBERG, P.P.: BIERMANN, P. SCHWAB, P.R.	The Nucleus of M82 at Radio and X-ray Bands: Discovery of a New Radio Population of Supernova Candidates
JACKSON, J.M.: ARMSTRONG, J.T. BARRETT, A.H.	HCNO in Molecular Clouds	KRUM, W.: BROSCHE, W.	Neutral Hydrogen in Cosmic Voids
JAPPE, D.T.: HILDEBRAND, R.H. KEENE, J.: HARPER, D.A. ET AL	Far-Infrared Selected Star Formation Regions	KULKARNI, S.R.: DICKEY, J.M. HEILES, C.	Measurement of Spin Temperatures in a Rapidly Moving Shell
JAHODA, K.: MCCAMMON, D. DICKEY, J.M.: LOCKMAN, F.J.	High Latitude H I Structure and the Soft X-ray Background	KUNDU, M.R.: GALZANUSKAS, V. WOODGATE, B.E.: SCHMAHL, E.J. ET AL	A Study of Flare Buildup from Simultaneous Observations in Microwave, H alpha and UV Wavelengths
JOHNSTON, K.J.: HENKEL, C. WILSON, T.L.	2 sub 11 -2 sub 12 Formaldehyde Emission from DR21 (OH)	KUTNER, M.L.: WINDY, L. HOWARD, R.J.	Interpretation of Absolute Line Intensities on the NRAO 11 Meter and Other Millimeter Wave Telescopes
JOHNSTON, K.J.: SPENCER, J.H. BOWERS, P.F.	The Circumstellar H2O Waser Emission Associated with Late Type Stars	KWOK, S.: PURTON, C.R. MATTHEWS, H.E.: SPOELSTRA, T.A.M.	Radio Synthesis Observations of M2-9, The Butterfly Nebula
JONES, D.L.	A Search for Changing Structure in Low-Luminosity Compact Radio Sources	LADA, C.J.: THOMPSON, H.A. JR. SMITH, R.A.: SCHWARTZ, P.R. GLACCUM, W.	The Nature of AFGL 2591 and Its Associated Molecular Outflow: Infrared and Millimeter-Wave Observations
JONES, D.L.: BAATH, L.B. DAVIS, M.M.: UNWIN, S.C.	The Sub-milliarsecond Radio Structure of AO 0235+164	LAWRENCE, C.R.: READHEAD, A.C.S. LINFIELD, R.P.: PAYNE, D.G. ET AL	Strong Source VLBI Survey at 22 GHz
JONES, T.W.: RUDNICK, L. ALLER, H.D.: ALLER, M.F. ET AL	Magnetic Field Structures in Active Compact Radio Sources	LEAHY, J.P.: WILLIAMS, A.G.	The Bridges of Classical Double Radio Sources
KEEL, W.C.	A Radio-Quiet Emission-Line Jet in the Type 2 Seyfert Galaxy NGC 7682		

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LESTRADE, J.-F.; PRESTON, R.A. WYLL, A.E.; MUTEL, R.L. PHILLIPS, R.B.	Results of VLBI Observations of Radio Stars and Their Potential for Linking the Hipparcos and Extragalactic Reference Frames	MUTEL, R.-L.; LESTRADE, J.-P. PRESTON, R.A.; NEILL, A.E. ET AL	VLBI Observations of Stellar Binary Systems
LINDBLAD, P.O.; JORSATER, S. SANDQVIST, A.A.	The Nuclear Radio Sources in the Elliptical Galaxies NGC 3309 and NGC 3311 in the Cluster Abel 1060	MUTEL, R.-L.; LESTRADE, J.-P.	Radio Emission from RS CVn Binaries I: VLA Survey and Period-Radio Luminosity Relationship
LISZT, R.S.	Determination of Galactic Spiral Structure at Radiofrequencies	MUTEL, R.-L.; LESTRADE, J.-P. PRESTON, R.A.; PHILLIPS, R.B.	Dual Polarization VLBI Observations of Stellar Binary Systems at 5 GHz
LISZT, H.S.	Determinations of the Molecular Mass of the Galaxy from Observations of CO	NGUYEN-Q-RIEU; BUJARRABAL, V. CLOFFSON, H.; JOHANSSON, L.E.B. TURNER, B.E.	Thermal and Maser Molecular Lines from the Envelope of IRC +10216
LISZT, H.S.; DUKE, R.S. VANDEN BOUT, P.A.	Upper Limits on the O2/CO Ratio in Dense Interstellar Clouds	O'DEA, C.P.	Constraints on the Properties of Bent Beams
