Radio Science Support

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Since 1967, radio scientists have used the Deep Space Network 26- and 64-m-diameter antenna stations to investigate pulsars, quasars, and radio galaxies, to study the effect of solar corona on radio signals, and to observe radio emissions from x-ray sources. Very long baseline interferometry (VLBI) techniques have been used for high-resolution studies of quasars. During the reporting period, VLBI obsevations were made of quasars and pulsars as part of the Quasar Patrol. Support was also provided by the 64-m-diameter antenna to search for interstellar molecules and to observe radiation from Jupiter.

I. Introduction

The 26- and 64-m-diameter antenna Deep Space Stations (DSSs) of the DSN have been used for several years to support Radio Science experiments. NASA, JPL, and university scientists have used key DSN facilities whose particular and unique capabilities were required for the performance of the experiments. In order to formalize the method of selecting experiments and experimenters, a Radio Astronomy Experiment Selection (RAES) Panel was formed in 1969. A renewed notice of availability of these facilities was placed in professional journals to inform the scientific community that they were available for limited use by qualified radio scientists (Ref. 1). No charge is made for use of the standard DSN facilities and equipment; special equipment, however, must be provided by the experimenters. A summary of all experiments conducted through August 1972 is reported in Refs. 2 through 8.

II. Radio Science Operations

During the period September through December 1972, approximately 507 h of support were provided to Radio Science experiments (Table 1). Table 2 identifies the experiments supported. The 64-m-diameter antenna at

Goldstone supported all of these experiments; Near-Earth Physics VLBI experiments also made use of a 26-m antenna station at Goldstone (DSS 12). Support in September was limited primarily to those Office of Space Sciences (OSS)-sponsored experiments which could make use of the available time. The major commitment of the 64-m antenna during this period was to the Relativity Experiment of Mariner 9. At the end of the Mariner 9 mission, Radio Science support increased again. An effort was made to obtain as much time on the antenna as possible during October and November because the experimental feed cone containing the X- and K-band equipment was to be removed at the end of November until late in January 1973 to upgrade it for a Mariner Venus/Mercury 1973 flight project S/X-band experiment. For this reason, the Quasar Patrol received two periods of observations in November. One of these was terminated prematurely because of antenna mechanical problems; nevertheless, about half of the nominal 24-h pass produced satisfactory data.

The Quasar Patrol, initiated during a previous reporting period, was continued, although with the schedule modifications mentioned. This activity accounts for most of the time provided to the non-NASA and university radio astronomers under the auspices of the RAES Panel. Results of these observations were included in presentations made by the experimenters at the Sixth Texas Symposium on Relativistic Astrophysics in New York, December 19–22, 1972. The reports discussed changes in the sources observed and demonstrated the need for the regular observations instituted by the Quasar Patrol.

The experiments sponsored by OSS and reported on previously (Refs. 2–9) continued with the search for interstellar microwave lines and observations of Jupiter and Uranus. The latter observations were terminated for the year because of the increasing range to Jupiter. A new observation on the 64-m antenna was that of pulsars at K-band (14.7 GHz). Announcement of this detection is being made to scientific periodicals. Observations were also made at S- and X-band using a 64-m antenna. Regular observations of Venus and Mercury by radar continued for the purpose of providing an improved ephemeris for the Mariner Venus/Mercury 1973 project.

The program on Earth Dynamics, sponsored by the Office of Applications (OA), repeated observations between the 64-m antenna at the Mars DSS and the 26-m antenna at the Echo DSS to obtain statistical data for the determination of the baseline between the stations with greater accuracy. The observations made during previous reporting periods were for the purpose of checking out equipment used to perform these observations.

References

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2. Linnes, K. W., Sato, T., and Spitzmesser, D., "Radio Science Support," in *The Deep Space Network Progress Report*, Technical Report 32-1526, Vol. III, pp. 46–51, Jet Propulsion Laboratory, Pasadena, Calif., June 15, 1971.

3. Linnes, K. W., "Radio Science Support," in *The Deep Space Network Progress Report*, Technical Report 32-1526, Vol. IV, pp. 47–48, Jet Propulsion Laboratory, Pasadena, Calif., Aug. 15, 1971.

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8. Linnes, K. W., "Radio Science Support," in *The Deep Space Network Progress Report*, Technical Report 32-1526, Vol. X, pp. 52–58, Jet Propulsion Laboratory, Pasadena, Calif., Aug. 15, 1972.

9. Linnes, K. W., "Radio Science Support," in *The Deep Space Network Progress Report*, Technical Report 32-1526, Vol. XI, pp. 26–29, Jet Propulsion Laboratory, Pasadena, Calif., Oct. 15, 1972.

