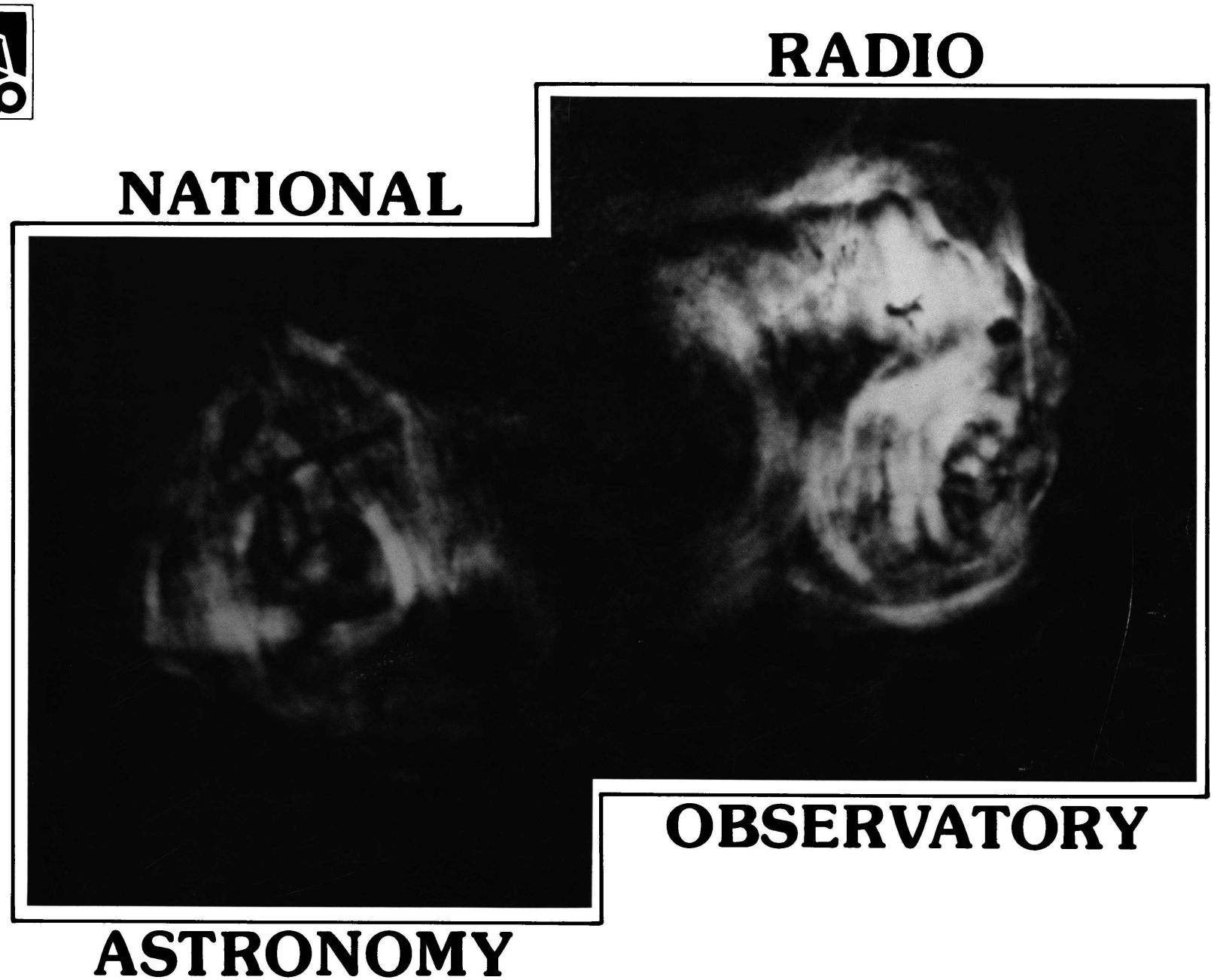

OBSERVING SUMMARY - 1988 STATISTICS

February 1989

Cover: The Polarized Radio Emission from Fornax A

The cover photograph is a VLA image of the linearly polarized radio emission from the radio galaxy Fornax A. The two main radio emitting lobes are produced by radiating electrons in magnetic fields which have been transported hundreds of thousands of light years from the elliptical galaxy NGC 1316 which lies between the two regions. The isolated, dark features are caused by the obscuration of the polarized emission by foreground material. The small elliptical "shadow" on the right is associated with a foreground spiral galaxy which depolarizes the radiation passing through it. But the "ant-like" feature in the center of the right lobe and the long dark features which are particularly prominent in the left lobe are not associated with luminous material.

Observation details:

Observers: E. Fomalont and R. Ekers (NRAO), K. Ebneter and W. Van Breugel (U. Calif.)

Frequency of 1.384 GHz. Five hours of D-configuration and five hours of C-configuration

Resolution of 15"; field of view is 40' x 20'

Maximum polarized emission is 15 mJy; rms noise is 0.3 mJy

NATIONAL RADIO ASTRONOMY OBSERVATORY

Observing Summary 1988 Statistics

February 1989

SOME HIGHLIGHTS OF THE 1988 RESEARCH PROGRAM

- Two-epoch VLA measurements were used to detect superluminal motion on kiloparsec scales in the 3C 120 radio jet. VLBI measurements had previously established superluminal motions within a few parsecs of the core. The new VLA observations, however, offer the first evidence that relativistic motions in jets exist to a considerable distance from the core.

- Atomic hydrogen (HI) was detected for the first time in S0 galaxies with the 300-ft telescope. The gas content of galaxies increases with type, from early to late. HI is an excellent tracer of this gas. Previous attempts to detect HI from S0 galaxies have been unsuccessful, but the steadily improved sensitivity of the 300-ft finally made the small amounts of gas present in these galaxies detectable. Fifty percent of the 32 S0 galaxies searched were detected. As a result, quantitative information now exists about the percentage of a galaxy's mass that is gas, which includes the earliest galaxy types. Thus, for the 300-ft telescope, 100 percent of Sb, Sc, and Irregular galaxies are detectable in HI, 75 percent of Sa's, and 50 percent of S0's.

- The VLA aperture synthesis radar technique that was preliminarily used on Saturn in 1987 was fully exploited on Mars, near opposition in 1988. X-band imaging of the planet was successfully carried out in less than one hour. At least five distinct geologic regions on Mars show anomalously strong diffusely scattered echo power.

- Carbon monoxide emission has been detected at the 12-m telescope at unprecedented redshifts. This is made possible by the high-performance receivers that reach sensitivities and frequency bands not previously available on a routine basis. CO emission has been detected from the distant quasar Mrk 1014 and the powerful radio galaxy Perseus A (3C 84). Large amounts of molecular gas are indicated in these objects. This gas may provide the fuel for the high luminosity output of quasars, thus explaining one of the chief enigmas of modern astronomy.

- A new interstellar radical, the cyanomethyl radical (CH_2CN), has been found with the 140-ft telescope in a spectral survey of cold, dark clouds, and in the galactic center. It is the heaviest radical yet found in space. The initial transition found, at 20.1 GHz, has been followed up in an international cooperation at other telescopes, at 40, 80, and 100 GHz. A comparison of the distribution of CH_2CN with that of methyl cyanide (CH_3CN) is underway to determine if certain chemical reactions, key to the formation of the long carbon-chain species, actually operate in space.

- VLA participation in the IAU International Solar Month resulted in the most comprehensive and detailed view of microwave emission from active regions yet obtained. The ultra high dynamic range images show thermal emission from dense, low-lying magnetic loops for the first time. Considerable time variation of the detailed emission from active regions was also apparent.

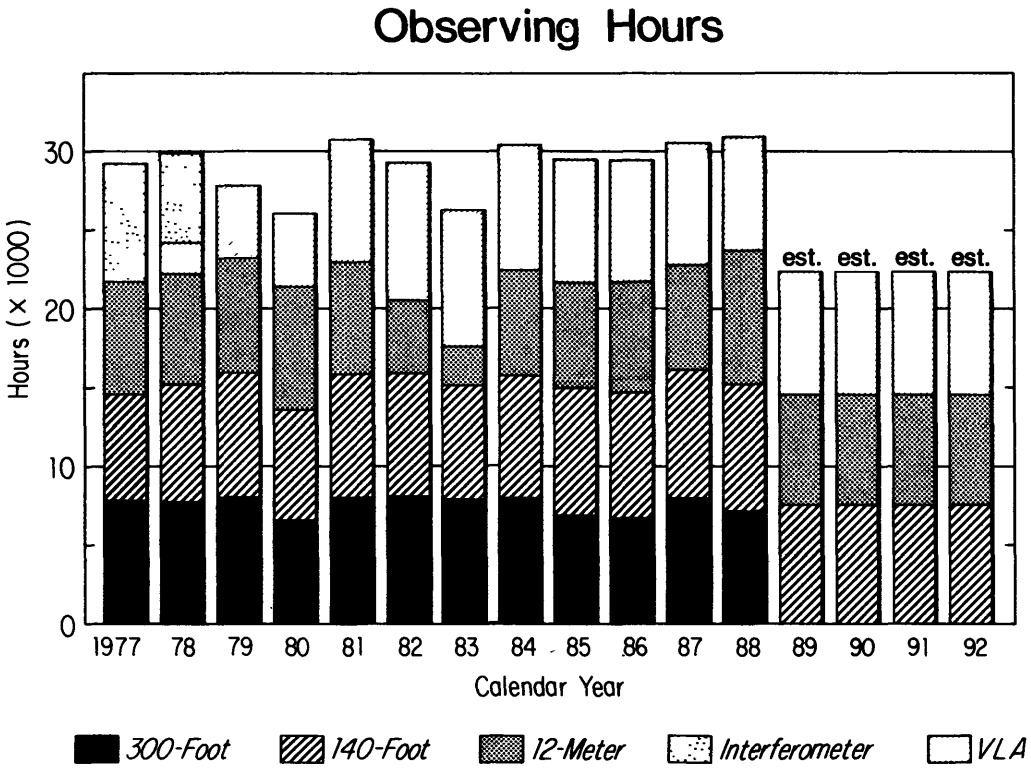

Fig. 1. This figure shows the hours scheduled for observing on each telescope during the last decade.

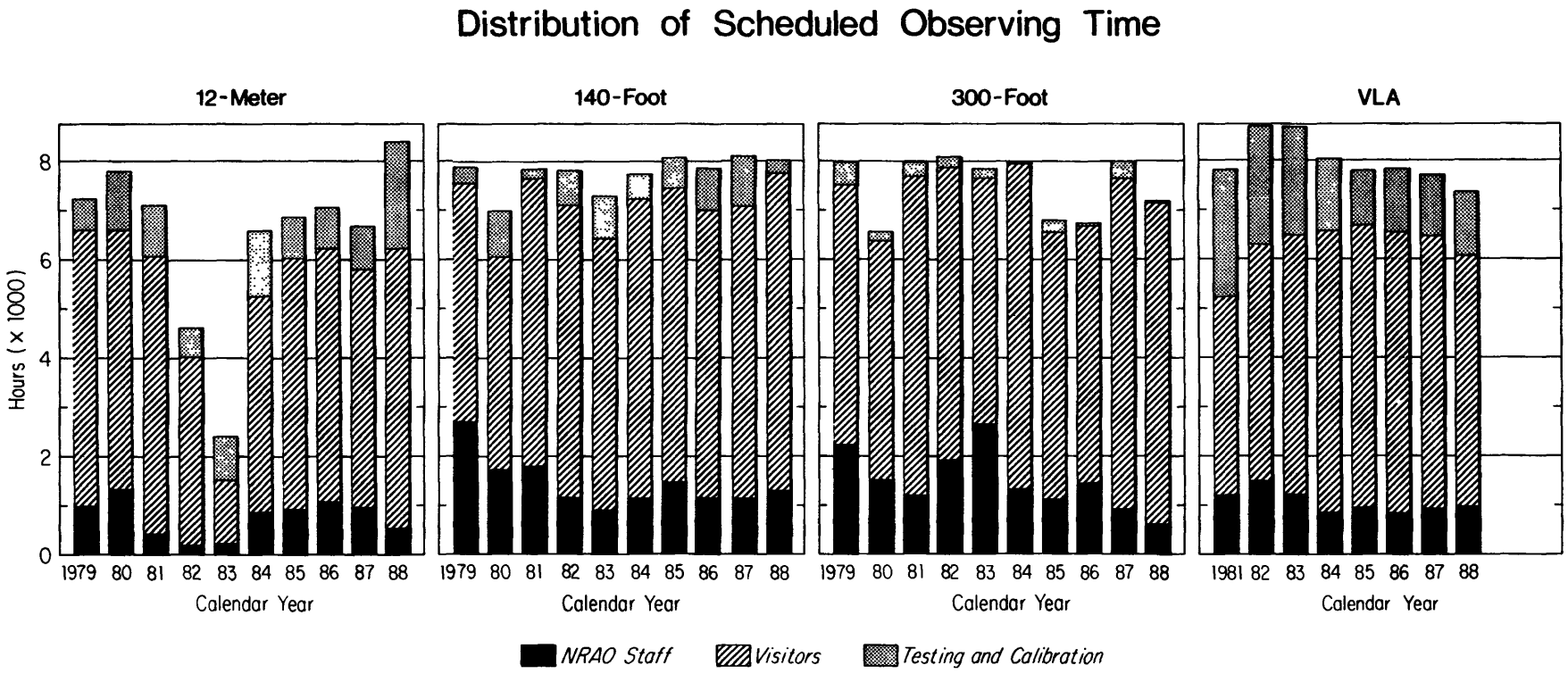

Fig. 2. These graphs show the number of hours scheduled for calibration and for observing by the NRAO staff and by visitors on each telescope system during the last decade.

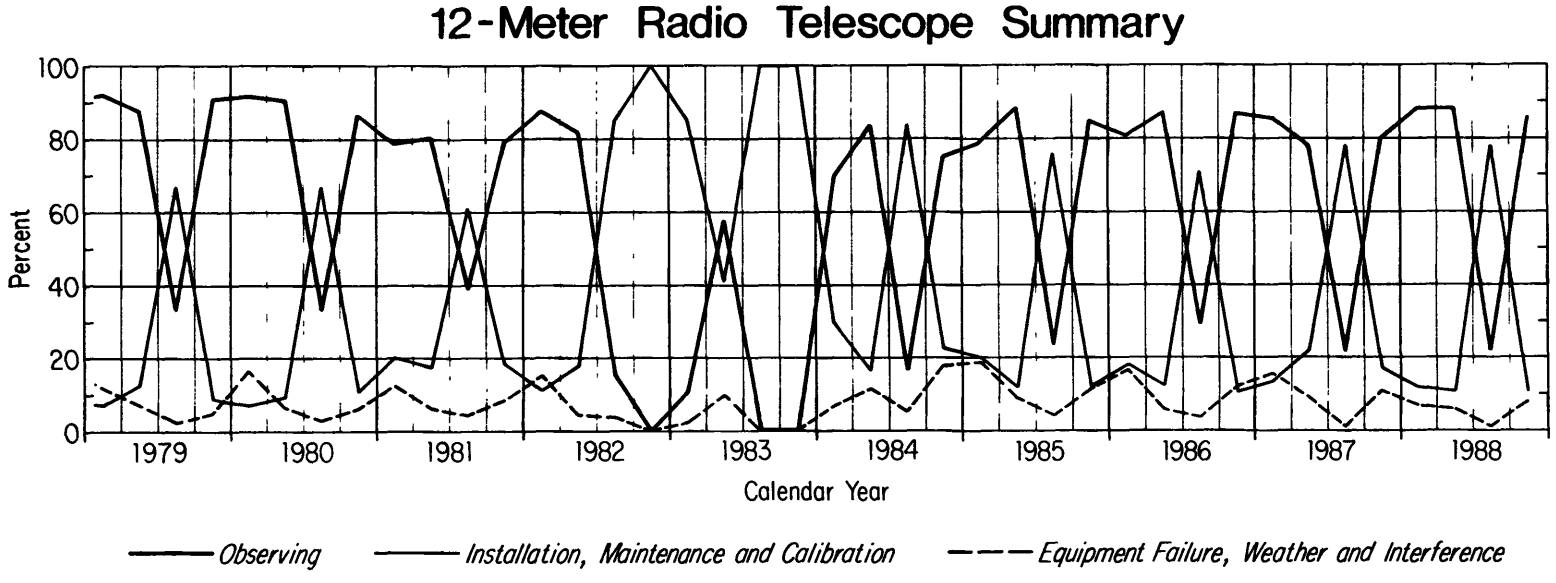

Fig. 3. This summary for each quarter of the calendar year shows the percentage of time the telescope was scheduled for observing, for routine calibration, maintenance, and installation of new experiments, and the percentage of time lost due to equipment failure, bad weather, and radio interference. The telescope is removed from service for a period of 4-6 weeks each summer during the wet season. This period is used for maintenance and upgrading of the instrument. During the last half of 1982 and most of 1983 the telescope was out of service for the replacement of the reflecting surface and its backup structure.

