

National Radio Astronomy Observatory  
Charlottesville, Virginia

Quarterly Report

October 1, 1975 - December 31, 1975

RESEARCH PROGRAMS

| <u>140-foot Telescope</u>                   | <u>Hours</u> |
|---------------------------------------------|--------------|
| Scheduled observing                         | 1760.50      |
| Scheduled maintenance and equipment changes | 334.00       |
| Scheduled tests and calibration             | 57.50        |
| Time lost due to: equipment failure         | 56.75        |
| power                                       | 0.00         |
| weather                                     | 8.75         |
| interference                                | 6.75         |

The following line programs were conducted during this quarter.

| <u>Observer</u>                                                           | <u>Program</u>                                                                                                                                                                                                                                          |
|---------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| B. Turner                                                                 | Continuation of a survey of the galaxy at all four 18-cm lines of OH.                                                                                                                                                                                   |
| L. DeNoyer (Colgate)                                                      | Observations of 18-cm recombination lines in interstellar clouds near supernova remnants.                                                                                                                                                               |
| P. Myers (MIT)<br>M. Schneps (MIT)<br>P. Crane (MIT)                      | Observations of 18-cm OH to map six dark clouds, to search for a systematic velocity pattern in an apparent ring of dark clouds in Sagittarius, and to conduct a pilot search of Air Force Cambridge Laboratory infrared sources for OH maser emission. |
| M. Kutner (Rensselaer)<br>R. Dickman (Columbia)                           | Observations of 14.488 GHz H <sub>2</sub> CO (formaldehyde) in interstellar clouds for comparison with visual extinction and CO abundance.                                                                                                              |
| M. Kutner (Rensselaer)<br>K. Tucker (Fordham)<br>N. Evans (Texas, Austin) | Observations of 14.488 GHz H <sub>2</sub> CO in the molecular ridge north of Ori A.                                                                                                                                                                     |

RADIO ASTRONOMY OBSERVATORY  
CHARLOTTESVILLE, VA.

JAN 19 1976

| <u>Observer</u>                                                                                                                                    | <u>Program</u>                                                                                                                                        |
|----------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| W. Peters (Texas, Austin)<br>G. Blair (Texas, Austin)                                                                                              | Observations at 14.488 GHz of H <sub>2</sub> CO in carbon monoxide concentrated areas of molecular clouds which exhibit line broadening.              |
| L. Rickard                                                                                                                                         | Observations at 4830 MHz to search for H <sub>2</sub> CO absorption in galaxies.                                                                      |
| P. Thaddeus (Inst. for Space Studies)<br>R. Cohen (Columbia)                                                                                       | Observations at 4830 MHz and 4926 MHz to measure H <sub>2</sub> CO and to search for C109 $\alpha$ in a molecular cloud associated with the Pleiades. |
| R. Giovanelli (Indiana)<br>M. Haynes (Indiana)<br>T. Cram                                                                                          | Measurements of 21-cm neutral hydrogen profiles in the direction of hot stars whose UV spectra have been measured by OAO-3.                           |
| R. Tully (Hawaii)<br>J. R. Fisher                                                                                                                  | Extension of a 21-cm neutral hydrogen survey of galaxies to declinations south of those attainable at the 300-foot telescope.                         |
| S. Simonson (Maryland)<br>R. Sinha (Maryland)                                                                                                      | Extension of a 21-cm neutral hydrogen survey within 20° of the galactic center to latitudes of $\pm 4^\circ$ .                                        |
| P. Schwartz (NRL)<br>D. Thacker (NRL)<br>J. Dowell (International Research and Technology Corp.)                                                   | Search at 19.5-cm wavelength for vibrationally excited OH in OH maser sources.                                                                        |
| B. Baud (Leiden, Netherlands)<br>H. Habing (Leiden, Netherlands)<br>H. Matthews (MPIR, Munich, W. Germany)<br>A. Winnberg (MPIR, Bonn, W. Germany) | Observations at 1612 MHz of the galactic center region to survey the distribution of type IIb OH maser sources.                                       |
| G. Rossano (Maryland)                                                                                                                              | Measurements at 6-cm wavelength of H109 $\alpha$ and H110 $\alpha$ recombination lines in the Rosette Nebula.                                         |

| <u>Observer</u>                                                    | <u>Program</u>                                                                                                                                               |
|--------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| G. Knapp (Caltech)<br>R. Brown                                     | Observations of 18-cm OH near early type stars which are embedded in dark clouds.                                                                            |
| V. Rubin (DTM)<br>N. Thonnard (DTM)<br>W. Ford (DTM)<br>M. Roberts | Observations at 21-cm wavelength to search for neutral hydrogen in 12-14 magnitude spiral galaxies and to map high velocity hydrogen in the vicinity of WLM. |

The following continuum programs were conducted.

| <u>Observer</u>                                                                     | <u>Program</u>                                                                                                                                |
|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| W. Altenhoff (MPIR, Bonn,<br>W. Germany)                                            | Observations at 2-cm wavelength to assist in the investigation of partially ionized hydrogen in the galactic background.                      |
| L. Rudnick                                                                          | Mapping at 14.465 GHz of galactic clusters to a lower limit of 10 mJy.                                                                        |
| S. Gottesman (Florida)<br>F. Maloney (Florida)                                      | Observations of the Venusian occultation of 4C 06.34 at 6-cm wavelength.                                                                      |
| C. Crannell (NASA, Goddard)<br>R. Hobbs (NASA, Goddard)<br>S. Maran (NASA, Goddard) | Observations at 1400 MHz and 1700 MHz of UV Ceti type flare stars coordinated with X-ray, optical, and other radio observations.              |
| G. Rossano (Maryland)                                                               | Observations of the Rosette Nebula at 6-cm wavelength.                                                                                        |
| A. Prakash (Cornell)<br>G. Zeissig (Puerto Rico)                                    | Observations at 1410 MHz of scintillations of an extragalactic radio source induced by Saturnian magnetospheric plasma during an occultation. |

The following very long baseline observations were conducted.

| <u>Observer</u>                                                                                                | <u>Program</u>                                                                                                                                                    |
|----------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| T. Clark (NASA, Goddard)<br>R. Coates (NASA, Goddard)<br>J. Ryan (NASA, Goddard)<br>W. Webster (NASA, Goddard) | Observations at 7.8 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 |

