

NATIONAL RADIO ASTRONOMY OBSERVATORY  
Charlottesville, Virginia

Quarterly Report

October 1, 1976 - December 31, 1976

RESEARCH PROGRAMS

<u>140-Foot Telescope</u>	<u>Hours</u>
Scheduled observing	1842.25
Scheduled maintenance and equipment changes	160.50
Scheduled tests and calibration	120.25
Time lost due to: equipment failure	83.00
power	21.50
weather	35.75
interference	3.00

The following line programs were conducted during this quarter.

<u>Observer</u>	<u>Program</u>
J. Moran (Center for Astrophysics) R. Leach (Center for Astrophysics)	Observations at 1612 MHz to complete the measurements of Stokes parameters in U Orionis and to search for polarization in six Type II stars.
L. Rickard	Search for the 4 <sub>13</sub> -4 <sub>14</sub> transition of HNC <sub>2</sub> O at 1604 MHz in Sgr B and a few other selected sources known to have high density components.
K. Bechis (Massachusetts) A. Lane (Massachusetts)	Search for 1612 MHz OH maser emission from objects in the supposed nearby satellite galaxy.
R. Giovanelli (U. Bologna, Italy) M. Haynes (Indiana) T. Giuffrida (MIT)	Observations to confirm the detection of 1667 MHz OH in a high velocity cloud.
B. Zuckerman (Maryland) B. Turner	Observations at 9-cm wavelength to study the distribution of interstellar CH and an attempt to detect <sup>13</sup> CH.
L. Rickard	Attempt at 9-cm wavelength to detect SiH in a number of sources having strong CH lines.

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CHARLOTTESVILLE, VA.

JAN 19 1977

- W. Boughton (Illinois)      Observations at 9-cm wavelength of the  $C126\alpha$  and  $158\beta$  recombination lines toward Ori A and Ori B and of the  $H126\alpha$  recombination line toward W49B.
- B. Andrew (NRC, Canada)  
L. Avery (NRC, Canada)  
N. Broten (NRC, Canada)      Study of the structure and dynamics of the galactic center region by means of the three 9-cm hyperfine transitions of the CH radical.
- R. Brown  
M. Roberts      Search at 3169 MHz for  $H_2CO$  absorption in AO 0235+164.
- R. Brown      Observations at 2-cm wavelength to search for the  $000-1_{01}$  transition of redshifted HNC0 (isocyanic acid) in AO 0235+164.
- F. J. Lockman  
R. Brown      Observations of  $He76\alpha$  at 14.696 GHz and  $H76\alpha$  at 14.690 GHz to study the helium abundance in galactic HII regions.
- N. Fourikis (CSIRO, Australia)  
K. Takagi (U. Toyama, Japan)      Observations of the following  $CH_3NHD$  (deuterated methylamine) transitions:  
the A,  $2_{02}^{(-)}-1_{10}^{(+)}$  transition at 14.42 GHz,  
and the  $2_{02}^{(+)}-1_{10}^{(-)}$  transition at 10.3 GHz.
- W. Ruml (Wisconsin)  
L. Rickard      Observations to confirm the detection of the  $C^{+134}\alpha$  line at 10.82 GHz and to check for the neighboring  $C^{+135}\alpha$  line at 10.58 GHz in Ori A.
- R. Whitehurst (Alabama)  
M. Roberts      Observations in the range of 250-500 MHz to search for the hyperfine line from a quark-electron pair.
- M. Haynes (Indiana)  
M. Roberts  
A. Rots      Search at 1421 MHz for HI satellites near galaxies.
- F. J. Lockman (DTM)      Search near 500 MHz for recombination lines from a few close spiral galaxies and observations to obtain the integrated low frequency recombination line profile from the Rosette nebula in the frequency range 250-500 MHz.

<u>Observer</u>	<u>Program</u>
P. Palmer (Chicago) B. Zuckerman (Maryland) T. Cram	Study at 1421 MHz of some possible new, high velocity hydrogen clouds.
G. Knapp (Caltech) R. Brown	Observations at 21-cm wavelength to search for the $166\alpha$ and $167\alpha$ series of recombination lines in a number of dark clouds.

The following continuum programs were conducted.