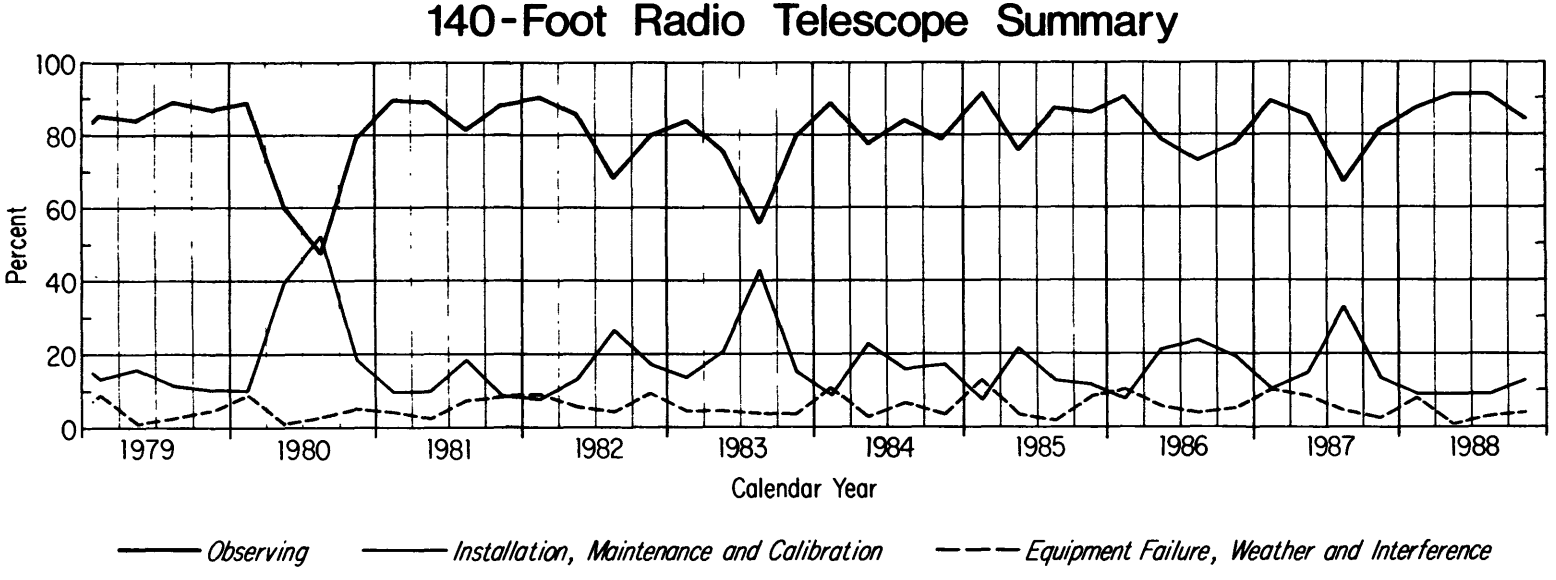

Fig. 4. This summary for each quarter of the calendar year shows the percentage of time the telescope was scheduled for observing, for routine calibration, maintenance, and installation of new experiments, and the percentage of time lost due to equipment failure, bad weather, and radio interference. Major improvements to the telescope system include: 1980 - installation of the Model IV autocorrelation receiver; 1982 - beam efficiency and pointing tests at 1.3 cm; 1983 - brake overhaul and installation of the second channel of the upconverter/maser receiver; 1987 - holographic surface tests and panel readjustments.

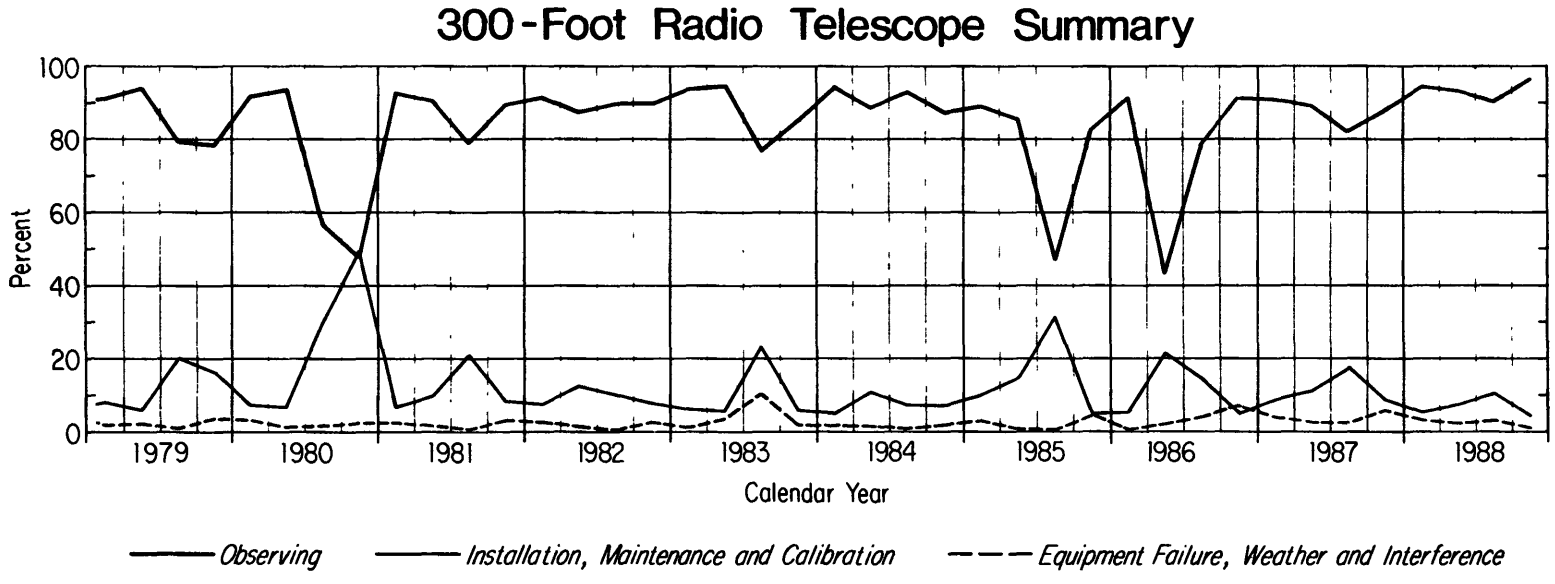

Fig. 5. This summer for each quarter of the calendar year shows the percentage of time the telescope was scheduled for observing, for routine calibration, maintenance, and installation of new experiments, and the percentage of time lost due to equipment failure, bad weather, and radio interference. During 1980 a new traveling feed was installed, in 1983 cables were replaced and the telescope was painted, during 1985 N-S motion was added to the traveling feed; and in 1986 a new 6 cm, seven-feed receiver was installed and tested.

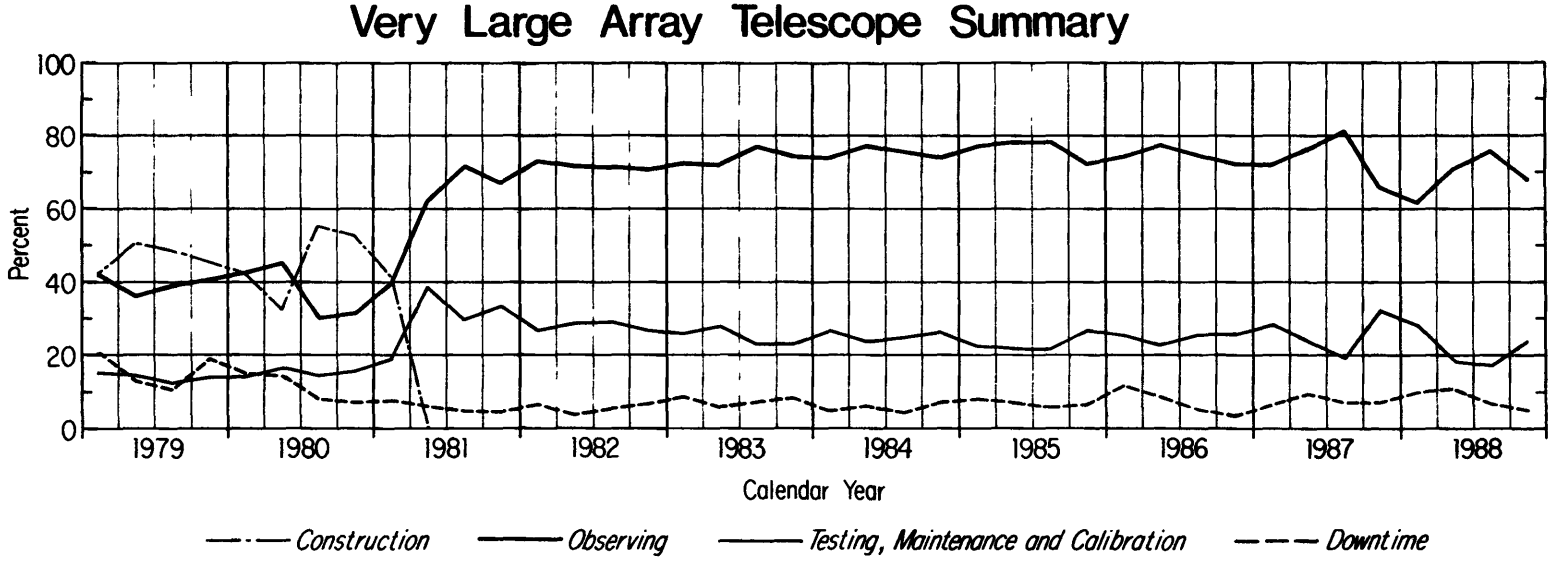

Fig. 6. This summary for each quarter of the calendar year shows the percentage of time the telescope was scheduled for observing, for routine system testing, maintenance, and calibration and the percentage of time lost due to hardware or software failure, power failure, or bad weather. During 1977 and 1978 no distinction was made between astronomical and test observing. Time scheduled for completion of the construction was reduced to zero after the first quarter of 1981.

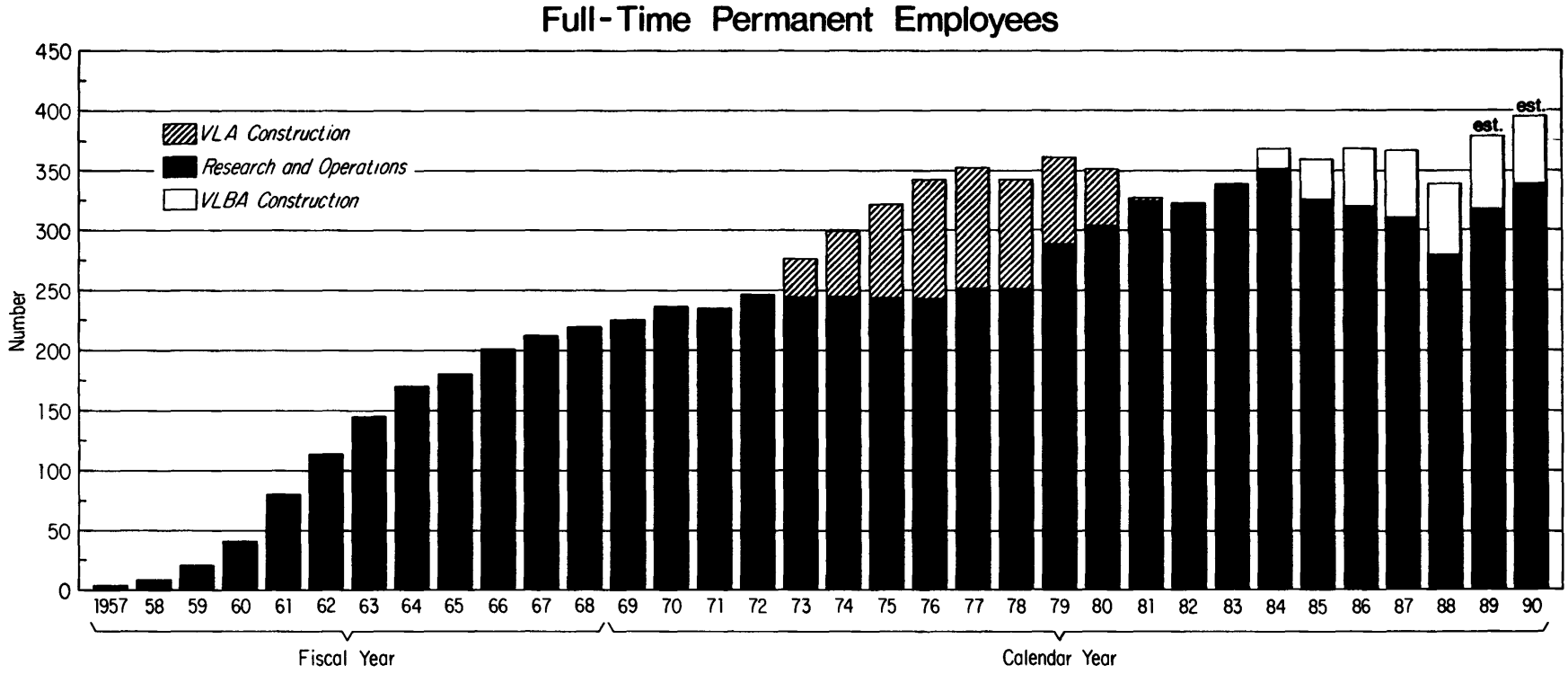

Fig. 7. This figure shows the total number of NRAO full-time, permanent employees at the end of each year, projected into the future.

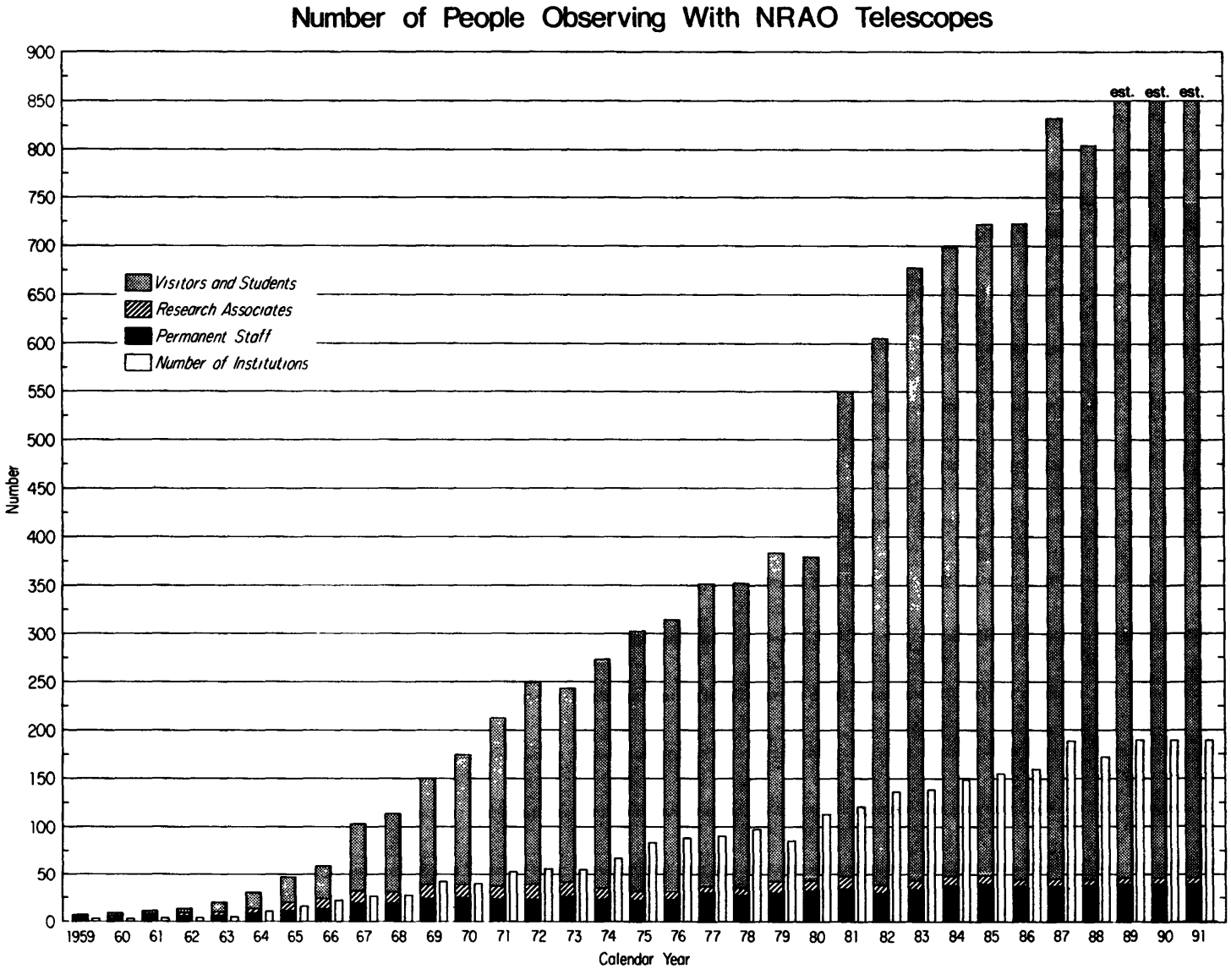

Fig. 8. This bar chart shows for each calendar year the number of NRAO permanent research staff and the number of research associates who use the telescopes. In addition, it shows the total number of visitor-users of NRAO telescopes and the number of institutions from which the NRAO visitors come. The significant jump in these last two categories for 1981 reflects the increased use of the VLA.

