

NATIONAL RADIO ASTRONOMY OBSERVATORY  
Charlottesville, Virginia

Quarterly Report

July 1 - September 30, 1968

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RESEARCH PROGRAMS

Interferometer (three 85-foot telescopes)

	<u>Hours</u>
Scheduled observing	2094.75
Scheduled maintenance and equipment changes	113.25
Time lost due to: equipment failure	89.50
power	6.50
weather	.25
interference	4.00

During this quarter the interferometer was used in nine different configurations. The observers and their programs are as follows:

<u>Observers</u>	<u>Program</u>
W. Webster (Case Western Reserve), W. Altenhoff and C. Wade	The observations necessary for a pencil-beam synthesis of a number of H II regions were completed.
J. Hogbom (Maryland)	The pencil-beam synthesis of selected northern 3C sources was finished.
D. Cudaback (Berkeley), C. Heiles (Berkeley) and B. Turner	Observations of H II regions were continued.
D. Heeschen	Observations of elliptical galaxies.
C. Wade	Determination of the position of 25 quasi-stellar sources.
J. Kraus (Ohio State) and D. Scheer (Ohio State)	Determination of the position of a number of radio sources from Ohio State University source catalogues.
H. Ko (Ohio State)	Measurements of radio source polarization.

<u>Observers</u>	<u>Program</u>
B. Clark and J. Basart	Observations with the 42-foot portable telescope at two sites located 8 and 25 miles from Green Bank. Performed phase calibrations, tested system stability.
J. Basart	Measurement of the correlation between observations made simultaneously with the interferometer and 3 infrared hygrometers. The experiment attempts to determine if the interferometer phase fluctuations are produced mainly by water vapor.
J. Basart and A. Sinclair (Bellcomm Inc.)	Observation of the occultation of the radio source Parkes 1122+05 by Jupiter.

300-foot Telescope

	<u>Hours</u>
Scheduled observing	2091.75
Scheduled maintenance and equipment changes	116.25
Time lost due to: equipment failure	6.25
power	5.00
weather	8.75
interference	0.00

The following neutral hydrogen line observations were made:

<u>Observers</u>	<u>Program</u>
G. Westerhout (Maryland)	Mapping the galactic plane, a continuing program.
G. Verschuur	Observations of the region near the ring of low radio continuum polarization at R.A. = $01^{\text{h}} 30^{\text{m}}$ to $4^{\text{h}}$ , Dec. = $+65^{\circ}5'$ . Observations of high latitude intermediate velocity clouds and 21 cm observations in the direction of known pulsars.
C. Gordon and W. Howard	Observations of neutral hydrogen in the vicinity of H II regions.
C. Gordon	Observations of neutral hydrogen in the region of the Orion Nebula and Pulsar CP 1919.
F. Kerr (Maryland)	Search for high velocity clouds at both positive and negative radial velocities.

<u>Observers</u>	<u>Program</u>
L. Emerson (Cornell)	Neutral hydrogen observations toward supernova remnants S 147, IC 443, and the Cygnus Loop.
S. Goldstein (Virginia)	Absorption measurements of high latitude hydrogen clouds.

All other observations at the 300-foot telescope during this quarter were pulsar programs, with measurements made in the range 100-120 MHz. Observers and programs were as follows:

<u>Observers</u>	<u>Program</u>
G. Huguenin (Harvard) and J. Taylor (Harvard)	Measurements of known pulsars and search for new ones.
D. Downes (Harvard)	Search for pulsar-like radiation in supernova remnants.
S. Goldstein (Virginia)	Search for pulsars.
D. Staelin (M.I.T.) and E. Reifenstein	Pulsar search with emphasis on the galactic plane and a detailed study of time, frequency and polarization structure of known pulsars.

#### 140-foot Telescope

	<u>Hours</u>
Scheduled observing	2016.75
Scheduled maintenance and equipment changes	194.50
Time lost due to: equipment failure	80.00
power	2.75
weather	31.25
interference	6.25

During this quarter the following line observations were conducted using the 50-channel filter receiver and the 400-channel autocorrelation receiver:

<u>Observers</u>	<u>Program</u>
B. Turner	Measurement of Stokes parameters of OH satellite line emission in selected sources, narrow-band spectral resolution measurements at 1665 and 1667 MHz, and a search for OH satellite lines in sources not previously investigated.
A. Barrett (M.I.T.) and W. Wilson (M.I.T.)	OH survey of infrared stars.