<u>Observer</u>	<u>Program</u>
J. Peebles (Princeton) D. Wilkinson (Princeton) L. Rudnick	A search at 2-cm wavelength for the plasma in clusters of galaxies using the scattering of 2.7 K radiation.
R. Porcas L. Rudnick	Observations at 2-cm wavelength of the spectra and time variability of selected groups of radio sources.
J. Dickel (Illinois)	Observations at 9-cm wavelength to map the polarization distribution in the supernova remnant HB9.

The following very long baseline programs were conducted.

<u>Observer</u>	<u>Program</u>
R. Mutel (Iowa) J. Weisberg (Iowa) S. Spangler	Observations at 18-cm wavelength to investigate interplanetary turbulence near the sun by observing toward 3C 273 and 3C 279 during small solar elongations, using the Fort Davis 85-foot telescope, the NAIC 1000-foot telescope, and the NRAO 140-foot telescope.
T. Clark (Goddard) R. Coates (Goddard) D. Robertson (Goddard) W. Webster (Goddard) J. Ryan (Goddard) C. Counselman (MIT) J. Wittels (MIT) I. Shapiro (MIT) L. Hutton (Maryland)	Observations at 8.4 GHz to measure the positions of and study the small-scale kinematics of the nuclei of various types of radio sources, to improve and validate the geodetic capabilities of VLB techniques, and to validate new VLB instrumentation and techniques using the Haystack 120-foot, the OVRO 130-foot, and the NRAO 140-foot telescopes.

<u>Observer</u>	<u>Program</u>
(continued)	
C. Ma (Maryland)	
H. Hinteregger (Haystack)	
C. Knight (Haystack)	
A. Rogers (Haystack)	
A. Whitney (Haystack)	
J. Moran (Center for Astrophysics)	
H. Penfield (Center for Astrophysics)	
G. Resch (JPL)	
D. Trask (JPL)	
A. Niell (JPL)	
K. Kellermann	Studies at 8.4 GHz of the structure and time variations of weak, central components found in extended sources using the Haystack 120-foot telescope and the NRAO 140-foot telescope.
D. Shaffer	
J. Yen (Toronto, Canada)	Observations at 2.8-cm wavelength, using the Algonquin, Canada 150-foot telescope and the NRAO 140-foot telescope, with the 140 foot data transmitted from the NRAO 85-1 telescope to the Canadian CTS geostationary satellite, and thence to Algonquin, Canada to permit on-line data analysis.
N. Broten (NRC, Canada)	
D. Fort (NRC, Canada)	
G. Swenson (Illinois)	
S. Knowles (NRL)	
W. Waltman (NRL)	
K. Kellermann	
B. Rayhrer	
K. Lo (Caltech)	Observations at 6-cm wavelength of the compact radio source in the galactic center, using the NRL 85-foot and the NRAO 140-foot telescopes.
M. Cohen (Caltech)	
K. Johnston (NRL)	
K. Kellermann	Observations at 6-cm wavelength to follow the changing structure of 3C 84, using the Fort Davis 85-foot telescope, the OVRO 130-foot telescope, and the NRAO 140-foot telescope.
D. Shaffer	
E. Preuss (MPIR, Bonn, W. Germany)	Observations at 2.8-cm wavelength of compact nuclei of extended radio sources using the MPIR, Bonn, W. Germany 100-meter telescope and the NRAO 140-foot telescope.
I. Pauliny-Toth (MPIR, Bonn, W. Germany)	
K. Kellermann	
D. Shaffer	

<u>Observer</u>	<u>Program</u>
K. Kellermann D. Shaffer	Observations of the galactic center at 8.4 GHz, using the Haystack 120-foot and the NRAO 140-foot telescopes.

In addition to the above programs, P. Palmer (Chicago) and B. Zuckerman (Maryland) completed a search near 1421 MHz for extraterrestrial intelligence, and T. Clark (Goddard), D. Black (Ames), J. Cuzzi (Ames), and J. Tarter (Ames) conducted high-resolution spectral observations at 8.5 GHz to search for extraterrestrial intelligence.

<u>Interferometer</u>	<u>Hours</u>
Scheduled observing	1908.00
Scheduled maintenance	111.50
Scheduled tests and calibration	119.50
Time lost due to: equipment failure	78.50
power	8.00
weather	41.75
interference	0.00

The use of the 45-foot telescope over a 35-km baseline (usually as a fourth element) is indicated in the program descriptions.

