

Lehman

National Radio Astronomy Observatory
Green Bank, West Virginia

Quarterly Report

July 1 - September 30, 1965

RESEARCH PROGRAMS

<u>85-foot Telescopes</u>	<u>Hours</u>
Scheduled	1649.00
Equipment installation and scheduled maintenance	245.00
Time lost due to: equipment failure	133.00
weather	0.50
interference	1.25
power	0.75

During this quarter the 85-foot telescopes were used in the interferometer configuration, with observations continuing at a baseline of 2100 meters, with the 85-2 at station 4. The rotatable feeds were used to investigate the polarization of 13 point sources. A preliminary attempt was made to measure polarization brightness distributions on two slightly extended sources.

Continuous observations for the total hour angle range available with the 85-foot telescopes were made of the 12 sources in the aperture synthesis program. These observations will be combined with those taken at other baselines to produce a measure of source brightness distributions. Accurate positions of about 15 small diameter sources were measured.

F. Bash (University of Virginia) in preparing data for his thesis, observed approximately 250 extragalactic sources. These observations will be combined with observations to be taken at other baselines to produce one dimensional brightness distributions for these sources.

A series of Jupiter observations were taken and sent to D. Morrison (Harvard University) for analysis, K. Kellerman observed Saturn, finding it to have essentially the same diameter at 11 cm as at optical wavelengths.

During this quarter the 140-foot telescope was used for observing whenever testing and painting of the dish were not being carried out. Various problems were encountered with the telescope--none of which were serious in nature, but they were none-the-less time consuming. In addition the entire telescope and structure were painted.

P. Mezger and B. Hoglund found an emission line of excited hydrogen gas at 5009 MHz, thus confirming the prediction in 1959 by N. S. Kardashev that such lines should be present in the radio spectrum.

P. Mezger continued antenna evaluation measurements and made flux measurements of some galactic thermal sources, and I. Pauliny-Toth made flux measurements at 5009 MHz and at 2695 MHz. M. Kaftan-Kassim observed planetary nebulae at both 5009 MHz and 2695 MHz, and M. DeJong made flux measurements at 2695 MHz.

S. von Hoerner and M. DeJong observed two lunar occultations of sources at 234, 256, and 405 MHz.

At the end of the quarter, a 15.375 GHz receiver was installed. At this wavelength (1.95 cm) preliminary results show the telescope to have about 43% aperture efficiency. J. Baars used the 15.375 GHz receiver for atmospheric measurements, and the testing of a beam switching technique.

There is still a substantial amount of work to be done on the telescope, but whenever possible work will be done while the telescope is in operation.

Millimeter Wave Program (1 millimeter and sub-millimeter)

One millimeter instrumentation for the 36-foot telescope is now essentially complete, with two complete low noise front ends and the NRAO-built back end. Also, liquid helium handling equipment and a temporary remote focusing mechanism have been completed.

An internal report, "Measurement of Atmospheric Attenuation at 1 mm and Description of the Portable Spectral Hygrometer," by F. J. Low and A. Davidson was issued this quarter.

ELECTRONICS DIVISION--EQUIPMENT DEVELOPMENT

Two parametric amplifiers, a 21 cm wideband amplifier, and a 6 cm cryogenics amplifier, have been received and tested. The 21 cm wideband amplifier has been packaged in one box with an 18 cm amplifier and is scheduled for installation on the 140-foot telescope on October 4.

The 9 mm radiometer has been tested and is ready for shipment to the 36-foot telescope. Components are tested and ready for construction of a 9 mm broadband radiometer.

Design has been completed on the 2 and 6 cm wideband tunnel diode systems. The 2 cm amplifier is scheduled for delivery in the middle of October and the 6 cm amplifier a few weeks later.

A low frequency phase detector for the 36-foot telescope millimeter wave experiments has been completed. The 3C computer should arrive at Kitt Peak for installation on the 36-foot telescope before mid-October.

A self-balancing, passive gain modulator has been designed and built successfully. This is the first stage toward a new, improved solid state back end.

Construction of a second ignition interference detection system has been started. Also, a modification program has been started on the 20-channel filter receiver to improve its reliability.

Some small changes have been made in the 140-foot telescope digital output systems to make it more adaptable to "on-off" and "drift" modes. Further changes are scheduled for the future.

A new precise solar oscillator which will "lock" on WWVL has been received and tested. This, combined with the solar sidereal clock converter, should supply the Observatory with very precise, reliable time signals.

The interferometer has been modified to include new low noise AIL parametric amplifiers combined with the old MPC amplifiers as a second stage. This should provide an antenna

temperature of 140 to 160°K. Multiplexing has been added to the position systems on the interferometer so that the position of telescope 85-1 can now be recorded on the magnetic tape output system.

THE NRAO MILLIMETER WAVE ANTENNA

On Site Work at Kitt Peak

Erection of the dome frame is completed, and installation of the drive machinery and electrical power is progressing.

The telescope pedestal has been installed, and preliminary alignment of the axes has been made.