<u>Observers</u>	<u>Program</u>
D. Staelin	Search for and a study of satellite line OH emission sources.
F. Kerr (Maryland)	Search for a neutral hydrogen correlation with the rings of stars found by Schmidt-Kaler and Isserstedt.
F. Kerr (Maryland) and A. Sandqvist (Maryland)	Galactic center lunar occultation at H and OH frequencies.
G. Walters (Rice), H. Goldwire (Rice), L. Blackwell (Rice), C. Predmore (Rice), and J. Halpain (Rice)	Search for 3.46 cm hyperfine emission from singly charged He <sup>3</sup> in H II regions.
E. Lilley (Harvard), P. Palmer (Harvard) and B. Zuckerman (Harvard)	Mapping of regions of galactic sources in the 11 cm recombination lines of hydrogen, helium, and the new recombination line of carbon.

Continuum observations were as follows:

<u>Observers</u>	<u>Program</u>
J. Dickel (Illinois)	15.375 GHz observations of Tycho's supernova.
D. Buhl	15.375 GHz high resolution mapping of the moon.
P. Mezger and J. Schraml	Mapping of M8 and M16 at 15.375 GHz.
A. Tlamicha (Ondrejov Observatory)	High resolution mapping of the sun to determine a model for sunspots and active solar regions at 15.375 GHz.
D. Heeschen	Observations of elliptical galaxies at 15.375 GHz.
C. Wade	Search for 15.375 GHz radiation from the nuclei of spiral galaxies.
W. Altenhoff	Continuation of 2695 MHz galactic survey and 2695 MHz flux determination of selected H II regions.
H. Wendker (Illinois)	2695 MHz mapping of the Cygnus complex.
M. Kundu (Maryland)	Polarization measurements of supernova remnants at 2.7, 5.0, and 15.375 GHz.

<u>Observers</u>	<u>Program</u>
K. Kellermann and I. Pauliny-Toth	Flux densities of variable sources at 2695 and 5000 MHz and at 15.375 GHz.
S. Goldstein (Virginia)	Search for periodic pulsed radiation from the variable star DQ Her.
J. Taylor (Harvard) and G. Huguenin (Harvard)	Pulsar studies at 111, 234, 256, 405, and 610 MHz to supplement observations taken at the 300-foot telescope during this quarter.
M. Cohen (California, San Diego), D. Jauncey (Arecibo), K. Kellermann, B. Clark, and C. Bare.	Very long baseline observations at 111 and 610 MHz using the NRAO 140-foot and the Arecibo 1000-foot telescopes.

Additionally, W. Altenhoff undertook an extensive 2695 MHz antenna pointing program and a small amount of time was allotted to the computing and electronics divisions for testing.

### 36-foot Telescope

	<u>Hours</u>
Scheduled observing	928.5
Scheduled maintenance and equipment changes	50.0
Time lost due to: equipment failure	153.0
power	0.0
weather	548.0
interference	0.0

During the quarter observers carried out the following programs at 85 GHz: K. Kellermann and I. Pauliny-Toth observed extragalactic sources; J. Schraml observed H II regions and other galactic sources; and A. Maxwell (Harvard) made observations of the galactic center. At 31.4 GHz Y. Terzian (Cornell) observed a small number of planetary nebulae, while J. Schraml carried on a program of pointing and dish calibration, supplemented by optical pointing data acquired with the 12-inch telescope attached to the 36-foot antenna.

### ELECTRONICS DIVISION--EQUIPMENT DEVELOPMENT

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

VLA Electronics Development	14%
Interference Protection	9%
Millimeter Receiver Development	8%
413-Channel Autocorrelation Receiver	3%
Very-Long Baseline Interferometer	7%
OH-Line Receiver Construction	10%
1-4 GHz Tunable Front-End	3%
2 cm/6 cm Receiver	4%
Water Vapor Receiver	3%

Universal Local-Oscillator Construction	3%
11 cm Radiometer Rebuilding	6%
Visitor Support and Routine Maintenance	30%

A receiver operating at wavelengths of 2 cm and 6 cm has been completed. The receiver utilizes tunnel diode amplifiers and is intended for quick installation operation on the 140-foot telescope.

Instruction manuals for the 50-channel receiver, the 413-channel auto-correlation receiver, and the universal local-oscillator system have been written during this quarter.