The following continuum programs were conducted at 2695 and 8085 MHz unless otherwise indicated.

<u>Observer</u>	<u>Program</u>
D. Backer (California, Berkeley) R. Sramek (NAIC, Puerto Rico)	Proper motion and parallax studies of pulsars and radio stars using the 45-foot telescope.
R. Porcas	Study of the structure of sources from the Jodrell Bank Mk IA survey to help with identification and to determine the spectral indices of their structure, using the 45-foot telescope.
J. Wardle (Brandeis) R. Potash (Brandeis)	Study of the structure, polarization, and spectra of a complete sample of quasars for which there exists accurate optical data.
M. Gearhart (Ohio State) E. Pacht (Ohio State) P. Kronberg (MPIR, Bonn, W. Germany)	Measurement of accurate positions and linear polarization of twenty 4C and Ohio State radio sources.

<u>Observer</u>	<u>Program</u>
D. Altschuler (Maryland) J. Wardle (Brandeis)	Monitor the variability of flux and polarization in approximately 80 sources.
M. Normandin (Toronto, Canada) P. Kronberg (MPIR, Bonn, W.Germany)	Linear polarization observations of quasi-stellar objects and radio galaxies with measured redshift.
C. Hazard (Inst. of Astronomy, Cambridge, England) J. Condon (VPI & SU)	Measurement of accurate positions of sources selected from the Molonglo 408 MHz survey.
L. Dressel (Virginia) J. Condon (VPI & SU)	Study at 2695 MHz the structure of 120 galaxies found in a survey of optically selected galaxies.
J. Stocke (Arizona) W. Tifft (Arizona)	Study of the spatial structure in the radio emission from isolated pairs of galaxies.
R. Hjellming B. Clark R. Brown	Observations coordinated with the NRAO Very Large Array to determine the spectrum of variable radio stars using the 45 foot.
J. Scott (Maryland) J. Stocke (Arizona) A. Pacholczyk (Arizona)	Detailed observations of known and probable radio-tailed galaxies.
D. Gibson (Jodrell Bank, England) F. Owen	Continuation of a survey to study the radio properties of RS CVn binaries.
K. Lang (Tufts)	Study of small-scale magnetic field structures in active solar regions using the 45-foot telescope.
W. Cotton (MIT) S. Spangler	Observations to monitor the variability--at these frequencies--of extragalactic radio sources which are known or probable variables at 365 MHz.
F. Owen R. Porcas	Measurements of the structures of quasars selected from the 966 MHz Jodrell Bank survey, using the 45-foot telescope.
W. Jaffee (Inst. for Advanced Study, Princeton)	Study of the sizes of the bright radio galaxies in the Coma cluster.

<u>Observer</u>	<u>Program</u>
R. Spencer (Jodrell Bank, England) J. Wardle (Brandeis)	Observations to measure the angular diameters of a sample of very weak quasars, using the 45 foot.
R. Spencer (Jodrell Bank, England)	Study of the radio "cores" in selected sources, using the 45-foot telescope.

During this quarter, the 85-1 telescope was used as a radio relay link for VLB data from the NRAO 140-foot telescope to the Canadian CTS geostationary satellite and thence to Algonquin, Canada to permit real-time data analysis.

<u>300-Foot Telescope</u>	<u>Hours</u>
Scheduled observing	1981.50
Scheduled maintenance and equipment changes	146.50
Scheduled tests and calibration	6.00
Time lost due to: equipment failure	54.50
power	4.25
weather	10.00
interference	4.75

The following line programs were conducted during this quarter.

<u>Observer</u>	<u>Program</u>
G. Knapp (Caltech) S. Faber (California, Santa Cruz) J. Gallagher (Minnesota)	Deep survey for 21-cm hydrogen in E and SO galaxies.
T. Thuan (Virginia) G. Knapp (Caltech)	Observations of 21-cm hydrogen redshifts in approximately 350 single galaxies.
B. Balick (Washington) W. Sullivan (Washington) T. Heckman (Washington)	Search for 21-cm hydrogen--both in emission and absorption in Seyfert galaxies and in radio galaxies.
R. Giovanelli (U. Bologna, Italy) M. Haynes (Indiana)	Study at 1421 MHz the small-scale hydrogen structure in high velocity clouds.
A. Wolfe (Pittsburgh) H. Liszt W. Brundage	Observations at several discrete frequencies between 1018 and 1094 MHz to search for redshifted hydrogen and OH absorption lines in four quasistellar objects.

