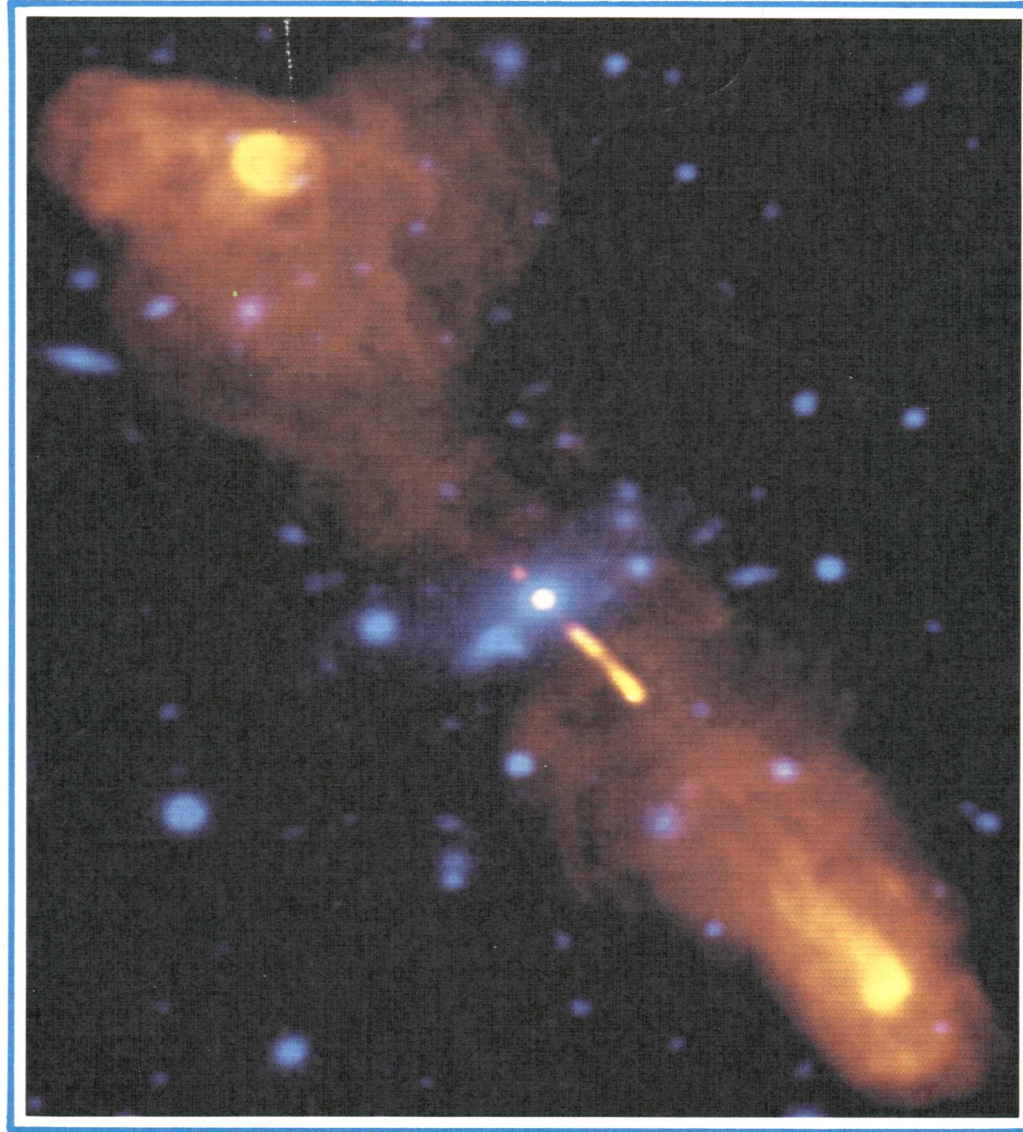


NATIONAL RADIO ASTRONOMY OBSERVATORY

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1993 STATISTICS

Cover: An image of the radio galaxy 3C 219. The radio image, made with the NRAO Very Large Array, is colored red and yellow and is shown superposed on an optical image (colored blue) of the parent galaxy. Thin jets of radio emission can be seen carrying energy from the nucleus of the galaxy to giant radio lobes that are much larger than the entire visible galaxy. The major features seen here—nuclear jets transporting energy to a network of magnetic filaments within large radio lobes—is characteristic of many bright radio galaxies. VLA Observers: D. Clarke, A. Bridle, J. Burns, R. Perley, M. Norman.

NATIONAL RADIO ASTRONOMY OBSERVATORY

**Observing Summary —
1993 Statistics**



February 1994

SOME HIGHLIGHTS OF THE 1993 RESEARCH PROGRAM

- CO emission has been detected at the 12 Meter Telescope from the high redshift radio galaxy 4C 28.55 ($z = 2.947$). This is the most distant detection of dense molecular gas in the universe. The mass of molecular hydrogen is $1.8 \times 10^{11} h^{-2} M_{\odot}$, comparable to the total mass in stars of a normal giant elliptical galaxy. The discovery of significant molecular gas in high- z radio galaxies supports arguments that they are young systems. The narrow observed CO line, in combination with the known complex kinematics of high- z radio galaxies, suggests that 4C 28.58 has not yet virialized, but is presently in an early state of gravitational collapse. 4C 28.55 must also have substantial star formation to synthesize the metals and the dust. The large CO luminosity and narrow CO line emission indicate that 4C 28.55 is a largely gaseous galaxy in early collapse, which still has the raw materials (dense molecular gas) to be a giant galaxy in the making.
- Using five stations at 7 mm wavelength, the VLBA has measured an upper limit of 0.4 milliarcseconds, or 3.3 astronomical units, for the diameter of the Galactic Center source Sgr A*, believed to be at the dynamical center of the Galaxy. The small size and large radio luminosity of Sgr A* add to the evidence that the object contains a black hole. Under current models, the upper limit on the diameter implies an upper limit of 1.5×10^6 solar masses for the black hole at the center of Sgr A*.
- The VLA and VLBA have monitored the expanding shell of Supernova 1993J in M81, the brightest northern optical supernova since 1937. The VLA detected 1.3 cm emission within three days of the explosion, and thereafter traced the light-curve at successively longer-wavelengths as the expanding ionized shell became optically thin. The VLBA, which resolves the expanding shell, began similar monitoring at 29 days. Other antennas from the DSN and the EVN were involved. The monitoring will continue as long as the supernova is visible. The resulting light curves are providing an important test for models of the progenitor star and its evolution prior to the explosion.
- New, sensitive measurements of the ${}^3\text{He}^+$ hyperfine line at 8.7 GHz have been made at the 140 Foot Telescope in several galactic HII regions. ${}^3\text{He}$ is produced in significant quantities during the epoch of cosmological nucleosynthesis, and is also formed and destroyed by stellar processes. Abundances are found in the range $1-4 \times 10^{-5}$, which does not fit that expected from the overall chemical evolution of the Galaxy. Local enrichment of some HII regions from Wolf-Rayet winds is possible. If stars, averaged over an initial mass function, are not a net sink for ${}^3\text{He}$, then the lowest-abundance source, W49, places a lower limit of $\sim 4 \times 10^{-10}$ on the cosmological baryon to photon ratio. The ${}^3\text{He}$ lower limit is about the same as the upper limit from ${}^2\text{H}$, ${}^4\text{He}$, and ${}^7\text{Li}$.