DISTRIBUTION OF TELESCOPE TIME BY PERCENT

	12-m	140-ft	300-ft	VLA	1988 Summary
Visitors	56%	69%	72%	51%	62%
Students	9%	4%	12%	7%	8%
Permanent Staff	6%	14%	8%	8%	9%
Research Associates	0%	1%	0%	3%	1%
Tests and Calibration	25%	3%	1%	15%	11%
Maintenance and Installation	3%	7%	6%	15%	8%
Holidays and Unscheduled	1%	2%	1%	1%	1%

DISTRIBUTION OF SCHEDULED OBSERVING PROGRAMS IN VARIOUS RESEARCH AREAS, BY PERCENT

		12-m	140-ft	300-ft	VLA	Overall
I.	SOLAR SYSTEM --					
	Sun, Planet, Satellites, and Comets	1%	0%	6%	6%	3%
II.	STELLAR --					
	Pulsars, X-ray Sources, Planetary Nebulae, Circumstellar Shells, Supernova Remnants, Masers, Novae, Supernovae, and Stars	8%	13%	6%	27%	14%
III.	GALACTIC --					
	Galactic Structure, Center, Molecular Clouds, HII Regions, Star Formation, Molecules, and Interstellar Medium	60%	34%	12%	24%	32%
V.	EXTRAGALACTIC --					
	Normal and Active Galaxies, Radio Galaxies, Clusters, Quasars, VLBA Studies, Extra-galactic Molecules, and Cosmology	31%	53%	76%	43%	51%

INSTITUTIONS FROM WHICH VISITORS CAME TO USE NRAO TELESCOPES DURING 1988

	INSTITUTION	TELESCOPES 140-FT	12-M	300-FT	VLA
1.	Anglo Australian Observatory				x
2.	Amsterdam, U. of - Astronomy Institute				x
3.	Applied Research Corporation		x		
4.	Arcetri Astrophysical Observatory (Italy)		x		x
5.	Arizona, U. of - Steward Obs., L & P Laboratory	x	x	x	x
6.	Arizona State University		x		x
7.	Armagh Observatory (Ireland)				x
8.	Barcelona, U. of (Spain)				x
9.	Beijing Astronomical Observatory (P.R. of China)	x			
10.	Bell Laboratories (New Jersey)	x	x		x
11.	Bologna, U. of (Italy)	x			x
12.	Bonn U. (FRG)				x
13.	Bordeaux Observatory (France)		x		x
14.	Boston U.	x			x
15.	Brandeis University	x			x
16.	British Columbia, U. of (Canada)		x	x	x
17.	Brookhaven National Laboratories	x			
18.	Calgary, U. of (Canada)				x
19.	California, U. of, Davis				x
20.	California, U. of, Berkeley - Hat Creek Obs.	x	x	x	x

	INSTITUTION	TELESCOPES 140-FT	12-M	300-FT	VLA
21.	California, U. of, Irvine		x		
22.	California, U. of, L.A.	x	x		x
23.	Caltech - OVRA, Mt. Palomar	x	x	x	x
24.	Cambridge University - Cavendish, Mullard, IOA	x	x		x
25.	Carleton College				x
26.	CFA (Harvard + SAO)	x	x		x
27.	CNRS, France (CEN, Saclay)				x
28.	CNPq - Observatorio Nacional (Brazil)	x		x	
29.	Chalmers-Onsala Space Observatory (Sweden)	x			x
30.	Chicago, U. of - Yerkes Observatory	x			x
31.	Chile, U. of				x
32.	CSIR (Johannesburg, South Africa)	x			x
33.	Colgate University		x	x	
34.	Cologne, U. of				x
35.	Colorado, U. of - JILA (Boulder)	x	x	x	x
36.	Columbia University				x
37.	Copernicus U. - Torun Observatory (Poland)				x
38.	Cornell University	x		x	x
39.	CSIRO (Australia)	x	x		x
40.	Dartmouth College				x

	INSTITUTION	TELESCOPES 140-FT	12-M	300-FT	VLA
41.	DAO (Dominion Astrophysical Observatory)				x
42.	DRAO (Dominion Radio Astrophysical Observatory)		x		x
43.	Delaware, U. of				x
44.	Delft University of Technology (Netherlands)				x
45.	DSRI, Denmark				x
46.	Ecole Normale Superieure (Paris)	x	x		
47.	ESO (European Southern Observatory - FRG, Chile)	x	x		x
48.	Georgia, U. of				x
49.	George Mason University				x
50.	Grenoble, U. of		x		x
51.	Groningen, U. of - Kapteyn Lab				x
52.	Hamburger Sternwarte (FRG)				x
53.	Haverford College		x		x
54.	Hawaii, U. of - Institute of Astronomy		x	x	x
55.	Haystack Observatory - NEROC	x	x		x
56.	Heidelberg Observatory				x
57.	Hofstra University	x	x		
58.	IAR, Buenos Aires (Argentina)				x
59.	IAS-Frascati (Italy)				x
60.	Illinois, U. of - Vermillion River Observatory	x	x		x

	INSTITUTION	TELESCOPES 140-FT	12-M	300-FT	VLA
61.	Imperial College (London)				x
62.	Institute of Astrophysics (Granada)	x			
63.	Institute for A & A Andalucia				x
64.	Interferometrics, Inc.	x			x
65.	Iowa. U. of	x			x
66.	Iowa State University				x
67.	IPAC, Pasadena		x		x
68.	IRAM (France, Spain)	x			x
69.	Itapetinga Observatory (Brazil)	x	x		x
70.	Johns Hopkins University		x		x
71.	JPL - Goldstone	x			x
72.	Kent, U. of (U.K.)		x		x
73.	Kentucky, U. of	x			x
74.	Krakow, U. of (Poland)				x
75.	Leiden, U. of - Huygens Labs.	x	x		x
76.	Lille, U. de (France)	x	x		
77.	Lockhead Research Laboratory				x
78.	Los Alamos Scientific Laboratory (LANL)	x			x
79.	Louisiana State University				x
80.	Lowell Observatory		x		

	INSTITUTION	TELESCOPES 140-FT	12-M	300-FT	VLA
81.	Maine, U. of				x
82.	Manchester, U. of - Jodrell, Nuffield	x			x
83.	Marseille Observatory				x
84.	Maryland, U. of - Clark Lake Observatory		x	x	x
85.	Massachusetts, U. of - Five College Observatory	x	x	x	x
86.	Meudon Observatory	x	x		x
87.	Mexico, U. of - Institute of Astronomy				x
88.	Michigan State University				x
89.	Michigan, U. of	x	x	x	x
90.	Middleburg College				x
91.	Milano (Italy)				x
92.	Minnesota, U. of	x			x
93.	Missouri, U. of (at St. Louis)		x		x
94.	MIT - Lincoln Laboratories	x		x	x
95.	Monash University (Australia)	x			
96.	Montreal, U. of				x
97.	MPI (Heidelburg, FRG)				x
98.	MPIR (Bonn, FRG)	x	x	x	x
99.	MPIfEP, Garching (FRG)		x		
100.	Mt. Stromlo Observatory (Australia)	x		x	x

	INSTITUTION	TELESCOPES 140-FT	12-M	300-FT	VLA
101.	Mt. Wilson & Las Campanas - Carnegie				x
102.	NAIC - Arecibo Observatory	x	x	x	x
103.	Nagoya University (Japan)		x		x
104.	Nanjing Observatory				x
105.	NASA, Ames		x		
106.	NASA/GSFC - Goddard	x	x	x	x
107.	NASA/MSFC - Huntsville				x
108.	NBS (National Bureau of Standards)		x		
109.	NFRA (Netherlands Found. for Radio Astronomy)	x		x	x
110.	NMINT (New Mexico Inst. of Mining Technology)		x		x
111.	New Mexico, U. of				x
112.	New York University		x		
113.	Nobeyama Observatory (Japan)	x			x
114.	Nigeria, U. of	x			x
115.	North Carolina State University				x
116.	Northwestern University		x		
117.	NRC - Algonquin, Herzberg	x	x		
118.	NRL (Naval Research Laboratories)	x	x	x	x
119.	Ohio State University				x
120.	Oklahoma, U. of				x

	INSTITUTION	TELESCOPES 140-FT	12-M	300-FT	VLA
121.	Oregon, U. of				x
122.	Oxford University (U.K.)	x			x
123.	Padova Observatory (Italy)				x
124.	Paris Observatory		x		x
125.	Peking Observatory				x
126.	Penn State University				x
127.	Pennsylvania, U. of				x
128.	Pittsburgh, U. of - Allegheny Observatory	x			x
129.	Preston/Lancashire Polytechnic (U.K.)				x
130.	Princeton University - Inst. Advanced Studies	x			x
131.	Puerto Rico University				x
132.	Queen Mary College (U.K.)				x
133.	Queens University (Canada)				x
134.	Raman Institute (India)	x			x
135.	Rensselaer Polytechnic Institute		x		x
136.	Rice University				x
137.	Rikkyo University (Japan)				x
138.	Rochester, U. of				x
139.	Royal Greenwich Observatory (U.K.)				x
140.	Royal Observatory - UKIRT (Scotland)	x			x

	INSTITUTION	TELESCOPES 140-FT	12-M	300-FT	VLA
141.	Sandia Laboratories		x		
142.	San Diego State University	x			
143.	SERC, Rutherford Appleton Lab. (U.K.)				x
144.	Solar Physics Research Corporation				x
145.	Space Telescope Science Institute	x	x	x	x
146.	Starburst Foundation				x
147.	SUNY (all campi)				x
148.	SFIT - Swiss Federal Institute of Technology				x
149.	Sydney, U. of (Australia)			x	x
150.	Systems & Applied Science Corporation				x
151.	Tata Institute - TIFR, RAC (India)				x
152.	Tel-Aviv University - Wise Observatory				x
153.	Texas, U. of - McDonald Observatory	x	x		x
154.	Tokyo University - Tokyo Astronomical Observatory				x
155.	Toronto, U. of - David Dunlap Observatory	x			x
156.	Trieste Astronomical Observatory (ISAS)				x
157.	Tufts University				x
158.	University College London				x
159.	USNA - United States Naval Academy	x			
160.	USNO - United States Naval Observatory				x

INSTITUTION	TELESCOPES 140-FT	12-M	300-FT	VLA
161. Utrecht, U. of - Astronomical Inst. (Netherlands)				x
162. Utsunomiya University (Japan)				x
163. Victoria, U. of (Canada)				x
164. Virginia, U. of	x	x	x	x
165. VPI & SU	x		x	
166. Warsaw University Observatory (Poland)				x
167. Washington, U. of	x			
168. Waterloo, U. of (Canada)	x	x		x
169. Wellesley College				x
170. Wien Universitat (Austria)				x
171. Wisconsin, U. of - Washburn Observatory	x	x		x
172. Wyoming, U. of		x		x
173. Yale University				x
No. of Institutions	65	58	23	150
No. of Visitors	189	125	38	511
No. of Students	19	27	15	87
No. of Research Associates	1	0	0	6
No. of Permanent Staff	12	10	7	30
Total Observers	211	162	60	634

All told, 761 visitors, including 121 students, from 173 institutions.

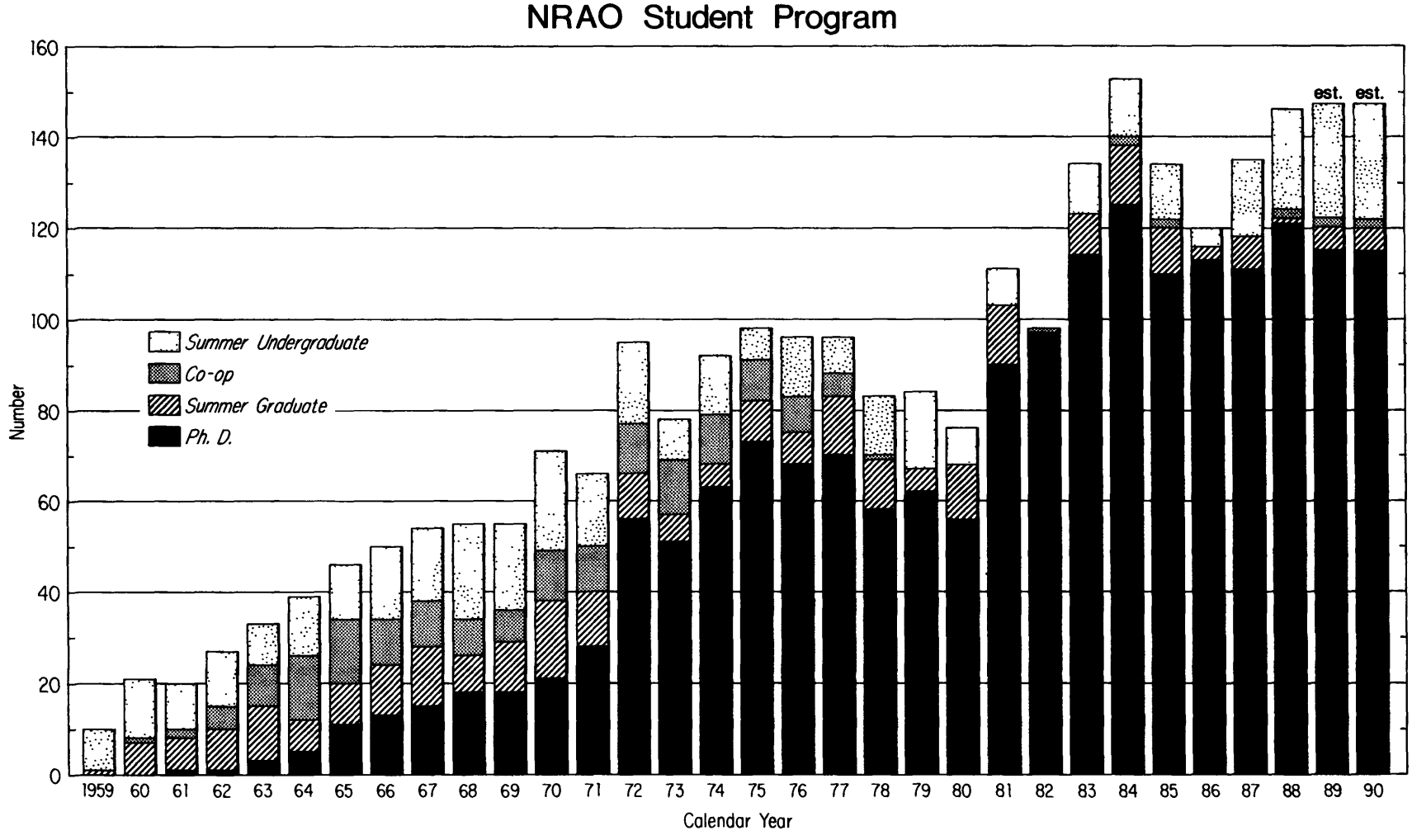

Fig. 9. This figure shows for each calendar year the number of Ph.D. students (salaried and non-salaried), co-op students, and summer undergraduate and graduate students who observed or worked at the NRAO during that year. Beginning in 1987 the majority of the undergraduate summer students were funded by a separate NSF Grant for Research Experience for Undergraduates.

RECEIVER NAME	APPLICABLE TELESCOPE	FREQUENCY (GHz)	AMPLIFIER TYPE	SYSTEM TEMPERATURE (KELVIN)	3 dB BANDWIDTH (MHz)	FEED TYPE	POLARIZATION	CALIBRATION VALUE	SWITCHING SYSTEM	REMARKS	PERSON(S) IN CHARGE
50–250 MHz Rx	140 FT	50–88 MHz	HIGH DYNAMIC RANGE TRANSISTOR DUAL CHANNEL	300 + Tsky	38	OPEN SLEEVE CROSSED DIPOLE	ORTHOGONAL LINEAR OR REMOVABLE QUAD HYBRID AT FEED FOR RCP AND LCP	ADJUSTABLE 2 TO 2500K	DICKE SWITCH: REFERENCE TEMPERATURE ADJUSTABLE FROM 100 TO 100,000K OR FREQUENCY SWITCH	FEED CHANGES FROM 50–88 MHz TO 110–240 MHz OR TO 450–500 MHz REQUIRE TWO HOURS.	COE (OLIVER)
		110–240 MHz			130	BROADBAND CROSSED DIPOLE					
		450–500 MHz	FET AMP	50–80	50	CAVITY BACKED CROSSED DIPOLE	RCP AND LCP		FREQUENCY SWITCH	450–500 MHz AMP IN 50–250 MHz Rx	
300–1000 MHz Rx	140 FT	280–350 MHz	COOLED GASFET AMP DUAL CHANNEL	60–100	70	280–350 350–410 450–500 CAVITY BACKED CROSSED DIPOLES	DUAL ORTHOGONAL LINEAR IF POLARIMETER OR RF HYBRID FOR RCP AND LCP	5K	FREQUENCY SWITCHING	ONE OF THE FIVE FEEDS 280–350 MHz 350–420 MHz 450–500 MHz 500–750 MHz OR 750–1000 MHz CAN BE USED. TO CHANGE FEEDS REQUIRES TWO HOURS.	COE (SHANK)
		350–420 MHz			60						
		450–500 MHz	COOLED GASFET AMP DUAL CHANNEL	50–70	50	500–750 SCALAR WITH CROSSED DIPOLES					
		500–750 MHz			250						
		750–1000 MHz	COOLED GASFET AMP DUAL CHANNEL		250	750–1000 SCALAR WITH CROSSED DIPOLES					
6/25 CM Rx	140 FT	1.00–1.45 (25 CM)	COOLED GASFET DUAL CHANNEL	35–40	450	SINGLE BEAM SCALAR	ORTHOGONAL LINEAR	4K TO 6K	FREQUENCY SWITCHING NOISE ADDING	FEED CHANGE REQUIRED TO SWITCH BANDS TAKES TWO HOURS.	COE (SHANK)
		4.47–5.05 (6 CM)	COOLED GASFET DUAL CHANNEL	50–60	580	SINGLE BEAM	ORTH CIRCULAR OR ORTH LINEAR	1.4K OR 12.8K	OTHER POLARIZATION		
						DUAL BEAM OFFSET 3 HPBW	IDENTICAL OR ORTH CIRCULAR OR IDENTICAL LINEAR		BEAM SWITCHING		
21 CM, 4–FEED Rx	140 FT	1.30–1.50	UNCOOLED GASFET 4 CHANNEL	90–100	200 MAX. 77 MIN.	FOUR HORNS	LINEAR	7K (CAL) 440K NOISE ADD	NOISE ADDING OR FREQUENCY SWITCHING	LINE OR CONTINUUM FROM CONTROL ROOM. RF BANDWIDTH VARIABLE FROM CONTROL ROOM.	BEHRENS (VRABLE)