ObserverProgram

(continued)

|                                    |                                            |
|------------------------------------|--------------------------------------------|
| C. Counselman (MIT)                | the capabilities of VLB techniques, and    |
| H. Hinteregger (MIT)               | to validate new VLB instrumentation        |
| D. Robertson (MIT)                 | and techniques using the NASA Goldstone    |
| J. Wittels (MIT)                   | 210-foot telescope, the Haystack 120-      |
| I. Shapiro (MIT)                   | foot telescope, and the NRAO 140-foot      |
| L. Hutton (Maryland)               | telescope.                                 |
| C. Ma (Maryland)                   |                                            |
| 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)                     |                                            |
|                                    |                                            |
| M. Cohen (Caltech)                 | Observations at 2.8-cm wavelength to       |
| R. Schilizzi (Caltech)             | monitor 3C 120 to observe structure and    |
| G. Seielstad (Caltech)             | flux changes using the OVRO 130-foot       |
| A. Maxwell (Harvard, Fort Davis)   | telescope, the Harvard, Fort Davis 85-     |
| D. Shaffer                         | foot telescope and the NRAO 140-foot       |
| K. Kellermann                      | telescope.                                 |
|                                    |                                            |
| B. Rönäng (Onsala Space            | Observations at 18-cm wavelength of the    |
| Observatory, Sweden)               | small-scale structure in a number of       |
| R. Schilizzi (Caltech)             | radio galaxies and quasars using the       |
| D. Shaffer                         | Onsala, Sweden 84-foot telescope, the      |
|                                    | OVRO 130-foot telescope, and the NRAO      |
|                                    | 140-foot telescope.                        |
|                                    |                                            |
| J. Romney (Caltech)                | Observations at 1421 MHz to study the      |
|                                    | redshifted HI absorption line in 3C 84     |
|                                    | using the MPIR, Bonn, W. Germany 100-      |
|                                    | meter telescope, the OVRO 130-foot tele-   |
|                                    | scope, and the NRAO 140-foot telescope.    |
|                                    |                                            |
| M. Cohen (Caltech)                 | Observations at 18-cm wavelength to        |
| K. Kellermann                      | survey sources to select candidates for    |
| D. Shaffer                         | further detailed study and to select       |
|                                    | calibrators using the OVRO 130-foot        |
|                                    | telescope and the NRAO 140-foot telescope. |

| <u>300-foot Telescope</u>                   | <u>Hours</u> |
|---------------------------------------------|--------------|
| Scheduled observing                         | 1886.50      |
| Scheduled maintenance and equipment changes | 141.25       |
| Scheduled tests and calibration             | 119.25       |
| Time lost due to: equipment failure         | 105.50       |
| power                                       | 0.00         |
| weather                                     | 0.00         |
| interference                                | 2.50         |

The following line programs were conducted during this quarter.

| <u>Observer</u>                                                                                      | <u>Program</u>                                                                                                                                                    |
|------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| R. Whitehurst (Alabama)<br>M. Roberts                                                                | Continued search for absorption or emission from a quark--electron hyperfine transition over the range of 200-300 MHz.                                            |
| M. Roberts<br>D. De Young                                                                            | Survey for 21-cm neutral hydrogen within or near radio galaxies.                                                                                                  |
| M. Haynes (Indiana)<br>R. Giovanelli (Indiana)                                                       | Observations of ring structure in high-velocity complexes of neutral hydrogen at 21-cm wavelength.                                                                |
| R. Tully (Hawaii)<br>J. R. Fisher                                                                    | Survey for nearby galaxies by the measurement of 21-cm neutral hydrogen.                                                                                          |
| R. Whitehurst (Alabama)<br>J. Soukup (City College of N.Y.)<br>W. B. Burton<br>M. Roberts<br>T. Cram | Measurements at 21-cm of a possible neutral hydrogen envelope around the Galaxy.                                                                                  |
| A. Rots                                                                                              | Measurements of 21-cm neutral hydrogen distribution in spiral galaxies having angular diameters greater than nine minutes of arc and less than 35 minutes of arc. |
| K. Lo (Caltech)<br>J. R. Fisher                                                                      | Survey of 21-cm neutral hydrogen from approximately 200 Markarian galaxies.                                                                                       |
| J. Soukup (City College of N.Y.)                                                                     | Observations of 21-cm neutral hydrogen to investigate the longitude extent and continuity of the high-velocity extension of spiral arms in the galaxy.            |

| <u>Observer</u>                                                         | <u>Program</u>                                                                                                                           |
|-------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| H. Rood (Michigan State)<br>J. Dickel (Illinois)                        | Investigate masses of groups of galaxies by the measurement of 21-cm neutral hydrogen.                                                   |
| B. Zuckerman (Maryland)                                                 | Observations to investigate the presence of 21-cm neutral hydrogen shells near selected carbon stars, planetary nebulae, and IR objects. |
| S. Goldstein (Virginia)<br>E. Greisen                                   | Observations of 21-cm emission profiles of anti-center clouds including positions near 3C 136.1.                                         |
| B. Burke (MIT)<br>A. Haschick (MIT)<br>P. Crane (MIT)                   | Search for 21-cm neutral hydrogen absorption in radio sources near Sc galaxies.                                                          |
| S. Peterson (Cornell)<br>M. Roberts                                     | Continuation of a 21-cm survey of neutral hydrogen in a statistically complete sample of optical pairs of galaxies.                      |
| M. Haynes (Indiana)<br>R. Giovanelli (Indiana)<br>M. Burkhead (Indiana) | Observations of 21-cm neutral hydrogen in the outer regions of nearby spiral galaxies.                                                   |
| B. Burke (MIT)<br>A. Haschick (MIT)<br>W. Bean (MIT)                    | Search for 21-cm neutral hydrogen in absorption or emission in the vicinity of galaxies.                                                 |
| M. Haynes (Indiana)<br>M. Roberts<br>R. Brown                           | Search for 21-cm neutral hydrogen absorption at the systemic velocity of approximately 30 clusters of galaxies.                          |
| A. Wolfe (Pittsburgh)<br>M. Haynes (Indiana)<br>R. Brown<br>M. Roberts  | Search at 997 MHz for red-shifted neutral hydrogen absorption in P 0735+178 and A0 0235+16.                                              |

The following continuum programs were conducted.

| <u>Observer</u>                                                                      | <u>Program</u>                                                                                                                                                            |
|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| W. Dent (Massachusetts)<br>J. Kapitzky (Massachusetts)<br>T. Balonek (Massachusetts) | Polarization and flux density measurements of variable radio sources at 2695 MHz.                                                                                         |
| J. Gallagher (Minnesota)<br>J. Warner (Minnesota)<br>J. Black (Minnesota)            | Search for 6-cm radio emission from a selection of objects in the Air Force Cambridge Research Laboratory infrared survey.                                                |
| J. Machalski (Jagellonian U., Poland)                                                | Measurements at 6-cm wavelength of sources which exhibit flat spectra.                                                                                                    |
| R. Porcas                                                                            | Observations at 6-cm and 11-cm wavelength of selected sources observed with the Jodrell Bank Mk IA telescope and the Jodrell Bank Mk IA - Mk II interferometer.           |
| C. Crannell (NASA, Goddard)<br>R. Hobbs (NASA, Goddard)<br>S. Maran (NASA, Goddard)  | Observations of UV Ceti-type flare stars at four different simultaneous frequencies between 250 and 500 MHz coordinated with X-ray, optical and other radio observations. |
| M. Haynes (Indiana)<br>L. Pataki (Indiana)                                           | Observations at 2695 MHz of several galaxies showing extended radio sources that have been previously observed with the NRAO interferometer.                              |
| M. Haynes (Indiana)<br>R. Giovanelli (Indiana)<br>M. Burkhead (Indiana)              | Search at 2695 MHz for emission from a nearby dwarf galaxy and from Complex A.                                                                                            |