- Sodium cyanide (NaCN) has been detected at the 12 Meter Telescope, in the outer envelope of the evolved circumstellar shell IRC 10216. It is only the second sodium-containing molecule detected extraterrestrially. Together with the earlier discovered MgNC and several compounds of silicon, it indicates a rich gas-phase refractory-element chemistry in the outer envelope of this mass-losing object. The fraction of cosmic sodium in the form of NaCN appears to be several percent in IRC 10216, so that significant amounts of Na escape incorporation into grains in the inner envelope, contrary to conventional ideas about the fate of refractory elements in such objects. Such chemistry may provide the dominant source of refractory elements as seen in the gas phase in the interstellar medium.
- The VLA and 140 Foot Telescope have been used to discover a possible planetary companion to a binary pulsar. The instruments have made regular timing observations of the pulsar B1620-26 in the globular cluster M4. This millisecond pulsar has a binary companion of about 0.3 solar masses. The pulsar underwent a sudden acceleration in 1993. The VLA/140 Foot timing results made between 1989 and 1993 are consistent with the effect of either a planet in an orbit at approximately 10 AU or a star in an orbit at about 50 AU. Thus B1620-26 is likely to be either the first pulsar found in a triple stellar system or part of the first binary star system found with a planet.
- A sequence of VLA observations has linked a Soft Gamma-ray Repeater source SGR 1806-20 to the supernova remnant G10.0-0.3. The initial link was made using archival VLA datasets which established that the SGR is coincident with the SNR within the gamma-ray position uncertainties. New VLA observations on G10.0-0.3 then revealed a compact nebula within the SNR, with morphology suggestive of a plerion, or pulsar-powered SNR. A subsequent flare-up of the SGR was accompanied by a "new" X-ray source whose satellite-determined position coincided with the VLA position for the compact nebula, the most likely position of the putative pulsar. This identification of a SGR with a plerion is highly significant for constraining models of SGR's.

OBSERVING HOURS

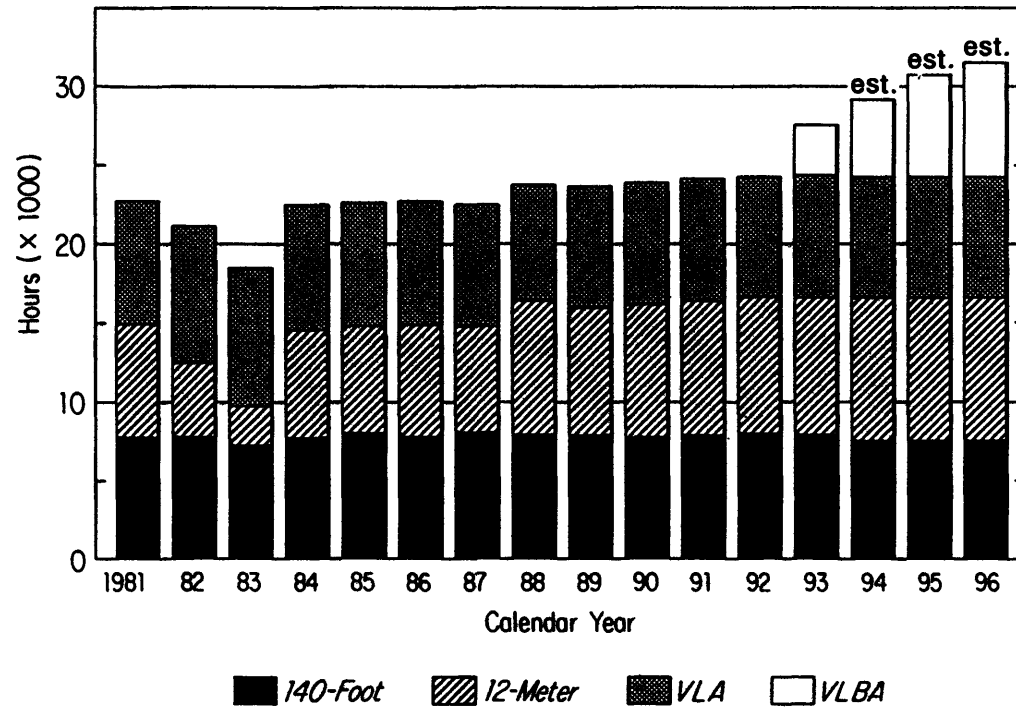


Fig. 1

This figure shows the hours scheduled for observing on each telescope during the last decade. Includes astronomical observing, testing, and calibration.

DISTRIBUTION OF SCHEDULED OBSERVING TIME

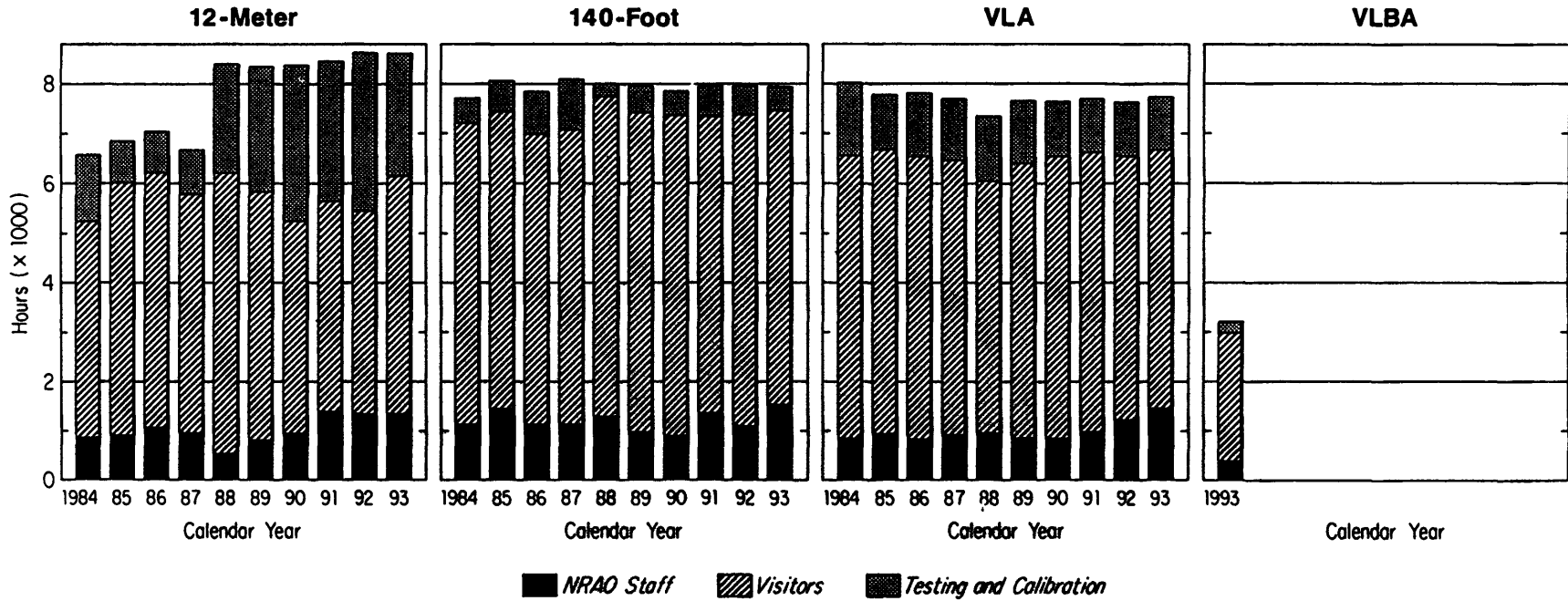


Fig. 2. These graphs show the number of hours scheduled for testing and calibration, and for observing by the NRAO staff and by visitors on each telescope system during the last decade.