<u>Observer</u>	<u>Program</u>
P. Crane (MIT) A. Haschick (MIT)	Study of the variability of 21-cm hydrogen absorption in 3C 84.
R. Giovanelli (U. Bologna, Italy)	Search for 21-cm hydrogen emission at very high LSR velocities between $\ell = 80^\circ$ and $\ell = 110^\circ$ around the galactic plane.
P. Crane (MIT) A. Haschick (MIT) A. Rots	Observations of 21-cm hydrogen toward what is thought to be a newly discovered galaxy.
S. Perrenod (Center for Astrophysics) E. Chaisson (Center for Astrophysics) G. Field (Center for Astrophysics)	Search at 350-450 MHz for redshifted 21-cm hydrogen absorption in high redshift radio quasars.
A. Marscher (Virginia) R. Brown	Search at 740-1000 MHz for high redshift 21-cm hydrogen absorption in quasars.

The following continuum programs were conducted.

<u>Observer</u>	<u>Program</u>
P. Gregory (British Columbia, Canada) E. Seaquist (Toronto, Canada)	Search at 6-cm wavelength for emission from early-type stars, and other selected stars.
D. Gibson (Jodrell Bank, England) F. Owen R. Hulse S. Spangler	Observations of close binary systems at 5 GHz.
W. Cotton (MIT) S. Spangler	Observations at 265, 320, 365, and 430 MHz to monitor variable sources selected from the U. Texas interferometer survey.
J. Burns (Indiana) F. Owen	Observations of Zwicky clusters of galaxies at 2695 MHz.
W. Dent (Massachusetts) J. Kapitzky (Massachusetts) T. Balonek (Massachusetts) M. Hartman (Massachusetts)	Polarization and flux density measurements of variable radio sources at 2695 MHz.



<u>Observer</u>	<u>Program</u>
J. Armstrong S. Spangler	Observations at 385 MHz to search for interstellar scintillation of selected low frequency variable sources.

The following pulsar programs were conducted.

<u>Observer</u>	<u>Program</u>
R. Hulse	Search at 390 MHz for new, high latitude pulsars.
J. Taylor (Massachusetts) D. Helfand (Massachusetts) P. Backus (Massachusetts) L. Fowler (Massachusetts)	Observations of the positions, proper motion, and timing of known pulsars and a search for new pulsars at 410 and 418 MHz.

The following very long baseline observations were conducted.

<u>Observer</u>	<u>Program</u>
J. Broderick (VPI & SU) J. Condon (VPI & SU) A. Wolfe (Pittsburgh) K. Johnston (NRL)	Observations of AO 0235+164 at 932 MHz to examine the recently detected hydrogen absorption feature using the NAIC 1000-foot telescope and the NRAO 140-foot telescope.

<u>36-Foot Telescope</u>	<u>Hours</u>
Scheduled observing	1912.50
Scheduled maintenance and equipment changes	125.50
Scheduled tests and calibration	111.00
Time lost due to: equipment failure	76.75
power	3.25
weather	60.25
interference	1.75

<u>Observer</u>	<u>Program</u>
M. Allen (Inst. for Space Studies) G. Knapp (Caltech)	Relative abundances of CO and CN in interstellar clouds.
R. Brown (Monash, Australia) P. Godfrey (Monash, Australia) J. Storey (California, Berkeley) H. Gunn (Monash, Australia)	Search for DNC in the interstellar medium.