Construction work is continuing on the new interference van, the new OH-line receiver, and the new terminals for very-long baseline interferometer work.

A 9.5 mm crystal-mixer radiometer has been completed and installed on the 36-foot telescope. The 3.5 mm receiver has been brought back to Charlottesville for improvements. The 11 cm paramp receiver was rebuilt in order to incorporate improved components and to improve stability.

The 42-foot antenna has been moved to a more distant site and is now back in operation.

The construction of receivers operating at a wavelength of 1.25 cm has been started. These receivers will be used to measure water vapor in the beam of two of the interferometer antennas.

The VLA development work is proceeding with in-house work on the IF transmission system and correlators and with contract work on the local-oscillator system, delay lines, antenna feed, and parametric amplifiers.

## ANTENNA DESIGN STUDIES

### The Very Large Array (VLA)

The contract with Rohr Corporation to study the antenna element structure has been completed. A contract with Raytheon Service Company to study the operation and maintenance of the VLA has been negotiated. The equipment for atmospheric studies at possible VLA sites has been installed near Tucson.

## THE CALIBRATION HORN

J. W. Findlay and F. X. Witkowski (a summer student) have made another absolute calibration of the flux of Cas A at 1440 MHz. This is the first step in a series of measurements to be made of neutral hydrogen brightness temperatures.

## THE SWIMMING POOL

A new swimming pool was opened at Green Bank informally on the evening of the Trustees meeting of July 11, and subsequently was used regularly until the first week in September. The pool, which is 75 x 35 feet, has changing rooms;

it has been landscaped, fenced, and equipped with poolside chairs and tables. It was built using funds generously provided by the Trustees of AUI and has already been recognized as a most valuable addition to the Green Bank recreational facilities. Management of the pool follows rules set by the Recreation Association. There was an experimental period during which the pool was open to local residents, in addition to its use by NRAORA members. A qualified lifeguard was employed, and two summer students gave unofficial, but very successful, swimming lessons to children during August.

#### SCIENCE WRITERS SEMINAR

On September 29 through October 1, AUI was host to 21 science writers at a Science Writers Seminar at Green Bank. Six NRAO staff and six radio astronomers from other institutions delivered a series of talks on various areas of current research in radio astronomy designed to give the science writers an up-to-date background of developments in the field. Representatives from major newspapers in Boston, New York, Philadelphia, Washington, and Detroit were present, together with others from NSF, university public relations, and journal staffs. The talks presented were:

- D. S. Heesch, National Radio Astronomy Observatory  
"The NRAO: Its Purpose and Relationship with Universities"
- Geoffrey R. Burbidge, University of California, San Diego  
"Radio Astronomy and Optical Astronomy: Introduction"
- Sander Weinreb, National Radio Astronomy Observatory  
"Radio Telescopes and Receivers"
- Kenneth I. Kellermann, National Radio Astronomy Observatory  
"Radio Astronomy of Planets in the Solar System" and  
"Quasi-stellar Radio Sources and Radio Galaxies"
- David E. Hogg, National Radio Astronomy Observatory  
"Introduction to Radio Interferometry"
- Marshall Cohen, California Institute of Technology  
"Very Long Baseline Interferometry"
- Robert G. Conway, Jodrell Bank Experimental Station, England  
"Polarization of Radio Sources"
- Frank D. Drake, Arecibo Ionospheric Observatory  
"Pulsars, A New Class of Radio Sources"
- Gart Westerhout, University of Maryland  
"The Structure of the Milky Way System"
- Alan H. Barrett, Massachusetts Institute of Technology  
"Observations and Interpretation of the OH (Oxygen-Hydrogen)  
Spectral Lines"
- Peter G. Mezger, National Radio Astronomy Observatory  
"H II (Ionized Hydrogen) Regions and Regions of Star Formation"
- Sebastian von Hoerner, National Radio Astronomy Observatory  
"Cosmology - Evolution of the Stars, Galaxies and the Universe"

There was considerable discussion and information exchange between the scientists and science writers, and feature articles are anticipated from many of the guests as a result of the meeting. It was the general consensus of those present that the Seminar was quite useful and worthwhile.

PERSONNEL

Appointments

Edward C. Reifenstein III	Research Associate	August 1, 1968
Marcello Felli	Visiting Assistant Scientist	September 16, 1968

Terminations

Antonin Tlamicha	Visiting Scientist	August 5, 1968
Karel H. Wesseling	Electronics Engineer I	August 31, 1968