12-METER RADIO TELESCOPE SUMMARY

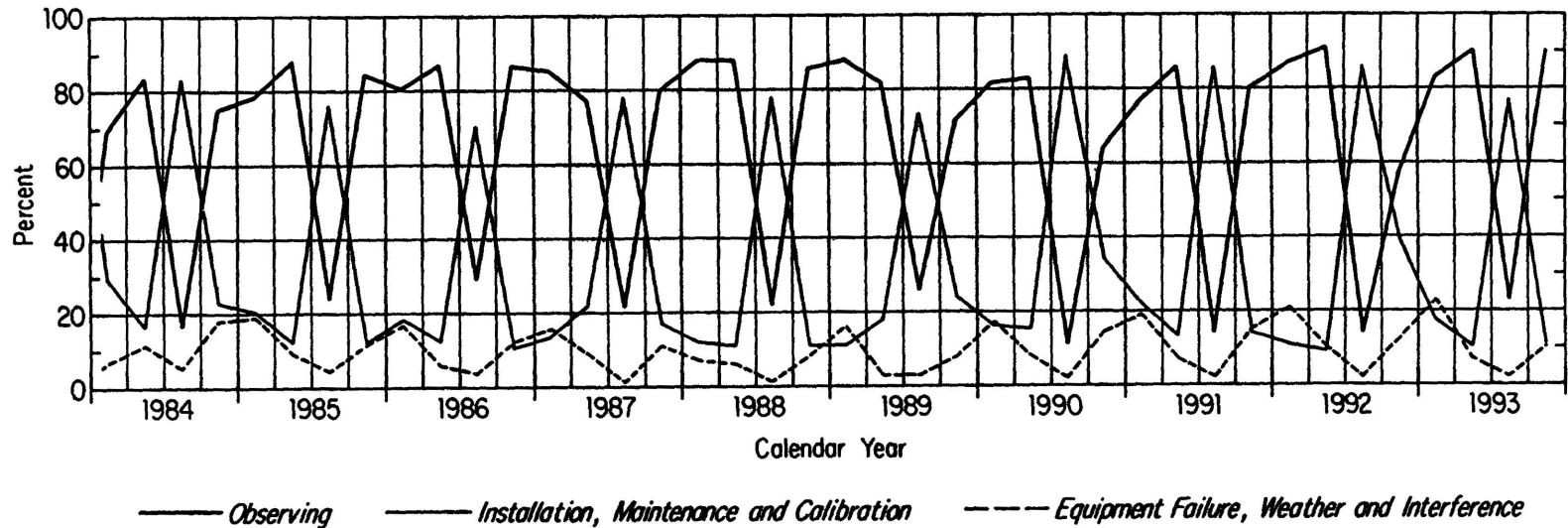


Fig. 3.

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 four to six weeks each summer during the wet season. This period is used for maintenance and upgrading of the instrument. For most of 1983 the telescope was out of service for the replacement of the reflecting surface and its backup structure.

140-FOOT RADIO TELESCOPE SUMMARY

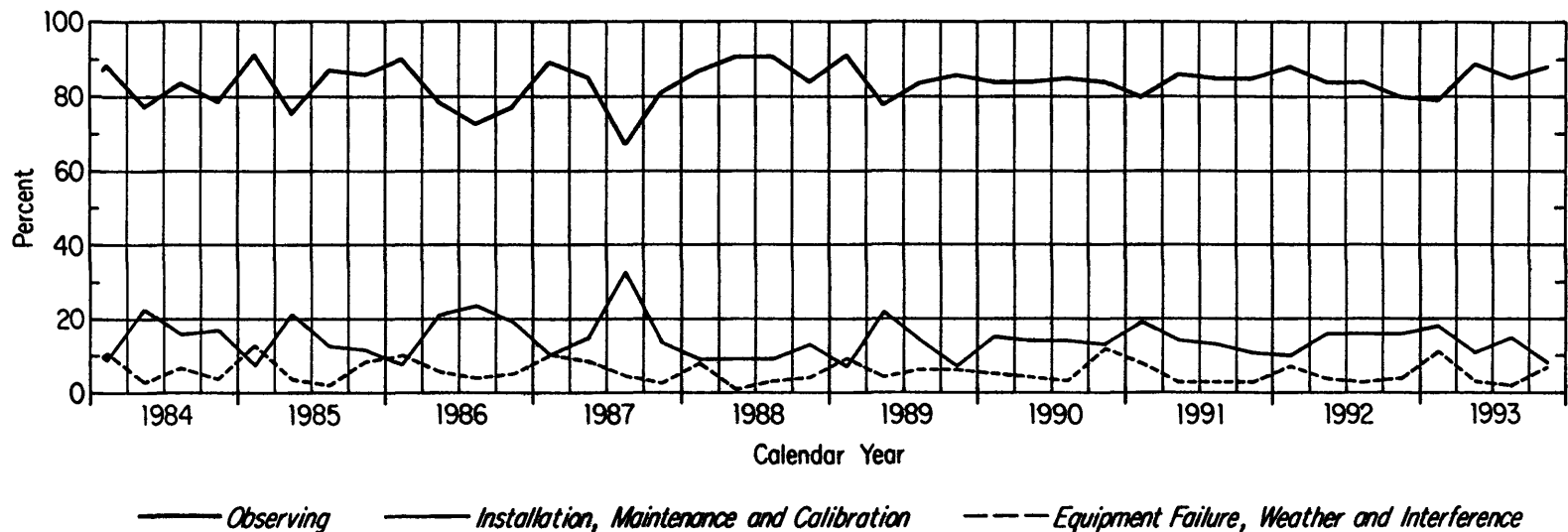


Fig. 4

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 holographic surface tests and panel readjustments in 1987.

