DSN Research and Technology Support

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The activities of the Development Support Group in operating and maintaining the Venus station (DSS 13) and the Microwave Test Facility are discussed and progress noted. Activities include interferometric planetary radar measurements of the surface of Venus, support of station automation (pulsar) testing and observing, weak radio source observation for 64-m antenna gain calibration, completion of the sidelobe measurements on the 26-m antenna (with resultant changes in gain and system temperature), and extensive sky survey measurements. Additionally, major support was given to spacecraft projects with Faraday rotation data collection, support of the Block IV receiver/exciter at DSS 14, X-band (400-kW) radar testing and DSS 63 100-kW transmitter testing.

During the two-month period ending April 15, 1974, the Development Support Group, in its operation of the Venus station (DSS 13) and the Microwave Test Facility, made progress on various projects as discussed below.

I. In Support of Section 331

A. Planetary Radar

In support of the Mariner Venus/Mercury 1973 (MVM'73) mission, ground-based planetary radar mapping of the Venusian surface continued. The planet was illuminated with the 400-kW transmitter and 64-m antenna at DSS 14, and the reflected signals were simultaneously received by DSS 13 with its 26-m antenna and DSS 14. A total of 17 hours, during which 57 separate data runs were collected, was devoted to this project.

B. Station Automation (Pulsars)

As part of the overall DSN Station Automation Project (Station Monitor and Control (RTOP-68)), a demonstration is planned using the Venus station to perform a pulsar track under remote control from JPL in Pasadena. The dedicated 26-m antenna pointing computer has been interfaced with the "master" computer at DSS 13, and a computer-to-computer link has been successfully established between the SDS-930 computer at DSS 13 and the SDS-930 computer in building 238 at JPL. Testing of the automation hardware and software has consumed 70

hours during these 2 months, while during the 103 hours devoted to observing, the 22 pulsars tabulated in Table 1 were monitored.

II. In Support of Section 333

A. Weak Source Observation

During the 81½ hours devoted to observing weak radio sources (Ref. 1), the sources tabulated in Table 2 were observed.

B. Radio Star Calibration

With the receiver tuned to 2278.5 MHz, and right circular polarization selected on the 26-m antenna, flux measurements were made on radio sources 3C123, 3C218, and Cygnus A during the 41½ hours of observation performed during these 2 months.

C. 26-m Antenna Sidelobe Measurements

Using the Sun as a source of signal, measurements were made for 30 hours with the quadripod on the 26-m antenna covered with flat perforated aluminum sheet. Other radio source measurements indicate that the antenna gain has decreased approximately 0.1 dB, and system temperature at zenith has decreased approximately 0.6 K. Except for confirming measurements to be made when the coverings are removed from the quadripod, this program is now complete at Venus.

D. Sky Survey

During this period, the antenna positions for this testing have been 180-deg azimuth with elevations between 83.0 and 84.2 deg, in 0.1-deg increments. With the antenna in this range of positions, a total of 609½ hours of data have been collected. During the latter part of the period, a modification was made to the data collection system to install an incremental tape recorder to replace the previously used digital printer.

E. Faraday Rotation Data Collection

During the MVM'73 encounters with Venus and Mercury, data were collected from two receivers and put onto punched paper tape, digital printer, and analog chart recorder. During the encounter with Mercury and for two weeks prior, one of the receivers was receiving signals from ATS-1 while the other received signals from ATS-5.

During the week ending March 17 a receiver purchased from Teledyne Micronetics was installed for evaluation, and the previously loaned receiver was returned to Teledyne. At the close of the two-month period, data continue to be collected on two receivers, one each on ATS-1 and ATS-5, 24 hours per day, 7 days per week.

III. In Support of Section 335

A. Block IV Receiver/Exciter

Personnel from the Development Support Group continued to provide test operation, troubleshooting, and corrective maintenance to this system at DSS 14. Continued doppler counting problems prompted examination of all system coaxial cables with a Time Domain Reflectometer (TDR) and resulted in replacement of several cables having impedance discontinuities.

Other support provided included operation of the system for pre-encounter testing of the associated ranging system, module repair and replacement, and general corrective maintenance culminating in wholly successful equipment operation during MVM'73 encounter with Mercury. A total of 586 manhours of support was provided by the Development Support Group during the two-month period ending April 15, 1974.

B. X-Band Planetary Radar

A 250-kW klystron, which had arced in the electron gun region during testing at DSS 13 and was returned to the manufacturer, was reprocessed and received back at DSS 13.

Significant progress has been made on other areas as the dual klystron setup was completed, dismantled, and shipped to JPL, where it was installed into the final configuration in the Cassegrain Feedcone to be used at DSS 14.

The traveling wave resonator (TWR) has achieved a circulating power of 240 kW, but the need for more cooling and greater excitation power has become apparent from initial testing. Additional cooling, particularly of the input tuners, has been applied, and the beam voltage power supply has been modified to provide up to 25 kV to gain additional power from the klystron used for TWR excitation.

C. DSS 63 100-kW Transmitter Testing

The transformer/rectifier, crowbar cabinet, high-voltage filter choke, and vault control junction box have been

assembled onto the test pad inside of a protective enclosure. The output of the high-voltage power supply was connected to the 1-MW oil-cooled dc load, and a 22-hour test run at 1 MW at 70 kV dc was accomplished.

Contractor personnel have been authorized to aid in testing at DSS 13 and implementation at DSS 63. Three have arrived at DSS 13 and training has commenced. Additionally, two members of the station staff from DSS 63 have arrived to train on the system so as to provide better support when the 100-kW transmitter is installed.

IV. In Support of Section 442

A. Clock Synchronization Transmissions

Five transmissions to DSS 42 and one transmission to DSS 51 were made during this period.

B. DSN Klystron Testing

The DSN High-Power Transmitter Maintenance Facility at DSS 13 performed acceptance class testing on three X-3075 400-kW klystrons for later use at DSS 14. Testing has been temporarily suspended while the dc power supply is used for support of DSS 63 and X-band radar testing.

V. In Support of Section 825

With the approaching encounter of Pioneer 11 with Jupiter, approximately five hours per week of support are being provided. During the period, radiation from the planet Jupiter was observed with the 26-m antenna at DSS 13, wtih the system set to receive 2295 MHz, right circular polarization. Observations of Jupiter and radio star calibrators 3C48, 3C123, 3C286, 3C348, and 3C353 were made for a total of 54 hours.

Reference

1. Jackson, E. B., "DSN Research and Technology Support," in *The Deep Space Network Progress Report 42-20*, pp. 124–127, Jet Propulsion Laboratory, Pasadena, Calif., Apr. 15, 1974.

Table 1. Pulsars selected for test observation at DSS 13

0031−07	1133+16	1929+10
0329+54	1237+25	1933+16
0355+54	1604−00	2021+51
0525+21	1642−03	2045−16
0628−28	1706−16	2111+46
0736−40	1749−28	2218+47
0823+26	1818−04	
0833−45	1911−04	

Table 2. Weak radio sources observed at DSS 13

3C48	3C218	NGC 4736
3C123	3C309.1	NGC 7027
3C138	3C348	PKS 0237-23
3C147	NGC 4258	