US/BR BK/

NATIONAL RADIO ASTRONOMY OBSERVATORY
Charlottesville, Virginia

Quarterly Report
January 1 - March 31, 1968

RESEARCH PROGRAMS

Interferometer (three 85-foot telescopes)

		Hours
Scheduled observing		2072.00
Scheduled maintenance and equipment changes		111.00
Time lost due to:	equipment failure	74.50
	power	.25
	weather	89.50
	interference	7.75

During this quarter the program of R. Colomb (Argentina), for the determination of accurate positions of southern sources, was completed. In all, about 50 objects were measured. D. Heeschen and C. Wade used the interferometer for two weeks to observe about 200 normal galaxies. J. Hogbom (Maryland) began a program of aperture synthesis observations. The rest of the quarter was devoted to the fan-beam synthesis observations of B. Clark and D. Hogg. By observing a source at a given hour angle on each of the 9 possible antenna configurations, a picture of the brightness distribution of the source can be derived which is equivalent to the picture obtained by scanning across the source with a fan-beam approximately 10" x 5' in size.

Observations by J. Basart and B. Clark, using the 42-foot telescope at the Spencer's Ridge site (baseline 100,000 wavelengths), were continued. Preliminary analysis of the data shows that the phase is quite stable, with an rms scatter, minute to minute, of less than 10 degrees during most weather conditions.

300-foot Telescope

		Hours
Scheduled observing		1975.75
Scheduled maintenance and equipment changes		182.25
Time lost due to:	equipment failure	13.75
	power	0.00
	weather	20.50
	interference	2.00

The following continuum observations were undertaken:

Observers	Observations
M. Davis	Four feed survey at 1400 MHz.
M. Davis	Check of the Canadian Penticton source list at 750 and 1400 MHz.
D. Jauncey (Cornell) and A. Neill (Cornell)	Flux density measurements at 750 and 1400 MHz to be used in conjunction with lower frequency measurements made with the Arecibo 1000-foot telescope.
I. Pauliny-Toth and K. Kellermann	Flux densities of variable sources at 750 and 1400 MHz

M. Roberts and K. Gordon (Michigan) undertook extragalactic hydrogen studies with the NRAO multifilter receiver and the 100-channel autocorrelator.

During this quarter, a Honeywell DDP-116 computer was installed at the 300-foot telescope, which has been used for data processing and recording.

140-foot Telescope

		Hours
Scheduled observing		2002.75
Scheduled maintenance and equipment changes		181.25
Time lost due to:	equipment failure	76.50
	power	1.25
	weather	5.50
	interference	2.50

The following continuum observations were conducted:

Observers	Observations
F. Kerr (Maryland), A. Sandqvist (Maryland), and J. Taylor (Harvard)	Lunar occultation of galactic center at 234, 256, 405, 1420, and 1667 MHz. The latter two were line frequencies, H and OH, respectively.
I. Pauliny-Toth and K. Kellermann	Flux densities of variable sources at 4.995 and 15.375 GHz.
E. Gundermann (Cornell), D. Harris (Cornell), R. Ekers (Calif. Inst. of Tech.), M. Cohen (Calif. Inst. of Tech.) and W. Coles (California, San Diego)	Scintillation observations of the source 3C 2 at 21 cm wavelength over the range 3 to 30 solar radii. Simultaneous observations at 50, 70, and 154 cm at Arecibo and 13 cm at Goldstone were carried out to study the structure of the solar wind.
M. Davis, K. Kellermann, and I. Pauliny-Toth	4.995 GHz survey of sources from declination +24 degrees to +30 degrees from those sources listed in the 5C1 Cambridge Survey.

Observers	Observations
E. Blum (Observatoire de Paris)	Repeat of some 4.995 GHz observations made in September 1967 of discrete sources near the north galactic polar cap.
D. Gulkis (Cornell)	Lunar occultation observations of radio sources at 234, 256, and 405 GHz.
H. Friedman (Naval Research Laboratory), D. Sadah (Naval Research Laboratory)	Investigation of X-ray sources for pulsar-type radiation at 234, 256, and 405 MHz.
S. Goldstein (Virginia)	Search for extragalactic thermal sources at 15.375 GHz.
D. Buhl	High resolution lunar mapping at 15.375 GHz.
A. Tlamicha (Ondrejov Observatory, Czechoslovakia)	High resolution mapping of the sun at 15.375 GHz to determine changes in the sun over a period of days -- part of a co-ordinated worldwide investigation from λ = 3.75 meters to λ = 3 mm.

The following observations were conducted using the NRAO 50-channel filter receiver and the 100-channel autocorrelator:

Observers	Observations
T. Menon (Hawaii)	Line search from 1-2 GHz toward selected sources.
B. Turner	Stokes parameters of OH satellite line emission were observed in the radio sources W28, W43, W44, and Cas A.
E. Lilley (Harvard), P. Palmer (Harvard), B. Zuckerman (Harvard) and H. Penfield (Harvard)	Search for 6.3 cm emission due to a transition in the OH molecule between excited energy states. Mapping of various galactic sources at frequencies of recombination lines and helium near 6 cm wavelength, including the new recombination line of carbon.
A. Penzias (Bell Telephone Laboratory)	Intergalactic hydrogen absorption measurements between 1300 and 1440 MHz.
A. Rogers (Lincoln Laboratory), A. Barrett (M.I.T.), J. Ball (Lincoln Laboratory), T. Wilson (M.I.T.), M. Meeks (Lincoln Laboratory)	To determine the optical depth and spin temperature of neutral hydrogen emission and to undertake a high resolution study of neutral hydrogen emission regions using lunar occultation techniques.