RECEIVER NAME	APPLICABLE TELESCOPE	FREQUENCY (GHz)	AMPLIFIER TYPE	SYSTEM TEMPERATURE (KELVIN)	3 dB BANDWIDTH (MHz)	FEED TYPE	POLARIZATION	CALIBRATION VALUE	SWITCHING SYSTEM	REMARKS	PERSON(S) IN CHARGE
1.3–1.8 GHz Rx	140 FT	1.30–1.80	DUAL CHANNEL COOLED HEMT	19–25	UP TO 120 FEED LIMITED	THREE 2HE SINGLE BEAM 1.30–1.36 1.36–1.43 1.60–1.72	ORTHOGONAL LINEAR OR CIRCULAR	2K AND 200K	FREQUENCY OR POLARIZATION SWITCHING OR NOISE ADDING	EITHER CIRCULAR OR LINEAR POLARIZATIONS ARE SELECTABLE. CIRCULAR POLARIZATION REQUIRES ADJUSTMENTS FROM THE CONTROL ROOM. BAND CHANGE REQUIRES 2 TO 3 HOURS. OBSERVATIONS OUTSIDE STATED FEED BANDS POSSIBLE AT REDUCED EFFICIENCIES.	NORROD (CHESTNUT)
11 CM, 3–FEED Rx	140 FT	2.64–2.75	UNCOOLED GASFET 4 CHANNEL	130	110 DSB (IF 5–55)	3 HORNS	CIRCULAR OR LINEAR	4K	300 K LOAD OR POLARIZATION OR BEAM	CONTINUUM RECEIVER. ON–AXIS HORN HAS RECEIVERS ON BOTH POLARIZATIONS. FOUR HOURS TO CHANGE POLARIZATION. FIXED LO AT 2.695 GHz.	NORROD (CHESTNUT)
2–5 GHz Rx	140 FT	2.9–3.4	DUAL CHANNEL COOLED FET	38±4	UP TO 250 FEED LIMITED	TWO 2HE SINGLE BEAM 2.90–3.1 3.20–3.4	ORTHOGONAL LINEAR	2K AND 150K	FREQUENCY SWITCHING NOISE ADDING	BAND CHANGE REQUIRES FEED CHANGE. THIS TAKES 2–3 HOURS. FREQUENCY SWITCHING REQUIRES 50 MS BLANKING TIME.	BEHRENS (CHESTNUT)
		4.6–5.0	DUAL CHANNEL COOLED HEMT	EST. 27±1	UP TO 200 FEED LIMITED	ONE 2HE SINGLE BEAM 4.6–4.8	CIRCULAR	3K AND 150K		RECEIVER BAND LIMITED BY 4.6–4.8 GHz FEED. FREQUENCY SWITCHING REQUIRES 50 MS BLANKING TIME.	
6 CM, 7–FEED Rx	140 FT	4.6–5.1	COOLED FET FOURTEEN CHANNEL	60–70	500	7 CORRUGATED HORNS 3 HPBW APART	DUAL CIRCULAR	5K	NONE	CONTINUUM USE ONLY. TOTAL POWER RF DETECTION.	BEHRENS (CHESTNUT)
CASSEGRAIN A AND B RECEIVERS	140 FT	4.7–7.2	UPCONVERTER MASER	30–50	60–300	CASSEGRAIN	FIXED LINEAR CIRCULAR VLB	3–7K	FREQUENCY OR NUTATOR BEAM	FREQUENCY T_{sys} 4.7–4.9 40–50 4.9–6.5 30–40 6.5–7.2 40–50	BROCKWAY (DUNBRACK)
		7.6–11.2	UPCONVERTER MASER	35–80	60–300	CASSEGRAIN	FIXED LINEAR CIRCULAR VLB	3–7K	FREQUENCY OR NUTATOR BEAM	7.6–8.5 50–80 8.5–11.2 35–45	
		12–18.2	UPCONVERTER MASER	50–80	60–300	CASSEGRAIN	FIXED LINEAR	3–7K	FREQUENCY OR NUTATOR BEAM	12.0–18.2 50–80	
		18.2–25.2	MASER	40–70	60–300	CASSEGRAIN	FIXED LINEAR CIRCULAR VLB	2–6K	FREQUENCY OR NUTATOR BEAM	18.2–25.2 40–70	
	NUTATOR	SUBREFLECTOR CORRECTS FOR TELESCOPE ASTIGMATISM AND LATERAL OFFSET. BEAM SPLITTER AVAILABLE ABOVE 8 GHz. NUTATING TRANSITION TIME 50 MILLISECONDS. 5 Hz MAXIMUM FREQUENCY. BEAM SHIFT DIRECTION FIXED. A RECEIVER: 22.5° SOUTH OF EAST. B RECEIVER: 22.5° NORTH OF WEST.							BEAM SHIFT = 0–18 ARC MIN.	FOUR HOURS FOR BAND CHANGE. NOISE ADDING AVAILABLE.	

APPLICABLE TELESCOPE	FREQUENCY (GHz)	AMPLIFIER TYPE	RECEIVER TEMPERATURE (KELVIN)	CONTINUUM SENSITIVITY (JANSKY √SEC)	3 dB BANDWIDTH (MHz)	FEED TYPE	POLARIZATION	CALIBRATION VALUE	SWITCHING SYSTEM	REMARKS	PERSON(S) IN CHARGE
12 M	70–115	COOLED MIXER	260–400 SSB	1.0	600 MHz	HORN–LENS	DUAL LINEAR	10 K	NUTATING SUBREFLECTOR		PAYNE
12 M	90–115	SIS	APPROX. 100	TO BE MEASURED	600 MHz	HORN–LENS	DUAL LINEAR	10 K	NUTATING SUBREFLECTOR		LAMB
12 M	330–360	COOLED MIXER	1400–2000 SSB	12	600 MHz	HORN–LENS	SINGLE LINEAR	–	NUTATING SUBREFLECTOR		PAYNE
12 M	200–270	COOLED MIXER	500–1000 SSB	6 AT 230 GHz	600 MHz	HORN–LENS	DUAL LINEAR	–	NUTATING SUBREFLECTOR	RANGE WILL BE EXTENDED TO 270–300 LATER IN 1987.	PAYNE

APPLICABLE TELESCOPE	FREQUENCY (MHz)	AMPLIFIER TYPE	SYSTEM TEMPERATURE (KELVIN)	3 dB BANDWIDTH (MHz)	FEED TYPE	POLARIZATION	CALIBRATION VALUE	SWITCHING SYSTEM	REMARKS	PERSON(S) IN CHARGE
VLA	308–343	UNCOOLED TRANSISTER	150	3 MHz (LIMITED BY INTERFERENCE)	PRIME FOCUS	DUAL ORTHOGONAL CIRCULAR	10	NOISE INJECTION, 9.6 Hz, 50 PERCENT CYCLE.	ON 21 ANTENNAS AS OF OCTOBER 1988.	LILIE
VLA	1340–1730	COOLED FET	60	55	CASSEGRAIN	DUAL ORTHOGONAL CIRCULAR	4	NOISE INJECTION, 9.6 Hz, 50 PERCENT CYCLE.		LILIE
VLA	4500–5000	COOLED PARAMP OR COOLED PARAMP AND FET	60	55	CASSEGRAIN	DUAL ORTHOGONAL CIRCULAR	4	NOISE INJECTION, 9.6 Hz, 50 PERCENT CYCLE.		LILIE
VLA	8000–8800	COOLED HEMT	35	55	CASSEGRAIN	DUAL ORTHOGONAL CIRCULAR	4	NOISE INJECTION, 9.6 Hz, 50 PERCENT CYCLE.	ON 26 ANTENNAS AS OF OCTOBER 1988.	LILIE
VLA	14400–15400	COOLED FET	110	55	CASSEGRAIN	DUAL ORTHOGONAL CIRCULAR	7	NOISE INJECTION, 9.6 Hz, 50 PERCENT CYCLE.		LILIE
VLA	22000–24000	COOLED MIXER	350	55	CASSEGRAIN	DUAL ORTHOGONAL CIRCULAR	20	NOISE INJECTION, 9.6 Hz, 50 PERCENT CYCLE.		LILIE
VLA	22000–24000	COOLED HEMT	130	55	CASSEGRAIN	DUAL ORTHOGONAL CIRCULAR	10	NOISE INJECTION, 9.6 Hz, 50 PERCENT CYCLE.	ON 22 ANTENNAS AS OF OCTOBER 1988.	LILIE

NRAO - STAFF AND VISITOR PUBLICATIONS 1988

Alef, W.; Gotz, M. M. A.; Preuss, E. and K. I. Kellermann. "Structural Changes in the Nucleus of the Double Radio Galaxy 3C 390.3." Astron. Astrophys., 192, 53-56, 1988.

Alef, W.; Preuss, E., Kellermann, K. I.; Whyborn, N.; and Wilkinson, P. N. "Structural Variability in the Core of 3C147." IAU Symp., 129, 95-96, 1988.

Anatharamaiah, K. R. and Narayan, R. "The Origin of Scattering in the Inner Galaxy." In: Radio Wave Scattering in the Interstellar Medium. Ed. J. M. Cordes, B. J. Rickett, and D. C. Backer. (New York: American Institute of Physics, 1988) 185-189.

Anatharamaiah, K. R.; Payne, H. E.; and Erickson, W. C. "Detection of Carbon Recombination Lines below 100 MHz Towards the Galactic Centre and M16." Mon. Not. Roy. Astron. Soc., 235, 151-160, 1988.

Andre, P.; Montmerle, T.; Feigelson, E. D.; Stine, P. C., and Klein, K. L. "A Young Radio-Emitting Magnetic B Star in the Rho Ophiuchi Cloud." Astrophys. J., 335, 940-952, 1988.

Antonucci, R. R. J. and Barvainis, R. "The Cores of Lobe-Dominated Quasars." Astrophys. J., 325, L21-L23, 1988.

Antonucci, R. and Barvainis, R. "Excess 2 Centimeter Emission: A New Continuum Component in the Spectra of Radio-Quiet Quasars." Astrophys. J., 332, L13-L17, 1988.

Antonucci, R. R. J. and Ulvestad, J. S. "A Large Family of Compact Radio Sources in the Starburst Nucleus of NGC 253." Astrophys. J., 330, L97-L100, 1988.

Bajaja, E.; Dettmar, R.-J.; Hummel, E.; and Wielebinski, R. "The Large-Scale Radio Continuum Structure of the Sombrero Galaxy (NGC 4594)." Astron. Astrophys., 202, 35-40, 1988.

Barthel, P. D. and Miley, G. K. "Evolution of Radio Structure in Quasars: A New Probe of Protogalaxies?" Nature, 333, 319-325, 1988.

Barthel, P. D.; Miley, G. K.; Schilizzi, R. T. ; and Lonsdale, C. J. "Observations of the Large Scale Radio Structure in High Redshift Quasars." Astron. Astrophys. Suppl., 73, 515-547, 1988.

Barthel, P. D.; Pearson, T. J.; and Readhead, A. C. S. "3C 216 - A New Type of Superluminal Quasar." Astrophys. J., 329, L51-L55, 1988.

Barvainis, R.; Clemens, D. P.; and Leach, R. "Polarimetry at 1.3 mm Using MILLIPOL: Methods and Preliminary Results for Orion." Astron. J., 95, 510-515, 1988.

Bastian, T. S.; Dulk, G. A.; and Chanmugam, G. "Radio Flares From AE Aquarii: A Low-Power Analog to Cygnus X-3?" Astrophys. J., 324, 431-440, 1988.

Bastian, T. S.; Dulk, G. A.; and Slee, O. B. "A Search for Radio Emission From Flare Stars in the Pleiades." Astron. J., 95, 794-803, 1988.

Baudry, A.; Diamond, P. J.; Booth, R. S.; Graham, D.; and Walmsley, C. M. "First VLBI Synthesis Observations of the Excited-State OH Emission Sources at 4765 MHz in W3(OH)." Astron. Astrophys., 201, 105-112, 1988.

Baum, S. A.; Heckman, T.; Bridle, A.; van Breugel, W.; and Miley, G. "Extended Optical-Line-Emitting Gas in Radio Galaxies: Broad-Band Optical, Narrow-Band Optical, and Radio Imaging of a Representational Sample." Astrophys. J. Suppl. Ser., 68, 643-714, 1988.

Becker, R. H. and Helfand, D. J. "A Search for Shells Around Crabs." IAU Colloq., 101, 335-338, 1988.

Becker, R. F. and White, R. L. "LkHα 101: The Stellar Wind, the Surrounding Nebula, and an Associated Radio Star Cluster." Astrophys. J., 324, 893-898, 1988.

Bell, M. B.; Avery, L. W.; Matthews, H. E.; Feldman, P. A.; Watson, J. K. G.; Madden, S. C.; and Irvine, W. M. "A Study of C_3HD in Cold Interstellar Clouds." Astrophys. J., 326, 924-930, 1988.

Bell, M. B. and Seaquist, E. R. "Detection of C_3H_2 Emission in the Radio Galaxy Centaurus A (=NGC 5128)." Astrophys. J., 329, L17-L20, 1988.

Benn, C. R.; Grueff, G.; Vigotti, M.; and Wall, J. V. "A Deep Radio and Optical Survey Near the North Galactic Pole - IV. VLA Observations and Optical Identifications of 5C12 Sources." Mon. Not. Roy. Astron. Soc., 230, 1-53, 1988.

Benson, J. M.; Walker, R. C.; Muxlow, T. W. B.; Wilkinson, P. N.; Booth, R.; Pilbratt, G.; and Unwin, S. C. "High Dynamic Range VLBI Observations of the 3C120 Radio Jet." IAU Symp., 129, 31-32, 1988.

Benson, J. M.; Walker, R. C.; Unwin, S. C.; Muxlow, T. W. B.; Wilkinson, P. N.; Booth, R. S.; Pilbratt, G.; and Simon, R. S. "VLBI and MERLIN Observations of 3C 120 at 1.7 GHz: Superluminal Motions Beyond 0".05." Astrophys. J., 334, 560-572, 1988.

Berge, G. L.; Muhleman, D. O.; and Linfield, R. P. "Very Large Array Observations of Uranus at 2.0 cm." Astron. J., 96, 388-395, 1988.

Bignell, R. C.; Simard-Normandin, M.; and Vallee, J. P. "Linear Polarization Observations in Selected Celestial Zones: The Central Region of Our Galaxy." Astrophys. J., Suppl. Ser., 67, 279-282, 1988.

Blitz, L.; Magnani, L.; and Wandel, A. "Broad-Wing Molecular Lines Without Internal Energy Sources." Astrophys. J., 331, L127-L130, 1988.

Boisse, P.; Dickey, J. M.; Kazes, I.; and Bergeron, J. "A 21 cm Study of Some QSR/Galaxy Pairs." Astron. Astrophys., 191, 193-200, 1988.

Bowers, P. F. and Johnston, K. J. "Envelope Structure of the Mira Variable U Orionis." Astrophys. J., 330, 339-349, 1988.

Bowers, P. F. and Knapp, G. R. "Detection of H I Emission in the Circumstellar Envelope of Omicron Ceti (Mira)." Astrophys. J., 332, 299-304, 1988.

Braun, R. "The Dominant Interactions Between SNR and the ISM." IAU Colloq., 101, 227-230, 1988.

Bregman, J. N. "BL Lacertae Objects: A Comparison of X-ray Variability to Variability in Different Wavelengths." In: Variability of Galactic and Extragalactic X-ray Sources. Ed. A. Treves. (Milano: Associazione per l'Avanzamento dell'Astronomia, 1988) 15-28.

Bregman, J. N. "Continuum Properties and Rapid Variability in BL Lac Objects and Violently Variable Quasars." In: Supermassive Black Holes. Ed. M. Kafatos. (Cambridge: Cambridge University Press, 1988) 43-54.

Bregman, J. N. "A Theoretical Understanding of Hot Gas Around Galaxies." In: Hot Thin Plasmas in Astrophysics. Ed. R. Pallavicini. (Dordrecht: Kluwer, 1988) 247-260.

Bregman, J. N. and David, L. P. "Alternative Cooling Flow Models." In: Cooling Flows in Clusters and Galaxies. Ed. A. C. Fabian. (Dordrecht: Kluwer, 1988) 41-46.

Bregman, J. N. and David, L. P. "Heat Conduction in Cooling Flows." Astrophys. J., 326, 639-644, 1988.

Bregman, J. N. and Hogg, D. E. "A Search for CO Emission in Cooling Flows." Astron. J., 96, 455-457, 1988.

Bregman, J. N.; Glassgold, A. E.; Huggins, P. J.; Kinney, A. L.; McHardy, I.; Webb, J. R.; Pollock, J. T.; Leacock, R. J.; Smith, A. G.; Pica, A. J.; Aller, H. D.; Aller, M. F.; Hodge, P. E.; Miller, J. S.; Stephens, S. A.; Dent, W. A.; Balonek, T. J.; Barvainis, R.; Neugebauer, G.; Impey, C. D.; Soifer, B. T.; Mattews, K.; Elias, J. H.; and Wisniewski, W. Z. "Multifrequency Observation of the Optically Violent Variable Quasar 3C 446." Astrophys. J., 331, 746-763, 1988.

Bregman, J. N.; Roberts, M. S.; and Giovanelli, R. "H I in Cooling Flow Ellipticals." In: Cooling Flows in Clusters and Galaxies. Ed. A. C. Fabian. (Dordrecht: Kluwer, 1988) 373-374.

