73-019A-09B

JET PROPULSION LABORATORY *California Institute of Technology • 4800 Oak Grove Drive, Pasadena, California 91103*

20 October 1980

Mr. Ralph Post
Code 601
National Space Science Data Center
Goddard Space Flight Center
Greenbelt, Maryland 20771

Dear Mr. Post:

We are mailing you a magnetic tape containing the Pioneer 11 Doppler tracking data used by the Pioneer 10/11 Celestial Mechanics experimenters. These data were taken near Saturn and covered the time span 1 August 1979-18 September 1979. The data tape was Fortran written on a UNIVAC 1108 7 track unit and has 800 BPI with a 36 bit word length. Please send us a replacement tape.

Some explanatory notes are enclosed as follows:

1. A listing of the data tape and a detailed description of its format.

2. One copy of TR 32-1527 defining the S-band, two-way and three-way Doppler observables found on the data tape. See pages 19-22, 46-50, 72-75. Since the Pioneer 11 antenna is rotating and is right-hand circularly polarized, the observables on the data tape have already been adjusted for the effect of spacecraft spin on the observable by

$$\Delta f = \omega \ (.034766213) \text{ Hertz},$$

where ω is the spacecraft spin rate in revolutions per minute. This correction was verified by ground tests and with the spacecraft itself. Corrections for our time period 1 August 1979 - 18 September 1979 varied between .27048 Hz and .27143 Hz. Doppler biases of this size have a negligible effect on the Saturn gravity solution provided that either a constant Doppler bias or a conic planetary ephemeris correction is included in the solution. The use of an erroneous value of the bias could, however, introduce an error in the range rate correction to the planetary ephemeris.

3. One copy of TM 391-412 by T.D. Moyer combining the equations for computing Doppler observables.

8-792-4321

Telephone ~~(213) 354-4321~~ *Twx 910-588-3269* *Twx 910-588-3294*

4. A draft of our results of the Pioneer 11 Celestial Mechanics Experiment.

5. A list of Deep Space Net Tracking station locations.

6. Trajectory coordinates sufficient to start a least squares adjustment.

7. The Pioneer 11 spacecraft was perturbed by orientation maneuvers at the following times (UTC):

4 August 1979	22:30
8 August 1979	15:58, 19:29
12 August 1979	16:14
16 August 1979	15:00, 19:55
17 August 1979	00:15
20 August 1979	09:31
28 August 1979	13:37, 17:47
4 September 1979	13:38

8. A summary of the data used in our Pioneer 11 Celestial Mechanics Experiment.

9. Calibrations should be made to adjust for station reference frequency biases in the 3-way Doppler data as follows:

Transmitting Station	Receiving Station	Time Interval	Bias (Hz)
62	63	1 Sept 79 10:40:00 to 1 Sept 79 18:00:00	.0194
62	63	2 Sept 79 10:24:00 to 2 Sept 79 16:15:00	.0194
62	63	3 Sept 79 10:20:00 to 3 Sept 79 12:00:00	.0194
62	14	2 Sept 79 16:16:00 to 2 Sept 79 18:55:00	.0180
12	14	2 Sept 79 19:00:00 to 3 Sept 79 00:13:00	-.0028

The tabulated bias should be subtracted from the observed value of the data. Biases for all other station pairs were negligible.

10. The velocity perturbations were almost entirely along the earth line and usually had a magnitude of less than 5 mm/sec. The tracking data provided is S-band, two-way Doppler data. Each data record contains both the observed Doppler (F) and the transmitter frequency (f_q) as defined in the enclosed document TM 391-412.

    The effect of solar pressures due primarily to the parabolic antenna and RTG's can be approximated by an acceleration in the sun-spacecraft direction

$$\ddot{r}_R \ (\mathrm{km/sec^2}) = K/r^2$$

    where r = sun-spacecraft distance (km) and $K = 3.938 \times 10^6 \ \mathrm{km^3/sec^2}$.

At a distance of almost 10 AU to Saturn, the error in the approximation of acceleration $\ddot{r}_R$ is negligible as is the normal acceleration to the radial line.

Please feel free to contact us should any other questions arise.

Sincerely,

Eunice L. Lau
Senior Engineer

George W. Null
Pioneer Co-Experimenter

ELL/GWN:ac
Encs.

354-4209