

NATIONAL RADIO ASTRONOMY OBSERVATORY
Charlottesville, Virginia

Quarterly Report

April 1, 1975 - June 30, 1975

RESEARCH PROGRAMS

<u>140-foot Telescope</u>	<u>Hours</u>
Scheduled observing	2027.25
Scheduled maintenance and equipment changes	147.00
Scheduled tests and calibration	5.75
Time lost due to: equipment failure	64.00
power	2.00
weather	14.00
interference	0.50

The following line programs were conducted during this quarter.

<u>Observer</u>	<u>Program</u>
F. Clark (Kentucky)	Attempt to detect two ring compounds $C_6H_5CH_3$ (toluene) at 7764 MHz and $C_6H_5NH_2$ at 7925 MHz.
F. Lovas (NBS)	
D. Johnson (NBS)	
D. Levy (Chicago)	Search at 7260 MHz for interstellar CH emission in the excited rotational state.
L. Rickard (Chicago)	
P. Palmer (Chicago)	
B. Zuckerman (Maryland)	
B. Turner	
R. Brown	Observations of 14.7 GHz $H76\alpha$ recombination lines in very compact HII regions.
J. Lockman (Massachusetts)	Observations at 14.7 GHz of $H76\alpha$ and $He76\alpha$ recombination lines to investigate the abundance of helium in Sgr B2.
R. Brown	
J. Lockman (Massachusetts)	Recombination line studies at 2-cm wavelength of galactic HII regions.
G. Rossano (Maryland)	Studies at 6-cm wavelength of $H109\alpha$ recombination lines in S187 and S298.

<u>Observer</u>	<u>Program</u>
F. Clark (Kentucky) F. Lovas (NBS) D. Johnson (NBS)	Observations at 4841 MHz to confirm the detection of the SO-dimer molecule in Sgr B2, W51 and NGC 2024 and to search for the SO-dimer molecule in IRC+10° 216. Map of H ₂ CO (formaldehyde) at 4830 MHz in small area around Tau A.
E. Chaisson (Center for Astrophysics) D. Jaffe (Center for Astrophysics) L. Rodriguez (Center for Astrophysics)	Observations over the frequency range of 4800-5020 MHz to (1) map 110 α -recombination lines and H ₂ CO in M8; (2) complete H ₂ CO study of W3; (3) measure H ₂ CO toward several near IR sources; and (4) complete Stark effect program in Ori A through observations of higher order recombination lines.
B. Turner	Search at 2-cm wavelength for a number of heavy molecules to explore the mechanism of molecule formation. Continue survey of the galaxy at all four 18-cm lines of OH.
L. Rickard (Chicago) R. Loren (Texas) W. Peters (Texas)	Search for 2.8-cm recombination line emission from dark clouds with associated bright rims.
B. Zuckerman (Maryland) N. Fourikis (CSIRO, Australia) M. Morris (Caltech) P. Palmer (Chicago) B. Turner	Search for the 2 ₂₀ -2 ₂₁ transition of HDO at 10.278 GHz, for SiH ₃ OCH ₃ at 10.993 GHz and 11.001 GHz and CH ₃ CH ₂ CHO at 10.492 GHz.
G. S. Shostak (Penn Central) M. Roberts	Observations of 1421 MHz neutral hydrogen to investigate the ratio of neutral hydrogen to optical effective diameters of galaxies as a function of galaxy type.
R. Whitehurst (Alabama) T. Cram W. B. Burton M. Roberts	Preliminary search at 1421 MHz for a faint neutral hydrogen component at high galactic latitude.
M. Roberts	Measurement of the distribution of 1421 MHz neutral hydrogen along the major axis of NGC 253, and in the general region of the Sculptor group of galaxies.