The following pulsar observations were conducted.

| <u>Observer</u>                                                                      | <u>Program</u>                         |
|--------------------------------------------------------------------------------------|----------------------------------------|
| J. Taylor (Massachusetts)<br>D. Helfand (Massachusetts)<br>P. Backus (Massachusetts) | Pulsar timing measurements at 610 MHz. |

| <u>Interferometer</u>                       | <u>Hours</u> |
|---------------------------------------------|--------------|
| Scheduled observing                         | 1969.75      |
| Scheduled maintenance and equipment changes | 106.50       |
| Scheduled tests and calibration             | 75.75        |
| Time lost due to: equipment failure         | 27.75        |
| power                                       | 11.25        |
| weather                                     | 6.75         |
| interference                                | 0.25         |

While most programs used the 45 foot over a 35-km baseline, only those specifically requiring its use are 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>                                                                                            |
|---------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| R. Hjellming<br>C. Leung                                                                                | Detailed measurements of the radio properties of Nova Cygni 1975 using the 45-foot telescope.             |
| P. Crane (MIT)<br>R. Price (MIT)                                                                        | Survey of spiral galaxies.                                                                                |
| G. Brandie (Queens, Canada)<br>A. Bridle (Queens, Canada)<br>B. Guindon (Queens, Canada)<br>E. Fomalont | Comparison of the radio and optical orientation of elliptical radio galaxies using the 45-foot telescope. |
| B. Burke (MIT)<br>T. Giuffrida (MIT)                                                                    | Aperture synthesis of M31, M81 and M101.                                                                  |
| W. Gilmore (Maryland)<br>B. Zuckerman (Maryland)<br>R. Brown                                            | Search for compact HII regions in dark clouds.                                                            |
| J. Wardle (Brandeis)<br>D. Altschuler (Maryland)                                                        | Monitor of the variability of flux and polarization in approximately 80 sources.                          |
| M. Ulmer (Center for Astrophysics)<br>R. Hjellming<br>L. Blankenship                                    | Observations to confirm whether Cyg X-2 is surrounded by a double source similar to Sco X-1.              |
| R. Sramek (NAIC, Puerto Rico)                                                                           | Measurements of accurate positions of two sources identified with Markarian galaxies.                     |

| <u>Observer</u>                                                                                                                      | <u>Program</u>                                                                                                                           |
|--------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| S. Gottesman (Florida)<br>D. Florkowski (Florida)<br>F. Wood (Florida)                                                               | Attempt to detect radio emission from seven binary star systems.                                                                         |
| F. Maloney (Florida)<br>S. Gottesman (Florida)                                                                                       | Observations of the structure of 4C 06.34 in preparation for Venusian occultation observations of this source.                           |
| P. Kronberg (Toronto, Canada)<br>Ger de Bruyn (Leiden, Netherlands)                                                                  | Completion of a dual frequency synthesis of NGC 2146.                                                                                    |
| K. Lo (Caltech)<br>R. Brown                                                                                                          | Study of the time variations of the compact radio source in Sgr A, using the 45-foot telescope.                                          |
| W. Altenhoff (MPIR, Bonn,<br>W. Germany)                                                                                             | Observations to measure an accurate radio position for $\alpha$ Orionis.                                                                 |
| K. Lang (Tufts)                                                                                                                      | High-resolution observations of the sun using the 45-foot telescope.                                                                     |
| L. Rudnick                                                                                                                           | Observations of radio galaxies selected from the 4C catalog using the 45-foot telescope.                                                 |
| R. Becker (NASA, Goddard)<br>E. Boldt (NASA, Goddard)<br>P. Serlemitsos (NASA, Goddard)<br>S. Pravdo (NASA, Goddard)<br>R. Hjellming | Coordinated observations of Cyg X-1 and Cyg X-3, using the OSO-I satellite, and the NRAO interferometer including the 45-foot telescope. |
| D. Backer (California, Berkeley)<br>R. Sramek (NAIC, Puerto Rico)                                                                    | Proper motion and parallax studies of pulsars and radio stars using the 45-foot telescope.                                               |
| D. Backer (California, Berkeley)                                                                                                     | Measurements of the absolute positions of pulsars using the 45-foot telescope.                                                           |
| R. Hjellming<br>F. Owen                                                                                                              | Observations of three red dwarf flare stars, coordinated with X-ray observations.                                                        |
| P. Kronberg (MPIR, Bonn,<br>W. Germany)                                                                                              | Maps of 3C 196.                                                                                                                          |

| <u>Observer</u>                                                                                                  | <u>Program</u>                                                                                                                                                                       |
|------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| D. Gibson (Jodrell Bank, England)<br>F. Owen                                                                     | Continuation of a survey to study RSCVn binaries.                                                                                                                                    |
| R. Porcas<br>F. Owen                                                                                             | Measurements of the structures of quasars selected from the 966 MHz Jodrell Bank Mk IA survey using the 45-foot telescope.                                                           |
| R. Porcas                                                                                                        | Study of the structure of sources from the Jodrell Bank Mk IA survey to assist with identification and to determine spectral indices of their structure using the 45-foot telescope. |
| F. Owen                                                                                                          | Continued observations of Abell clusters of galaxies using the 45-foot telescope.                                                                                                    |
| G. Miley (Leiden, Netherlands)<br>L. Rudnick<br>F. Owen                                                          | Observations to map three objects which show radio tails that have been found in Abell clusters of galaxies.                                                                         |
| J. Pipher (Rochester)<br>M. Savedoff (Rochester)<br>J. Krassner (Rochester)<br>B. Soifer (California, San Diego) | Observations of compact HII regions.                                                                                                                                                 |
| H. Johnson (Lockheed)                                                                                            | Observations to attempt to detect compact ionized gas regions in globular clusters.                                                                                                  |
| K. Johnston (NRL)<br>E. Devinney (South Florida)                                                                 | Observations to attempt to detect emission from close binary systems.                                                                                                                |
| F. Owen<br>L. Rudnick                                                                                            | Structure and polarization maps of the head-tail galaxy NGC 1265.                                                                                                                    |