VERY LARGE ARRAY TELESCOPE SUMMARY

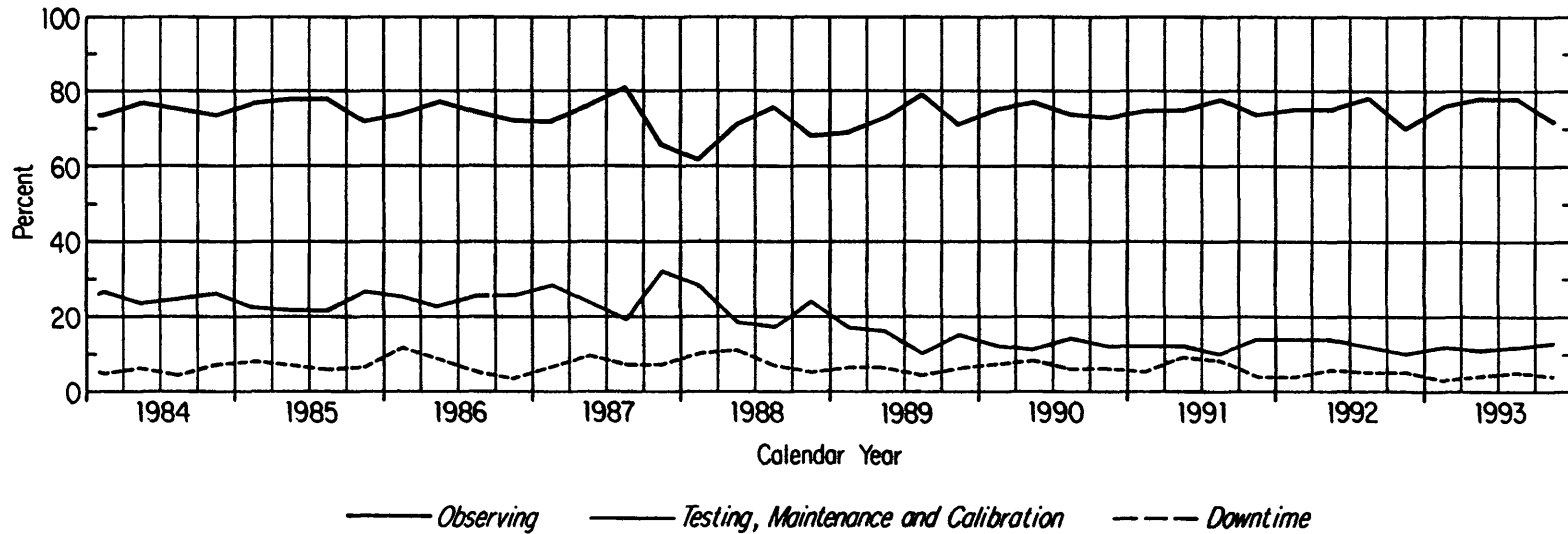


Fig. 5 This summary for each quarter of the calendar year shows the percentage of time the telescope was scheduled for observing; for routine system testing, maintenance, and calibration; and the percentage of time lost due to hardware or software failure, power failure, or bad weather.

FULL-TIME EMPLOYEES

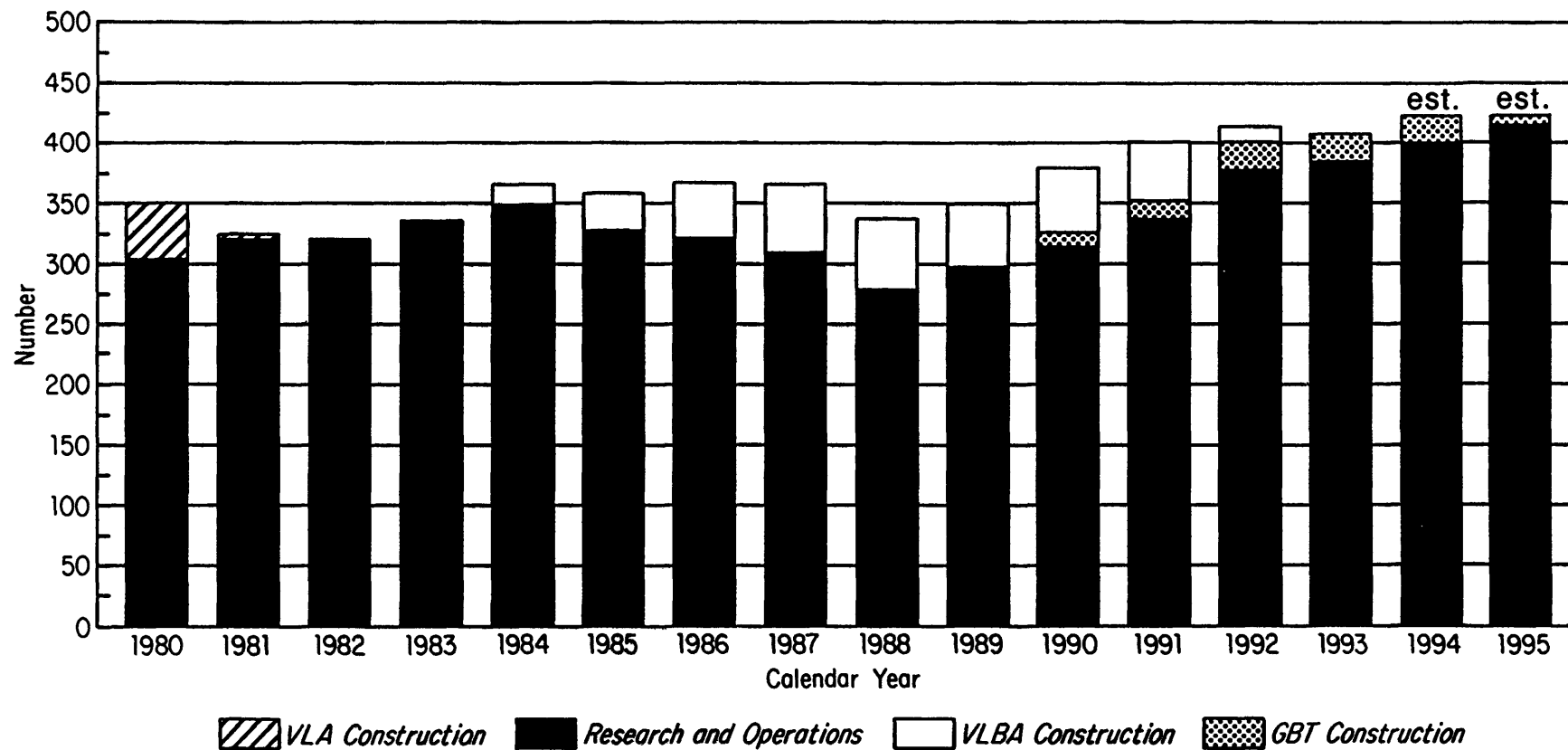


Fig. 6 This figure shows the total number of NRAO full-time employees at the end of each year, projected into the future.