<u>Observer</u>	<u>Program</u>
J. Lyon R. Brown	Search at 21-cm wavelength for hydrogen recombination lines in the direction of Copernicus stars.
J. Lockman (Massachusetts)	Coarse grid of observations of 21-cm recombination lines from distributed ionized gas and closely spaced observations near supernova remnants and at critical points in the hydrogen rotation curve.
R. Tully (Observatoire de Marseille, France) J. R. Fisher	Extension of 1421 MHz neutral hydrogen survey of galaxies to declinations south of those attainable at the 300-foot telescope.
P. Myers (MIT)	Study of 21-cm neutral hydrogen and hydrogen recombination lines near the dark cloud L896, maps of 21-cm neutral hydrogen in a set of six dark clouds, and a search for a systematic neutral hydrogen velocity pattern in an apparent ring of dark clouds in Sagittarius.
P. Myers (MIT) A. Barrett (MIT) R. Martin (MIT)	Observations of the 14.489 GHz line of ortho-formaldehyde in galactic dark clouds.
E. Grayzeck (Nevada)	Observations of 21-cm neutral hydrogen in an intermediate velocity cloud at galactic coordinates $l = 122^\circ$, $b = -15^\circ$.

The following continuum program was conducted.

<u>Observer</u>	<u>Program</u>
R. Becker (Maryland) M. Kundu (Maryland)	Measurements of linear polarization in supernova remnants at 6-cm wavelength.

The following VLB programs were conducted.

<u>Observer</u>	<u>Program</u>
I. Pauliny-Toth (MPIR, W. Germany) A. Witzel (MPIR, W. Germany) E. Preuss (MPIR, W. Germany) K. Kellermann	Studies at 6-cm wavelength of known compact nuclei and search for new nuclei of galaxies and quasars that are associated with extended radio sources, using the Bonn, West

<u>Observer</u>	<u>Program</u>
Pauliny-Toth, et als.(continued)	Germany 100-meter telescope and the NRAO 140-foot telescope.
D. Shaffer (Yale)	Studies at 2-cm wavelength of the structure and time variations of weak central components found in extended sources, using the NASA JPL 210-foot telescope, the Bonn, W. Germany 100-meter telescope, the Haystack 120-foot telescope, and the NRAO 140-foot telescope.
I. Pauliny-Toth (MPIR, W. Germany)	
A. Niell (JPL)	
K. Kellermann	
G. Purcell	
B. Clark	
A. Witzel (MPIR, W. Germany)	Observations at 2.8-cm wavelength to study compact radio structure in Cyg A, using the Bonn, W. Germany 100-meter telescope and the NRAO 140-foot telescope.
I. Pauliny-Toth (MPIR, W. Germany)	
E. Preuss (MPIR, W. Germany)	
K. Kellermann	
M. Cohen (Caltech)	Observations at 2.8-cm wavelength to monitor 3C120 for one year to observe structure and flux changes, using the OVRO 130-foot telescope, the Harvard, Fort Davis 85-foot telescope, the NRL Algonquin, Canada 150-foot telescope, and the NRAO 140-foot telescope.
R. Schilizzi (Caltech)	
J. Yen (Toronto)	
D. Shaffer (Yale)	
A. Maxwell (Harvard, Fort Davis)	
K. Kellermann	
D. Shaffer (Yale)	Studies at 2-cm wavelength of the structure and time variations of weak central components found in extended sources, using the NASA JPL 210-foot telescope, the Haystack 120-foot telescope, and the NRAO 140-foot telescope.
D. Jones (Santa Barbara)	
J. Broderick (VPI)	
A. Niell (JPL)	
G. Purcell	
G. Grove	
K. Kellermann	
B. Clark	

Also, during this quarter, H. Hvatum, C. Moore and J. Dolan conducted tests to evaluate the effects of the SMS-1 and SMS-2 satellites upon the 1660-1670 MHz radio astronomy band.

<u>Interferometer</u>	<u>Hours</u>
Scheduled observing	1912.25
Scheduled maintenance and equipment changes	146.25
Scheduled tests and calibration	125.50
Time lost due to: equipment failure	39.25
power	5.25
weather	46.25
interference	1.25

The use of the 45-foot telescope over a 35-km baseline (actually as a fourth element) is indicated in the program description.

The following continuum programs were conducted at 2695 and 8085 MHz unless otherwise indicated.