Bregman, J. N.; Roberts, M. S.; and Giovanelli, R. "H I in Giant Elliptical Galaxies With Cooling Flows." Astrophys. J., 330, L93-L96, 1988.

Bridle, A. H. "Large Scale Radio Structures." In: Active Galactic Nuclei. Ed. H. R. Miller and P. J. Wiita. (New York: Springer, 1988) 329-343.

Brinks, E. and Klein, U. "Dark Matter in the Dwarf Galaxy II Zwicky 40." Mon. Not. Roy. Astron. Soc., 231, 63p-67p, 1988.

Brouillet, N.; Baudry, A.; and Combes, F. "The Molecular Content of Messier 81." Astron. Astrophys., 196, L17-L19, 1988.

Brown, L. F. and Roberts, D. H. "Global Fringe Fitting for Polarization VLBI." IAU Symp., 129, 155-156, 1988.

Brown, R. L.; Broderick, J. J.; Johnston, K. J.; Benson, J. M.; Mitchell, K. J.; and Waltman, W. B. "The Size of the z = 0.437 H I Absorption Cloud Toward the QSO 3C 196." Astrophys. J., 329, 138-141, 1988.

Burns, J. O.; Moody, J. W.; and Gregory, S. A. "Radio Sources Associated With Emission-Line Galaxies in the Bootes Void." Astron. J., 95, 668-671, 1988.

Caganoff, S.; Ekers, R. D.; Bicknell, G. V.; and Carter, D. "An Optical and Radio Survey of Southern Radio Galaxies." In: Active Galactic Nuclei. Ed. H. R. Miller and P. J. Wiita. (Berlin: Springer-Verlag, 1988) 137-139.

Caillault, J.-P. "VLA Observations of the X-ray Bright Hyades M-Dwarfs." In: Activity in Cool Star Envelopes. Ed. O. Havnes et al. (Dordrecht: Kluwer, 1988) 289-292.

Caillault, J. P.; Drake, S.; and Florkowski, D. "A VLA Survey of BY Draconis Variables." Astron. J., 95, 887-893, 1988.

Campbell, B. and Persson, S. E. "Images of Star-Forming Regions. III. Sources in the NGC 7538 Molecular Cloud Complex." Astron. J., 95, 1185-1196, 1988.

Carignan, C. and Freeman, K. C. "DDO 145: A 'Dark' Galaxy?", Astrophys. J., 332, L33-L36, 1988.

Carilli, C. L.; Perley, R. A.; and Dreher, J. W. "Discovery of the Bow Shock of Cygnus A." Astrophys. J., 334, L73-L76, 1988.

Chiang, W.-H. and Bregman, J. N. "A Model for the Interaction Between Stars and Gas in the Interstellar Medium." Astrophys. J., 328, 427-439, 1988.

Chiang, W.-H. and Bregman, J. N. "A Model for the Interaction Between Stars and Gas in the Interstellar Medium." IAU Colloq., 101, 91-94, 1988.

Condon, J. J. "Radio Sources and Cosmology." In: Galactic and Extragalactic Radio Astronomy. Ed. G. L. Verschuur and K. I. Kellermann. (New York: Springer-Verlag, 1988) 641-678.

Condon, J. J. and Broderick, J. J. "Radio Identifications of UGC Galaxies: Starbursts and Monsters." Astron. J., 96, 30-61, 1988.

Cornwell, T. J. "A Novel Principle for Optimization of the Instantaneous Fourier Plane Coverage of Correlation Arrays." IEEE Tr. Ant. Prop., AP-36, 1165-1167, 1988.

Cornwell, T. J. "Radio-Interferometric Imaging of Very Large Objects." Astron. Astrophys., 202, 316-321, 1988.

Cornwell, T. J.; Anantharamaiah, K. R.; and Narayan, R. "Spatial Coherence in a Scatter-Broadened Image - Observations of 3C279 Close to the Sun." In: Radio Wave Scattering in the Interstellar Medium. Ed. J. M. Cordes, B. J. Rickett, and D. C. Backer. (New York: American Institute of Physics, 1988) 92-96.

Cornwell, T. J. and Napier, P. J. "The Focal Plane Coherence Function of an Imaging Antenna and Its Use in Measuring And Correcting Aberrations." Radio Sci., 23, 739-748, 1988.

Cowan, J. J.; Henry, R. B. C.; and Branch, D. "Radio and Optical Studies of Supernova 1961V in NGC 1058." Astrophys J., 329, 116-121, 1988.

Crocker, D. A.; Rood, R. T.; and O'Connell, R. W. "Multiple Populations on the Horizontal Branch. I. Observations in the (log g, log T_{eff})-Diagram." Astrophys. J., 332, 236-246, 1988.

D'Addario, L. R. "Saturation of the SIS Mixer by Out-of-Band Signals." IEEE Tr. Micro. Th. Tech., MTT-36, 1103-1105, 1988.

David, L. P. and Bregman, J. N. "Emission From Thermal Instabilities." In: Cooling Flows in Clusters and Galaxies. Ed. A. C. Fabian. (Dordrecht: Kluwer, 1988) 199-204.

David, L. P.; Bregman, J. N.; and Seab, C. G. "The Growth of Thermal Instabilities in Cooling Flows." Astrophys. J., 329, 66-81, 1988.

de Muizon, M.; Strom, R. G.; Oort, M. J. A.; Class, J. J.; and Braun, R. "G70.7+1.2: Supernova, Nova, or Stellar Shell?" Astron. Astrophys., 193, 248-264, 1988.

de Pater, I. and Gulkis, S. "VLA Observations of Uranus at 1.3-20 cm." Icarus, 75, 306-323, 1988.

de Ruiter, H. R.; Parma, P.; Fanti, R.; and Ekers, R. D. "B2 1637+29, A Massive Radio Galaxy Probing a Poor but Gas-Rich Group." Astrophys. J., 329, 225-231, 1988.

del Castillo, E.; Gavazzi, G.; and Jaffe, W. "Radio-Continuum Survey of the Coma/A1367 Supercluster. IV. 1.4 GHz Observations of CGCG Galaxies." Astron. J., 95, 1340-1353, 1988.

DePoy, D. L.; Wynn-Williams, C. G.; Hill, G. J.; and Becklin, E. E. "IRAS 17138-1017: A Highly Obscured Luminous Starburst Galaxy." Astron. J., 95, 398-407, 1988.

Dewey, R. J.; Taylor, J. H.; Maguire, C. M.; and Stokes, G. H. "Period Derivatives and Improved Parameters for 66 Pulsars." Astrophys. J., 332, 762-769, 1988.

Diamond, P. J. "Observations of Cosmic Masers." IAU Symp., 129, 213-222, 1988.

Diamond, P. J. "W43A: A Maverick Maser Source." IAU Symp., 129, 249-250, 1988.

Diamond, P. J.; Martinson, A.; Dennison, B.; Booth, R. S.; and Winnberg, A. "Preliminary Results From a 7 Station VLBI Survey of OH Masers in the Galactic Plane." In: Radio Wave Scattering in the Interstellar Medium. Ed. J. M. Cordes, B. J. Rickett, and D. C. Backer. (New York: American Institute of Physics, 1988) 195-198.

Dickel, J. R.; Sault, R.; Arendt, R. G.; Matsui, Y,; and Korista, K. T. "The Evolution of the Radio Emission From Kepler's Supernova Remnant." Astrophys. J., 330, 254-263, 1988.

Dickey, J. M. and Brinks, E. "An HI Absorption Line Survey of Messier 31." Mon. Not. Roy. Astron. Soc., 233, 781-790, 1988.

Djorgovski, S.; Spinrad, H.; McCarthy, P.; Dickinson, M.; van Breugel, W.; and Strom, R. G. "Identifications and Redshifts of Faint 3CR Radio Sources." Astron. J., 96, 836-840, 1988.

Duric, N. "VLA Observations of SNRs in M33." IAU Colloq., 101, 289-292, 1988.

Duric, N. and Dittmar, M. R. "The Discovery of a Population of Compact Radio Sources in the Spiral Galaxy NGC 4736." Astrophys. J., 332, L67-L70, 1988.

Duric, N. and Gregory, P. C. "VLA Structure of Variable Radio Sources in the Galactic Plane." Astron. J., 95, 1149-1158, 1988.

Duric, N. and Seaquist, E. R. "A Nuclear, Disk-Focused Wind and the Bipolar Structure of the Spiral Galaxy NGC 3079." Astrophys. J., 326, 574-587, 1988.

Eales, S. A.; Wynn-William, C. G.; and Beichman, C. A. "The Radio Properties of Galaxies With High Far-Infrared Luminosities." Astrophys. J., 328, 530-551, 1988.

Emerson, D. T. and Grave, R. "The Reduction of Scanning Noise in Raster Scanned Data." Astron. Astrophys., 190, 353-358, 1988.

Fanti, C.; Fanti, R; Parma, P.; Nan, R.; Schilizzi, R. T.; Spencer, R. E.; van Breugel, W. J. M.; and Venturi, T. "The Radio Structure of Compact Steep Spectrum Radio Sources." IAU Symp., 129, 111-114, 1988.

Feretti, L. and Giovannini, G. "NGC 6047: Radio Source Interaction With the Environment." Astron. Astrophys., 191, 21-28, 1988.

Fey, A. L.; Spangler, S. R.; and Mutel, R. L. "VLBI Angular Broadening Measurements in the Cygnus Region." In: Radio Wave Scattering the Interstellar Medium. Ed. J. M. Cordes, B. J. Rickett, and D. C. Backer. (New York: American Institute of Physics, 1988) 190-194.

Fich, M. "Extinction and Metal Abundances in the Outer Galaxy." In: The Outer Galaxy. Ed. L. Blitz and F. J. Lockman. (New York: Springer-Verlag, 1988) 187-191.

Fleck, R. C. Jr. "The Mechanical Equilibrium of Interstellar Clouds: Scaling Relations for Gas Density, Line Width, and Magnetic Field Strength." Astrophys. J., 328, 299-303, 1988.

Fomalont, E. B. "The VLB Array: A New Geophysical Tool." IAU Symp., 128, 445-451, 1988.

Fomalont, E. B.; Kellermann, K. I.; Anderson, M. C.; Weistrop, D.; Wall, J. V.; Windhorst, R. A.; and Kristian, J. A. "New Limits to Fluctuations in the Cosmic Background Radiation at 4.86 GHz Between 12 and 60 Arcsecond Resolution." Astron J., 96, 1187-1191, 1988.

Foster, R. S.; Backer, D. C.; Taylor, J. H.; and Goss, W. M. "Period Derivative of the Millisecond Pulsar in Globular Cluster M28." Astrophys. J., 326, L13-L15, 1988.

Gabuzda, D. C.; Roberts, D. H.; Wardle, J. F. C.; and Brown, L. F. "Millarcsecond Polarization Properties of Several BL Lacertae Objects." IAU Symp., 129, 167-168, 1988.

Garcia, M. R.; Grindlay, J. E.; Molnar, L. A.; Stella, L.; White, N. E.; and Seaquist, E. R. "Simultaneous X-ray and Radio Observations of GX 13+1." Astrophys. J., 328, 552-558, 1988.

Garcia-Barreto, J. A.; Burke, B. F.; Reid, M. J.; Moran, J. M.; Haschick, A. D.; and Schilizzi, R. T. "Magnetic Field Structure of the Star-Forming Region W3(OH): VLBI Spectral Line Results." Astrophys. J., 326, 954-966, 1988.

Garrington, S. T. "The Depolarization of Radio Sources by Cluster Gas." In: Cooling Flows in Clusters and Galaxies. Ed. A. C. Fabian. (Dordrecht: Kluwer, 1988) 209-213.

Garrington, S. T.; Leahy, J. P.; Conway, R. G.; and Laing, R. A. "A Systematic Asymmetry in the Polarization Properties of Double Radio Sources With One Jet." Nature, 331, 147-149, 1988.

Garwood, R. W.; Perley, R. A.; Dickey, J. M.; and Murray, M. A. "A VLA Snapshot Continuum Survey of the First Quadrant of the Galactic Plane at 1.5 GHz." Astron. J., 96, 1655-1670, 1988.

Gary, D. E. and Zirin, H. "Microwave Structure of the Quiet Sun." Astrophys. J., 329, 991-1001, 1988.

Gaume, R. A. "The Ground State Hydroxyl Masers Associated With OH 340.78-0.10." IAU Symp., 129, 251-252, 1988.

Gear, W. K.; Robson, E. I.; and Griffin, M. J. "Millimetre and Submillimetre Observations of the Emission From Dust in Compact H II Regions." Mon. Not. Roy. Astron. Soc., 231, 55p-62p, 1988.

Gilmore, G. and Roberts, M. S. "The Stellar Luminosity Function and Its Derivative the Initial Mass Function: Are They Universal?" Comments Astrophys., 12, 123-129, 1988.

Giovanelli, R. and Haynes, M. P. "Results of the Pisces-Perseus HI Redshift Survey." IAU Symp., 130, 113-120, 1988.

Gordon, M. A. "The Continuum Spectra of Warm Cloud Complexes Associated With Radio-Bright H II Regions." Astrophys. J., 331, 509-522, 1988.

Gordon, M. A. "H II Regions and Radio Recombination Lines." In: Galactic and Extragalactic Radio Astronomy. Ed. G. L. Verschuur and K. I. Kellermann. (New York: Springer-Verlag, 1988) 37-94.

Gorenstein, M. V.; Cohen, N. L.; Shapiro, I. I.; Rogers, A. E. E.; Bonometti, R. J.; Falco, E. E.; Bartel, N.; and Marcaide, J. M. "VLBI Observations of the Gravitational Lens System 0957+561: Structure and Relative Magnification of the A and B Images." Astrophys. J., 334, 42-58, 1988.

Goss, W. M.; Kalberla, P. M. W.; and Schwarz, U. J. "KI Associated With Cas A." IAU Colloq., 101, 239-243, 1988.

Goss, W. M.; Kulkarni, S. R.; and Lyne, A. G. "Radio Synthesis Observations of the Globular Cluster M4." Nature, 332, 47-49, 1988.

Green, D. A.; Gull, S. F.; Tan, S. M.; and Simon, A. J. B. "G11.2-0.3, an Evolved Cassiopeia A." Mon. Not. Roy. Astron. Soc., 231, 735-738, 1988.

Gregorini, L; Padrielli, L.; Parma, P.; and Gilmore, G. "Radio Galaxies of Intermediate Strength I. VLA Observations." Astron. Astrophys. Suppl., 74, 107-126, 1988.

Grosbol, P.; Harten, R. H.; Greisen, E. W.; and Wells, D. C. "Generalized Extensions and Blocking Factors for FITS." Astron. Astrophys. Suppl., 73, 359-364, 1988.

Guhathakurta, P.; van Gorkom, J. H.; Kotanyi, C. G.; and Balkowski, C. "A VLA H I Survey of the Virgo Cluster Spirals. II. Rotation Curves." Astron. J., 96, 851-866, 1988.

Guilloteau, S.; Forveille, T.; Baudry, A.; Despois, D.; and Goss, W. M. "H_2CO and Excited OH Toward G 10.6-0.4: Another Rotating Disk?" Astron. Astrophys., 202, 189-202, 1988.

Gwinn, C. R.; Cordes, J. M.; Bartel, N.; Wolszczan, A.; and Mutel, R. L. "VLBI Observations of a Pulsar's Scattering Disk." Astrophys. J., 334, L13-L16, 1988.

Gwinn, C. R.; Cordes, J. M.; Bartel, N.; Wolszczan, A.; and Mutel, R. "VLBI Observations of the Scattering Disk of Pulsar 1933+16." In: Radio Wave Scattering in the Interstellar Medium. Ed. J. M. Cordes, B. J. Rickett, and D. C. Backer. (New York: American Institute of Physics, 1988) 106-110.

Gwinn, C. R.; Moran, J. M.; and Reid, M. J. "Interstellar Scattering of Radiation From H_2O Masers in W49 and Sgr B2." In: Radio Wave Scattering in the Interstellar Medium. Ed. J. M. Cordes, B. J. Rickett, and D. C. Backer. (New York: American Institute of Physics, 1988) 129-133.

Gwinn, C. R.; Moran, J. M.; Reid, M. J.; and Schneps, M. H. "Limits on Refractive Interstellar Scattering of H_2O Masers." IAU Symp., 129, 295-296, 1988.

Gwinn, C. R.; Moran, J. M.; Reid, M. J.; and Schneps, M. H. "Limits on Refractive Interstellar Scattering Toward Sagittarius B2." Astrophys. J., 330, 817-827, 1988.

Habbal, S. R. and Harvey, K. L. "Simultaneous Observations of 20 Centimeter Bright Points and He I 10830 Å Dark Points in the Quiet Sun." Astrophys. J., 326, 988-996, 1988.

Haniff, C. A.; Wilson, A. S.; and Ward, M. J. "High-Resolution Emission-Line Imaging of Seyfert Galaxies. I. Observations." Astrophys. J., 334, 104-120, 1988.

Hardee, P. E.; Owen, F. N.; and Cornwell, T. J. "VLA Observation of the M87 Jet and Small Scale Jet Structures." In: Active Galctic Nuclei. Ed. H. R. Miller and P. J. Wiita. (Berlin: Springer-Verlag, 1988) 347-352.

Harris, D. E.; Dewdney, P. E.; Costain, C. H.; McHardy, I.; and Willis, A. G. "An X-ray and Radio Study of Steep Spectrum Radio Sources. I. Four Fields From the Clark Lake Observatory 26 MHz Survey." Astrophys. J., 325, 610-627, 1988.