<u>Observer</u>	<u>Program</u>
R. Brown (Monash, Australia) P. Godfrey (Monash, Australia) J. Storey (California, Berkeley) H. Gunn (Monash, Australia)	Further studies of the isotope $H^{15}NC$ .
M. Cohen (California, Berkeley)	Search for nebulosity around young objects.
R. Cohen (Columbia) P. Thaddeus (Inst. for Space Studies) H. Cong (Columbia)	Maps of CO, CS, and HCN in molecular clouds associated with Pleiades and Cygnus X.
W. Dent (Massachusetts) R. Hobbs (Goddard)	Flux density variations of variable extra- galactic radio sources.
P. Encrenaz (Observatoire de Paris, France) R. Lucas (Observatoire de Paris, France) L. Welachew (Observatoire de Paris, France)	Study of CO distribution in M81.
E. Epstein (Aerospace) N. Woolf (Arizona)	Measurements of intra-day flux variations.
K. Fox (Tennessee) D. Jennings (Inst. for Space Studies)	Search for methane.
W. Gilmore (Maryland) P. Bowers (Maryland)	Search for CO on oxygen-rich variable stars.
R. Giovanelli (U. Bologna, Italy) M. Haynes (Indiana)	Search for CO emission from high-velocity clouds.
M. Guelin (Inst. for Space Studies) P. Thaddeus (Inst. for Space Studies)	Observations of $C_3N$ and search for $C_4H$ and $C_2N$ .
J. Hollis D. Buhl (Goddard) L. Snyder (Illinois) B. Ulich	Search for $CH_3C_3N$ and $CO^+$ .
D. Johnson (NBS) F. Lovas (NBS) F. Clark (Kentucky)	Measure of the Q branch transitions of dimethyl ether.

<u>Observer</u>	<u>Program</u>
T. Kuiper (JPL) E. Kuiper (California, L.A.) B. Zuckerman (Maryland)	Study of line profiles in young objects.
M. Kutner (Rensselaer) K. Tucker (Fordham)	Search for interstellar furan.
D. Lambert (Texas) P. Vanden Bout (Texas)	Study of CO and SiO in the expanding shell around Alpha Orinois.
H. Liszt W. B. Burton	Maps of the galactic center in CS.
H. Liszt S. Mufson (Marshall Space Flight Center) M. Kaifu (U. Tokyo, Japan)	Study of NCO emission.
K. Lo (California, Berkeley) G. Knapp (Caltech) N. Evans (Texas) R. Redman (Caltech)	Survey of CO in Herbig-Haro objects.
K. Lo (California, Berkeley) M. Morris (Caltech)	Study of CO in late-type galaxies.
T. Phillips (Bell Labs) N. Scoville (Massachusetts)	Observations of 1.3 mm transitions of $\text{H}_2^{18}\text{O}$ , NO, $\text{H}_2\text{S}$ and HD0.
T. Phillips (Bell Labs) M. Rowan-Robinson (Queen Mary College, England)	Search for CO in external galaxies.
P. Schwartz (NRL) J. Waak (NRL)	Search for continuum emission from radio-quiet quasars with low red shifts.
B. Turner A. Kislyakov (Gorky Radio Physical Inst., USSR)	Confirmation of ketene detection and studies of cyanamide.

## ELECTRONICS DIVISION

Charlottesville

Work is continuing on the VLB Mark III system. The objective is to have sufficient equipment built and tested to run a VLB experiment between Green Bank and Haystack mid-1977.

Development of Model 4 autocorrelator is continuing.

Testing of U.Va. Josephson junction devices has continued, and at the moment is directed towards getting reliable DC operation of the device when mounted in a 100 GHz mount at a temperature of 4 K.

A subharmonically pumped mixer for 230 GHz is being developed. This type of mixer is attractive because it is driven at half the signal frequency and consequently sufficient LO signal can be supplied using currently available klystrons.

The Tucson operation has been supported with the supply of diode assemblies for all the cooled mixer receivers. An evaluation of the assembly has been made in order to improve the reliability of operation when cooled.

Tucson

During this quarter several projects have been completed and tested at the telescope.

A quasi-optical polarizer has been constructed for 100 GHz. Rotation of a quarter wave plate that is positioned in front of the receiver feed switches the receiver between RH circular and LH circular polarizations. The addition of a second plate allows the receiver to switch between orthogonal linear polarizations. The switching rate is 0.5 Hz which proves to be sufficiently fast for continuum work under good atmospheric conditions. The polarizer has been tested in both modes on the telescope and gives good performance. Several more plates are being constructed for different frequencies.

The 9 mm, four-channel receiver has been tested on the telescope. The double sideband noise temperature of the four channels was somewhat better than anticipated, varying from 450 K to 500 K. The bandwidth of each channel is 1.1 GHz. The receiver performed well on the telescope although the overall sensitivity was somewhat less than we had anticipated. The reasons for this are currently being investigated.

The 128 channel, 30 kHz filter bank has been tested at the telescope and performs well.