36-foot TelescopeHours

|                                             |         |
|---------------------------------------------|---------|
| Scheduled observing                         | 1932.50 |
| Scheduled maintenance and equipment changes | 98.50   |
| Scheduled tests and calibration             | 129.00  |
| Time lost due to: equipment failure         | 72.25   |
| weather                                     | 94.75   |
| power                                       | 0.00    |
| interference                                | 0.00    |

| <u>Observer</u>                                                                                                                          | <u>Program</u>                                                                        |
|------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| W. Altenhoff (MPIR, Bonn,<br>W. Germany)                                                                                                 | Flux density variations of variable extra-<br>galactic radio sources.                 |
| D. Buhl (NASA, Goddard)<br>L. Snyder (Illinois)                                                                                          | Search for HCN in directions of red giants.                                           |
| F. Clark (Kentucky)<br>R. Stokes (Battelle-Northwest Obs.)<br>K. Davis (Battelle-Northwest Obs.)<br>P. Ekstrom (Battelle-Northwest Obs.) | Attempt to detect chlorine radical in<br>the stratosphere.                            |
| E. Conklin (NAIC, Puerto Rico)<br>J. Dickel (Illinois)<br>B. Ulich                                                                       | Continuum observations at 3.5 mm of planets,<br>planetary satellites and asteroids.   |
| W. Dent (Massachusetts)<br>R. Hobbs (NASA, Goddard)                                                                                      | Continuum measurements of time variable<br>sources at 3 and 9 mm (2 runs Oct. & Dec). |
| J. Hollis (Virginia)<br>L. Snyder (Illinois)<br>D. Buhl (NASA, Goddard)<br>B. Ulich                                                      | Mapping of X-ogen sources.                                                            |
| R. Kakar (JPL)<br>W. Wilson (Aerospace)<br>F. Shimabukuro (Aerospace)<br>J. Waters (JPL)                                                 | Search for CO lines in Venus, Mars and<br>Jupiter.                                    |
| K. Kellermann<br>R. M. Price (NSF)                                                                                                       | Continuum observations of selected quasars,<br>radio and normal galaxies.             |
| T. Kuiper (JPL)<br>E. Kuiper (California, Los Angeles)<br>B. Zuckerman (Maryland)                                                        | Exploration of CO line shapes in Orion<br>region.                                     |
| T. Kuiper (JPL)<br>E. Kuiper (California, Los Angeles)<br>B. Zuckerman (Maryland)                                                        | Confirmation of detection of ethylene oxide.                                          |
| M. Kutner (Rensselaer)<br>K. Tucker (Fordham)                                                                                            | Survey of CO and CS in reflection nebulae.                                            |
| R. Martin (MIT)<br>A. Barrett (MIT)                                                                                                      | Maps of CO and CS in dust globules.                                                   |

| <u>Observer</u>                                                                                               | <u>Program</u>                                                          |
|---------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|
| R. Partridge (Haverford)<br>G. Lake (Princeton)                                                               | Continuum observations of galaxies exhibiting X-ray emission.           |
| J. Rather (Lulejian & Assoc.)<br>E. Rather (Forth, Inc.)<br>R. Landau (Forth, Inc.)<br>C. Van Ingen (Caltech) | Search for CO in galaxies with high dust content.                       |
| L. Rickard<br>P. Palmer (Chicago)<br>B. Zuckerman (Maryland)<br>M. Morris (Caltech)<br>B. Turner              | Search for CS and HCN in galaxies.                                      |
| P. Schwartz (NRL)<br>J. Spencer (NRL)                                                                         | Search for continuum emission from stellar objects.                     |
| L. Snyder (Illinois)<br>D. Buhl (NASA, Goddard)<br>R. Gammon (McKenzie, Brazil)                               | Search for interstellar ketene.                                         |
| M. Simon (SUNY, Stonybrook)<br>N. Simon (BNL)                                                                 | Observations of molecular lines in infrared sources, Orion and Jupiter. |
| P. Thaddeus (Inst. for Space Studies)<br>S. Green (Columbia)                                                  | Search for C <sub>2</sub> H <sup>+</sup> .                              |
| B. Turner<br>B. Zuckerman (Maryland)<br>P. Palmer (Chicago)<br>M. Morris (Caltech)                            | Observations of rare CS isotopes.                                       |
| B. Wills (Texas, Austin)<br>D. Wills (Texas, Austin)                                                          | Search for mm-wave emission from radio quiet objects.                   |
| B. Wills (Texas, Austin)<br>D. Wills (Texas, Austin)                                                          | Observations of mm-wave emission from strong extragalactic sources.     |
| B. Zuckerman (Maryland)<br>T. Kuiper (JPL)<br>E. Kuiper (California, Los Angeles)                             | Observations of HNC in IRC+10216.                                       |

## ELECTRONICS DIVISION

Green BankManpower Assignments

|                                                 | <u>%</u> |
|-------------------------------------------------|----------|
| Visitor support and maintenance .....           | 49.00    |
| New receiver development .....                  | 12.5     |
| Sick leave and vacation .....                   | 12.0     |
| VLBI effort .....                               | 6.0      |
| 140-foot Cassegrain receiver improvements ..... | 4.0      |
| Digital standard receiver development .....     | 3.0      |
| VLA support .....                               | 4.0      |
| 140-foot computer hardware support .....        | 4.0      |
| Interferometer digital delay development .....  | 2.0      |
| Tucson support .....                            | 2.0      |
| Improved ULO developments .....                 | 1.5      |

The Cassegrain receiver has been reinstalled on the 140-foot telescope and is presently being used for scientific observations. Work is continuing to understand and improve performance and solve various problems. Filters are being designed in an effort to reduce the interference experienced at 18 and 21 cm with the system.

The new computer for the 140-foot telescope has been installed in the basement of the Jansky Lab and various hardware problems are being solved as the programming proceeds.

A cooled diode switch for 6 cm load/polarization/beam switching has been developed. It is at present being tested in the new 1.0-1.4 GHz/4.5-5.0 GHz receiver.

Work is continuing on a digital standard receiver, a cooled dual-frequency 1.0-1.4 GHz/4.5-5.0 GHz receiver, a cooled 9-cm receiver, a 22-25 GHz maser receiver, and a digital delay and correlator system for the interferometer.

Work has started on retuning the cooled 7.8 GHz receiver to 8.4 GHz, and an ambient paramp for 6.0 GHz has been ordered to improve the 5-10 GHz receiver performance at this important frequency.

Tucson

During the last quarter the following projects have continued:

The high resolution filter bank is in the final stages of construction and estimated completion is 2/1/76.

The new 9-mm continuum receiver will be delayed by at least a month due to late delivery on the mixer pre-amps. The estimated completion date for this project is now 2/1/76.

A new digital multiplexer has been constructed that will allow more computer interfaces; in particular, it will provide the means to read and record LO settings on the observer's tape.

An I.F. switching circuit is being built to further facilitate filter bank switching.

The new 33-50 and 80-120 GHz receiver continues to be constructed. It is planned to complete this receiver in the spring of 1976.

A new local oscillator system is being developed to replace the existing system, which will then become available for lab use.

#### Charlottesville

Cooled mixers having single-sideband noise temperatures  $\leq 300^\circ$  K in the 33-50 GHz range have been developed. An LO injection cavity for 127-174 GHz has been completed. Work is continuing on the fabrication of Josephson junctions.

A delay-memory for the satellite VLB experiment has been completed.