During heavy rains in September part of the fill around the dome foundation and the access road were washed out, but no serious damage occurred.

Electric power at the telescope site is still being supplied by a 75 kVA generator. Negotiations are underway with Trico (the power company supplying electric power to the Kitt Peak Observatory) in order to provide permanent power to the 36-foot telescope.

Telescope Fabrication--Rohr Corporation

Welding of the surface panels has been completed, and about 85% of the surface has been machined. The work on the surface has been delayed by difficulties which may be traced to internal stresses in the dish structure. On one occasion a small part of the surface showed a tendency to "oilcan". Rohr has so far been able to correct deficiencies as they occur, but progress is slow. Estimated delivery of the dish is now late October or early November.

Computer

The computer hardware is ready, and the computer will be shipped to Kitt Peak during the first week of October. Work on the software is progressing.

ANTENNA DESIGN STUDIES

The Largest Feasible Steerable Paraboloid

The engineering group has met twice in this quarter to consider progress made by the members' studies of the floating sphere and the azimuth steerable transit concepts. A preliminary cost estimate has been prepared for the latter and another is in preparation for the spherical concept. Engineering analyses of all concepts will continue. North American submitted a preliminary proposal for a novel, air-supported sphere which is of great interest and will be further investigated. J. W. Findlay continues to be in charge of the technical work; M. M. Small is providing management.

The Very Large Antenna Array Project

Studies of appropriate array configurations have continued, with emphasis on Tee, Wye, Circle, and Star configurations. A computer program is in use which determines the transfer function (autocorrelation of the aperture-plane excitation) for a given array, including the effect of hour-angle tracking. The Wye-shaped array is promising; further studies will attempt to optimize the numbers and spacings of antennas.

Budgetary figures have been received from five firms for a tropospheric, phase-locked local oscillator system for the very-long-baseline interferometer experiment. Invitations for firm bids are in preparation. A purchase order for a transportable 42-foot dish has been issued to Peninsula Steel Products, Inc., of San Jose, California, for completion by December 15, 1965. A search for a site for this dish indicates that Paddy's Knob, approximately 11-1/2 miles south of the Observatory, would be suitable.

VLA site selection activities were continued. S. Smith visited the map collection of the Library of Congress and listed 47 sites on the basis of a list of criteria relating to latitude, proximity to cultural features, and topography. Maps, aerial photographs, and meteorological data have been acquired for these sites. Recent difficulties experienced by observers using the 140-foot telescope at Green Bank suggest that microwave radio telescopes perform better in the absence of clouds. Thus, a dry climate (and presumably a high altitude) is to be preferred.

PERSONNEL

Dr. C. V. Sastry, who received his doctors degree at the Aligarh University and recently a member of the Yale University staff, joined the NRAO staff in September as a research associate. Dr. Sastry intends to collaborate with M. Roberts on problems of extragalactic studies.

Mr. A. W. Robichaud has been employed as electronics project engineer for the interferometer group. Before coming here he was associated with the Raytheon Corporation.

Mr. Glenn Ertell has been employed in the electronics division. Mr. Ertell is head of the digital output group.

Three programmers, Mr. Paul Hitch, Mr. Joseph Greenhalgh and Mr. Sebastian Sora, have been employed in the computer division.

Dr. J. W. Findlay, deputy director, was granted a year's leave of absence from the Observatory on September 1. He has assumed the directorship of the Arecibo Ionospheric Observatory, Arecibo, Puerto Rico, for this period.

Dr. Bertil Höglund, who was at the Observatory for two years as a visiting associate scientist from Chalmers Institute of Technology, returned to Chalmers in September.

Mr. Heinrich Wendker, who came here for two years as a visiting research assistant from the Astronomisches Institut der Universität, Munster, Germany, returned there in August to do his doctoral dissertation.

Mr. Frank Bash, University of Virginia, and Mr. Carl Heiles, Princeton University, have returned to their universities to do their doctoral dissertations after completing their research work at the NRAO.

An updating of NRAO reprints

Series A

<u>No.</u>	<u>Title</u>	<u>Author</u>	<u>Journal</u>
39	On Grating Plateaux of Nonuniformly Spaced Arrays	Y. Leonard Chow	IEEE Trans. on Antennas and Propagation, AP-13, No. 2, March 1965
40	Performance of Thermal Detection Radiometers at 1.2 mm	F. J. Low	Proc. IEEE, 53, No. 5, May 1965
41	First Results from the National Radio Astronomy Observatory Interferometer	W. C. Tyler, D. E. Hogg and C. M. Wade	American Inst. of Physics, 70, No. 5

Series B

48	An Absolute Flux-Density Measurement of Cassiopeia A at 1440 MHz	J. W. Findlay, H. Hvatum, and W. B. Waltman	Astroph. J., 141, No. 3, 1965
49	The Flux Density of the Strongest Thermal Radio Sources at the Frequency 14.5 GHz	J.W.M. Baars, P. G. Mezger and H. Wendker	Zeitschrift fur Astroph., 61, 134, 1965