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National Radio Astronomy Observatory

Charlottesville, Virginia

Quarterly Report

July 1 - September 30, 1967

RESEARCH PROGRAMS

Interferometer (three 85-foot telescopes)

		Hours
Scheduled observing		1958.00
Scheduled maintenance and equipment changes		164.00
Time lost due to:	equipment failure	126.50
	power	0.00
	weather	2.60
	interference	4.75

R. G. Conway (Jodrell Bank, United Kingdom), D. E. Hogg and C. M. Wade undertook a synthesis program during this quarter designed to yield brightness maps of seven sources, including Cygnus A, Taurus A, and Virgo A. At declination +60° the synthesized beam will be almost circular, of half-width 8 seconds of arc. The distribution of linear polarization over the sources is also being measured.

Observations have been completed in this quarter for six of the nine configurations required for the full synthesis. Each configuration requires about two weeks of time, of which about one and one-half days are used in moving and recalibrating the telescope, and two more days in measuring the baseline constants and instrumental polarization functions.

300-foot Telescope

		Hours
Scheduled observing		1825.75
Scheduled maintenance and equipment changes		188.75
Time lost due to:	equipment failure	13.75
	power	0.00
	weather	0.00

Observations of neutral hydrogen with the autocorrelation receiver:

Observations	Observers
Mapping the galactic plane within a one to three degree strip	G. Westerhout (University of Maryland)

Observations	Observers
Investigation of neutral hydrogen in high velocity regions	J. Rickard (University of Maryland)
Survey of narrow strip of sky 2 degrees in latitude centered on the zero meridian of longitude running from the north galactic pole to b = +17° to search for possible material coming into the galactic center	F. Kerr (University of Maryland)
Observations of neutral hydrogen in the direction of stars that have optical interstellar lines of the molecule CN.	P. Thaddeus (Institute for Space Studies)
Observations of neutral hydrogen distribution in the vicinity of selected HII regions	K. Riegel (University of California, Los Angeles)
Investigation of the correlation between neutral hydrogen densities and the amounts of visual absorption within the Taurus dark nebulae	C. Varsavsky (Argentine National Radio Astronomy Institute)

Continuum observations conducted at 1414 MHz, 750 MHz, 405 MHz, and 234 MHz, with various observers using any or all of the available frequencies.

Observations	Observers
Survey of galactic plane within 2 degrees of galactic plane between galactic longitudes of 10° and 75° to determine positions and fluxes of galactic sources in that area. Map Cygnus Loop (1414 MHz)	A. Maxwell, D. Downs (Harvard University)
Occultation of Taurus A by solar corona (234 MHz)	W. Erickson (University of Maryland)
Flux measurements of selected HII regions (234, 405, 750 MHz)	P. Mezger
Mapped continuum intensity in and around the Coma Cluster of galaxies and certain other clusters of galaxies (405, 750, 1414 MHz)	H. Ko (Ohio State University)
Observations of planetary nebula (750, 1414 MHz)	M. Kassim (Dudley Observatory)
High resolution measurements of the galactic background and mapping of selected HII regions (750, 1414 MHz)	W. Altenhoff

Observations	Observers
Determination of flux densities of sources whose flux densities have been measured at other frequencies at the Arecibo Ionospheric Observatory (750, 1414 MHz)	D. Jauncey (Cornell University)
Mapped continuum intensity of selected clusters of galaxies (234, 405, 750, 1414 MHz)	T. Carr (University of Miami)
Observations to confirm data collected during the Ohio State north galactic survey program (750, 1414 MHz)	J. Kraus (Ohio State University)

140-foot Telescope

		Hours
Scheduled observing		1884.75
Scheduled maintenance and equipment changes		223.25
Time lost due to:	equipment failure	149.00
	power	0.75
	weather	72.75
	interference	0.25

Several VLB (very long baseline) observations were conducted during this quarter, as follows:

Observations	Observers
OH line; 140-foot and Hat Creek, California 85-foot telescope, simultaneously with 140-foot and Jodrell Bank Experimental Station 250-foot Mark I antenna	B. Burke, J. Ball, A. Barrett, J. Carter, P. Crowther, J. Moran, A. Rogers (all from Massachusetts Institute of Technology), R. Davies, R. Booth (Jodrell Bank Experimental Station), D. Cudaback (University of California, Berkeley)
Continuum observations near OH line frequency, 140-foot and Hat Creek, California 85-foot telescope	D. Jauncey (Cornell), M. Cohen (University of California, San Diego), D. Cudaback (University of California, Berkeley), B. Clark, C. Bare
OH line; 140-foot and Jodrell Bank Experimental Station 85 x 120-foot Mark II Elliptical Antenna	B. Burke, J. Ball, A. Barrett, J. Carter, P. Crowther, J. Moran, A. Rogers (all Massachusetts Institute of Technology), R. Davies, R. Booth, J. Cooper (Jodrell Bank Experimental Station), C. Bare