<u>Observer</u>	<u>Program</u>
G. Brandie (Queens, Canada) A. Bridle (Queens, Canada) B. Guindon (Queens, Canada)	Comparison of the radio and optical orientation of elliptical radio galaxies, using the 45-foot telescope.
E. Fomalont R. Sramek	Observations to remeasure the relativistic bending of radiation as a test of the general theory of relativity, using the 45-foot telescope.
R. Hjellming L. Blankenship	Observations of variable radio emission from Sco X-1 and companions, using the 45-foot telescope.
R. M. Price (MIT) P. Crane (MIT)	Survey of spiral galaxies, using the 45-foot telescope.
T. Guiffrida (MIT) B. Burke (MIT)	An attempt to detect the radio counterparts of X-ray sources in globular clusters, using the 45-foot telescope.
J. Carlson (Maryland) F. Kerr (Maryland)	Observations to detect and study small components in the nuclei of spiral and Seyfert galaxies, using the 45-foot telescope.
R. Becker (Maryland) M. Kundu (Maryland)	Observations of the central component of 3C386, using the 45-foot telescope.
J. Wardle (Brandeis) D. Altschuler (Maryland)	Monitor of the variability of flux and polarization in approximately 80 sources.
F. Owen L. Rudnick	Observations of Abell clusters of galaxies; structure and polarization maps of the head-tail galaxy NGC 1265, using the 45-foot telescope.
D. Gibson (Virginia) R. Hjellming F. Owen	Observations to confirm that RS CVn binaries, as a class, are radio emitters.

<u>Observer</u>	<u>Program</u>
F. Owen L. Rudnick	Observations of low brightness radio structure in rich clusters of galaxies.
K. Johnson (NRL) C. Wade	Observations of precise astrometric positions of approximately 40 radio sources; measurements of time and polar motion, using the 45-foot telescope.
K. Lang (Tufts)	High spatial resolution observations of the sun, using the 45-foot telescope.
J. Spencer (NRL) P. Schwartz (NRL)	Search for radio continuum emission from ultraviolet stars.
D. Backer (NASA, Greenbelt) R. Sramek	Parallax and proper motion studies of pulsars and radio stars, using the 45-foot telescope.
L. Pataki (Indiana) M. Haynes (Indiana) B. Lockaby (Indiana)	Detailed study of seven galaxies which have extended radio sources.
G. Miley (Leiden, Netherlands) F. Owen L. Rudnick	Observations to map three objects which show radio tails and are found in Abell clusters of galaxies, using the 45-foot telescope.
H. Johnson (Lockheed)	Measurements of positions, structure, spectral indices, and polarization of several small galactic optical nebulae which are either ambiguous supernova remnants or are analogous to supernova remnants.
J. Condon (VPI) J. Broderick (VPI) M. Davis (NAIC, Puerto Rico)	Measurements of the positions and spectral indices of sources contained in the M. Davis 1400 MHz extragalactic survey.
J. Condon (VPI)	Accurate positions of a sample of 150 sources having flat spectra.
P. Kronberg (Toronto, Canada)	Monitor of flux variations in the nucleus of M82.
B. Zuckerman (Maryland) R. Brown	Search for compact continuum sources in dense molecular clouds.

<u>Observer</u>	<u>Program</u>
G. Knapp (Caltech) J. Broderick (VPI) R. Brown	Survey of reflection nebulae.
J. Kraus (Ohio State)	Accurate measurements of the positions of approximately 25 Ohio State University sources which have centimeter excess spectra.

<u>300-foot Telescope</u>	<u>Hours</u>
Scheduled observing	2015.25
Scheduled maintenance and equipment changes	164.75
Scheduled test and calibration	4.00
Time lost due to: equipment failure	88.00
power	2.75
weather	5.75
interference	0.00

The following line programs were conducted during this quarter.

<u>Observer</u>	<u>Program</u>
G. Knapp (Caltech) R. Brown	Search at 21-cm wavelength for $\text{Cl}66\alpha$ recombination lines in early-type and pre-main-sequence stars that are associated with dense nebulosity.
R. Tully (Observatoire de Marseille, France) J. R. Fisher	Survey for nearby galaxies by the measurement of 1421 MHz neutral hydrogen.
S. Simonson (Maryland) B. Williams (Maryland) F. Kerr (Maryland) P. Bowers (Maryland)	An all-sky survey of OH sources at 1612 MHz.
L. Brown (NASA, Greenbelt) D. Buhl (NASA, Greenbelt) T. Clark (NASA, Greenbelt) R. Hobbs (NASA, Greenbelt) S. Mosier (NASA, Greenbelt) J. Novaco (NASA, Greenbelt)	Preliminary survey at 4830 MHz of H_2CO (formaldehyde) near the galactic plane.
R. Whitehurst (Alabama) M. Roberts	Search at 281 MHz for absorption or emission from a quark-electron hyperfine transition.