LOREN, R.B.; WOOTEN, A. MUNDY, L.G.	The Detection of Interstellar Methyl-Diacetylene	O'DEA, C.P.; DENT, W.A. BALONEK, T.J.	Broadband Spectral Evolution of Outbursts in Extragalactic Radio Sources
LOREN, R.B.; WOOTEN, A. SANDQVIST, A.A.; FRIEBERG, P. HJALMARSON, A.	High Velocity HCO+ in Cep A: Ionization Levels in High Density Clumps Within a Molecular Flow	O'DEA, C.P.; OWEN, F.W.	Polarization Structure of the Jets in NGC 1265
MACHALSKI, J.; CONDON, J.J.	A Complete Sample of Intermediate-Strength Radio Sources Selected from the GB/GB2 1400-MHz Surveys. V. VLA Observations of Very Extended and	PALMER, P.; GARDNER, P.P. WHITESAK, J.B.	OH Maser Emission at 4765 MHz in NGC 7538 (IRS1)
MACHALSKI, J.; CONDON, J.J.	The GB/GB2 Sample of 122 Intermediate-Strength Radio Galaxies	PATNAIK, A.R.; BANHATTI, D.G. SUBRAHMANYA, C.R.	VLA Observations of the Wide-Angle Tailed Radio Source 1313+073
MACLEOD, J.-M.; AVERY, L.W. BROTEN, N.W.	The Detection of Interstellar Methyl-diacetylene (CH3C4H)	PEPLEY, R.A.; DREHER, J.W. COFAN, J.J.	The Jet and Filaments in Cygnus A
MACLEOD, J.-M.; VALLEE, J.P. BROTEN, N.W.	Linear Polarization Observations in Selected Celestial Zones. Gemini and Its Neighbourhood	READHEAD, A.C.S.	A Study of the Imaging Potential of QUASAT
MACCAIDE, J.M.; SHAPIRO, I.I. COPEY, B.E.; CORTON, W.D. ET AL	On the Quasars 1038+528 A and B	REID, M.J.; HO, P.T.P.	GS4.3+0.2: A "Cometary" HII Region
MILLER, J.S.; CLARK, F.C. TROLAND, T.H.	polarization Properties and Time Variations of the SiO Maser Emission of Omicron Ceti (Mira)	REYNOLDS, S.P.	An Evolutionary History for the Crablike, Pulsar-powered Supernova Remnant 0540-693
MOLNAR, L.A.; REID, M.J. SPINDLAY, J.E.	Low Level Radio Flares from Cygnus X-3	ROBERTS, D.H.; GREENFIELD, P.E. HEWITT, J.N.; BURKE, B.F. DUPREE, A.K.	The Multiple Images of the Quasar 0957+561
MUTEL, R.-L.; HODGES, M.W. PHILLIPS, R.B.	The Structure of Three Compact Double Radio Sources at 5 GHz	ROOD, H.J.; WILLIAMS, R.A.	The Intergalactic HI Cloud in Leo: A Simple Modeling of the Spitzer-Baade Collision Event

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RUDNICK, L.; JONES, T.W. ALLER, H.D.; ALLER, M.P. ET AL	Broadband Polarization Observations of Active Compact Radio Sources	SPANGLER, S.R.; MYERS, S.T. POSGE, J.J.	VLA Observations of Radio Galaxies with Extended Lobe Emission: 3C 79 and 3C 430
RUDNICK, L.; SIKKO, M.L. STEIN, W.A.	The Nature of Radio-Quiet OSOs - VLA Observations of 0026+129, 0205+024, and 1351+640	SPAMER, R.A.; PANAGIA, N. WEILER, K.W.	Radio Emission from a Type I Supernova: SN 1983.51 in NGC 5236
SAHAI, R.; WOOTEN, A. CLEGG, R.E.S.	SIS in Circumstellar Shells	STROM, R.J.; ANGERHOFER, R.E. DICKEL, J.R.	A Radio Study of the Flat Spectrum Component in CT9 80
SAIKIA, D.J.; SHASTRI, P. SINHA, R.P.; KAPARI, V.K. SWARUP, G.	Extragalactic Sources with Asymmetric Radio Structure I. Observations of 17 Sources	SWARUP, G.; SINHA, R.P. HILLDRUP, K.	Hotspots and Radio Lobes of Quasars
