Radio Astronomy

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This article reports on the activities of the Deep Space Network in support of Radio Astronomy Operations during September and October 1981. Work in progress in support of a program sponsored by the Director's Discretionary Fund is reported.

I. Introduction

Deep Space Network (DSN) 26-, 34- and 64-meter antenna stations are utilized in support of three categories: NASA Office of Space Science (OSS), Radio Astronomy Experiment Selection (RAES), and Host Country. This report also features progress of the Science Utilization of the Radio Frequency Interference Surveillance System (SURFISS). While this activity does not fit the categories on which we normally report, it is basically radio astronomy, and thus is included here.

II. Radio Astronomy Operations

A. NASA OSS Category

During this period, 73 hours and 35 minutes of DSN station support was given for Pulsar Rotation Constancy, 17 hours and 30 minutes of support was given for Planetary Radio Astronomy, and 8 hours and 15 minutes of support was given for Southern Hemisphere Radio Source positions.

B. RAES Panel Category

While no primary DSN support for any RAES experiment was rendered during this reporting period, RA 178 (superluminal radio sources at 13 cm) was approved by the RAES panel and scheduled for DSN support in late 1981. Another new proposal, "A Statistical VLBI Test of the Self-Compton Mechanism for X-Ray Emission from Compact Extragalactic Radio Sources," was also received and is being reviewed by the RAES panel members.

C. Host Country

At time of going to press, the figures for this activity were unavailable.

III. SURFISS Progress Report

Science Utilization of the Radio Frequency Interference Surveillance System (SURFISS), a program sponsored by the

Director's Discretionary Fund, is designed to utilize JPL's 65,000-channel Radio Frequency Interference Surveillance System (RFISS) for radio astronomical studies. The RFISS is a unique microwave spectrum analyzer developed to detect radio frequency interference (RFI) at the DSN facility at Goldstone. It is a trailer-based microwave receiver and data processing system which includes a 65,000-channel spectrum analyzer. The receiver and spectrum analyzer are controlled by a Modcomp II computer, allowing the RFISS to process two 10-MHz channels into 32,000 channels, each with a resolution of 305 Hz.

The RFISS was connected to the 26-m antenna receiver system at DSS 13 (Venus Station) in September 1981 in order to carry out the first step of the SURFISS program. Both S- and X-band signals were coupled to the RFISS for these tests. The objective of the series of tests which took place on September 10/11, 17/18, and 24/25 was to obtain experience with the RFISS as the processor for DSS 13 output and to investigate the system stability and gain characteristics. Observational procedures were tested for first-order calibration of data.

The data obtained during the five observing runs are analyzed both in the field and off-line on a PDP 11/44 at JPL. The software available on the Modcomp II in the field allows the observer to inspect spectra in near-real-time in both normalized and calibrated format. Thus the observer may make informed decisions in real-time. For off-line analyses, the data are written on magnetic tape.

Astronomical observations were carried out October 8/9. During this run, recombination lines in M17, Orion A, and W51 at S-band were observed. H142α and He142α were seen in all three sources of thermal microwave emission. H178α was seen in M17 and Orion A. At X-band, the transition H115β was seen in Orion A, and an unidentified line was seen in M17. Figure 1 is a calibrated spectrum of M17 at S-band showing the H142α and He142α recombination lines. Since these lines are several hundred kilohertz wide, the frequency resolution of the data has been degraded through averaging adjacent channels from the original 305 Hz to 16.16 kHz. The vertical scale is antenna temperature in kelvin; the horizontal scale is frequency in MHz. Figure 2 is a similarly calibrated spectrum of Orion A at X-band showing the H115β recommendation line.

Observations of Voyager 2 at X-band and Pioneer 12 at S-band were also made. Figure 3 is a calibrated spectrum of Voyager 2 showing the suppressed carrier and upper- and lower-sidebands out to the ninth sideband, at a resolution of 16.16 kHz. Figures 4 and 5 are calibrated spectra of the first lower- and upper-sidebands, and illustrate the asymmetry which is present in the signal.

Work is currently underway to evaluate the performance of the system when observing astronomical sources and spacecraft. It is planned to conduct observations at DSS 14 in January 1982 after the completion of a series of RFI surveys at both DSS 13 and DSS 14.