The following continuum programs were conducted.

<u>Observer</u>	<u>Program</u>
J. Machalski (Jagellonian U., Poland)	Observations at 1400 MHz to extend the Bridle, Davis, Fomalont, Lequeux complete sample of strong radio sources to a lower flux density. Survey at 1400 MHz of sources from the Bologna (Italy) catalog to study statistics of the spectral index distribution.
W. Erickson (Maryland) J. R. Fisher	A 250-1000 MHz study of radio source variability coordinated with observations conducted at the Clark Lake radio telescope.
T. Stocke (Arizona)	Complete an 11-cm survey of radio emission from double galaxies found in the Karachentsev catalog.
J. Kapitzky (Massachusetts) W. Dent (Massachusetts)	Monitor at 2695 MHz the flux density and polarization of known variable extragalactic sources and a continued search for other variable sources.
F. Owen L. Rudnick	Continued 11-cm observations of sources lying in the direction of Abell clusters of galaxies.
J. Pipher (Rochester) J. Krassner (Rochester) M. Savedoff (Rochester) B. Soifer (San Diego)	Observations at 11-cm wavelength of compact HII regions to be used with observations taken at the NRAO interferometer.
R. Porcas	Observations at 6-cm wavelength to measure the flux density of about 750 sources whose flux density is greater than 0.7 Jy at 966 MHz as measured by the Jodrell Bank, England Mk IA telescope, and to measure positions of about 250 sources whose sizes are greater than 1.5 arc minutes as measured by the Jodrell Bank, England Mk IA-MK II interferometer.

36-foot TelescopeHours

Scheduled observing	2000.75
Scheduled maintenance and equipment changes	106.00
Scheduled tests and calibration	77.25
Time lost due to: equipment failure	75.25
power	0.00
weather	85.25
interference	0.00

ObserverProgram

B. Balick (Lick Observatory)	Search for CO in early-type galaxies.
S. Faber (Lick Observatory)	
J. Gallagher (Minnesota)	
K. Bechis (MIT)	CO mapping around dust clouds and reflection nebulae associated with early-type objects.
K. Lo (MIT)	
P. Bruston (Lab. de Physique Stellaire et Planetaire, France)	Observations of the Crab Nebula and F Corona.
N. Coron (Lab. de Physique Stellaire et Planetaire, France)	
A. Vidal-Madjar (Lab. de Physique Stellaire et Planetaire, France)	
W. B. Burton	CO mapping in inner galactic nucleus.
H. Liszt	
R. Sanders	
N. Coron (Lab. de Physique Stellaire et Planetaire, France)	Observations at 1 mm of the galactic center and compact sources in galactic nuclei.
P. Bruston (Lab. de Physique Stellaire et Planetaire, France)	
A. Vidal-Madjar (Lab. de Physique Stellaire et Planetaire, France)	
D. Dickinson (Harvard)	Search for HCNO at 68814 MHz and various A and B transitions of CH ₃ CHO.
C. Gottlieb (Harvard)	
W. Dent (Massachusetts)	Flux density variations of variable extragalactic radio sources.
R. Hobbs (NASA, Goddard)	
K. Fox (Tennessee)	Studies of hyperfine structure of methane.
C. Mumford (Tennessee)	
D. Jennings (Tennessee)	