NUMBER OF PEOPLE OBSERVING WITH NRAO TELESCOPES

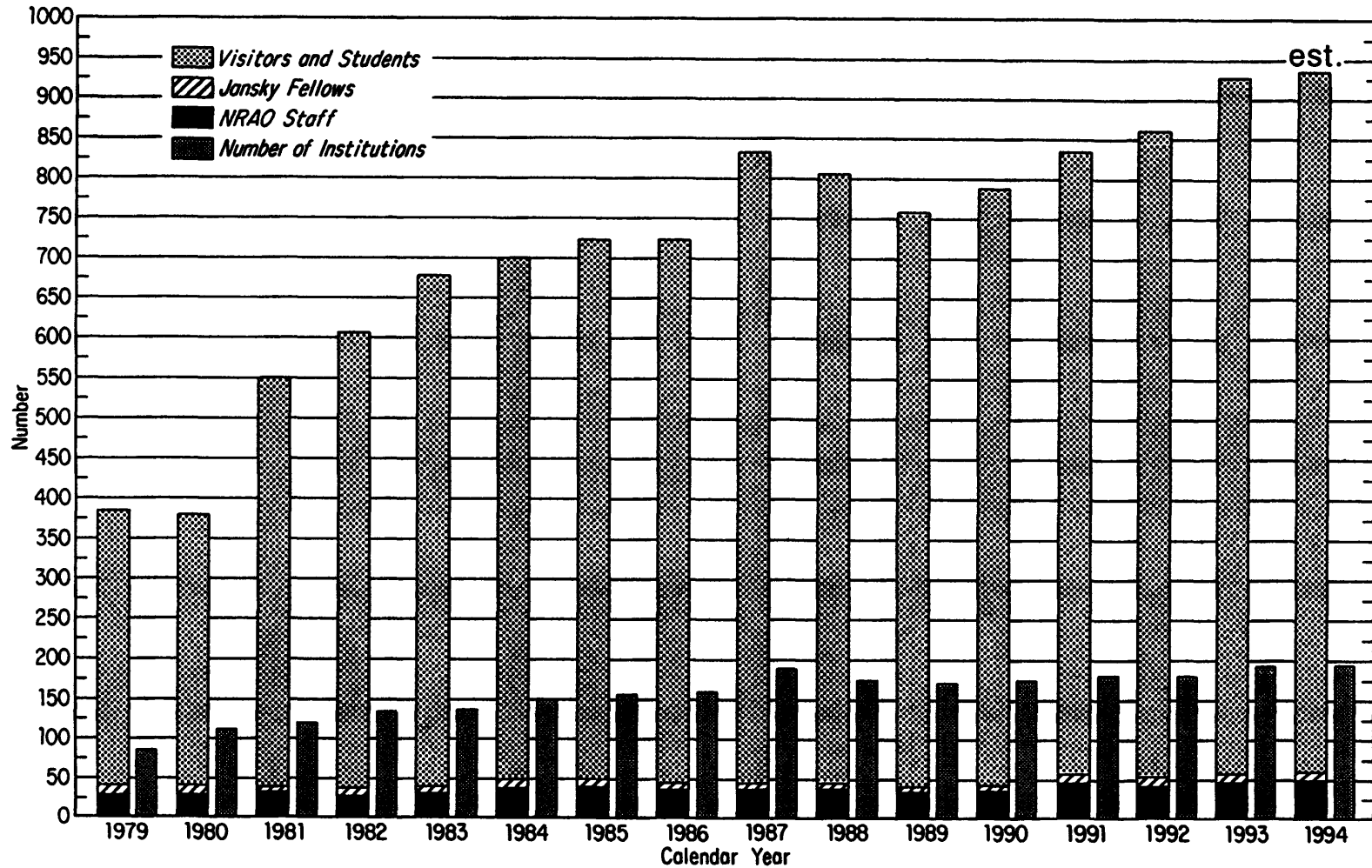


Fig. 7

This bar chart shows for each calendar year the number of NRAO research staff and the number of NRAO postdoctorals (Jansky Postdoctorals) who used 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 came. The significant jump in these last two categories starting in 1981 reflects the increased use of the VLA.

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

	12 Meter	140 Foot	VLA	VLBA	Overall
I. SOLAR SYSTEM --					
Sun, Planet, Satellites, and Comets	4%	0%	7%	0%	5%
II. STELLAR --					
Pulsars, X-ray Sources, Planetary Nebulae, Circumstellar Shells, Supernova Remnants, Masers, Novae, Supernovae, and Stars	7%	35%	26%	31%	25%
III. GALACTIC --					
Galactic Structure, Center, Molecular Clouds, HII Regions, Star Formation, Molecules, and Interstellar Medium	61%	46%	24%	13%	30%
IV. EXTRAGALACTIC --					
Normal and Active Galaxies, Radio Galaxies, Clusters, Quasars, VLBA Studies, Extragalactic Molecules, and Cosmology	28%	19%	43%	56%	40%

DISTRIBUTION OF TELESCOPE TIME BY PERCENT

	12 Meter	140 Foot	VLA	VLBA	1993 Summary
Visitors	42%	53%	52%	33%	46%
Students	12%	14%	7%	2%	9%
NRAO Staff	14%	14%	14%	4%	12%
Postdoctorals (Jansky Fellows)	2%	4%	3%	1%	2%
Test and Calibration	28%	5%	12%	3%	13%
Maintenance and Installation	1%	8%	11%	12%	7%
Holidays and Unscheduled	1%	2%	2%	45%	11%

INSTITUTIONS FROM WHICH VISITORS CAME TO USE NRAO TELESCOPES DURING 1993

INSTITUTION	TELESCOPES			
	140 FOOT	12 METER	VLA	VLBA
1. Air & Space Museum		X		
2. Alabama, University of		X	X	
3. Applied Research Corporation				X
4. Arcetri Astrophysical Observatory (Italy)	X		X	X
5. Arizona, University of - Steward Observatory, L & P Lab.	X	X	X	
6. Arizona State University		X	X	
7. Armagh Observatory (Ireland)			X	
8. Astrophysical Institute Potsdam (Germany)			X	
9. Barcelona, University of (Spain)			X	X
10. Beijing Astronomical Observatory (P.R. of China)	X			X
11. Bologna, University of (Italy)	X		X	X
12. Bonn University (Germany)			X	
13. Bordeaux Observatory (France)		X	X	
14. Boston University	X		X	X
15. Brandeis University			X	X

INSTITUTION	TELESCOPES			
	140 FOOT	12 METER	VLA	VLBA
16. Brazilian Space Agency - INPE			X	
17. Byurakan Astrophysical Observatory (Armenia)			X	
18. Calgary, University of (Canada)			X	X
19. California, University of, Davis			X	
20. California, U. of, Berkeley - Hat Creek Observatory	X	X	X	X
21. California, University of, Los Angeles		X	X	
22. California, University of, San Diego			X	
23. California, University of, Santa Cruz - Lick Observatory			X	
24. California, University of, Santa Barbara		X	X	X
25. Caltech - OVRA, Mt. Palomar	X	X	X	X
26. Cambridge University - Cavendish, Mullard, IOA			X	
27. CFHT (Canada-France-Hawaii-Telescope)				X
28. Canadian Military College			X	
29. Catania University (Italy)			X	
30. CFA (Harvard + SAO)	X	X	X	X
31. CNRS, France (CEN, Saclay)		X	X	
32. Chalmers-Onsala Space Observatory (Sweden)	X	X	X	X
33. Chicago, University of - Yerkes Observatory			X	
34. Chungnam National University (Korea)		X	X	
35. CITA - Canadian Inst. of Theoretical Astrophy.			X	

INSTITUTION	TELESCOPES			
	140 FOOT	12 METER	VLA	VLBA
36. Colgate University		X		
37. Colorado, University of - JILA		X	X	
38. Columbia University			X	
39. Cornell University	X		X	
40. Cosmic Physics, School of (Dublin)			X	
41. CSIRO (Australia)			X	X
42. Curtin, University of (Australia)	X			
43. DRAO (Dominion Radio Astrophysical Observatory)		X	X	
44. Delaware, University of			X	
45. DTM - Carnegie Institute/Observatory			X	
46. Durham, University of (UK)			X	
47. Edinburgh, University of (Scotland)			X	
48. ESO (European Southern Observatory - Germany, Chile)		X	X	
49. ESTEC (Netherlands)			X	X
50. Florida, University of			X	
51. Georgia, University of	X	X		
52. Georgia Tech		X		
53. Groningen, University of - Kapteyn Lab.			X	X
54. Hamburger Sternwarte (Germany)			X	
55. Hampden-Sydney College (Virginia)			X	

INSTITUTION	TELESCOPES			
	140 FOOT	12 METER	VLA	VLBA
56. Hartebeesthoek Radio Astronomy Observatory				X
57. Haverford College			X	
58. Hawaii, University of - Institute of Astronomy		X	X	X
59. Haystack Observatory - NEROC		X	X	X
60. Helsinki, University of (Finland) - METSAHOVI			X	X
61. Heidelberg Observatory (Germany)			X	X
62. Hofstra University		X		
63. IBM (Watson Research Center)			X	
64. IAR, Buenos Aires (Argentina)	X		X	
65. IAS-Frascati (Italy)			X	
66. Illinois, University of - Vermillion River Observatory	X	X	X	X
67. Indiana, University of			X	
68. Institute of Astrophysics (Granada)			X	X
69. Institute of Astrophysics (Paris)			X	
70. Institute for A & A (Andalucia)			X	X
71. Institute for Space Research (Russia)	X		X	X
72. Interferometrics, Inc.			X	X
73. Inst. Space & Aeronautical Sciences (Japan)			X	X
74. Iowa, University of			X	X
75. Iowa State University			X	