#### ENGINEERING DIVISION

The Engineering Division provided assistance in establishing a contract for two prototype panels for a future 25-meter millimeter antenna and in establishing a contract for a laboratory building at the 36-foot telescope on Kitt Peak. Further research, design and studies for the 25-meter antenna and a radome enclosure were carried out. Preparations were started for measuring and testing the prototype panels for the 25-meter antenna. Research and design was started for the installation of inductosyns on the 300-foot antenna. Further studies and tests were carried out relative to the thermal deformation on the 140-foot telescope.

Assistance was provided in the design and purchasing of equipment to humidify the control room at the 300 foot. Routine engineering assistance and inspection was provided Green Bank, Charlottesville and Tucson operations, and the VLA project.

## COMPUTER DIVISION

### 140-foot Pointing

Hardware and software have been installed at the telescope for recording environmental parameters. These include ambient temperature, atmospheric pressure, relative humidity, and temperature sensors on the telescope structure. This information will later be used to improve telescope pointing by correcting for atmospheric refraction and thermal effects on the structure.

### 140-foot Control Computer Replacement

The software and hardware design is continuing. The clock/calendar interface has been completed. The replacement computer is now in the Jansky Lab basement.

### Manuals

A manual describing the use of the 140-foot telescope has been drafted. The manual will be kept at the telescope and in the observer room in the Jansky Lab and periodically updated. It will not receive the normal distribution of an NRAO Users Manual at this time.

### Dicomed Image Recorder

An engineering feature has been implemented which corrects the problem of shadowing around alphanumeric characters and facilitates overlaying of images.

## VLA PROJECT

### Site & Wye Division

Phase II construction, consisting of permanent buildings, site work, and utilities was 83% complete at the end of the quarter. Phase III construction is progressing and is estimated at 9% complete.

### Antenna Division

Antenna No. 1 - Mechanical checkout and testing has continued.

Antenna No. 2 was accepted from E-Systems on November 13, 1975. Installation of NRAO equipment commenced and was 95% complete by the end of December 1975.

Work on Antennas 3-10 has continued at E-Systems. Trial assembly of Antenna No. 3 was completed.

### Electronics Division

During the October-December quarter of 1975, the outfitting of Antenna No. 1 was continued and reached the point where operation in the single-dish mode is now possible with full computer control and all signals going back and forth through the waveguide system. The first observations of a radio source were made October 24 using the receiver and control system in the single-dish testing trailer. Performance at 1.3, 2 and 6-cm wavelengths confirmed that the surface accuracy of the main reflector and subreflector are satisfactory. During November, the 20-mm diameter waveguide was installed on the antenna, a minor problem involving mode generation in a rotating joint was overcome, and the waveguide run was found to perform within specifications. During the same month, control of the antenna from the computer was achieved using a direct cable link. The antenna was moved to Station CW-5 next to the electronics trailer in December.

Outfitting of Antenna No. 2 with cables and waveguide commenced in November and has now been completed. Testing of the electronics for No. 2 antenna has continued and it is expected that this antenna also will be fully outfitted before the end of January. Procurement of the modules, racks and other units for Antennas 3 to 6 by the engineering groups at the site and in Charlottesville have progressed on schedule.

### Computer Division

#### Asynchronous Subsystem

During the fourth quarter a number of areas underwent considerable progress. Portions of the graphics system were checked out, and progress was made on checking out the capabilities of the line drawing CRT. Procedures for line printer map display, classical fourier transform mapping, and a one-dimensional FFT were completed. In CANDID a help file system for routines was established, array sectioning and sub-element addressing implemented as were capabilities to type our current defined symbols and data hierarchies.

The FFT box was installed. Unfortunately DEC provided no software to test or operate the box, so extensive work is underway to do this ourselves.

Finally a set of programs to allow transfer of Green Bank interferometer data on the DEC-10 was completed so real data is now available to test routines being developed.

### Synchronous Subsystem

During the fourth quarter the computer system was used to operate Antenna No. 1 in single dish mode, take data, and derive and analyze pointing information. An error was removed from the pointing mode control program.

A more convenient program for exercising and monitoring the antenna control unit has been added to the system.

### System Integration Division

The front end of Antenna No. 1 was mounted on October 14, 1975, and the first signals from a radio source were received on October 24, 1975. At 1.3-cm wavelength, Venus and 3C 273 were detected, and at 6 cm Virgo A.

Antenna No. 1 operations continued through the end of the quarter following the first receipt of signals in October. The outfitting of Antenna No. 2 was completed except for the installation of the electronic racks.

### Project Management Division

Work has continued on the take up of rail at Redstone Arsenal and is now about 70% complete. Also, a small quantity of rail was obtained from the Sunflower Ordnance Depot. Sufficient rail material is on hand to support the Phase III construction requirements. Additional contracts have been awarded for the rail take up at Eglin AFB and Myrtle Beach AFB.

Procurement activity has continued for the items needed for Antennas 3-10. During this quarter, Amendment No. 15 to the antenna subcontract with E-Systems was effected to provide the remaining \$2,437,480 in funding required for Antennas 3 through 10.

## PERSONNEL

### Appointments

|                    |                       |          |
|--------------------|-----------------------|----------|
| Lee J. Rickard     | Research Associate    | 10/15/75 |
| Russell A. Hulse   | Research Associate    | 10/21/75 |
| Jesse K. Hill      | Research Associate    | 10/23/75 |
| Ernest M. Caloccia | Electronic Engineer I | 11/17/75 |

### Terminations

|                    |                          |          |
|--------------------|--------------------------|----------|
| John C. Lyon       | Research Associate       | 11/14/75 |
| C. Read Predmore   | Electronic Engineer I    | 11/21/75 |
| Jerzy Machalski    | Visiting Asst. Scientist | 12/10/75 |
| Thuppalay K. Menon | Visiting Scientist       | 12/15/75 |

## JANSKY LECTURE

The Tenth Annual Karl G. Jansky Lecture was delivered on the evening of November 19, 1975 by Dr. Grote Reber of the Commonwealth Scientific and Industrial Research Organization, Tasmania, Australia. The topic of the lecture was "Beginning of Radio Astronomy at Wheaton, Illinois".

Dr. Reber is a member of a number of professional societies, including the American Astronomical Society and the American Association for the Advancement of Science. He was the Russell Lecturer of the AAS in 1962, and has received the Cresson Medal of the Franklin Institute and the Bruce Medal of the Astronomical Society of the Pacific. Dr. Reber received his D.S. (Hon.) from Ohio State University in 1962.