Harten, R. H.; Grosbol, P.; Greisen, E. W.; and Wells, D. C. "The FITS Tables Extension." Astron. Astrophys. Suppl., 73, 365-372, 1988.

Hawarden, T. G.; Mountain, C. M.; Puxley, P. J.; and Leggett, S. K. "The Role of Bars in Starburst Galaxies." In: Comets to Cosmology. Ed. A. Lawrence. (New York: Springer-Verlag, 1988) 246-252.

Haynes, M. P.; Giovanelli, R.; Starosta, B.; and Magri, C. "A 21 cm Survey of the Pisces-Perseus Supercluster. III. The Region North of +38 Degrees." Astron. J., 95, 607-643, 1988.

Healy, A. P. and Huggins, P. J. "CO in the Bipolar Planetary Nebula NGC 2346." Astron. J., 95, 866-872, 1988.

Heaton, B. D. and Little, L. T. "Twin Beams From a Young B Star?" Astron. Astrophys., 195, 193-197, 1988.

Heflin, M. B.; Gorenstein, M. V.; Falco, E. E.; Shapiro, I. I.; Burke, B. F.; Hewitt, J. N.; Rogers, A. E. E., and Lawrence, C. R. "VLBI Observations of the Gravitational Lens System 2016+112." IAU Symp., 129, 209-210, 1988.

Heiles, C.; Reach, W. T.; and Koo, B.-C. "Molecules, Grains, and Shocks: A Comparison of CO, H I, and IRAS Data." Astrophys. J., 332, 313-327, 1988.

Hermsen, W.; Wilson, T. L.; and Bieging, J. H. "VLA Maps of Ammonia in Orion-KL: Fine-Scale Structure and Geometry." Astron. Astrophys., 201, 276-284, 1988.

Hewitt, J. N.; Turner, E. L.; Schneider, D. P.; Burke, B. F.; Langston, G. I.; and Lawrence, C. R. "Unusual Radio Source MG1131+0456: A Possible Einstein Ring." Nature, 333, 537-540, 1988.

Higdon, J. L. "Neutral Hydrogen Observations of Arp 144." Astrophys. J., 326, 146-156, 1988.

Hill, G. J.; Wynn-Williams, C. G.; Becklin, E. E.; and MacKenty, J. W. "The Nature of the Extended Emission Features in IRAS 04210+0400." Astrophys. J., 335, 93-103, 1988.

Hjellming, R. M. "Radio Stars." In: Galactic and Extragalactic Radio Astronomy. Ed. G. L. Verschuur and K. I. Kellermann. (New York: Springer-Verlag, 1988) 381-438.

Hjellming, R. M.; Calovini, T. A.; and Cordova, F. A. "ASM 2000+25." IAU Circ., 4607, June 7, 1988.

Hjellming, R. M.; Calovini, T. A.; Han, X. H.; and Cordova, F. A. "Transient Radio Emission From the X-ray Nova ASM 2000+25." Astrophys. J., 325, L75-L78, 1988.

Hjellming, R. M. and Johnston, K. J. "Radio Emission From Concical Jets Associated With X-ray Binaries." Astrophys. J., 328, 600-609, 1988.

Houck, J. R.; Hacking, P. B.; and Condon, J. J. "A Very Deep IRAS Survey at the North Ecliptic Pole." In: Comets to Cosmology. Ed. A. Lawrence. (New York: Springer-Verlag, 1988) 340-343.

Huchtmeier, W. K.; Bregman, J. N.; Hogg, D. E.; and Roberts, M. S. "Detection of CO in the Elliptical Galaxy NGC 4472." Astron. Astrophys., 198, L17-L19, 1988.

Huggins, P. J.; Olofsson, H.; and Johansson, L. E. B. "The CO Envelope of IRC +10216." Astrophys. J., 332, 1009-1018, 1988.

Hughes, V. A. "Radio Observations of Cepheus A. I. The Evolving Pre-Main-Sequence Stars in Cepheus A East?" Astrophys. J., 333, 788-800, 1988.

Hummel, C. A.; Schalinski, C. J.; Kirchbaum, T. P.; Witzel, A.; and Johnston, K. J. "The Quasar 0153+74." Astron. Astrophys., 204, 68-72, 1988.

Hummel, E.; Lesch, H.; Wielebinski, R.; and Schlickeiser, R. "The Radio Halo of NGC 4631: Ordered Magnetic Fields Far Above the Plane." Astron. Astrophys., 197, L29-L31, 1988.

Hutchings, J. B. and Neff, S. G. "Tidal Interactions and Infrared-Bright QSOs." Astron. J., 96, 1575-1580, 1988.

Hutchings, J. B; Neff, S. G.; and van Gorkom, J. H. "The Twin-Nucleus Merging Galaxy Markarian 266 (NGC 5256)." Astron. J., 96, 1227-1234, 1988.

Hutchings, J. B.; Price, R.; and Gower, A. C. "Radio Evolution of Quasars at z<1. Astrophys. J., 329, 122-137, 1988.

Irvine, W. M.; Brown, R. D.; Cragg, D. M.; Friberg, P.; Godfrey, P. D.; Kaifu, N.; Matthews, H. E.; Ohishi, M.; Suzuki, H.; and Takeo, H. "A New Interstellar Polyatomic Molecule: Detection of Propynal in the Cold Dark Cloud TMC-1." Astrophys. J., 335, L89-L93, 1988.

Irvine, W. M.; Friberg, P.; Hjalmarson, A.; Ishikawa, S.; Kaifu, N.; Kawaguchi, K.; Madden, S. C.; Matthews, H. E.; Ohishi, M.; Saito, S.; Suzuki, H.; Thaddeus, P.; Turner, B. E.; Yamamoto, S.; and Ziurys, L. M. "Identification of the Interstellar Cyanomethyl Radical (CH_2CN) in the Molecular Clouds TMC-1 and Sagittarius B2." Astrophys. J., 334, L107-L111, 1988.

Irwin, J. A. and Seaquist, E. R. "Nuclear Jets in the Radio Lobe Spiral Galaxy, NGC 3079." Astrophys. J., 335, 658-667, 1988.

Irwin, J. and Seaquist, E. R. "VLBI Observations of the Radio Lobe Spiral Galaxy, NGC3079." In: Active Galactic Nuclei. Ed. H. R. Miller and P. J. Wiita. (Berlin: Springer-Verlag, 1988) 314-316.

Israel, F. P.; Seielstad, G. A.; and Berge, G. L. "10.7 GHz Observations of Markarian/Seyfert Galaxies." Astron. Astrophys., 189, 7-10, 1988.

Itoh, M.; Inagaki, S.; and Saslaw, W. C. "Gravitational Clustering of Galaxies: Comparison Between Thermodynamic Theory and N-Body Simulations." Astrophys. J., 331, 45-63, 1988.

Jackson, J. M. and Ho, P. T. P. "Elongated CO Structure in the Starburst Galaxy NGC 2146." Astrophys. J., 324, L5-L9, 1988.

Jackson, J. M; Ho, P. T. P.; and Haschick, A. D. "A Rotating Circumstellar Molecular Disk Surrounding NGC 6334 I." Astrophys. J., 333, L73-L77, 1988.

Jacq, T.; Jewell, P. R.; Henkel, C.; Walmsley, C. M.; and Baudry, A. "$H_2{}^{12}O$ in Hot Dense Molecular Cloud Cores." Astron. Astrophys., 199, L5-L8, 1988.

Jannuzi, B. T.; Black, J. H.; Lada, C. J.; and van Dishoeck, E. F. "The Small Molecular Cloud Toward HD 169454." Astrophys J., 332, 995-1008, 1988.

Jauncey, D. L.; White, G. L.; Harvey, B. L.; Batty, M. J.; Wright, A. E.; Savage, A.; Peterson, B. A.; Peters, W. L.; Reynolds, J. E.; Gulkis, S.; Preston, R. A.; Morabito, D. D.; Tzioumis, A. K.; Condon, J. J.; Malin, D. F.; Nicolson, G. D.; and Nothnagel, A. "Complete Samples of Flat Spectrum Radio Sources From the Parkes 2.7 GHz Survey." IAU Symp., 129, 77-78, 1988.

Jauncey, D. L.; White, G. L.; Harvey, B. R.; Batty, M. J.; Wright, A. E.; Savage, A.; Peterson, B. A.; Peters, W. L.; Reynolds, J. E.; Gulkis, S.; Preston, R. A.; Morabito, D. D.; Tzioumis, A. K.; Condon, J. J.; Malin, D. F.; Nicolson, G. D.; Nothnagel, A.; Argue, A. N.; and Stolz, A. "Mapping the Radio Sky: Compact Radio Quasars From the Parkes 2.7 GHz Survey." IAU Symp., 133, 487-490, 1988.

Jones, T. J.; Garwood, R.; and Dickey, J. M. "Compact Radio Sources in the Galactic Plane." Astrophys. J., 328, 559-568, 1988.

Joy, M. and Ghigo, F. D. "Luminous Extranuclear Star Formation in the Interacting Galaxy Arp 118 (NGC 1143, 1143/44)." Astrophys. J., 332, 179-182, 1988.

Kaplan, G. H.; Johnston, K. J.; Seidelmann, P. K.; Wade, C. M.; and Carroll, T. S. "Fundamental Radio Reference Frame From VLA Observations of Minor Planets." IAU Symp., 128, 97, 1988.

Kashlinsky, A. "On Dynamical Models of Stellar Systems of Finite Extent." Astrophys. J., 325, 566-582, 1988.

Kashlinsky, A. "Small-Scale Fluctuations in the Microwave Background and Multiple Gravitational Lensing." Astrophys. J., 331, L1-L4, 1988.

Kazes, I.; Troland, T. H.; Crutcher, R. M.; and Heiles, C. "The Magnetic Field in the Vicinity of S106." Astrophys. J., 335, 263-268, 1988.

Keel, W. C. and Hummel, E. "Jets and Loops From the Nucleus of NGC 2655." Astron. Astrophys., 194, 90-98, 1988.

Kellermann, K. I. and Cohen, M. H. "The Origin and Evolution of the N.R.A.O.-Cornell VLBI System." J. Roy. Astron. Soc. Canada, 82, 248-265, 1988.

Kellermann, K. I. and Fomalont, E. B. "The Distribution of Faint Radio Sources at 6 cm." IAU Symp., 130, 379-385, 1988.

Kellermann, K. I. and Owen, F. N. "Radio Galaxies and Quasars." In: Galactic and Extragalactic Radio Astronomy. Ed. G. L. Verschuur and K. I. Kellermann. (New York: Springer-Verlag, 1988) 563-602.

Kellermann, K. I. and Thompson, A. R. "The Very-Long-Baseline Array." Sci. Am., 258, (January) 54-63, 1988.

Kerr, A. R.; Pan, S.-K.; and Feldman, M. J. "Integrated Tuning Elements for SIS Mixers." Int. J. Inf. Mm. Waves, 9, 203-212, 1988.

Keto, E. R.; Ho, P. T. P.; and Haschick, A. D. "The Observed Structure of the Accretion Flow Around G10.6-0.4." Astrophys. J., 324, 920-930, 1988.

Killeen, N. E. B. and Bicknell, G. V. "The Mass Distribution of NGC 1399 From Optical and X-ray Surface Photometry." Astrophys. J., 325, 165-179, 1988.

Killeen, N. E. B and Bicknell, G. V. "The Radio Galaxy IC 4296 (PKS 1333-33). III. Interpretation of the Radio, Optical, and X-ray Data." Astrophys. J., 324, 198-222, 1988.

Killeen, N. E. B.; Bicknell, G. V.; and Ekers, R. D. "The Thermally Confined Radio Source in NGC 1399." Astrophys. J., 325, 180-188, 1988.

Kim, D.-W.; Guhathakurta, P.; van Gorkom, J. H.; Juran, M.; and Knapp, G. R. "H I Observations of the Elliptical Galaxies NGC 2974 and NGC 5018." Astrophys. J., 330, 684-694, 1988.

Kim, K.-T.; Kronberg, P. P.; and Landecker, T. L. "Probe of the Magnetic Field Structure in and Around the Supernova Remnant OA 184 (G166.2+2.5) Using Background Radio Source Rotation Measures." Astron. J., 96, 704-717, 1988.

Kim, K.-T. and Kronberg, P. P. "The Rotation Measure of a Background Radio Sources Seen Through the Supernova Remnant OA184 (G166.2+2.5)." IAU Colloq., 101, 355-358, 1988.

Knapp, G. R. and Bowers, P. F. "Small Scale Structure in the Interstellar Medium. I. Discovery of Very Small Molecular Clouds Toward α Orionis." Astrophys. J., 331, 974-985, 1988.

Kulkarni, S. R.; Clifton, T. C.; Backer, D. C.; Foster, R. S.; Fruchter, A. S.; and Taylor, J. H. "A Fast Pulsar in Radio Nebula CTB80." Nature, 331, 50-53, 1988.

Kulkarni, V. K. and Romney, J. D. "VLBI Observations of Compact Extragalactic Radio Sources With Steep Spectra." IAU Symp., 129, 123-124, 1988.

Kundu, M. R.; Pallavicini, R.; White, S. M.; and Jackson, P. D. "Co-ordinated VLA and EXOSAT Observations of the Flare Stars UV Ceti, EQ Pegasi, YZ Canis Minoris, and AD Leonis." Astron. Astrophys., 195, 159-171, 1988.

Kundu, M. R.; Schmahl, E. J.; and Fu, Q.-J. "Coronal Bright Points at 6 and 20 Centimeter Wavelengths." Astrophys. J., 325, 905-911, 1988.

Kundu, M. R. and Shevgaonkar, R. K. "Detection of the dMe Flare Star YZ Canis Minoris Simultaneously at 20 and 90 Centimeter Wavelengths." Astrophys. J., 334, 1001-1007, 1988.

Kutner, M. L. "The Outer Galaxy as a Star Formation Laboratory." In: The Outer Galaxy. Ed. L. Blitz and F. J. Lockman. (New York: Springer-Verlag, 1988) 198-200.

Lada, C. J.; Margulis, M.; Sofue, Y.; Nakai, N.; and Handa, T. "Observations of Molecular and Atomic Clouds in M31." Astrophys. J., 328, 143-160, 1988.

Lada, E. A. and Blitz, L. "Two Populations of Diffuse Molecular Clouds." Astrophys. J., 326, L69-L73, 1988.

Lang, K. R. and Willson, R. F. "Narrow-Band, Slowly Varying Decimetric Radiation From the Dwarf M Flare YZ Canis Minoris. II." Astrophys. J., 326, 300-304, 1988.

Lang, K. R. and Willson, R. F. "Ultraviolet and Radio Flares From UX Arietis and HR 1099." Astrophys. J., 328, 610-616, 1988.

Lang, K. R.; Willson, R. F.; and Trottet, G. "High-Resolution Maps of the Quiescent Corona at 90 cm Wavelength." Astron. Astrophys., 199, 325-328, 1988.

Lestrade, J.-F.; Mutel, R. L.; Preston, R. A.; and Phillips, R. B. "Dual-Frequency and Dual-Polarization VLBI Observations of the Stellar System Algol." Astrophys. J., 328, 232-242, 1988.

Lestrade, J.-F.; Niell, A. E.; Preston, R. A.; and Mutel, R. L. "Mark III Very Long Baseline Interferometry Positions of Eight Stellar Systems and Astrometric Comparisons." Astron. J., 96, 1746-1754, 1988.

Likkel, L. and Morris, M. "The Circumstellar Water Fountains of IRAS 16342-3814: A Very High Velocity Bipolar Outflow." Astrophys. J., 329, 914-919, 1988.

Lind, K. R. "Kinematic and Dynamical Models of Small Structures in Radio Sources." IAU Symp. 129, 55-64, 1988.

Liszt, H. S. "The Galactic Center." In: Galactic and Extragalactic Radio Astronomy. Ed. G. L. Verschuur and K. I. Kellermann. (New York: Springer-Verlag, 1988) 359-380.

Little-Marenin, I. R.; Benson, P. J.; and Dickinson, D. F. "Masers Associated With Two Carbon Stars: V778 Cygni and EU Andromedae." Astrophys. J., 330, 828-834, 1988.

Liu, T.; Janes, K. A.; Bania, T. M.; and Phelps, R. L. "Stellar and Molecular Radial Velocities for Six Young Open Clusters." Astron. J., 95, 1122-1131, 1988.

Lizano, S.; Heiles, C.; Rodriguez, L. F.; Koo, B.-C.; Shu, F. H.; Hasegawa, T.; Hayashi, S.; and Mirabel, I. F. "Neutral Stellar Winds That Drive Bipolar Outflows in Low-Mass Protostars." Astrophys. J., 328, 763-776, 1988.

Lockman, F. J. "Rotation and the Outer Galaxy: Comments on Topics Raised by the Work of Frank Kerr." In: The Outer Galaxy. Ed. L. Blitz and F. J. Lockman. (Berlin: Springer-Verlag, 1988) 79-88.

Lonsdale, C. J. and Barthel, P. D. "The Working Surface of a Powerful Radio Source: Global MkIII Observations of the Southern Lobe of 3C205." IAU Symp., 129, 135-136, 1988.

McCarthy, P. J.; Dickinson, M.; Filippenko, A. V.; Spinrad, H.; and van Breugel, W. J. M. "Serendipitous Discovery of a Redshift 4.4 QSO." Astrophys. J., 328, L29-L33, 1988.

McIntosh, G. C.; Predmore, C. R.; and Barvainis, R. E. "Circular Polarimetry of SiO Masers." In: Interstellar Matter. Ed. J. M. Moran and P. T. P. Ho. (New York: Gordon and Breach, 1988) 229-230.

MacLeod, J. M.; Vallee, J. P.; and Broten, N. W. "Linear Polarization Observations in Selected Celestial Zones." Astron. Astrophys. Suppl., 74, 63-66, 1988.