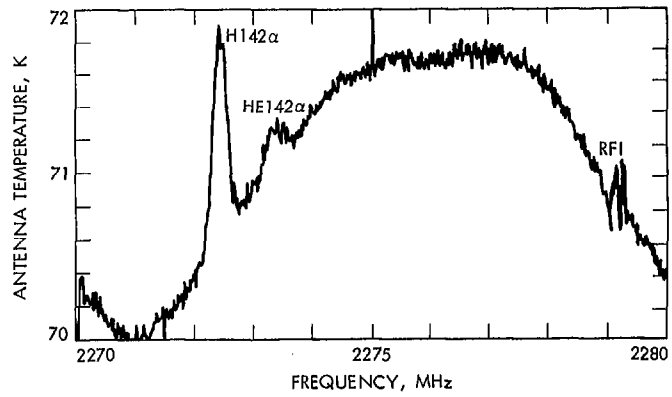

Fig. 1. M17 at S-band

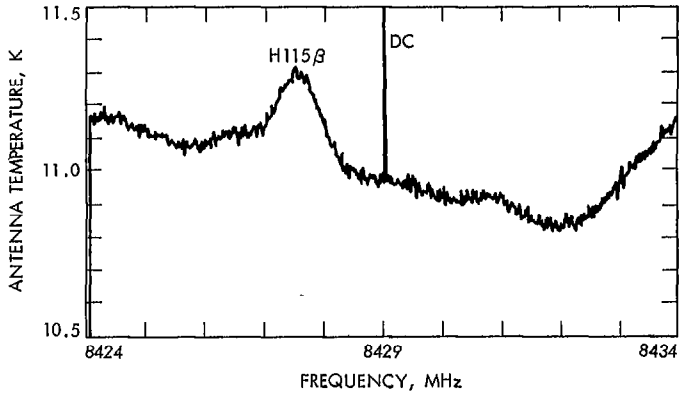

Fig. 2. Orion A at X-band

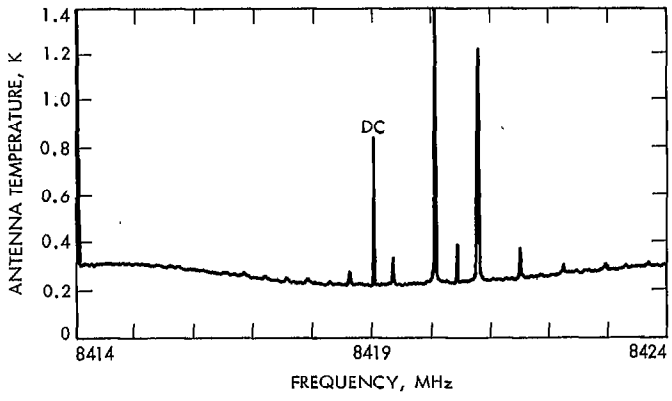

Fig. 3. Voyager 2 calibrated spectrum

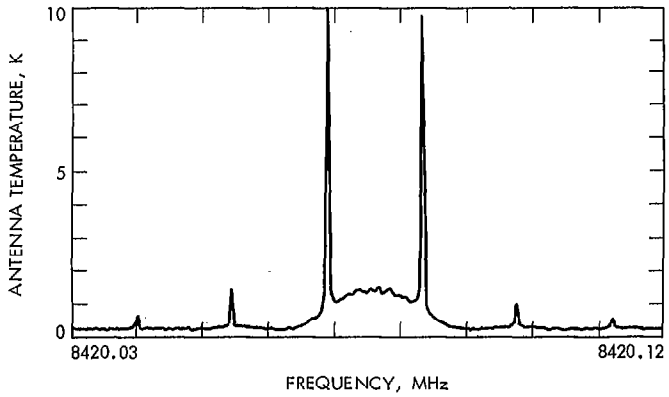

Fig. 4. Voyager 2, lower 1st sideband

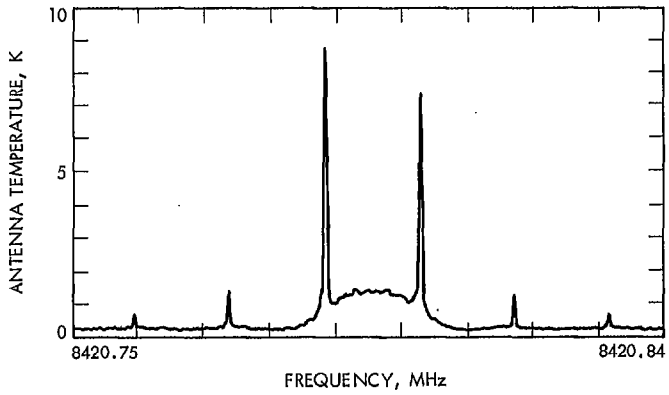

Fig. 5. Voyager 2, upper 1st sideband