The 33-50 GHz/80-120 GHz receiver is almost finished, and if no further diode problems are encountered it should be complete within the next three months. This receiver has been modified to permit the mounting of a high-frequency room temperature mixer on top of the dewar enabling us to take advantage of the low noise I.F.

A 130-170 GHz room temperature mixer receiver with cooled I.F. amplifier is currently being assembled, and should be available for evaluation soon.

### Green Bank

Improvements have been made on the 6/25 cm and 9 cm receivers after the first observing sessions.

The electronics for the 300-foot telescope tower level is complete and awaits integration with the computer. Nearly all of the interface electronics are constructed between the 140-foot on-line Modcomp and existing equipment. Mark III VLB terminal I.F. electronics work is well underway.

The superconducting magnet and refrigerator for the first NRAO-built 18-25 GHz maser were delivered by cryogenics and the Green Bank shop in December. The AIL study of an 8 to 11 GHz upconverter is going more slowly than expected, but shows promise of a working system. Parts procurement and design of the NAIC 6/25 cm receiver is proceeding.

A complete overhaul was performed on the cooled 21-cm receiver and some housecleaning was done on the 250-500 MHz receiver to improve its sensitivity.

Design and performance studies of a C-band upconverter, waveguide losses, and Cassegrain feeds were begun this quarter.

## ENGINEERING DIVISION

Routine engineering assistance was provided Green Bank, Charlottesville, and Tucson operations. Field engineering support was given the VLA project. Conceptual design and research continued for a 25-meter millimeter telescope structure, astrodome, surface panels, and radome materials. Further research along with modification of the design and specifications of a deformable sub-reflector for the 140-foot telescope was continued.

## COMPUTER DIVISION

300-foot telescope - An on-line data processing system will be installed at the 300-foot telescope. The system will be nearly identical to that now in use at the 140-foot telescope. The computer has been procured. Installation will be scheduled for late spring.

VLA post-processing - Work has begun on preparing programs for VLA post-processing. The eventual task will be to develop programs to analyze data, particularly map data, prepared by the DEC 10 at the site. For the present, however, efforts are concentrated on preparing programs similar to the Green Bank interferometer package to aid in the test and calibration of the instrument. These programs will be used for approximately one year.

140-foot telescope - Work is progressing on the software for the replacement of the DDP 116 control computer. Installation of the new system is planned for spring of 1977.

- The first edition of a manual describing the operation of the on-line data processing system has been completed, and will be available soon.

Optical/hybrid processor - A design review was held between personnel from NRAO and ERIM (Environmental Research Institute of Michigan) in mid-December. The design work should be completed in the next few months. The special processor is being investigated for use with the VLA data.

## VLA PROGRAM

Antennas No. 7 and No. 8 were accepted from E-Systems during the fourth quarter, and the electronic outfitting of antenna No. 6 has been completed. On October 18, 1976 a four-element array obtained first fringes. On December 9, 1976 a five-element array was successfully operated. Following this, station BW8 was occupied by an antenna, and on December 12, 1976 the five-element array operated with maximum spacing on a 5.2 km baseline.

The Electronics Division has successfully completed the redesign of the L-2 and L-3 modules of the local oscillator system. The measured phase stability has improved by a factor of 10 over the previous design.

The Phase III construction is now 99% complete, with the subcontractor mainly involved in final alignment of the wye trackage. The waveguide installation is now completed along the southwest arm from the center of the wye to station BW8.

An open house for the public was held on Saturday, November 7, 1976 with over 2000 people attending.

## PERSONNEL

### Appointments

Hernan Quintana	Research Associate	10/11/76
R. Carl Bignell	Mathematician (VLA)	10/18/76

Appointments (continued)

Richard J. Lacasse	Electronics Engineer I	11/01/76
Albert K. Y. Wu	Electronics Engineer I	11/03/76
Patrick C. Crane	Research Associate	12/06/76

Terminations

William E. Howard	Asst. Director, Green Bank Operations/Scientist	12/31/76
Arnoldus H. Rots	Research Associate	12/31/76

## JANSKY LECTURE

Professor Edward M. Purcell delivered the Eleventh Annual Karl G. Jansky Lecture on November 10, 1976 in Charlottesville. His lecture topic was "A Story of Spinning Particles, from Protons and Electrons to Interstellar Dust".