Observations	Observers
VLB at 610 MHz, 140-foot and Arecibo 1000-foot telescopes	D. Jauncey (Cornell), M. Cohen (University of California, San Diego), B. Clark, C. Bare

Neutral hydrogen line observations were made at the 140-foot telescope during this quarter as follows:

Observations	Observers
Observations of neutral hydrogen distribution in the vicinity of selected HII regions	K. Riegel (University of California, Los Angeles)
Observations of high velocity hydrogen clouds, attempting to confirm a proposal by I. S. Shklovsky that those clouds emit by maser amplification of the 3° black body radiation	L. Hinrichs (University of California, Berkeley)
Observations of high resolution 21-cm spectra to complete the high latitude portion of a program to observe stars with optical interstellar lines	S. Goldstein (University of Virginia)
Studies of Cygnus Loop	T. K. Menon
Observations of the galaxies M 33 and M 82	K. Gordon (University of Michigan) and M. Roberts
Observations of neutral hydrogen that may lead to determination of a better value of the local solar motion in the galaxy	P. Henderson (Manhattan College)

Continuum observations at the 140-foot telescope were as follows:

Observations	Observers
15.375 GHz	
Mapping of selected HII regions	P. Mezger
Measurement of the flux densities of sources selected from Dwingeloo Finding List	M. Davis
Flux density measurements of Mercury and Venus	C. Sagan and D. Morrison (Harvard)
Flux densities of variable sources	K. Kellermann and I. Pauliny-Toth

Observations	Observers
Scans of lunar craters using the switched beam technique	D. Buhl
Scintillation measurements of the occultation of 3C 279 by the sun's corona	M. Cohen (University of California, San Diego)
4.995 GHz	
Extragalactic source survey in the north polar region and the measurement of fluxes of sources from the Dwingeloo Finding List	M. Davis
Determination of an improved spectral index for nonthermal radiation to investigate the ratio of neutral to ionized hydrogen density and measurements of atmospheric refraction and extinction	W. Altenhoff
Observations of positions of galactic HII regions in preparation for a later run of 6-cm recombination line and continuum observations scheduled in October and November 1967	B. Burke, T. Reifenstein and T. Wilson (all Massachusetts Institute of Technology), P. Mezger
Mapping and polarization measurements of the Cygnus Loop and IC 443	M. Kundu (Tata Institute, India)
Observations of planetary nebulae	M. Kassim (Dudley Observatory)
Observations of two particular sources having unusual spectra found in the Ohio State radio source survey	J. Kraus (Ohio State University)
Polarization of discrete sources	J. Hollinger (Naval Research Laboratory)
Observations of discrete sources near the north galactic polar cap	E. Blum (Observatoire de Paris)

Lunar occultation observations of radio sources at 234 MHz, 256 MHz, and 405 MHz were conducted by S. Gulkis (Cornell).

Some telescope time during this quarter was devoted to telescope tests, some to the testing of a new 50-channel line receiver and some to testing the newly installed Honeywell DDP-116 computer which is now being used primarily as a data recording device at the telescopes.

ELECTRONICS DIVISION--EQUIPMENT DEVELOPMENT

During the past quarter the manpower assignments within the Electronics Division have been divided among the following programs:

New 416-channel Autocorrelation Receiver	12%
Interference Protection	4%
New Standard Receivers	8%
Millimeter Receiver Development	5%
Very Long Baseline Interferometer	10%
Construction of 50-channel Radiometer	6%
On-Line Computer Installation	3%
3-Element Interferometer Completion	8%
42-foot Antenna Electronics	6%
VLA Electronics Development	6%
4-Feed 21-cm Radiometer	6%
1-4 Gc/s Front Ends	3%
Visitor Support and Routine Maintenance	23%

The construction of the 416-channel autocorrelation receiver is proceeding according to scheduled, and completion is expected during the next quarterly report period.

Construction of electronics for a third terminal for the very-long baseline interferometer is proceeding. This equipment includes a digital magnetic tape recorder and a rubidium frequency standard for independent local oscillator operation.