INSTITUTION	TELESCOPES			
	140 FOOT	12 METER	VLA	VLBA
76. IRA (Ukranian Academy of Sciences)			X	
77. IPAC, Pasadena			X	X
78. IRAM (France, Spain)	X	X	X	X
79. Johns Hopkins University			X	
80. JPL - Goldstone		X	X	X
81. Katholieke University (The Netherlands)		X		
82. Keele, University of (UK)			X	
83. Kentucky, University of			X	
84. Koln, University of (Germany)			X	
85. KPNO - NOAO (National Solar Observatory)			X	X
86. Lebedev Physics Institute (Russia)				X
87. Leiden, University of - Huygens Laboratories		X	X	
88. Liege, University of (Belgium)			X	
89. Liverpool Polytechnic - Johns Moores (UK)		X	X	
90. Lockheed Research Laboratory			X	
91. Los Alamos Scientific Laboratory (LANL)			X	
92. Madrid Observatory			X	X
93. Manchester, University of - Jodrell, NRAL (UK)	X		X	X
94. Marseille Observatory			X	
95. Maryland, University of - Clark Lake Observatory		X	X	

INSTITUTION	TELESCOPES			
	140 FOOT	12 METER	VLA	VLBA
96. Massachusetts, University of - Five College Observatory	x	x	x	x
97. McMaster University (Canada)		x		
98. Melbourne, University of (Australia)			x	
99. Meudon Observatory	x		x	x
100. Mexico, University of - Inst. of Astronomy (UNAM)			x	x
101. Michigan, University of			x	
102. Middlebury College			x	
103. Minnesota, University of		x	x	
104. Missouri, University of			x	
105. MIT - Lincoln Laboratories		x	x	
106. MMT0 - Multimirror Telescope Observatory			x	
107. Molecular Research Institute (CA)	x			
108. Montreal, University of	x		x	
109. Moscow, University of - SSAI (Russia)			x	
110. MPIPA (Munich, Germany)			x	
111. MPIR (Bonn, Germany)	x		x	x
112. MPIfEP, Garching (Germany)			x	
113. Mt. Stromlo Observatory (Australia)			x	
114. NAIC - Arecibo Observatory	x	x	x	x
115. Nagoya University (Japan)		x		

INSTITUTION	TELESCOPES			
	140 FOOT	12 METER	VLA	VLBA
116. NASA/Ames		X	X	
117. NASA/GSFC - Goddard	X	X	X	X
118. NASA/MSFC - Huntsville	X	X	X	
119. Nevada, University of (@ Las Vegas)		X	X	
120. NFRA (Netherlands Foundation for Research in Astronomy)			X	X
121. NMIMT (New Mexico Inst. of Mining Technology)	X		X	
122. New Mexico, University of			X	X
123. New Mexico State University			X	X
124. New South Wales, University of			X	
125. Nobeyama Observatory (Japan)		X		X
126. North Carolina, University of	X		X	
127. Northern Arizona University		X		
128. Northwestern University	X		X	
129. NRC - Algonquin, Herzberg (Canada)	X	X		X
130. NRL (Naval Research Laboratories)	X	X	X	X
131. Oberlin College			X	
132. Ohio State University			X	
133. Oklahoma, University of			X	
134. Oregon, University of			X	
135. Ottawa, University of (Canada)			X	X

INSTITUTION	TELESCOPES			
	140 FOOT	12 METER	VLA	VLBA
136. Oxford University (UK)		X	X	
137. Paris Observatory		X	X	
138. Penn State University			X	X
139. Pennsylvania, University of			X	
140. Pittsburgh, University of - Allegheny Observatory		X	X	X
141. Preston/Lancashire Polytechnic (UK)				X
142. Princeton University - Inst. Advanced Studies	X	X	X	
143. Pulkovo Observatory (Russia)			X	
144. Queen Mary College (UK)			X	
145. Queens University (Canada)			X	
146. Raman Institute (India)			X	
147. Rensselaer Polytechnic Institute		X		
148. Rhodes College (Memphis)	X			
149. Rochester, University of			X	
150. Royal Greenwich Observatory (UK)			X	
151. Royal Observatory - UKIRT (Scotland)			X	X
152. Rijksuniversiteit Gent, RUG Observatory (Belgium)			X	
153. Sao Paulo University (Brazil)				X
154. SERC, Rutherford Appleton Laboratories (UK)			X	
155. Seoul National University (Korea)	X	X	X	

INSTITUTION	TELESCOPES			
	140 FOOT	12 METER	VLA	VLBA
156. South African Astronomical Observatory (SAAO, Cape Town)				X
157. Southampton, University of (UK)				X
158. Space Telescope Science Institute	X	X	X	X
159. Special Astrophysical Observatory (Russia)	X			
160. Stanford University - Inst. Plasma Research	X		X	
161. St. Lawrence University			X	
162. Stockholm Observatory			X	
163. SUNY (all campi)		X	X	
164. SFIT, ETH - Swiss Federal Institute of Technology			X	
165. Sydney, University of (Australia)			X	X
166. Tasmania, University of (Australia)				X
167. Tata Institute - TIFR, RAC (India)		X	X	
168. Tel-Aviv University - Wise Observatory			X	
169. Texas, University of - McDonald Observatory	X	X	X	
170. Tohoku University (Japan)			X	
171. Tokyo University - Tokyo Astronomical Observatory				X
172. Toledo, University of			X	
173. Torino University (Italy)			X	
174. Toronto, University of - David Dunlap Observatory	X		X	
175. Trieste Astronomical Observatory (ISAS)			X	

INSTITUTION	TELESCOPES			
	140 FOOT	12 METER	VLA	VLBA
176. Tufts University			X	
177. Turku, University of (Finland)			X	
178. Union College		X		
179. United Nations - Outer Space Division			X	
180. University College London (UK)			X	
181. USNO - United States Naval Observatory			X	X
182. Utrecht, University of - Astr. Inst. (Netherlands)			X	
183. Vassar College			X	
184. Victoria, University of (Canada)			X	
185. Villanova University			X	
186. Virginia, University of	X	X		
187. Washington, University of			X	
188. Waterloo, University of (Canada)		X		
189. Wesleyan University (Connecticut)			X	
190. Williams College		X		
191. Wisconsin, University of - Washburn Observatory	X	X	X	
192. Yebes Observatory - CAY (Spain)			X	X
193. York University (Canada)			X	X

INSTITUTION	TELESCOPES			
	140 FOOT	12 METER	VLA	VLBA
Number of Institutions	40	58	162	63
Number of Visitors	72	121	515	172
Number of Students	15	32	81	17
Number of Research Associates	6	1	8	3
Number of Permanent Staff	14	11	30	19
Total Observers	107	165	634	211

All told, 869 visitors, including 133 students, from 193 institutions.