<u>Observer</u>	<u>Program</u>
E. Chaisson (Harvard) B. Balick (Lick Observatory) R. Gammon (Sao Paulo, Brazil)	Mapping of C38 α and CO distribution in selected HII regions; observations of H recombination lines and isotopic lines of CO.
M. Gordon W. B. Burton	Latitude cuts of galactic carbon monoxide.
M. Gordon W. B. Burton	Fine structure of CO in galactic plane.
C. Gottlieb (Harvard) M. Litvak (Harvard)	Studies of $^{13}\text{CH}_3\text{OH}$ and $^{12}\text{CH}_3\text{OD}$ in galactic sources.
C. Gottlieb (Harvard) A. E. Lilley (Harvard) J. Ball (Harvard)	Studies of SO and search for ethyl alcohol and aminoacetonitrile.
C. Gottlieb (Harvard) A. E. Lilley (Harvard) H. Penfield (Harvard)	Observations of NS.
C. Gottlieb (Harvard) M. Litvak (Harvard) A. E. Lilley (Harvard) J. Ball (Harvard)	Search for formic acid and NCN.
A. Kislyakov (Gorky Radio Physical Institute, USSR) B. Turner	Search for vibrationally excited H $_2$ O, N $_2$ O and CO observations in nebulae.
P. Lena (Meudon, France) P. Bruston (Lab. de Physique Stellaire et Planetaire, France) D. Hall (KPNO) J. Rather (Lulejian and Associates) J. LeBlanc (Lab. de Physique Stellaire et Planetaire, France)	Observations of the solar corona.
J. Lyon S. Mufson P. Marionni (Maryland)	Search for CO emission from planetary nebulae.
R. Martin (MIT) P. Ho (MIT)	Mapping of microwave spectral lines in the galactic center region.

<u>Observer</u>	<u>Program</u>
A. Milman (Maryland) P. Marionni (Maryland)	CO observations near hot stars associated with dust clouds.
P. Nachman (Chicago) P. Palmer (Chicago) M. Morris (Caltech)	Search for 67.8 GHz transition of vibrationally excited water.
P. Thaddeus (NASA Inst. for Space Studies)	Search for the ion HCNH^+ .
K. Tucker (Fordham) M. Kutner (NASA Inst. for Space Studies)	Observations of C_2H .
B. Ulich J. Hollis (Virginia)	Search for interstellar fluorine.
M. Werner (Caltech) D. Gezari (Caltech) N. Scoville (Massachusetts) W. Westbrook (Caltech) W. Wilson (Aerospace)	Maps of molecules in dust clouds observed with the 200-inch telescope at 1 mm.

ELECTRONICS DIVISION

Green BankManpower Assignments

	<u>%</u>
Visitor support and maintenance.....	47.0
New receiver development	12.5
Sick leave and vacation.....	10.2
140-ft Cassegrain receiver improvements.....	5.7
VLA support.....	5.1
VLBI effort.....	4.5
Digital standard receiver development.....	3.4
140-ft temperature measurement system.....	3.4
Interferometer digital delay development.....	2.8
Tucson support.....	1.8
Interference protection and satellite monitoring.....	1.2
140-ft computer specification support.....	1.2
300-ft computer additions.....	1.2
	<u>100.0</u>

Work has begun on a system to monitor the temperature of several points on the 140-foot telescope structure and pass the data on to the position computer for use in making pointing and focus corrections.

Work is continuing on a digital standard receiver, a cooled dual-frequency 1.0-1.4 GHz/4.5-5 GHz receiver, a cooled diode switch, a digital delay and correlator system for the interferometer, and additional IF processor capability. The new 9-cm cooled paramp is due to be shipped from the vendor in July, and improvements to the 140-foot Cassegrain receiver are progressing on schedule for a mid-October reinstallation.

Engineering support was provided in writing specifications for a new computer for the 140-foot telescope.

Tucson

The filter-bank spectrometer system has been improved with regard to stability and a switching-network and 30 kHz filter-bank will be installed by the end of the year. Construction work is continuing on the new 9-mm continuum receiver and a 33-50/80-120 GHz cooled-mixer receiver. The 47.5 GHz cooled-paramp system has been delivered and will be tested on the telescope later this year. An automatic noise-figure monitoring system has been added to aid in tuning of receivers.

A spare sub-reflector assembly has been built and tested. A small indoor antenna-measuring range has been constructed to facilitate investigations of feed efficiency problems and quasi-optical components. Investigations of methods to improve the telescope surface accuracy are also in process.

ENGINEERING DIVISION

Design for improved access ways and work platforms for the 140-foot telescope was completed as was the installation design for a lift at the 300-foot telescope. An air conditioning system as designed and installed on the 45-foot telescope equipment trailer. Detail design continued on the modifications to the feed horn test range. Engineering continued to assist in the upgrading of fire fighting and emergency equipment. Preliminary design and research continued for a millimeter-wave telescope. Outline drawings and specifications were made for a laboratory building at the 36-foot telescope on Kitt Peak. The VLA project, Green Bank operations, Charlottesville operations, and Tucson operations were provided engineering assistance as requested.