Madden, S. C.; Friberg, P.; Brown, R.; and Godfrey, P. "Ammonia Maser Flare in W51." IAU Circ., 4537, January 27, 1988.

Magnani, L.; Blitz, L.; and Wouterloot, J. G. A. "Molecular Abundances in the High-Latitude Molecular Clouds." Astrophys. J., 326, 909-923, 1988.

Magri, C.; Haynes, M. P.; Forman, W.; Jones, C.; and Giovanelli, R. "The Pattern of Gas Deficiency in Cluster Spirals: The Correlation of H I and X-ray Properties." Astrophys. J., 333, 136-156, 1988.

Mangum, J. G.; Rood, R. T.; Wadiak, E. J.; and Wilson, T. L. "Observations of the ^{13}C Isomers of Cyanoacetylene: Implications for Carbon Isotope Studies in the Milky Way." Astrophys. J., 234, 182-190, 1988.

Marcaide, J. M.; Bartel, N.; Bonometti, R. J.; Corey, B. E.; Cotton, W. D.; Gorenstein, M. V.; Preston, R. A.; Ratner, M. I.; Rogers, A. E. E.; and Shapiro, I. I. "Second Epoch of Simultaneous λ3.6 and λ13 cm Observations of the Pair of Quasars 1038+528 A,B." IAU Symp., 129, 101-102, 1988.

Margon, B.; Anderson, S. F.; Mateo, M.; Fich, M.; and Massey, P. "An Exceptionally Bright, Compact Starburst Nucleus." Astrophys. J., 334, 597-604, 1988.

Margulis, M.; Lada, C. J.; and Snell, R. L. "Molecular Outflows in the Monoceros OB1 Molecular Cloud." Astrophys. J., 333, 316-331, 1988.

Marscher, A. P. "Contemporaneous X-ray and VLBI Radio Observations of the Quasar NRAO 140." Astrophys. J., 334, 552-559, 1988.

Martin, H. M. and Partridge, R. B. "A Search for Small-Scale Structure in the Background Radiation at 6 Centimeters." Astrophys. J., 324, 794-800, 1988.

Maslowski, J. and Kellermann, K. I. "The Structure of Faint Radio Sources. I. VLA Observations and Optical Identifications." Astron. J., 95, 1659-1677, 1988.

Massi, M.; Churchwell, E.; and Felli, M. "Small-Scale NH_3 Clumping in M17." Astron. Astrophys., 194, 116-124, 1988.

Massi, M.; Felli, M.; Pallavicini, R.; Tofani, G.; Palagi, F.; and Catarzi, M. "VLBI Observations of RS CVn and Algol-Type Binaries." Astron. Astrophys., 197, 200-204, 1988.

Mathieu, R. D.; Benson, P. J.; Fuller, G. A.; Myers, P. C.; and Schild, R. E. "L43: An Example of Interaction Between Molecular Outflows and Dense Cores." Astrophys. J., 330, 385-398, 1988.

Matveyenko, L. I.; Graham, D. A.; and Diamond, P. J. "VLBI Observations of the H_2O Maser Outburst in Orion KL." IAU Symp., 129, 257-258, 1988.

Mazzarella, J. M.; Gaume, R. A.; and Aller, H. D. "Triple Radio Structure in the 'Double-Nucleus' Galaxy Markarian 266." In: Active Galactic Nuclei. Ed. H. R. Miller and P. J. Wiita. (Berlin: Springer-Verlag, 1988) 344-346.

Mazzarella, J. M.; Gaume, R. A.; Aller, H. D.; and Hughes, P. A. "Multifrequency Observations of the Double-Nucleus Galaxy Markarian 266: Enhanced Synchrotron Emission Induced by a Merger." Astrophys. J., 333, 168-180, 1988.

Mead, K. N. "Molecular Clouds in the Outer Galaxy. II. CO Maps of Individual Clouds." Astrophys. J. Suppl. Ser., 67, 149-186, 1988.

Mead, K. N. and Kutner, M. L. "Molecular Clouds in the Outer Galaxy. III. CO Studies of Individual Clouds." Astrophys. J., 330, 399-414, 1988.

Menton, K. M.; Johnston, K. J.; Wadiak, E. J.; Walmsley, C. M.; and Wilson, T. L. "High-Resolution VLA Observations of the W3(OH) Methanol Masers." Astrophys. J., 331, L41-L45, 1988.

Menten, K. M; Reid, M. J.; Moran, J. M.; Wilson, T. L.; Johnston, K. J.; and Batrla, W. "VLBI Observations of 12 GHz Methanol Masers." Astrophys. J., 333, L83-L86, 1988.

Minh, Y. C.; Irvine, W. M.; and Ziurys, L. M. "Observations of Interstellar HOCO+: Abundance Enhancements Toward the Galactic Center." Astrophys. J., 334, 175-181, 1988.

Mirabel, I. F.; Kazes, I.; and Sanders, D. B. "Detection of the H I, OH, CO, and Optical Imaging of the Distant Galaxy IRAS 12112+0305." Astrophys. J., 324, L59-L62, 1988.

Molnar, L. A.; Reid, M. J.; and Grindlay, J. E. "VLBI Observations of Expansion in Cygnus X-3." Astrophys. J., 331, 494-508, 1988.

Morris, D. H. and Mutel, R. L. "Radio Emission From RS CVn Binaries. III. A VLA Survey of 103 Systems." Astron. J., 95, 204-214, 1988.

Mundy, L. G.; Cornwell, T. J.; Masson, C. R.; Scoville, N. Z.; Baath, L. B.; and Johansson, L. E. B. "High-Resolution Images of the Orion Molecular Ridge in the CS J=2-1 Transition." Astrophys. J., 325, 382-388, 1988.

Muxlow, T. W. B.; Junor, W.; Spencer, R. E.; Simon, R.; Benson, J.; and Reid, M. "High Dynamic Range Mapping of a Complex Radio Source - M87." IAU Symp., 129, 131-132, 1988.

Neff, S. G. and Ulvestad, J. S. "Compact Radio Cores in Three Seyfert Galaxies: High-Resolution Studies of Mkn 3, Mkn 231, and Mkn 463." Astron. J., 96, 841-850, 1988.

Nelson, R. F. and Spencer, R. E. "A Search for Radio Emission From X-ray Binaries and Related Objects." Mon. Not. Roy. Astron. Soc., 234, 1105-1118, 1988.

Niell, A. E.; Lestrade, J.-F.; Preston, R. A.; Mutel, R. L.; and Phillips, R. B. "VLBI Positions of Eight Stellar Systems." IAU Symp., 129, 327-328, 1988.

Noreau, L. and Hardy, E. "A VLA Search for Cosmological HI." IAU Symp., 130, 207-209, 1988.

Noreau, L. and Hardy, E. "A VLA Search for Cosmological H I at z = 3.3. II. New Observations of Three Fields." Astron. J., 96, 1845-1849, 1988.

Norris, R. P. "The Double Radio Nucleus of Arp 220." Mon. Not. Roy. Astron. Soc., 230, 345-351, 1988.

Norrod, R. D. "Cryogenic Receivers for Radio Astronomy." In: Midcon/88. (Los Angeles: Midcon, 1988), 230-234, 1988.

O'Dea, C. P.; Barvainis, R.; and Challis, P. M. "Sub-Arcsecond Resolution Radio Observations of Sixteen Core-Dominated Quasars and Active Galactic Nuclei." Astron. J., 96, 435-454, 1988.

O'Dell, S. L.; Dennison, B.; Broderick, J. J.; Altschuler, D. R.; Condon, J. J.; Payne, H. E.; Mitchell, K. J.: Aller, H. D.; Aller, M. F.; and Hodge, P. E. "Radio Variability of the Blazer AO 0235+164." Astrophys. J., 326, 668-679, 1988.

Oort, M. J. A. "High-Resolutions Observations of Millijansky Radio Sources: The Run of Median Angular Size at Low Flux Densities." Astron. Astrophys., 193, 5-14, 1988.

Owen, F. N.; White, R. A.; and Thronson, H. A. Jr. "Redshifts of Radio Galaxies in Abell Clusters of Galaxies." Astron. J., 95, 1-4, 1988.

Pan, S.-K.; Kerr, A. R.; Feldman, M. J.; Kleinsasser, A. W.; Stasiak, J.; Sandstrom, R. L.; and Gallagher, W. J. "An SIS Mixer for 85-116 GHz Using Inductivity Shunted Edge-Junctions." In: 1988 IEEE MTT-S International Microwave Symposium Digest. (New York: IEEE, 1988), 465-468.

Partridge, R. B.; Nowakowski, J.; and Martin, H. M. "Linear Polarized Fluctuations in the Cosmic Microwave Background." Nature, 331, 146-147, 1988.

Payne, H. E.; Phillips, J. A.; and Terzian, Y. "A Young Planetary Nebula With OH Molecules: NGC 6302." Astrophys. J., 326, 368-375, 1988.

Payne, J. M. "A Multibeam Receiver for Millimeter-Wave Radio Astronomy." Rev. Sci. Instrum., 59, 1911-1919, 1988.

Pearson, T. J. and Readhead, A. C. S. "The Milliarcsecond Structure of a Complete Sample of Radio Sources. II. First-Epoch Maps at 5 GHz." Astrophys. J., 328, 114-142, 1988.

Persi, P.; Rodriguez, L. F.; Tapia, M.; Ferrari-Toniolo, M.; and Roth, M. "Stellar Wind From Of Stars From Infrared and Radio Observations." In: Mass Outflows From Stars and Galactic Nuclei. Ed. L. Bianchi and R. Gilmozzi. (Dordrecht: Kluwer, 1988) 227-230.

Petuchowski, S. J. and Bennett, C. L. "Detection of the $2_{20} \rightarrow 2_{21}$ Transition of HDO in Orion A: Evidence for Dense Clumped Gas in the Hot Core." Astrophys. J., 326, 376-383, 1988.

Phillips, J. P. and Mampaso, A. "Radio Mapping of Type I Post-Main-Sequence Nebulae." In: Mass Outflows From Stars and Galactic Nuclei. Ed. L. Bianchi and R. Gilmozzi. (Dordrecht: Kluwer, 1988) 343-347.

Pospieszalski, M. W. "Comments on 'A Method for Measurement of Losses in the Noise-Matching Microwave Network While Measuring Transistor Noise Parameters'." IEEE Tr. Micro. Theory Tech., MTT-36, 170, 1988.

Pospieszalski, M. W.; Weinreb, S.; Norrod, R. D.; and Harris, R. "FET's and HEMT's at Cryogenic Temperatures--Their Properties and Use in Low-Noise Amplifiers." IEEE Tr. Micro. Th. Tech., MTT-36, 552-560, 1988.

Pottasch, S. R.; Bignell, C.; Olling, R.; and Zijlstra, A. A. "Planetary Nebulae Near the Galactic Center. I. Method of Discovery and Preliminary Results." Astron. Astrophys., 205, 248-256, 1988.

Preuss, E.; Alef, W.; and Kellermann, K. I. "Superluminal Behavior of the Double-Lobed Radio Galaxy 3C111." IAU Symp., 129, 105-106, 1988.

Puche, D.; Zijlstra, A. A.; Boettcher, C.; Plante, R. L.; Wilcots, E. M.; Wilkin, F. P.; Krause, S.; Sergo, S. P.; Bierman, G. S.; Ge, J.; Holliman, J. H.; Wu, X.; and Zhao, J. H. "The Distance to the Nebula M 1-78." Astron. Astrophys., 206, 89-94, 1988.

Rand, R. J.; Kulkarni, S. R.; Backer, D. C.; and Clifton, T. R. "Is There a Coherent Radiation Component in the Radio Emission of SS 433?" Astron. Astrophys., 196, 185-190, 1988.

Reid, M. J.; Schneps, M. H.; Moran, J. M.; Gwinn, C. R.; Genzel, R.; Downes, D.; and Ronnang, B. "The Distance to the Center of the Galaxy: H_2O Maser Proper Motions in Sagittarius B2(N)." Astrophys. J., 330, 809-816, 1988.

Reynolds, S. P. and Aller, H. D. "Radio Observations of the Crab-Like Supernova Remnant 3C 58. I. Total Intensity Observations." Astrophys. J., 327, 845-852, 1988.

Reynolds, S. P. and Fix, J. D. "The Flat-Spectrum Radio Source C1 in M33 Is a Background Radio Galaxy." Astron. J., 96, 1332-1335, 1988.

Roberts, M. S. "Intergalactic Hydrogen Clouds." In: New Ideas in Astronomy. Ed. F. Bertola, J. W. Sulentic, and B. F. Madore. (New York: Cambridge University Press, 1988) 65-74.

Roberts, M. S. "Interstellar Matter in Globular Clusters." IAU Symp., 126, 411-422, 1988.

Roelfsema, P. R.; Goss, W. M.; and Geballe, T. R. "Infrared and Radio Recombination Line Observations of K3-50." Astron. Astrophys., 207, 132-144, 1988.

Romney, J. D. "The Very Long Baseline Array." IAU Symp., 129, 461-468, 1988.

Roth, M; Tapia, M; Gomez, Y.; and Rodriguez, L. F. "The Blister H II Region Associated With GM24." Rev. Mexicana Astron. Astrof., 16, 3-6, 1988.

Rucinski, S. M. and Seaquist, E. R. "VLA Observations of the Contact Binary VW Cep." Astron. J., 95, 1837-1840, 1988.

Rudnick, L. "Fluid Structures in a Radio Galaxy Lobe: Observations of 3C33 South." Astrophys. J., 325, 189-203, 1988.

Rusk, R. "The Brightness and Polarization Structure of Compact Radio Sources." IAU Symp., 129, 161-162, 1988.

Saikia, D. J.; Yates, G. J.; Pedlar, A.; Axon, D. J.; van Gorkom, J.; Wolstencroft, R. D.; and Unger, S. W. "A Study of Sersic-Pastoriza Galaxies." In: Active Galactic Nuclei. Ed. H. R. Miller and P. J. Wiita. (New York: Springer, 1988) 140-142.

Salter, C. J. and Brown, R. L. "Galactic Nonthermal Continuum Emission." In: Galactic and Extragalactic Radio Astronomy. Ed. G. L. Verschuur and K. I. Kellermann. (New York: Springer-Verlag, 1988) 1-36.

Salter, C. J.; Sinha, R. P.; Stobie, E. B.; Kerr, F. J.; and Hobbs, R. W. "Millimetre-Wave Continuum Observations of the Galactic Centre." Mon. Not. Roy. Astron. Soc., 232, 407-417, 1988.

Sandell, G.; Magnani, L.; and Lada, E. A. "Detection of Shock-Enhanced CH Emission in Bipolar Outflows." Astrophys. J., 329, 920-926, 1988.

Sanders, D. B.; Scoville, N. Z.; and Soifer, B. T. "Detection of Abundant Molecular Gas in the UV-Excess Quasar Markarian 1014." Astrophys. J., 335, L1-L4, 1988.

Sanders, D. B.; Scoville, N. Z.; and Soifer, B. T. "IRAS 14348-1447, an Ultraluminous Pair of Colliding, Gas-Rich Galaxies: The Birth of a Quasar?" Science, 239, 625-627, 1988.

Sandquist, Aa.; Elfhad, T.; and Jorsater, S. "CO and Dust in the Barred Spiral Galaxy NGC 1365." Astron. Astrophys., 201, 223-231, 1988.

Sandquist, Aa.; Tomboulides, H.; and Lindblad, P. O. "HI and H_2CO in Dark Dust Clouds Along Gould's Belt." Astron. Astrophys., 205, 225-234, 1988.

Saslaw, W. C. and Whittle, M. "Radio Galaxy Jets as Probes of Galactic Structure." Astrophys. J., 325, 142-147, 1988.

Savage, A.; Jauncey, D. L.; White, G. L.; Peterson, B. A.; Peters, W. L.; Gulkis, S.; and Condon, J. J. "A Complete Sample of Flat-Spectrum Radio Sources From the Parkes 2.7 GHz Survey." ASP Conf. Proc., 2, 204-220, 1988.

Schenewerk, M. S.; Snyder, L. E.; Hollis, J. M.; Jewell, P. R.; and Ziurys, L. M. "HCO Emission From H II-Molecular Cloud Interface Regions." Astrophys. J., 328, 785-796, 1988.

Schilizzi, R. T.; Skillman, E. D.; Miley, G. K.; Barthel, P. D.; Benson, J. M.; and Muxlow, T. W. B. "3C236 - The Giant Radio Galaxy With a Compact Steep Spectrum Nucleus and a Compact Two-Sided Jet." IAU Symp., 129, 127-128, 1988.

Schmelz, J. T.; Baan, W. A.; and Haschick, A. D. "The Megamaser Galaxy Markarian 273. II. VLA Observations of the Neutral Hydrogen Absorption." Astrophys. J., 329, 142-148, 1988.

Schommer, R. A.; Caldwell, N.; Wilson, A. S.; Baldwin, J. A.; Phillips, M. M.; Williams, T. B.; and Turtle, A. J. "Ionized Gas and Radio Emission in the Barred Seyfert Galaxy NGC 5728." Astrophys. J., 324, 154-171, 1988.

Schwartz, P. R.; Gee, G.; and Huang, Y.-L. "CO Pedestal Features From IRAS Sources in Dark Clouds." Astrophys. J., 327, 350-355, 1988.

Seaquist, E. R.; Frail, D. A.; Bode, M. F.; Roberts, J. A.; Whittet, D. C. B.; Evans, A.; and Albinson, J. S. "Nova GK Persei - A Minature Supernova Remnant?" IAU Colloq., 101, 47-50, 1988.