A Honeywell DDP-116 computer has been installed at the 140-foot telescope and is now operational. The computer provides digital position indication, continuum data recording, and synchronous detection for a 50-channel spectral-line receiver. The computer will also be used for on-line processing of the autocorrelation receiver output.

The 50-channel spectral line receiver with 100 kc bandwidth filters has been completed and has been used for recombination line observations.

A 2695 MHz front-end and local oscillator transmission system have been installed on the 42-foot portable antenna. This antenna will be used for high-resolution observations and atmospheric testing as part of the interferometer system.

The four-feed 21-cm receiver for use on the 300-foot telescope is nearing completion. This receiver will allow low-noise continuum and spectral line observations to be made with four simultaneous antenna beams.

THE NRAO MILLIMETER WAVE ANTENNA

Adjustments and calibrations of the telescope have been made with the 9.5 mm receiver. The Sun, Moon and Venus were used as calibration sources. The dish aperture has been covered with 0.1 mm white polyethylene cover in order to protect the focal area from heat during observations of the sun. The measured aperture efficiency at 9.5 mm was $(53\pm3)\%$.

ANTENNA DESIGN STUDIES

The Very Large Array (VLA) Project

1. Scientific Studies

N. C. Mathur has continued to study array configuration, including complementary arrays, and arrays deficient in antennas by virtue of equipment malfunction. The performance of the VLA holds up well with one missing antenna. However, no complementary set of two arrays has been found which will permit realization of the VLA performance goals with fewer than approximately 24 antennas. The configuration computer programs have been extended to permit computation of detailed side lobe structures and beam shapes for the synthesized beam.

R. H. MacPhie (University of Waterloo) has submitted a detailed report on the effects on VLA performance of finite beam width in the receivers. The implications of this study on the VLA configuration have not been fully evaluated.

E. J. Blum of the Paris-Meudon Observatory has conducted studies of the effects on VLA side lobe performance of phase fluctuations due to meteorological influences. The results show that the inhomogeneous structure of the atmosphere has a substantial effect on the side lobe criteria adopted for the configuration studies. These interactions are the subject of continuing investigation.

Studies of the meteorological influences on interferometer performance are continuing, using the Green Bank three-element interferometer. The 42-foot antenna is presently being tested at Green Bank prior to its installation on the first of two mountain-top sites, which will give two seconds of arc and 1/2 second of arc resolution, respectively. The local oscillator and I.F. signal communication for the 42-foot system are accomplished by means of a microwave link system which has demonstrated its ability to maintain excellent phase synchronism between two widely separated sites.

Two infrared spectral hygrometers have been constructed and four more are under construction. These will be used in a variety of experiments in an attempt to determine the relationship between interferometer phase fluctuations and the water vapor structure of the atmosphere. These instruments track the sun throughout the day and their results will be correlated with the phase fluctuations of the three-element interferometer and the 42-foot interferometer system.

2. VLA Antenna Design

Proposals for the design of the VLA antenna element have been received from five industrial firms and are presently being evaluated. The manner in which the antenna design work is to be conducted is under review as a result of the report of the Dicke Panel.

3. VLA Electronics

Experimental development work is continuing. Contracts have been placed with two firms for the manufacture of experimental acoustical delay lines.

The University of Virginia is constructing, under contract, a prototype local oscillator phase-locking system. Experimental work is underway in the Green Bank laboratories on the design of phase equalizers, amplifiers, and other concomitants of the I.F. signal transmission system.

The Largest Feasible Steerable Telescope (LFST)

Plans for further work on the LFST are being reviewed as a result of the report of the Dicke Panel.

PERSONNEL

Appointments

R. B. Weimer	Electronics Engineer II	July 1, 1967
J. P. Basart	Research Associate	July 17, 1967
J. A. Kramer	Scientific Associate III	August 1, 1967
G. L. Verschuur	Research Associate	August 30, 1967
W. R. Burns	Assistant Scientist	September 1, 1967
R. H. Rubin	Research Associate	September 7, 1967
L. E. Snyder	Research Associate	September 8, 1967
B. E. Turner	Research Associate	September 14, 1967

K. I. Kellermann returned on August 1, 1967 from a three months leave of absence.

Terminations

F. N. Bash	Research Associate	July 21, 1967
H. van der Laan	Visiting Scientist	August 4, 1967
W. C. Tyler	Associate Scientist	August 31, 1967
R. G. Conway	Visiting Scientist	August 31, 1967
R. M. Hjellming	Visiting Assistant Scientist	September 1, 1967
R. Menon	Research Associate	September 29, 1967
E. J. Blum	Visiting Scientist	September 29, 1967