NRAO STUDENT PROGRAM

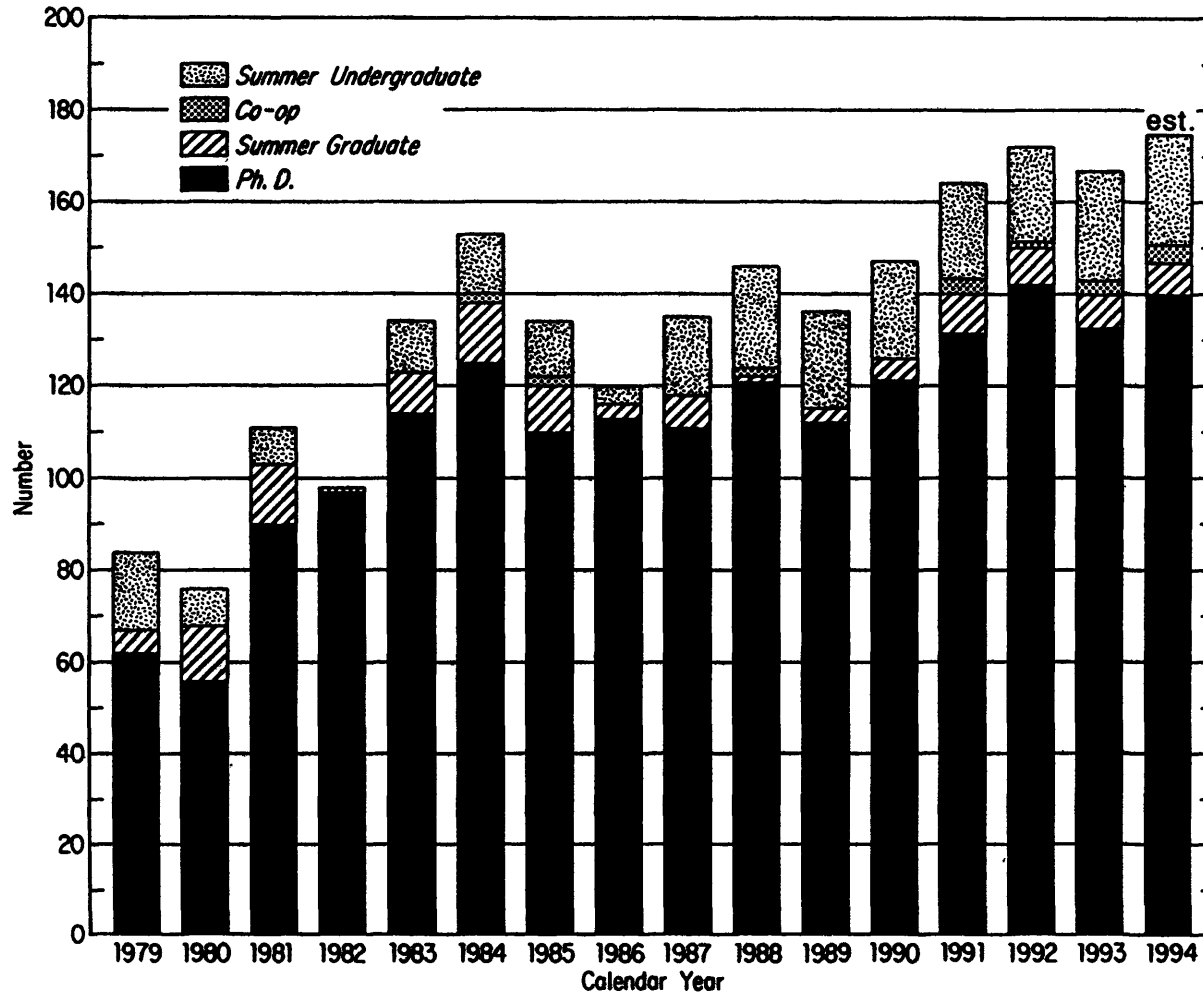


Fig. 8

This figure shows for each calendar year the number of PhD 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.

NRAO FRONT-END STATUS 140 FOOT TELESCOPE

FEBRUARY 1994

TECHNICAL DATA SHEET NO. 12

PAGE 1 OF 5

RECEIVER NAME	FREQUENCY (GHz)	AMPLIFIER TYPE	SYSTEM TEMPERATURE (KELVIN)	3 dB BANDWIDTH (MHz)	FEED TYPE	POLARIZATION	CALIBRATION VALUE	SWITCHING SYSTEM	REMARKS	PERSON(S) IN CHARGE
50-500 MHz Rx	50-88 MHz	HIGH DYNAMIC RANGE TRANSISTOR DUAL CHANNEL	300 + Toky	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	FEED CHANGES FROM 50-88 MHz TO 110-240 MHz OR TO 450-500 MHz REQUIRE TWO HOURS.	NORROD (OLIVER)
	110-240 MHz			130	BROADBAND CROSSED DIPOLE			FREQUENCY SWITCH		
	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	300-350 MHz	COOLED GASFET AMP DUAL CHANNEL	60-100	70	280-350 350-410 CAVITY BACKED CROSSED DIPOLES	DUAL ORTHOGONAL LINEAR RF HYBRID FOR RCP AND LCP	5K	FREQUENCY SWITCHING	ONE OF THE FIVE FEEDS 280-350 MHz 350-410 MHz 500-750 MHz 750-850 MHz OR 750-1000 MHz CAN BE USED. TO CHANGE FEEDS REQUIRES TWO HOURS.	NORROD (SHANK)
	350-410 MHz			80						
	500-750 MHz	50-70	80	500-750 SCALAR WITH CROSSED DIPOLES						
	750-950 MHz	45-50	80	750-850 CAVITY OR 750-1000 SCALAR						
	750-1000 MHz	50-70	80	750-1000 SCALAR WITH CROSSED DIPOLES						
6/25 CM Rx	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.	NORROD (SHANK)
	4.47-5.05 (6 CM)	COOLED GASFET DUAL CHANNEL	50-60	580	SINGLE BEAM DUAL BEAM OFFSET 3 HPBW	ORTH CIRCULAR OR ORTH LINEAR IDENTICAL OR ORTH CIRCULAR OR IDENTICAL LINEAR	1.4K OR 12.8K	OTHER POLARIZATION BEAM SWITCHING		

NRAO FRONT-END STATUS 140 FOOT TELESCOPE

FEBRUARY 1994

TECHNICAL DATA SHEET NO. 12

PAGE 2 OF 5

RECEIVER NAME	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	1.30-1.80	DUAL CHANNEL COOLED HFET	19-25	UP TO 120 FEED LIMITED	THREE 2HE SINGLE BEAM 1.30-1.38 1.38-1.43 1.80-1.72 ZEEMAN 1.38-1.43	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 (SIMMONS)
2-5 GHz Rx	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 (HALL)
	4.6-5.0	DUAL CHANNEL COOLED HFET	2875	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	4.6-5.1	COOLED HFET FOURTEEN CHANNEL	35-45	500	7 CORRUGATED HORNS 3 HPBW APART	DUAL CIRCULAR	4K	NONE	CONTINUUM USE ONLY. TOTAL POWER RF DETECTION.	BEHRENS (HALL)
CASSEGRAIN A AND B RECEIVERS	8-12	COOLED HFET	30-50	500	CASSEGRAIN	FIXED LINEAR	3-7K	FREQUENCY OR NUTATOR BEAM	TWO RECEIVERS	MASTERMAN (DUNBRACK)
	12-18	COOLED HFET	40-60	500	CASSEGRAIN	FIXED LINEAR	3-7K	FREQUENCY OR NUTATOR BEAM	TWO RECEIVERS	
	18.2-25.2	MASER	40-70	80-300	CASSEGRAIN	FIXED LINEAR CIRCULAR VLB	2-8K	FREQUENCY OR NUTATOR BEAM	18.2-25.2	
	25-35	COOLED HFET	50-80	500	CASSEGRAIN	FIXED LINEAR	3-7K	FREQUENCY OR NUTATOR BEAM	ONE RECEIVER	
	<u>BEAM SPLITTER IN</u> - TWO SIMULTANEOUS RECEIVERS 8-25 GHz POLARIZATION: ORTHOGONAL LINEAR <u>BEAM SPLITTER OUT</u> - SINGLE RECEIVERS 4.7-35 GHz POLARIZATION: LINEAR. CIRCULAR AT VLB AND SELECTED FREQUENCIES								BEAM SHIFT = 0-18 ARC MIN.	