Shevgaonkar, R. K.; Kundu, M. R.; and Jackson, P. D. "Variability of Metric Emission From the Sun." Astrophys. J., 329, 982-990, 1988.

Simon, R. S.; Hall, J.; Johnson, K. J.; Spencer, J. H.; Waak, J. A.; and Mutel, R. L. "Superluminal Motion Toward a Stationary Knot in the Radio Core of the Quasar 3C 395." Astrophys. J., 326, L5-L8, 1988.

Sivagnanam, P.; Diamond, P. J.; Le Squeren, A. M.; Gaigne, G.; Biraud, F.; Ortega-Molina, A.; and Graham, D. A. "VLBI Observations of the Main-Line OH Maser Around U Herculis." Astron. Astrophys., 194, 157-159, 1988.

Skillman, E. D. "A Nonthermal Superbubble in the Irregular Galaxy IC 10." IAU Colloq., 101, 465-467, 1988.

Skillman, E. D.; Terlevich, R.; Teuben, P. J.; and van Woerden, H. "H I Synthesis Observations of the Dwarf Irregular Galaxy Sextans A." Astron. Astrophys., 198, 33-42, 1988.

Soker, N; O'Dea, C. P.; and Sarazin, C. L. "Numerical Simulations of the Bending of Narrow-Angle-Tail Radio Jets by Ram Pressure or Pressure Gradients." Astrophys. J., 327, 627-638, 1988.

Solomon, P. M. and Sage, L. J. "Star-Formation Rates, Molecular Clouds, and the Origin of the Far-Infrared Luminosity of Isolated and Interacting Galaxies." Astrophys. J., 334, 613-625, 1988.

Spangler, S. R. and Cordes, J. M. "Angular Broadening Measurements of the Sources 1849+005 and 2013+370." In: Radio Wave Scattering in the Interstellar Medium. Ed. J. M. Cordes, B. J. Rickett, and D. C. Backer. (New York: American Institute of Physics, 1988) 117-121.

Spangler, S. R. and Cordes, J. M. "Interstellar Scattering of the Radio Source 2013 + 370." Astrophys. J., 332, 346-353, 1988.

Stine, P. C.; Feigelson, E. D.; Andre, P.; and Montmerle, T. "Multi-epoch Radio Continuum Surveys of the ρ Ophiuchi Dark Cloud." Astron. J., 96, 1394-1406, 1988.

Stone, J. L., Jr.; Wilson, A. S.; and Ward, M. J. "Collimated Nuclear Ejection of Radio-Emitting Plasma in the Seyfert Galaxy NGC 4388." Astrophys. J., 330, 105-110, 1988.

Sumi, D. M.; Norman, M. L.; and Smarr, L. L. "Radio Jets as a Probe of the Cooling Flow Environment." In: Cooling Flows in Clusters and Galaxies. Ed. A. C. Fabian. (Dordrecht: Kluwer, 1988) 257-261.

Surdej, J.; Magain, P.; Swings, J.-P.; Borgeest, U.; Courvoisier, T. J.-L.; Kayser, R.; Kellermann, K. I.; Kuhr, H.; and Refsdal, S. "Observations of the New Gravitational Lens System UM673 = Q0142-100." Astron. Astrophys., 198, 49-60, 1988.

Surdej, J.; Swings, J.-P.; Magain, P.; Borgeest, U.; Kayser, R.; Refsdal, S.; Courvoisier, T. J.-L.; Kellermann, K. I.; and Kuhr, H. "Search for Gravitational Lensing From a Survey of Highly Luminous Quasars." ASP Conf. Proc., 2, 183-193, 1988.

Tadhunter, C. N.; Fosbury, R. A. E.; di Serego Alighieri, S.; Bland, J.; Danziger, I. J.; Goss, W. M.; McAdam, W. B.; and Snijders, M. A. J. "Very Extended Ionized Gas in Radio Galaxies--IV. PKS 2152-69." Mon. Not. Roy. Astron. Soc., 235, 403-423, 1988.

Taylor, A. R. "Radio Imaging of Symbiotic Stars." IAU Colloq., 103, 77-83, 1988.

Taylor, A. R.; Hjellming, R. M.; Seaquist, E. R.; and Gehrz, R. D. "Radio Images of the Expanding Ejecta of Nova QU Vulpeculae 1984." Nature, 335, 235-238, 1988.

Taylor, A. R.; Seaquist, E. R.; and Kenyon, S. J. "Continued Radio Activity From CH Cygni." IAU Colloq., 103, 231-232, 1988.

Taylor, J. H. and Dewey, R. J. "Improved Parameters for Four Binary Pulsars." Astrophys. J., 332, 770-776, 1988.

Thronson, H. A. Jr.; Hunter, D. A.; Telesco, C. M.; Greenhouse, M.; and Harper, D. A. "The Magellanic Irregular Galaxy NGC 4214: Star Formation and the Interstellar Medium." Astrophys. J., 334, 605-612, 1988.

Tifft, W. G. and Cocke, W. J. "Uncertainties in 21 Centimeter Redshifts. I. Data." Astrophys J. Suppl. Ser., 67, 1-75, 1988.

Tilanus, R. P. J.; Allen, R. J.; van der Hulst, J. M.; Crane, P. C.; and Kennicutt, R. C. "Spiral Structure of M51: Thermal and Nonthermal Emission." Astrophys. J., 330, 667-671, 1988.

Turner, B. E. "Molecules as Probes of the Interstellar Medium and of Star Formation." In: Galactic and Extragalactic Radio Astronomy. Ed. G. L. Verschuur and K. I. Kellermann. (New York: Springer-Verlag, 1988) 154-199.

Turner, B. E. "Rotationally Excited Interstellar CH: Detection of Satellite Lines and Analysis of Abundance and Excitation." Astrophys. J., 329, 425-439, 1988.

Turner, B. E. "Vibrationally Excited CS and SiS in IRC+10216." In: Interstellar Matter. Ed. J. M. Moran and P. T. P. Ho. (New York: Gordon and Breach, 1988) 223-224.

Turner, B. E. and Ziurys, L. M. "Interstellar Molecules and Astrochemistry." In: Galactic and Extragalactic Radio Astronomy. Ed. G. L. Verschuur and K. I. Kellermann. (New York: Springer-Verlag, 1988) 200-254.

Turner, E. L.; Hillenbrand, L. A.; Scheider, D. P.; Hewitt, J. N.; and Burke, B. F. "Spectroscopic Evidence Supporting the Gravitational Lens Hypothesis for 1635+267 A,B." Astron. J., 96, 1682-1689, 1988.

Ulvestad, J. S. "Phasing the Antennas of the Very Large Array for Reception of Telemetry From Voyager 2 at Neptune Encounter." JPL Telecomm. Data Analysis Prog. Rpt., 42-49, 257-273, 1988.

Ulvestad, J. S. and Antonucci, R. R. J. "Radio Properties of the Highly Polarized, Quiescent Quasar OI 287." Astrophys. J., 328, 569-577, 1988.

Unger, S. W.; Pedlar, A.; Axon, D. J. Graham, D. A.; Harrison, B. A.; Saikia, D. J.; Whittle, M.; Meurs, E. J. A.; Dyson, J. E.; and Taylor, D. "Radio Ejection and Broad Forbidden Emission Lines in the Seyfert Galaxy NGC 7674." Mon. Not. Roy. Astron. Soc., 234, 745-754, 1988.

Uson, J. M. and Wilkinson, D. T. "The Microwave Background Radiation." In: Galactic and Extragalactic Radio Astronomy. Ed. G. L. Verschuur and K. I. Kellermann. (New York: Springer-Verlag, 1988) 603-640.

van Breugel, W.; McCarthy, P. J.; and van Gorkom, J. "Jet-Induced Starbursts: From Minkowski's Object to Distant Radio Galaxies." In: Cooling Flows in Clusters and Galaxies. Ed. A. C. Fabian. (Dordrecht: Kluwer, 1988) 251-256.

van der Hulst, J. M.; Kennicutt, R. C.; Crane, P. C.; and Rots, A. H. "Radio Properties and Extinction of the H II Regions in M51." Astron. Astrophys., 195, 38-52, 1988.

van der Werf, P. P.; Goss, W. M.; and Vanden Bout, P. A. "High Resolution H I Observations of Dark Clouds I. L 134." Astron. Astrophys., 201, 311-326, 1988.

van Driel, W.; Rots, A. H.; and van Woerden, H. "Distribution and Motions of Atomic Hydrogen in Lenticular Galaxies VII. The SO/a - Sa Galaxies NGC 1291, NGC 5101 and IC 5267." Astron. Astrophys., 204, 39-60, 1988.

van Moorsel, G. A. "A Neutral Hydrogen Study of Interacting Galaxies in the NGC 697 Group." Astron. Astrophys., 202, 59-69, 1988.

Vanden Bout, P. A. and Havlen, R. J. "National Radio Astronomy Observatory (Annual Report, July 1986 - June 1987)." Bull. Am. Astron. Soc., 20, 427-446, 1988.

Velusamy, T. and Becker, R. H. "G54.1+0.3: A New Crab-Like Supernova Remnant." Astron. J., 95, 1162-1166, 1988.

Vilhu, O.; Caillault, J.-P.; and Heise, J. "Simultaneous EXOSAT and VLA Observations of Contant Binaries VW Cephei and XY Leonis: Quiescent Emission and a Flare on VW Cephei." Astrophys. J., 330, 922-927, 1988.

Vilhu, O.; Caillault, J.-P.; Neff, J.; and Heise J. "Simultaneous EXOSAT and VLA Observations of the W UMa Binaries, VW Cep and XY Leo. A Flare on VW Cep." In: Activity in Cool Star Envelopes. Ed. O. Havnes et. al. (Dordrecht: Kluwer, 1988) 179-182.

Waak, J. A.; Simon, R. S.; Spencer, J. H.; and Johnston, K. J. "The Length of the Milliarcsecond Jet in 3C 345." Astron. J., 95, 1023-1024, 1988.

Waak, J. A.; Spencer, J. H.; Simon, R. S.; and Johnston, K. J. "18 cm High Resolution Observations of 15 Extragalactic Radio Sources." IAU Symp., 129, 141-142, 1988.

Wadiak, E. J.; Rood, R. T.; and Wilson, T. L. "Formaldehyde Observations of Giant Molecular Clouds." Astrophys. J., 324, 931-947, 1988.

Walker, C. K.; Lada, C. J.; Young, E. T.; and Margulis, M. "An Unusual Outflow Around IRAS 16293-2422." Astrophys. J., 332, 335-345, 1988.

Walker, R. C.; Walker, M. A.; and Benson, J. M. "Evidence for Superluminal Motion on Kiloparsec Scales in 3C 120." Astrophys. J., 335, 668-676, 1988.

Wardle, J. F. C.; Roberts, D. H.; Brown, L. F.; and Gabuzda, D. C. "Evolution of the Milliarcsecond Polarization Structure of the Superluminal Quasar 3C345." IAU Symp., 129, 163-164, 1988.

Webster, W. J. Jr.; Johnston, K. J.; Hobbs, R. W.; Lamphear, E. S.; Wade, C. M.; Lowman, P. D. Jr.; Kaplan, G. H.; and Seidelmann, P. K. "The Microwave Spectrum of Asteroid Ceres." Astron. J., 95, 1263-1268, 1988.

Wehrle, A. E. and Morris, M. "Radio and Hα Images of the 'Figure-8' Radio Nucleus of the Interacting Seyfert Galaxy NGC 2992." Astron. J., 95, 1689-1694, 1988.

Weiler, K. W. and Sramek, R. A. "Supernovae and Supernovae Remnants." Ann. Rev. Astron. Astrophys., 26, 295-341, 1988.

Weinreb, S.; Norrod, R.; and Pospieszalski, M. W. "Compact Cryogenic Receivers for the 1.3 to 4.3 GHz Range." IAU Symp., 129, 499-500, 1988.

Welch, D. L. and Duric, N. "VLA Observations of Cepheid Variations." Astron. J., 95, 1794-1796, 1988.

Whiteoak, J. B. and Gardner, F. F. "VLA Observations of NGC 5793." Proc. Astron. Soc. Australia, 7, 88-91, 1988.

Williams, B. A. and van Gorkom, J. H. "VLA Observations of Hydrogen in HCG 18." Astron. J., 95, 352-355, 1988.

Willson, R. F.; Lang, K. R.; and Foster, P. "VLA Observations of Dwarf M Flare Stars and Magnetic Stars." Astron. Astrophys., 199, 255-261, 1988.

Wilson, A. S. and Ulvestad, J. S. "A Radiation Bow Shock Wave (?) Driven by Nuclear Ejecta in a Seyfert Galaxy." In: Supermassive Black Holes. Ed. M. Kafatos. (Cambridge: Cambridge University Press, 1988) 85-86.

Wolstencroft, R. D.; Unger, S. W.; Pedlar, A.; Heasley, J. N.; Parker, Q. A.; Menzies, J. W.; Savage, A.; MacGillivray, H. T.; Leggett, S. K.; Gang, W.; and Clowes, R. G. "Radio and Optical Studies of a Complete Sample of IRAS Galaxies." In: Comets to Cosmology. Ed. A. Lawrence. (New York: Springer-Verlag, 1988) 202-205.

Wood, D. O. S.; Churchwell, E.; and Salter, C. J. "Flux Densities of Ultracompact H II Regions at 3 Millimeters." Astrophys. J., 325, 694-698, 1988.

Wouterloot, J. G. A.; Brand, J.; and Henkel, C. "Star Formation in the Outer Galaxy." Astron. Astrophys., 191, 323-340, 1988.

Wouterloot, J. G. A.; Brand, J.; and Henkel, C. "Star Formation in the Outer Galaxy." In: The Outer Galaxy. Ed. L. Blitz and F. J. Lockman. (New York: Springer-Verlag, 1988) 207.

Wrobel, J. M. and Heeschen, D. S. "Current Star Formation as the Origin of Kiloparsec-Scale Radio Sources in Nearby E/SO Galaxies." Astrophys. J., 335, 667-687, 1988.

Wrobel, J. M.; Pearson, T. J.; Cohen, M. H.; and Readhead, A. C. S. "VLA Polarimetry of VLBI Core-Jet Sources." IAU Symp., 129, 165-166, 1988.

Yusef-Zadeh, F. and Morris, M. "The Northern Extension of the Radio Arc Near the Galactic Center." Astrophys. J., 329, 729-738, 1988.

Zijlstra, A. A. and Pottasch, S. R. "The Rapidly Evolving Source OH5.89-0.39: H II Region or Proto-Planetary Nebula?" Astron. Astrophys., 196, L9-L12, 1988.

ADDITIONS TO THE 1987 PUBLICATIONS LIST

Antonucci, R. and Barvainis, R. "Low Frequency Cutoffs in the Spectra of Radioquiet Quasars." IAU Symp., 121, 135-139, 1987.

Bergvall, N.; Jorsater, S.; and Olofsson K. "The Young Face of the BCG ESO 400-G43." In: Starbursts and Galaxy Evolution." Ed. T. X. Thuan et al. (Gif sur Yvette: Editions Frontieres, 1987) 177-182.

Bookbinder, J. A. and Walter, F. M. "A VLA Survey of an X-ray Selected Sample of F Dwarfs." Camb. Wksp. Cool Stars, 5, 260-261, 1987.

Bookbinder, J. A.; Stencel, R. E.; Drake, S. A.; Simon, T.; Linsky, J. L.; and Florkowski, D. "VLA Observations of Rapid 6 cm Flux Variations in α Ori. Camb. Wksp. Cool Stars, 5, 337-339, 1987.

Condon, J. J. "Starburst Galaxies in Deep Radio Sources." In: Starbursts and Galaxy Evolution. Ed. T. X. Thuan et al. (Gif sur Yvette: Editions Frontieres, 1987) 425-435.

Cordova, F. A.; Hjellming, R. M.; Mason, K. O.; and Middleditch, J. "PSR 0656+14." IAU Circ., 4490, November 17, 1987.

Drake, S. A.; Brown, A.; and Reimers, D. "Radio Continuum Emission From the Ionized Stellar Winds of the Cool Supergiants in Zeta Aurigae-Like Systems." Camb. Wksp. Cool Stars, 5, 322-325, 1987.

Fich, M. and Terebey, S. "IRAS Colors of VLA Identified Objects in the Galaxy." In: Star Formation in Galaxies. Ed. C. J. Lonsdale Persson. (Washington, D. C.: NASA Office of Space Sciences and Applications, 1987) 63-66.

Martin, J.-M. "OH Megamasers in IRAS Galaxies." In: Starbursts and Galaxy Evolution. Ed. T. X. Thuan et al. (Gif sur Yvette: Editions Frontieres, 1987) 275-282.

Ulvestad, J. S.; Resch, G. M.; and Brundage, W. D. "X-Band System Performance of the Very Large Array." JPL Telecomm. Data Analysis Prog. Rpt., 42-92, 123-137, 1987.

Viallefond, F.; Lequeux, J.; and Comte, G. "New High-Resolution HI Observations of I Zx 18 and I Zw 36." In: Starbursts and Galaxy Evolution. Ed. T. X. Thuan et al. (Gif sur Yvette: Editions Frontieres, 1987) 139-143.

Wolstencroft, R. D.; Unger, S. W.; Pedlar, A.; Heasley, J. N.; Parker, Q. A.; Menzies, J. W.; Savage, A.; MacGillivray, H. T.; Leggett, S. K.; and Clowes, R. G. "Radio and Optical Studies of High Luminosity IRAS Galaxies." In: Starbursts and Galaxy Evolution. Ed. T. X. Thuan et al. (Gif sur Yvette: Editions Frontieres, 1987) 296-274.