Table 1. DSN support to Radio Science experiments

Month	Hours of support to experiments sponsored by			
	RAES	OSS	OA	Total
September	—	90	—	90
October	32	108.5	15	155.5
November	46.5	102	16	164.5
December	21	76	—	97
Total	99.5	376.5	31	507.0

Table 2. Radio Science experiments involving 64- and 26-m antenna facilities

Experiment	Purpose	Experimenters	DSN facility	Dates
RAES Panel				
Quasar Patrol	To make detailed measurements on radio galaxies and quasars at 2.3, 7.8, and 15.6 GHz; to search for weak compact sources in the nucleus of extended radio galaxies and quasars; to monitor time variations in fine structure and apparent positions of quasars	Group A D. S. Robertson, WRE A. J. Legg, WRE J. Gubbay, WRE A. T. Moffet, Caltech G. Nicholson, CSIR	DSS 14 (used with MIT Haystack and NRAO 42-m antenna)	
		Group B J. J. Broderick, NAIC B. G. Clark, NRAO M. H. Cohen, Caltech D. L. Jauncey, Cornell K. I. Kellermann, NRAO G. H. Purcell, Caltech D. B. Shaffer, Caltech		Oct. 23, 1972 Nov. 25, 1972
		Group C T. A. Clark, GSFC R. M. Goldstein, JPL H. J. Hinteregger, MIT C. A. Knight, MIT G. E. Marandino, Univ. of Maryland G Resch, Univ. of Maryland A. E. Rogers, Haystack Observatory I. I. Shapiro, MIT A. R. Whitney, MIT		Nov. 7, 1972
Ionized hydrogen observations	To detect free-free emission from ionized gas in globular clusters	J. Hills, Univ. of Michigan M. Klein, JPL	DSS 14	May 22, 29, 1972 June 11, 23, 30, 1972 Oct. 11, 1972
Weak radio source observations	To measure the "confusion distribution" of weak radio sources at 2.3 GHz	D. L. Jauncey, Cornell Univ. M. J. Yerbury, Cornell Univ. J. J. Condon, Cornell Univ. D. J. Spitzmesser, JPL	DSS 14	June 5, 12, 1972 July 5, 13, 1972 Dec. 6, 18, 1972

Table 2 (contd)

Experiment	Purpose	Experimenters	DSN facility	Dates
OSS				
Interstellar microwave low-noise spectroscopy	To search for interstellar molecules at 14 GHz	S. Gulkis, JPL T. Sato, JPL B. Zuckerman, Univ. of Maryland D. Cesarsky, Caltech J. Greenstein, Caltech	DSS 14	Apr. 2, 10, 18, 1972 May 2, 6, 14, 17, 1972 June 4, 19, 1972 Aug. 5, 1972 Sept. 5, 14, 19, 1972 Oct. 10, 17, 27, 30, 1972 Nov. 2, 10, 11, 17, 23, 26, 29, 1972
Planetary radio astronomy	To study radio emissions of Uranus and Jupiter at 14 GHz	G. Gulkis, JPL B. Gary, JPL M. Klein, JPL M. Jansen, JPL Resident Research Associate E. Olsen, JPL Resident Research Associate P. Rosenkranz, JPL Resident Research Associate	DSS 14	Apr. 29, 30, 1972 July 14, 1972 Aug. 3, 1972 Sept. 7, 21, 28, 1972 Oct. 3, 4, 21, 28, 31, 1972 Dec. 20, 1972
Pulsar observations	To study emissions from various pulsars at S-, X-, and K-bands	G. Downs, JPL G. Morris, JPL P. Reichley, JPL	DSS 14	Nov. 18, 21, 30, 1972 Dec. 1, 8, 21, 1972
Venus/Mercury radar ranging	To provide improved ephemerides of Venus and Mercury for Mariner Venus/Mercury 1973 Project	J. Lieske, JPL R. Goldstein, JPL	DSS 14	Sept. 1, 15, 19, 26, 1972 Oct. 3, 10, 1972 Nov. 24, 28, 1972 Dec. 1, 5, 8, 20, 26, 1972
OA				
Earth Dynamics VLBI	To demonstrate NRAO Mark II digital recording terminal by measuring the baseline between DSSs 14 and 12	P. MacDoran, JPL J. Fanselow, JPL J. Thomas, JPL J. Williams, JPL	DSS 14 DSS 12	Aug. 15, 1972 Oct. 14, 18, 1972 Nov. 5, 20, 1972