The following Very Long Baseline observations were conducted during this quarter:

Observers	Observations
J. Moran (M.I.T.), B. Burke (M.I.T.), A. Barrett (M.I.T.), A. Rogers (Lincoln Laboratory), J. Ball (Lincoln Laboratory), O. Rydbeck (Chalmers University of Technology, Sweden), B. Hansson (Chalmers University of Technology, Sweden), and D. Cudaback (California, Berkeley)	OH-line observations utilizing the Chalmers 84-foot telescope, the Hat Creek 85-foot telescope, the Lincoln Laboratory 84-foot Millstone telescope, and the NRAO 140-foot telescope.
O. Rydbeck (Chalmers University of Technology, Sweden), J. Ellder (Chalmers University of Technology, Sweden), B. Hansson (Chalmers University of Technology, Sweden), M. Cohen (California, San Diego), D. Jauncey (Cornell), K. Kellermann, B. Clark, and C. Bare	18 cm and 6 cm continuum observations using the Chalmers 84-foot telescope and the NRAO 140-foot telescope.
M. Cohen (California, San Diego), B. Clark, K. Kellermann, and C. Bare	610 MHz observations using the Arecibo 1000-foot telescope and the NRAO 140-foot telescope.

ELECTRONICS DIVISION -- EQUIPMENT DEVELOPMENT

The manpower assignment distribution in the Electronics Division is approximately the same as reported in the last period.

The new 413 channel autocorrelation receiver has been completed and debugged. The receiver is presently being tested with the DDP-116 computer.

The final standard receiver has been completed. Twelve units of the new solid state design have been constructed in the past 18 months.

A 40-channel receiver with 1 MHz bandwidth channels has been completed, and a similar 5 MHz bandwidth receiver is near completion.

The first of three new standard local-oscillator systems has been completed. These systems provide very versatile and stable local oscillators for use in spectral line measurements. The first unit is for the 140-foot telescope; the second unit is for the 300-foot telescope; and the final unit is for use in the laboratory and with the 36-foot telescope.

Progress has been made on the construction of a cryogenic parametric amplifier for use in OH-line observations. A unit operating at room temperature and voltage-tunable over a 300 MHz bandwidth has been constructed. We next plan to cool this amplifier to give very low noise temperature.

Work on a well equipped van for measurement of interference is proceeding. Completion by the end of 1968 is anticipated.

The construction of a moderate-sensitivity receiver to perform simultaneous measurements at 2 cm and 6 cm wavelengths has been started. This receiver can be quickly installed on and removed from the 140-foot telescope and will be used for measurements of time-varying sources.

THE NRAO 36-FOOT MILLIMETER WAVE ANTENNA, KITT PEAK, ARIZONA

The 36-foot telescope was put into regular operation in the beginning of January. A group from the Naval Research Laboratory observed at 4.2 mm wavelength from the beginning of January to the middle of March. After this period, the telescope was tested at 1.2 mm wavelength using a cooled germanium bolometer detector. The results were encouraging. The measured beamwidth was close to the theoretical (< 30") and the antenna efficiency was estimated to be approximately 15 percent.

A brief test was also made of the telescope's possible usefulness as an optical (infrared) light bucket. The results were promising and further tests are planned.

Towards the end of the reporting period, the telescope was shut down for a three week period in order to make modifications and additions to the installation: (1) A synchronizing gear was added to the polarization drive, (2) The azimuth encoder was dismounted for repair, and (3) A multiplex channel was added to the DDP-116 computer.

ANTENNA DESIGN STUDIES

The Very Large Array (VLA) Project

The array configuration studies are continuing.

During the last year measurements of the water vapor content in the atmosphere have been made both at Green Bank and at three possible VLA sites located in the southwestern United States. Preparations are now being made to expand these measurements to include the correlation of the water vapor content over distances typical for the VLA (tens of kilometers).

Continuing observations with the 42-foot telescope and the Green Bank three-element interferometer over a 11.4 km baseline show little increase in the phase fluctuations compared to the fluctuations that occur at 2.7 km baseline. This encouraging result proves that phase stable operation adequate for aperture synthesis can be made with resolutions of 2" arc.

A prototype local oscillator system has been constructed and tested. The required phase stability for VLA operation has been achieved using a simulated cable system consisting of phase shifters and attenuators. The tests are continuing.

Prototype components for the IF distribution system have been made. One major consideration in the IF system is the dispersion in coaxial cables. Orders have been placed for 4.8 km cable for a full scale test of the proposed solution of the IF distribution system.

Bids for the design and manufacture of a prototype antenna feed have been evaluated and a vendor (RCA) has been selected. The feed will permit simultaneous operation at two frequencies (2695 MHz and 8085 MHz) with both circular polarizations.

The study of the antenna element continues, essentially as an inhouse function. Smaller contracts for detailed work on the servo system and antenna structure have been awarded and are planned.

MOBILE SERVICE TOWER FOR 140-FOOT TELESCOPE

A mobile service tower for the 140-foot telescope was put into operation during the reporting period. Located to the east of the telescope, the tower will be used for rapid changes of equipment at the focus of the telescope at ambient temperatures, wind velocities and times that might not have permitted the telescope to be serviced with the former service elevator. It is built on rails and can be positioned so that the apex of the telescope can be swung into an opening in the front of the tower. The room at the top of the tower has an area of 625 square feet to which access can be gained by a stairway and an equipment elevator.

PERSONNEL

Appointments

Antonin Tlamicha	Visiting Scientist	January 12, 1968

Terminations

Thuppalay K. Menon	Scientist	January 31, 1968