Radio Science Support

K. W. Linnes
Mission Support Office

Since 1967, radio scientists have used the Deep Space Network 26- and 64-m antenna stations to investigate pulsars, to study the effect of solar corona on radio signals, and to observe radio emissions from X-ray sources. More recently, very long baseline interferometry (VLBI) techniques have been used for high-resolution studies of quasars. During the reporting period, VLBI observations were made in support of investigations of quasars. Support was also provided from the 64-m antenna for the mapping of nearby spiral galaxies.

I. Introduction

The 26- and 64-m antenna stations 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. 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 April 1971 was reported in Ref. 2. Activities through June 1971 were reported in Ref. 3. A summary of all experiments conducted through October 1971 is reported in Refs. 2, 3, and 4.

II. Radio Science Operations

Table 1 shows experiments supported in November and December 1971. The X-band VLBI observations repeated those made of some 37 sources in February 1971. The report on the results of this series of observations was published in Ref. 5.

After initial support of H. Arp during the previous reporting period to accomplish spiral galaxy mapping using the 26-m antenna at 13 cm, support was provided during this period from the 64-m antenna. The observations on the 64-m antenna were accomplished successfully. However, they were of only a few hours' duration; additional support will be requested in the future. During the reporting period, virtually all available support from this 64-m station was required for *Mariner 9*.

Support provided to the various radio science experiments over the past year by the DSN has resulted in a

number of papers being published or presented during the reporting period. In addition to Ref. 5, Ref. 6 shows some papers presented at the 136th meeting of the American Astronomical Society in San Juan, Puerto Rico, December 5–8, 1971. All of these papers were based on data derived through the use of DSN facilities.

The papers by Shapiro result from X-band VLBI observations between the Goldstone DSCC and Haystack Observatory (Refs. 3 and 4). The paper by Broderick derived from the X-band VLBI performed between Goldstone DSCC, the National Radio Astronomy Observatory, and the Crimean Astrophysical Observatory (Ref. 4). The paper by Handley and Lieske is based on planetary radar data obtained by R. Goldstein at DSS 14 64-m antenna station. The Jupiter observations were performed using the 64-m antenna (DSS 14) and the 26-m antenna at DSS 13 (Ref. 2).

III. RAES Panel Activities

Several new proposals were received and referred to the panel for evaluation.

References

1. *Bulletin of the American Astronomical Society,* Vol. 2, No. 1, p. 177, 1970.
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, California, June 15, 1971.
3. Linnes, K. W., "Radio Science Support," in *The Deep Space Network Progress Report,* Technical Report 32-1526, Vol. V, pp. 42–44. Jet Propulsion Laboratory, Pasadena, California, October 15, 1971.
4. Linnes, K. W., "Radio Science Support," in *The Deep Space Network Progress Report,* Technical Report 32-1526, Vol. VI, pp. 43–45. Jet Propulsion Laboratory, Pasadena, California, December 15, 1971.
5. Cohen, M., et al., "Small Scale Structure of Radio Galaxies and Quasars at 3.8 cm." *Astrophys. J.,* December 1, 1971.
6. Papers delivered at the 136th Meeting of the American Astronomical Society, San Juan, Puerto Rico. December 5–8, 1971:
   a. Shapiro, I., et al., "Observations with the Haystack-Goldstone Interferometer of Phase Scintillations Due to the Solar Corona."
   b. Shapiro, I., et al., "High Accuracy Determination of 3C273-3C279 Position Difference from Long-Baseline Interferometer Fringe Phase Measurements."
   c. Broderick, J., et al., "High Resolution Observations of Radio Sources Near 8 GHz."
   d. O'Handley, D., and Lieske, J. H., "Ephemeris of Mars for Mariner 9 Based on Radar Range and Optical Data."
   e. Shapiro, I., et al., "Measurement of Gravitational Deflection of Radio Waves."
   f. Gulkis, S., et al., "Jupiter: Secular Variations in Its Decimeter Flux."
   g. Reichley, P. E., and Downs, G. S., "Observations of Pulsar PSR0833-45."
   h. Arp, H., "Radio Sources Grouped in the MC731 and Stephans Quintet Area."

Table 1. Radio science experiments involving 64- and 26-m antenna facilities

Experiment	Purpose	Experimenter	DSN facility	Date
X-band VLBI	To study the structure of extra galactic sources with improved resolution.	J. Broderick (NRAO) B. Clark (NRAO) K. Kellermann (NRAO) D. Jauncey (Cornell University) M. Cohen (Caltech) D. Shaffer (Caltech)	DSS 14 (and MIT Haystack Antenna)	February 1971 Nov. 2, 1971
Spiral galaxy mapping	To study galaxies with anomolous red shifts and their possible association with radio sources.	H. Arp (Caltech)	DSS 13 (26-m) DSS 14 (64-m)	Oct. 4, 7, 13, 20, 27, 1971 Dec. 8, 1971