COMPUTER DIVISION

Manuals

Four new manuals are available describing the use of the NRAO-supported software packages:

- "36 Foot Telescope Computer System Manual", Computer Division Internal Report No. 18, July 1975 edition, by Jan M. Hollis.
- "Users Guide to 360/65 Interferometer Data Processing Programs" Computer Division Internal Report No. 25, April 1975 edition, by L. C. Blankenship, R. M. Hjellming, B. C. Meredith, F. R. Schwab. (Available in computer printout form only.)
- "The NRAO Line Interferometer; a Manual", Edition 2, May 1975, by Eric W. Greisen.
- "The NRAO Image Recording System", Computer Division Internal Report No. 21, Edition 1, May 1975, by Thomas R. Cram and Eric W. Greisen.

All of the above manuals may be obtained by contacting either an author or the Computer Division secretary. Although the 36 foot manual is available in Charlottesville, requests should go directly to Tucson.

Telescopes

Card input enabling the sequencing of observations according to start/stop times expressed relative to selected epochs has been implemented at the 300-foot telescope.

A Modcomp II/25 computer system has been purchased for replacement of the 140 foot DDP116 control computer. Software development has been started.

VERY LARGE ARRAY PROJECT

Site and Wye Division

Phase II construction, consisting of the permanent buildings, site work, and utilities, was 22% complete at the end of the quarter. The control building and cafeteria exterior walls are nearly complete with work progressing on the electrical work and plumbing.

Installation of 1.25 kilometers of TE_{01} mode, 60 mm waveguide on the southwest arm was started during May and was 60% completed by the end of June. Specifically, installation of seven waveguide manholes is in process and approximately 2400 linear feet of waveguide has been set to grade and back-filled in the trench. An additional 2800 feet of waveguide has been coupled, pressure tested, sleeved and has had the coating tested for defects.

Antenna Division

The reflector back-up structure has been assembled and mounted to the antenna base. Alignment checks are under way and installation of the aluminum reflector panels has begun. AUI-furnished antenna components and equipment are on hand at the site with the exception of the secondary reflector. The antenna transporter is nearly complete.

Electronics Division

At the VLA site the mock-up vertex equipment room has been erected and the feed ring and front-end rack have been installed. The feed horns for the 6.0, 2.0, and 1.3 cm bands have been connected and pressurized, and the wave-guide interconnections to the front-end rack have been tested.

System testing of prototype electronics has continued in Charlottesville. Some small design modifications have been made in the modules. In late June the electronics for antenna No. 1 were shipped to the site.

Tests of both the Westinghouse and TRG modems have now been made. The Hughes modems have been packaged but are awaiting Gunn oscillators before they can be tested in the system. The system tests made thus far have enabled us to specify their required characteristics in much more detail than was possible at the time of initial procurement. As a result, it has been decided to implement an NRAO design for at least some of the modems required for the next four antennas.

Computer Division

Asynchronous Subsystem - In early May, the last major components of the control language CANDID were completed, and a decision was made to adopt this language as the top level of the asynchronous computer's initial data processing system. Further development of basic CANDID capabilities continued through the remainder of the month; also, many new functional operators were added to the system. Based on specifications previously outlined, coding was begun on CANDID operators which plot and display data arrays. Extensive work on the basic mathematical applications routines was begun and these activities will be the dominant task of the Asynchronous Computer Group in the coming months.

Synchronous Subsystem - The group has devoted most of its effort to continued support and check-out of interfaces to NRAO-built electronic equipment. The automatic restart feature for the three peripheral CPU's was added to the system, and software written to support it. In late June the synchronous subsystem was shipped to the site for use with the prototype antennas.

Project Management

The take-up of rail at the Lincoln Ordnance Depot is nearing completion and shipments are arriving at the site. Rail take-up at the Redstone Arsenal was started in June. Rail take-up at Holloman AFB is complete.

By the end of June, all 1975 transfers of personnel to the New Mexico site will have taken place. This brings the total project personnel in New Mexico to 46.