A list of Observatory reprints issued since July 1, 1974

| No.      | Title                                                                                                                         | Author                                           | Reference                                                                 |
|----------|-------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|---------------------------------------------------------------------------|
| SERIES A |                                                                                                                               |                                                  |                                                                           |
| 301      | Observations of Neutral Hydrogen near the Galactic Center. II. The Nuclear Disc                                               | R. H. Sanders<br>G. T. Wrixon                    | <u>Astron. Astrophys.</u> ,<br>26, 365-377, 1973.                         |
| 302      | Comparison of Rotation Curves of Different Galaxy Types                                                                       | M. S. Roberts<br>A. H. Rots                      | <u>Astron. Astrophys.</u> ,<br>26, 483-485, 1973.                         |
| 303      | An Association of HI and H $\alpha$ Filaments                                                                                 | G. L. Verschuur                                  | <u>Astron. J.</u> , 78, 573 -<br>582, 1973.                               |
| 304      | Beam Characteristics of the 300-ft Telescope                                                                                  | R. H. Harten                                     | <u>Astron. J.</u> , 78, 565 -<br>568, 1973.                               |
| 305      | A Method for Accurately Compensating for the Effects of the Error Beam of the NRAO 300-ft Radio Telescope at 21-cm Wavelength | G. Westerhout<br>H. U. Wendlandt<br>R. H. Harten | <u>Astron. J.</u> , 78, 569-<br>572, 1973.                                |
| 306      | Measurements of Neutral-Hydrogen Absorption in the Spectra of Eight Pulsars                                                   | K. J. Gordon<br>C. P. Gordon                     | <u>Astron. Astrophys.</u> ,<br>27, 119-124, 1973.                         |
| 307      | Observations of Neutral Hydrogen near the Galactic Center                                                                     | G. T. Wrixon<br>R. H. Sanders                    | <u>Astron. Astrophys.</u> ,<br><u>Suppl. Ser.</u> , 11,<br>339-345, 1973. |
| 308      | Galactic Spiral Structure from 21-cm Data: a New Map                                                                          | G. L. Verschuur                                  | <u>Astron. Astrophys.</u> ,<br>27, 73-76, 1973.                           |
| 309      | The Galactic Gas-to-Dust Ratio from Observations in the Directions of Sixteen Globular Clusters                               | G. R. Knapp<br>F. J. Kerr<br>W. K. Rose          | <u>Astrophys. Lett.</u> ,<br>14, 187-190, 1973.                           |
| 310      | Bending of the Galactic Plane and the Nature of the High Velocity Clouds                                                      | G. L. Verschuur                                  | <u>Astron. Astrophys.</u> ,<br>27, 407-411, 1973.                         |

| No. | Title                                                                                                                                       | Author                                                | Reference                                                     |
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| 311 | Hydrogen-line Aperture Synthesis at the National Radio Astronomy Observatory: Techniques and Data Reduction                                 | M.C.H. Wright<br>B. G. Clark<br>C. H. Moore<br>J. Coe | <u>Radio Science</u> , 8,<br>763-773, 1973.                   |
| 312 | High Resolution Observations of Interstellar Neutral Hydrogen: Data Taking and Presentation                                                 | G. L. Verschuur<br>T. R. Cram<br>R. Giovanelli        | <u>Astron. Astrophys. Suppl. Ser.</u> , 12,<br>203-208, 1973. |
| 313 | High Resolution Studies of High Velocity Clouds of Neutral Hydrogen                                                                         | R. Giovanelli<br>G. L. Verschuur<br>T. R. Cram        | <u>Astron. Astrophys. Suppl. Ser.</u> , 12,<br>209-262, 1973. |
| 314 | Observations of Neutral Hydrogen Near the Galactic Plane                                                                                    | W. B. Burton<br>G. L. Verschuur                       | <u>Astron. Astrophys. Suppl. Ser.</u> , 12,<br>145-202, 1973. |
| 315 | An Expanding Shell of Neutral Hydrogen Surrounding the Supernova Remnant HB 21                                                              | G. E. Assousa<br>J. W. Erkes                          | <u>Astron. J.</u> , 78,<br>885-893, 1973.                     |
| 316 | An Astronomical Puzzle Called Cygnus X-3                                                                                                    | R. M. Hjellming                                       | <u>Science</u> , 182, 1089-1095, 1973.                        |
| 317 | Measurements of the Flux Density and Spectra of Discrete Radio Sources at Centimeter Wavelengths. IV. The Observations at 10.7 GHz (2.8 cm) | K. I. Kellermann<br>I.I.K. Pauliny-Toth               | <u>Astron. J.</u> , 78, 828-847, 1973.                        |
| 318 | 21-cm Observations of a Cross Section of Distant Spiral Arms                                                                                | G. L. Verschuur                                       | <u>Astron. J.</u> , 78, 898-912, 1973.                        |
| 319 | Optical Positions of the Markarian Galaxies                                                                                                 | S. D. Peterson                                        | <u>Astron. J.</u> , 78, 811-827, 1973.                        |
| 320 | Observations of the 21 cm Absorption Spectra of 3C 10 and 3C 58                                                                             | D.R.W. Williams                                       | <u>Astron. Astrophys.</u> , 28, 309-311, 1973.                |
| 321 | Extragalactic Radio Sources                                                                                                                 | K. I. Kellermann                                      | <u>Physics Today</u> , 26,<br>38-41, Oct. 1973.               |
| 322 | The Effect of Digitization Errors on Detection of Weak Signals in Noise                                                                     | B. G. Clark                                           | <u>IEEE Proc.</u> , 61,<br>1654-1655, 1973.                   |

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| 323 | HI Emission from Stephan's Quintet                                                                          | G. S. Shostak                                  | <u>Astrophys. J.</u> , 187, 19-23, 1974.             |
| 324 | Interstellar Hydrogen in Galaxies                                                                           | M. S. Roberts                                  | <u>Science</u> , 183, 371-378, 1973.                 |
| 325 | A Deviation-Defect Method for the Detection of Optically Thick Neutral Hydrogen                             | P. L. Baker                                    | <u>Astrophys. J.</u> , 187, 223-229, 1974.           |
| 326 | Limits to Solar Limb Darkening at a Wavelength of 1.4 Millimeters Derived from Antenna-Beam Parameters      | P.A.R. Ade<br>J.D.G. Rather<br>P. E. Clegg     | <u>Astrophys. J.</u> , 187, 389-392, 1974.           |
| 327 | The Structure of the Orion Nebula. I. Observations of the C85 $\alpha$ Recombination Line                   | B. Balick<br>R. H. Gammon<br>L. H. Doherty     | <u>Astrophys. J.</u> , 188, 45-52, 1974.             |
| 328 | Radio-Synthesis Observations of Planetary Nebulae                                                           | Y. Terzian<br>B. Balick<br>C. Bignell          | <u>Astrophys. J.</u> , 188, 257-277, 1974.           |
| 329 | Confusion and Flux-Density Error Distributions                                                              | J. J. Condon                                   | <u>Astrophys. J.</u> , 188, 279-286, 1974.           |
| 330 | The Radio Structure of Quasars. II.                                                                         | J.F.C. Wardle<br>G. K. Miley                   | <u>Astron. Astrophys.</u> , 30, 305-315, 1974.       |
| 331 | Simultaneous Interferometer Phase and Water Vapor Measurements                                              | K. H. Wesseling<br>J. P. Basart<br>J. L. Nance | <u>Radio Science</u> , 9, 349-353, 1974.             |
| 332 | Green's-Function Approach to Inverse Compton Scattering                                                     | P. S. Yeung<br>R. L. Brown                     | <u>Phys. Rev. D.</u> , 8, 4286-4297, 1973.           |
| 333 | Studies of Neutral-Hydrogen Cloud Structure                                                                 | G. L. Verschuur                                | <u>Astrophys. J. Suppl. Ser.</u> , 27, 65-112, 1974. |
| 334 | Polarization of Supernova Remnants KE 69, G357.7-0.1, HC 26, and $\gamma$ Cygni at 6 and 2.8-cm Wavelengths | M. R. Kundu<br>T. Velusamy<br>P. E. Hardee     | <u>Astron. J.</u> , 79, 132-138, 1974.               |
| 335 | The Kinematics of Galactic Spiral Structure                                                                 | W. B. Burton                                   | <u>Publ. Astron. Soc. Pac.</u> , 85, 679-703, 1973.  |