SAIKIA, D.J.; SWARUP, G. SINHA, R.P.	Radio Observations of the BL Lac Object 1400 + 162	TAYLOR, A.R.; SEQUIST, E.R.	Radio Emission from Symbiotic Stars: A Binary Model
SANCISI, R.; THONNARD, N. KERS, R.D.	HI Gas Near the Giant Elliptical Galaxy NGC 4472	TAYLOR, A.R.; SEQUIST, E.R. GREGORY, P.C.	High-Resolution Observations of Galactic-Plane Radio Variables
ANDERS, D.B.; SCOVILLE, N.Z. OLOMON, P.M.	Giant Molecular Clouds in the Galaxy. II. Characteristics of Discrete Features	THOMSON, H.A. JR.; SCHWARTZ, P.R. SMITH, H.A.; LADA, C.J. ET AL	W3 North: Far-Infrared and Radio Molecular Observations
CHMITT, J.H.M.M.; REID, M.J.	VLBI Observations of the Nucleus of M87 at Two Epochs	THOMSON, E.A. JR; LADA, C.J.	A Search for High-Velocity Carbon Monosulfide Emission in Star-Forming Regions
CHWAB, P.R.	Relating the Isoplanatism Assumption in Self-Calibration; Applications to Low-Frequency Radio Interferometry	THUAN, T.X.; WINDHORST, R.A. PUSCHELL, J.J.; ISACHAN, R.B. OWEN, F.N.	Near-Infrared Photometry of Paint Radio Galaxies in Selected Areas
CHWARTZ, P.R.; SIMON, T. UCKERMAN, B.; DYCK, H.M. OWELL, R.R.	The T Tauri Radio Source	TORPELLES, J.M.; HO, P.T.P. RODRIGUEZ, L.F.; CANTO, J.	VLA Observations of Ammonia and Continuum in Regions with High Velocity Gaseous Outflows
CHWARTZ, P.R.; THOMSON, H.A. DENWALD, S.F.; GLACCUH, W. ET AL	Active Star Formation in NGC2264	TURNER, B.E.	VLA Observations of OH in Galaxies. I. NGC 253 and Its Nuclear Plume
IMON, R.S.; JOHNSTON, K.J. PENCER, J.H.	A 0.25 Arcsecond Jet in the Quasar 3C446	TURNER, B.E.	How Stars Form: A Synthesis of Modern Ideas
ITKO, M.L.; RUDNICK, L. JONES, T.W.; SCHMIDT, G.D.	Optical and Radio Polarimetry of the Quasar 0846+513	ULRICH, M.-H.; MEIER, D.L.	5-GHz Observations of Cores in Extended Radio Galaxies
KILLMAN, E.D.	Spatial Variations in the Physical Conditions in the Giant Extragalactic H II Region NGC 5471	ULVESTAD, J.S.	The Radio Structure and Host Galaxy of 3C 459
NELL, R.L.; BALLY, J. TROM, S.E.; STROM, K.M.	Radio and Optical Observations of the Jets from L1551 IRS-5	ULVESTAD, J.S.; WILSON, A.S.	Radio Structures of Seyfert Galaxies. VI. VLA Observations of a Nearby Sample
		UNWIN, S.C.; COHEN, M.H. BIRETTA, J.A.; PEARSON, T.J. ET AL	VLBI Monitoring of the Superluminal Quasar 3C 273, 1977-1982

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VAN BREUGAL, W.: FILIPPENKO, A.V. HECKMAN, T.: MILEY, G.	Minkowski's Object: A Starburst Triggered by a Radio Jet	WYNN-WILLIAMS, C.G.: BECKLIN, E.E.;	The Infrared and Radio Morphology of the "Hot-Spot" Galaxy NGC 2903
VAN BREUGEL, W.: MILEY, G. HECKMAN, T.: BUTCHER, H. BRIDLE, A.	Optical Emission-Line Gas Associated with the Radio Source 3C 277.3	YOUNG, J.S.: SCOVILLE, N.Z.	Molecular Clouds in M82
VAN GORKOM, J.: KOTANYI, C.	Neutral Hydrogen Observations at the VLA	YUSEP-ZADEH, P.: MORRIS, M. CHANCE, D.	Large, Highly Organized Radio Structures Near the Galactic Center
VAN GORKOM, J.H.: SCHWARZ, U.J. BREGMAN, J.D.	Recombination-Line Observations of the Galactic Center	ZENUS, J.A.: HOUGH, D.H. POPCAS, R.W.	Milliarcsecond Structure in the Core of the Quasar 3C263
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