SUMMER STUDENT PROGRAM

Announcement of our 1975 summer student program was sent to about 100 colleges and universities in December. From the more than 250 applications received, 17 students were selected to participate in the program as research assistants to the scientific staff and in the electronics and computer divisions. Four students are working in Green Bank, 12 in Charlottesville and one in Socorro. These students will spend at least 11 weeks at the NRAO. Twenty-eight lectures will be given by the staff on various topics in radio astronomy and instrumentation; students are encouraged to attend the regular NRAO colloquia and seminars. They will also assist as tour guides in our public education program in Green Bank.

A total of 405 students have participated in the program since its beginning in 1959. Several students have returned to NRAO as thesis students and some as full-time employees.

The names of the 1975 students, their academic year and school are given below.

Name	Academic Year	School
Baines, K. H.	U-3	Amherst College
Berg, D. M.	U-5	Drexel University
Brasunas, J. C.	G-1	Harvard University
Burns, J. O.	G-1	Indiana University
Carter, M. J.	U-4	University of Michigan
Cosner, K. J.	U-4	University of Kentucky
Glassco, R. A.	U-3	Cornell University
Gorman, W. L.	G-1	State University of New York, Albany
Jafolla, J.	G-1	Brown University
Jones, D. L.	G-1	University of Cali- fornia
Krassner, J.	G-1	University of Rochester
Kust, A. L.	G-1	University of Massachusetts
Marscher, A. P.	G-2	University of Virginia
Ng, C. Y.	U-3	California Institute of Technology

continued:

Name	Academic Year	School
Soukup, J. E.	G-2	City College of New York
Teyssier, E. M.	U-3	University of California, Berkeley
Waldhuter, J. S.	G-1	Columbia University

PERSONNEL

Appointments

Lester M. Temple	Mechanical Engineer I	4/07/75
Richard W. Porcas	Research Associate	4/10/75
Mikio Ogai	Electronic Engineer I	5/05/75

Terminations

Norio Kaifu	Visiting Assistant Scientist	4/04/75
Richard M. Sramek	Associate Scientist	6/16/75
Paul R. Woodward	Research Associate	6/17/75

OPTICAL PROCESSING WORKSHOP

Optical storage and processing techniques are being investigated for application to line observations with the VLA. An optical processing "workshop" was held at the NRAO on June 2, 1975 in which 13 outstanding university, government and industry scientists participated. An intensive one-day program addressed the technical feasibility, current state-of-the-art, and operational implications of optical storage and processing.

OBSERVATORY COLLOQUIA

The twenty-two speakers in the NRAO colloquium program for the year ending June 30, 1975 are outlined below. The speakers are usually invited by the scientific staff, and talk on topics of current interest in radio astronomy or closely allied fields. The Astronomy Department of the University of Virginia also invites speakers to their own colloquium series. These two series are jointly announced and well attended by our staff, university physicists, and astronomers and students.

Speaker	Institution	Date
J. N. Bahcall	Institute for Advanced Studies	3/06/75
J. C. Brandt	Goddard Space Flight Center	10/18/74
L. D'Addario*	Stanford Radio Astronomy Institute	7/18/74
A. G. de Bruyn	Sterrewacht, Leiden	7/11/74
E. Gerard	Paris Observatory	10/25/74
T. R. Gull	Kitt Peak National Observatory	3/14/75
E. R. Harrison	University of Massachusetts	11/14/74
R. Hulse	University of Massachusetts	3/31/75
P. C. Joss	Massachusetts Institute of Technology	11/21/74
A. G. Kislyakov	Gorky Radiophysical Institute	6/26/75
W. C. Liller	Harvard University	5/01/75
P.J.E. Peebles	Princeton University	3/27/75
K. H. Prendergast	Columbia University	4/24/75
J. I. Silk	University of California, Berkeley	5/22/75
B. A. Smith	University of Wisconsin	4/07/75
G. Steigman	Yale University	2/06/75
J. A. Tyson	Bell Telephone Laboratories	2/13/75
H. van der Laan	Leiden Observatory and Institute for Space Studies	10/31/74
G. L. Verschuur	University of Colorado	8/15/74
K. W. Weiler	Kapteyn Astronomical Institute	1/16/75
A. M. Wolfe	University of Pittsburgh	3/17/75
S. Yngvesson	University of Massachusetts	1/09/75

* Now at NRAO