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| 336 | Microwave Detection of Interstellar CH                                    | B. E. Turner<br>B. Zuckerman                                                                                  | <u>Astrophys. J.</u> , 187,<br>L59-L62, 1974.          |
| 337 | Radio Emission from Normal Spiral Galaxies                                | H. M. Tovmassian<br>Y. Terzian                                                                                | <u>Astrophys. Lett.</u> ,<br>15, 97-99, 1973           |
| 338 | Interpolation and Fourier Transformation of Fringe Visibilities           | A. R. Thompson<br>R. N. Bracewell                                                                             | <u>Astron. J.</u> , 79,<br>11-24, 1974,                |
| 339 | A Distance Limit for NGC 7318B in Stephan's Quintet                       | G. S. Shostak                                                                                                 | <u>Astrophys. J.</u> , 189,<br>L1-L3, 1974.            |
| 340 | The $\text{He}^+/\text{H}^+$ Ratio in Dark Clouds                         | R. L. Brown<br>J. Gómez-González                                                                              | <u>Astrophys. J.</u> , 188,<br>475-480, 1974.          |
| 341 | Pulsar Flux-Density Spectra                                               | D. C. Backer<br>J. R. Fisher                                                                                  | <u>Astrophys. J.</u> , 189,<br>137-145, 1974.          |
| 342 | Radio Emission from R Aquarii                                             | P. C. Gregory<br>E. R. Seaquist                                                                               | <u>Nature</u> , 247, 532-534,<br>1974.                 |
| 343 | The Nature of Small HII Regions Deduced from their Radio Emissions        | Y. Terzian<br>B. Dennison<br>B. Balick                                                                        | <u>Publ. Astron. Soc. Pac.</u> , 85, 806-810,<br>1973. |
| 344 | Search for Radio Emission from Faint Variable Starlike Objects            | A. H. Bridle<br>E. B. Fomalont                                                                                | <u>Astron. J.</u> , 79, 6-7,<br>1974.                  |
| 345 | The Distribution of Neutral Hydrogen Around $\alpha$ Virginis             | I. Fejes                                                                                                      | <u>Astron. J.</u> , 79, 25-30,<br>1974.                |
| 346 | Coordinated Observations of OJ 287 at Radio and Optical Wavelengths       | T. D. Kinman<br>J.F.C. Wardle<br>E. K. Conklin<br>B. H. Andrew<br>G. A. Harvey<br>J. M. Macleod<br>W. J. Medd | <u>Astron. J.</u> , 79,<br>349-357, 1974.              |
| 347 | 21-cm Observations in the Directions of 43 Hot Stars and 34 X-ray Sources | E. J. Grayzeck<br>F. J. Kerr                                                                                  | <u>Astron. J.</u> , 79,<br>368-375, 1974.              |
| 348 | Structure of the Local Galactic Magnetic Field                            | R. N. Manchester                                                                                              | <u>Astrophys. J.</u> , 188,<br>637-644, 1974.          |

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| 350 | The Problem of Satellite Radio Sources in the Vicinity of Spiral Galaxies                                  | M. L. De Jong                                                                                                      | <u>Publ. Astron. Soc. Pac.</u> , 86, 90-91, 1974.     |
| 351 | Detection of Radio Recombination-Line Emission from the RHO Ophiuchi Dark Cloud                            | R. L. Brown<br>G. R. Knapp                                                                                         | <u>Astrophys. J.</u> , 189, 253-258, 1974.            |
| 352 | Astronomical Aspects of Interstellar Communication                                                         | S. von Hoerner                                                                                                     | <u>Astronaut. Acta.</u> , 18, 421-430, 1973.          |
| 353 | Observations of Abell Clusters of Galaxies at 1400 MHz                                                     | F. N. Owen                                                                                                         | <u>Astron. J.</u> , 79, 427-436, 1974.                |
| 354 | Intensity Dependent Radio Spectral Distributions in the Parkes 2700-MHz Survey                             | J. J. Condon<br>D. L. Jauncey                                                                                      | <u>Astron. J.</u> , 79, 437-452, 1974.                |
| 355 | Detection of Possible Maser Emission near 3.48 Millimeters from an Unidentified Molecular Species in Orion | L. E. Snyder<br>D. Buhl                                                                                            | <u>Astrophys. J.</u> , 189, L31-L33, 1974.            |
| 356 | Further Observations of Apparent Changes in the Structure of 3C 273 and 3C 279                             | K. I. Kellermann<br>B. G. Clark<br>D. B. Shaffer<br>M. H. Cohen<br>D. L. Jauncey<br>J. J. Broderick<br>A. E. Niell | <u>Astrophys. J.</u> , 189, L19-L22, 1974.            |
| 357 | The Correlation of Radio Emission and Optical Type with X-ray Emission from Clusters of Galaxies           | F. N. Owen                                                                                                         | <u>Astrophys. J.</u> , 189, L55-L58, 1974.            |
| 358 | Individual Pulse Polarization Properties of Three Pulsars                                                  | J. M. Rankin<br>D. B. Campbell<br>D. C. Backer                                                                     | <u>Astrophys. J.</u> , 188, 609-613, 1974.            |