NRAO FRONT-END STATUS 12 METER TELESCOPE

FEBRUARY 1994

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FREQUENCY (GHz)	AMPLIFIER TYPE	RECEIVER TEMPERATURE (KELVIN)	CONTINUUM SENSITIVITY (JANSKY $\sqrt{\text{SEC}}$)	3 dB BANDWIDTH (MHz)	FEED TYPE	POLARIZATION	CALIBRATION VALUE	SWITCHING SYSTEM	REMARKS	PERSON(S) IN CHARGE
85-118	SIS MIXER	80-100 SSB	1.0	600	COOLED HORN-LENS + OFFSET PARABOLA	DUAL LINEAR	6 K	NUTATING SUBREFLECTOR	SINGLE-SIDEBAND MIXERS	PAYNE
130-170	SIS MIXER	100-180 SSB	NOT MEASURED	600	COOLED HORN-LENS + OFFSET PARABOLA	DUAL LINEAR	-	NUTATING SUBREFLECTOR	SINGLE-SIDEBAND MIXERS	PAYNE
200-300	SIS MIXER	150-400 SSB	NOT MEASURED	600	COOLED HORN-LENS	DUAL LINEAR	-	NUTATING SUBREFLECTOR	SINGLE-SIDEBAND FILTER IMAGE TERMINATED IN COLD LOAD	PAYNE

NRAO FRONT-END STATUS VERY LARGE ARRAY

FEBRUARY 1994

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FREQUENCY (MHz)	AMPLIFIER TYPE	SYSTEM TEMPERATURE (KELVIN)	3 dB BANDWIDTH (MHz)	FEED TYPE	POLARIZATION	CALIBRATION VALUE	SWITCHING SYSTEM	REMARKS	PERSON(S) IN CHARGE
74	UNCOOLED FET	~1200	0.8	PRIME	DUAL ORTHOGONAL CIRCULAR	120	NOISE INJECTION, 9.6 Hz, 50 PERCENT CYCLE.	ANTENNAS 3, 6, 7, 10, 14, 20, 21 & 28 (REMOVED UNTIL 95Q1)	LJJE
308-343	UNCOOLED FET	150	3 MHz (LIMITED BY INTERFERENCE)	PRIME FOCUS	DUAL ORTHOGONAL CIRCULAR	10	NOISE INJECTION, 9.6 Hz, 50 PERCENT CYCLE.		LJJE
1340-1730	COOLED HFET	35	55	CASSEGRAIN	DUAL ORTHOGONAL CIRCULAR	4	NOISE INJECTION, 9.6 Hz, 50 PERCENT CYCLE.		LJJE
4500-5000	COOLED HFET	60	55	CASSEGRAIN	DUAL ORTHOGONAL CIRCULAR	4	NOISE INJECTION, 9.6 Hz, 50 PERCENT CYCLE.		LJJE
8000-8800	COOLED HFET	35	55	CASSEGRAIN	DUAL ORTHOGONAL CIRCULAR	4	NOISE INJECTION, 9.6 Hz, 50 PERCENT CYCLE.		LJJE
14400-15400	COOLED FET	110	55	CASSEGRAIN	DUAL ORTHOGONAL CIRCULAR	7	NOISE INJECTION, 9.6 Hz, 50 PERCENT CYCLE.		LJJE
22000-24000	COOLED HFET	130	55	CASSEGRAIN	DUAL ORTHOGONAL CIRCULAR	10	NOISE INJECTION, 9.6 Hz, 50 PERCENT CYCLE.		LJJE
40000-50000	COOLED HFET	110	55	CASSEGRAIN	DUAL ORTHOGONAL CIRCULAR	7	NOISE INJECTION, 9.6 Hz, 50 PERCENT CYCLE.	7 ANTENNAS: 4, 8, 12, 14, 22, 25 & 27 (10 ANTENNAS BY DEC., 94) EFFICIENCY LOW, DEPENDS ON FREQUENCY	LJJE

NRAO FRONT-END STATUS VERY LONG BASELINE ARRAY

FEBRUARY 1994

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FREQUENCY (MHz)	AMPLIFIER TYPE	SYSTEM TEMPERATURE (KELVIN)	3 dB BANDWIDTH (MHz)	FEED TYPE	POLARIZATION	CALIBRATION VALUE	SWITCHING SYSTEM	REMARKS	PERSON(S) IN CHARGE
312-342	WARM FET	200	30	PRIME FOCUS	DUAL ORTHOGONAL CIRCULAR	10	NOISE INJECTION, 80 Hz, 50 PERCENT CYCLE.		LJJE
598-622	WARM FET	200	30 OR 4	PRIME FOCUS	DUAL ORTHOGONAL CIRCULAR	5	NOISE INJECTION, 80 Hz, 50 PERCENT CYCLE.		LJJE
1350-1750	COOLED HFET	30	128	CASSEGRAIN	DUAL ORTHOGONAL CIRCULAR	2	NOISE INJECTION, 80 Hz, 50 PERCENT CYCLE.		LJJE
2150-2350	COOLED HFET	35	128	CASSEGRAIN	DUAL ORTHOGONAL CIRCULAR	2	NOISE INJECTION, 80 Hz, 50 PERCENT CYCLE.		LJJE
4800-5100	COOLED HFET	40	128	CASSEGRAIN	DUAL ORTHOGONAL CIRCULAR	2	NOISE INJECTION, 80 Hz, 50 PERCENT CYCLE.		LJJE
8000-8800	COOLED HFET	37	128	CASSEGRAIN	DUAL ORTHOGONAL CIRCULAR	3	NOISE INJECTION, 80 Hz, 50 PERCENT CYCLE.		LJJE
10200-11200	COOLED FET	95	128	CASSEGRAIN	DUAL ORTHOGONAL CIRCULAR	3	NOISE INJECTION, 80 Hz, 50 PERCENT CYCLE.	PIE TOWN ONLY	LJJE
12000-15400	COOLED HFET	80	128	CASSEGRAIN	DUAL ORTHOGONAL CIRCULAR	4	NOISE INJECTION, 80 Hz, 50 PERCENT CYCLE.		LJJE
21700-24100	COOLED HFET	100	128	CASSEGRAIN	DUAL ORTHOGONAL CIRCULAR	5	NOISE INJECTION, 80 Hz, 50 PERCENT CYCLE.		LJJE
41000-45000	COOLED HFET	120	128	CASSEGRAIN	DUAL ORTHOGONAL CIRCULAR	8	NOISE INJECTION, 80 Hz, 50 PERCENT CYCLE.		LJJE

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