Professor Purcell, Gerhard Gade University Professor at Harvard University, is an experimental physicist known chiefly for his work in nuclear magnetism and radio astronomy. Purcell shared the 1952 Nobel Prize in Physics with Felix Bloch of Stanford for their independent discovery of nuclear magnetic resonance. Most of his career has been spent at Harvard, where he received his Ph.D. in 1938.

Professor Purcell has served on several national advisory committees. He has been involved in innovations in physics teaching and was awarded the Oersted Medal of the American Association of Physics Teachers in 1968. In 1970 he was president of the American Physical Society. He is a member of the National Academy of Sciences, the American Philosophical Society, and the American Academy of Arts and Sciences.

A list of Observatory reprints issued since January 1, 1976

No.	Title	Author	Reference
SERIES A			
494	Gravitational Deformation and Astigmatism of Tilttable Radio Telescopes	S. von Hoerner W. Y. Wong	<u>IEEE Trans. Ant. Prop.</u> , AP-23, 689-695, 1975.
495	Observations of Quasi-Thermal and Maser Phenomena in Rotationally Excited OH. I.	L. J. Rickard B. Zuckerman P. Palmer	<u>Astrophys. J.</u> , 200, 6-21, 1975.
496	5-GHz Survey of Bright Galaxies	R. Sramek	<u>Astron. J.</u> , 80, 771-777, 1975.
497	18-cm Visibility Functions of High-Frequency Compact Sources	D. B. Shaffer R. T. Schilizzi	<u>Astron. J.</u> , 80, 753-758, 1975.
498	Recombination Line Observations of a Normal Helium Abundance in the Galactic-Center H II Region Sagittarius B2	R. L. Brown F. J. Lockman	<u>Astrophys. J.</u> , 200, L155-L159, 1975.
499	Detection of 2.6-Millimeter Radiation Probably Due to Nitrogen Sulfide	T. B. H. Kuiper B. Zuckerman R. K. Kakar E. N. R. Kuiper	<u>Astrophys. J.</u> , 200, L151-L153, 1975.
500	An Unusually Strong Radio Outburst in Algol: Flux Density, Spectral, and Polarization Observations	D. M. Gibson M. R. Viner S. D. Peterson	<u>Astrophys. J.</u> , 200, L143-L145, 1975.
501	Constraints on the Molecular Properties of Interstellar X-Ogen Derived from Radio Observations	J. M. Hollis L. E. Snyder D. Buhl P. T. Giguere	<u>Astrophys. J.</u> , 200, 584-593, 1975.
502	High-Resolution, Multifrequency Radio Observations of M82	P. P. Kronberg P. N. Wilkinson	<u>Astrophys. J.</u> , 200, 430-438, 1975.



No.	Title	Author	Reference
503	Detection of an Additional Hydrogen Recombination Line Source at the W49A Position	A. Parrish	<u>Astrophys. J., 200</u> <u>594-597, 1975.</u>
504	An Interpretation of the Radio Outbursts of Cygnus X-3	A. P. Marscher R. L. Brown	<u>Astrophys. J., 200</u> <u>719-726, 1975.</u>
505	Variable Radio Emission from UX Arietis (HD 21242)	D. M. Gibson R. M. Hjellming F. N. Owen	<u>Astrophys. J., 200</u> <u>L99-L102, 1975.</u>
506	The Relative Positions of the OH and H <sub>2</sub> O Masers in W49N and W3(OH)	G. L. Mader K. J. Johnston J. M. Moran S. H. Knowles S. A. Mango P. R. Schwartz W. B. Waltman	<u>Astrophys. J., 200</u> <u>L111-L114, 1975.</u>
507	The Detection of Carbon Monoxide Emission in Planetary Nebulae	S. L. Mufson J. Lyon P. A. Marionni	<u>Astrophys. J., 201,</u> <u>L85-L89, 1975.</u>
508	The Transfer of Radio Recombination Line Radiation Through a Cold Gas. I. Hydrogen and Helium Lines in Compact H II Regions	R. L. Brown J. Gómez-González	<u>Astrophys. J., 200</u> <u>598-608, 1975.</u>
509	Spectral Intensity Dependence and Isotropy of Sources Stronger than 0.1 Jy at 2700 MHz	T. J. Balonek J. J. Broderick J. H. Condon D. F. Crawford D. L. Jauncey	<u>Astrophys. J., 201,</u> <u>20-25, 1975.</u>
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