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| 360 | The Microwave Properties of<br>Saturn's Rings                                           | F. H. Briggs                                               | <u>Astrophys. J.</u> , 189,<br>367-377, 1974.                      |
| 361 | Time Variation in the OH Microwave<br>and Infrared Emission from Late-<br>Type Stars    | P. M. Harvey<br>K. B. Bechis<br>W. J. Wilson<br>J. A. Ball | <u>Astrophys. J. Suppl.</u><br><u>Ser.</u> , 27, 331-358,<br>1974. |
| 362 | Detection of Methyl Cyanide in<br>Comet Kohoutek                                        | B. L. Ulich<br>E. K. Conklin                               | <u>Nature</u> , 248, 121-<br>122, 1974.                            |
| 363 | National Radio Astronomy Observa-<br>tory [Annual Report]                               | D. S. Heeschen                                             | <u>Bull. Amer. Astron.</u><br><u>Soc.</u> , 6, 144-153, 1974.      |
| 364 | The Polarization of Normal Galaxies<br>at Radio Wavelengths                             | J.F.C. Wardle<br>R. A. Sramek                              | <u>Astrophys. J.</u> , 189,<br>399-404, 1974.                      |
| 365 | Detection of Pulsar Proper Motion                                                       | R. N. Manchester<br>J. H. Taylor<br>Y. Y. Van              | <u>Astrophys. J.</u> , 189,<br>L119-L122, 1974.                    |
| 366 | Detection of OH at 18-centimeter<br>Wavelength in Comet Kohoutek<br>(1973f)             | B. E. Turner                                               | <u>Astrophys. J.</u> , 189,<br>L137-L139, 1974.                    |
| 367 | Super-relativistic Phase Velocities<br>of Radio Source Components                       | R. H. Sanders                                              | <u>Nature</u> , 248, 390-<br>392, 1974.                            |
| 368 | Radio Spectra for Three QSOs                                                            | H. S. Murdoch                                              | <u>Nature</u> , 247, 443-<br>444, 1974.                            |
| 369 | Observations of HI in Dense Inter-<br>stellar Dust Clouds: I. A Survey<br>of 88 Clouds  | G. R. Knapp                                                | <u>Astron. J.</u> , 79,<br>527-540, 1974.                          |
| 370 | Observations of HI in Dense Inter-<br>stellar Dust Clouds: II. The<br>Cloud Khavtassi 3 | G. R. Knapp                                                | <u>Astron. J.</u> , 79, 541-<br>554, 661, 1974.                    |
| 371 | On Microwave Recombination Lines<br>from HI Regions                                     | B. Zuckerman<br>J. A. Ball                                 | <u>Astrophys. J.</u> , 190,<br>35-51, 1974.                        |

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| 373 | The V1057 Cygni OH Source: Time Variation, Polarization Properties, and Accurate Position              | K. Y. Lo<br>K. P. Bechis                                                                         | <u>Astrophys. J.</u> , 190,<br>L125-L128, 1974.             |
| 374 | Upper Limit to the Neutral Hydrogen Content of the Elliptical Galaxy NGC 4472                          | G. R. Knapp<br>F. J. Kerr                                                                        | <u>Astron. J.</u> , 79,<br>667-670, 1974.                   |
| 375 | 21 cm Line Observations near the Galactic Plane in the Galactic Longitude Interval 339° - 72°          | P. O. Lindblad                                                                                   | <u>Astron. Astrophys. Suppl. Ser.</u> 16,<br>207-236, 1974. |
| 376 | 21-cm Study of Peculiar Galaxies                                                                       | S. D. Peterson<br>G. S. Shostak                                                                  | <u>Astron. J.</u> , 79,<br>767-774, 1974.                   |
| 377 | Observations of Intensity and Linear Polarization in Supernova Remnants at 11 cm Wavelength            | T. Velusamy<br>M. R. Kundu                                                                       | <u>Astron. Astrophys.</u> ,<br>32, 375-390, 1974.           |
| 378 | Period Irregularities in Pulsars                                                                       | R. N. Manchester<br>J. H. Taylor                                                                 | <u>Astrophys. J.</u> , 191,<br>L63-L65, 1974.               |
| 379 | Interstellar Scattering of the Vela Pulsar                                                             | D. C. Backer                                                                                     | <u>Astrophys. J.</u> , 190,<br>667-671, 1974.               |
| 380 | Gas Kinematics Near the Galactic Center from CO Observations                                           | R. H. Sanders<br>G. T. Wrixon                                                                    | <u>Astron. Astrophys.</u> ,<br>33, 9-14, 1974.              |
| 381 | CO and CS in the Orion Nebula                                                                          | H. S. Liszt<br>R. W. Wilson<br>A. A. Penzias<br>K. B. Jefferts<br>P. G. Wannier<br>P. M. Solomon | <u>Astrophys. J.</u> , 190,<br>557-564, 1974.               |
| 382 | Observational Evidence for the Excitation of HCN and H <sub>2</sub> O in Protostellar Molecular Clouds | F. O. Clark<br>D. Buhl<br>L. E. Snyder                                                           | <u>Astrophys. J.</u> , 190,<br>545-556, 1974.               |

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| 383 | Radio Detection of Interstellar Dimethyl Ether                                                                                                    | L. E. Snyder<br>D. Buhl<br>P. R. Schwartz<br>F. O. Clark<br>D. R. Johnson<br>F. J. Lovas<br>P. T. Giguere | <u>Astrophys. J.</u> , 191,<br>L79-L82, 1974.     |
| 384 | Markarian 348: a Variable Radio Source                                                                                                            | R. A. Sramek<br>H. M. Tovmassian                                                                          | <u>Astrophys. J.</u> , 191,<br>L13-L14, 1974.     |
| 385 | Narrow-band Observations of Galactic and Extragalactic Sources at 1 mm                                                                            | P. E. Clegg<br>P.A.R. Ade<br>M. Rowan-Robinson                                                            | <u>Nature</u> , 249, 530-532,<br>1974.            |
| 386 | A Cold H I Shell Around the Supernova Remnant W 44                                                                                                | G. R. Knapp<br>F. J. Kerr                                                                                 | <u>Astron. Astrophys.</u> ,<br>33, 463-467, 1974. |
| 387 | A Kinematic Investigation of Galactic Structure                                                                                                   | W. B. Burton<br>T. M. Bania                                                                               | <u>Astron. Astrophys.</u> ,<br>33, 425-442, 1974. |
| 388 | Lunar Occultations of the Galactic Center Region in H I, OH and H <sub>2</sub> CO Lines. II. The Continuum and the +40 km s <sup>-1</sup> Feature | A. Sandqvist                                                                                              | <u>Astron. Astrophys.</u> ,<br>33, 413-424, 1974  |
| 389 | Radio Emission from Markarian 6                                                                                                                   | R. A. Sramek<br>H. M. Tovmassian                                                                          | <u>Astrophys. J.</u> , 191,<br>633-637, 1974.     |
| 390 | A Search for a Cosmological Component of the Soft X-ray Background in the Direction of M31                                                        | B. Margon<br>S. Bowyer<br>R. Cruddace<br>C. Heiles<br>M. Lampton<br>T. Troland                            | <u>Astrophys. J.</u> , 191,<br>L117-L119, 1974.   |
| 391 | Optical Identifications and Radio Spectra of Sources Found by the Michigan 8-GHz Survey                                                           | G. W. Brandie<br>A. H. Bridle                                                                             | <u>Astron. J.</u> , 79, 903-<br>917, 985, 1974.   |
| 392 | On the Interpretation of the Kinematics of the Local Interstellar Neutral Hydrogen as Indicative of a Separate Subsystem                          | W. B. Burton<br>T. M. Bania                                                                               | <u>Astron. Astrophys.</u> ,<br>34, 75-79, 1974.   |

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