DSN Telemetry System

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The Telemetry System Analysis Group is responsible for analyzing the total performance of the DSN telemetry system. The group's tasks include both real time and non-real time functions. By combining these two functions, the telemetry system can be analyzed for short- and long-term performance. This can be illustrated by the results of the data which was accumulated during real-time operations for the solar occultation of Pioneer 9, and compiled and analyzed during non-real time periods.

I. Introduction

The Telemetry System Analysis Group evaluates the telemetry system performance, reports status and anomalies to the operations chief, generates telemetry predicts, establishes and monitors standards and limits, provides performance data to various engineering organizations, and will supervise the generation of telemetry master data records.

II. Real-Time Operations and Analysis

During real-time operations, the quality of incoming telemetry data is assessed to ascertain that it is within limits of the predicted values and various parameters are recorded for further analysis. If anomalies create degradation within the system, corrective actions are recommended to the operations chief.

III. Non-Real Time Analysis

Operations for non-real time include the generation of telemetry signal-to-noise ratio and the signal level predicts. These are generated by use of station and spacecraft parameters, and by the range of the spacecraft from the station. Also standards and limits are established for various parameters, which if not met are cause for corrective action to be taken by the real-time analyst.

Analysis in non-real time is performed to determine long-term trends of station parameters and residuals, and to provide this data to various engineering organizations.

IV. Illustration

An example of the data, which was obtained during the superior conjunction of the sun and *Pioneer* 9 spacecraft, collected by the real-time analysts, and examined and compiled by the non-real-time analysts, is shown in Figs. 1 through 4.

Figure 1 shows the degradation of the system temperature T_S from approximately ± 9 deg of the sun-earth-probe (SEP) angle related to the day of year (DOY). There are two actual curves and two predicted curves. The dual curves are due to the effect of the quadripod structure on the 64-m (210-ft) antenna at DSS 14 as can be seen in

Fig. 3. After approximately 6 or 7 deg of SEP angle, the effect of the quadripod structure is minimal.

Figure 2a shows the degradation of the telemetry data by actual and predicted residual signal-to-noise ratio (SNR) curves up to ± 9 deg of SEP angle. The predicted curve data was compiled from system temperatures taken during this period.

Figure 2b is a continuation of Fig. 2a which shows the degradation continuing past 15 deg prior to syzygy.

Figure 3 is an actual reproduction of the T_S strip chart recording for Pass 760 on December 7, 1970. This graph shows the high peaks due to the effect of the quadripod structure.[1]

Figure 4 shows the fixed sun–earth line trajectory for *Pioneer* 9 giving the dates and angles concerned.[2]

The data in Fig. 2b is discontinuous from approximately 15 to 18 deg of SEP angle due to DSS 14 not tracking during this period. After 18 deg the data is within ± 0.5 dB tolerance.

[1]DSN Doc. 810-5 Rev. A, Oct. 1, 1970 (Fig. 2-5).

[2]IBM 7094 Trajectory Program Tapes 12309 and 12856.

Due to a retrograde motion of PN9, as can be seen in Fig. 4, the SEP angle has been less than 8.78 deg since 15 March 1971. This will continue until June 30, 1971 when the angle will increase until the next retrograde. A maximum range was reached on April 30, 1971. Since March 15, the SNR residuals have maintained predictions within ± 0.5 dB.

The compiled data in Figs. 1 and 2a show that the change in system temperature created most of the degradation in the telemetry. Figures 1 and 2b indicate that the degradation continued past the time when the system temperature was at its predicted value. Figure 4 shows that from less than 18 deg prior to syzygy, and greater than 9 deg after syzygy, the only difference is the distance from the sun. Therefore, other solar effects have influenced the signal besides the change in system temperature.

V. Summary

In order to have an efficient telemetry system which can operate at maximum performance, the system has to be monitored, analyzed, and corrected for degradations. These tasks are the responsibility of the DSN Telemetry System Analysis Group. The group plans to continue to provide engineering results, as described in *Subsection IV* above, for all Projects and to provide real-time support of spacecraft missions as required.

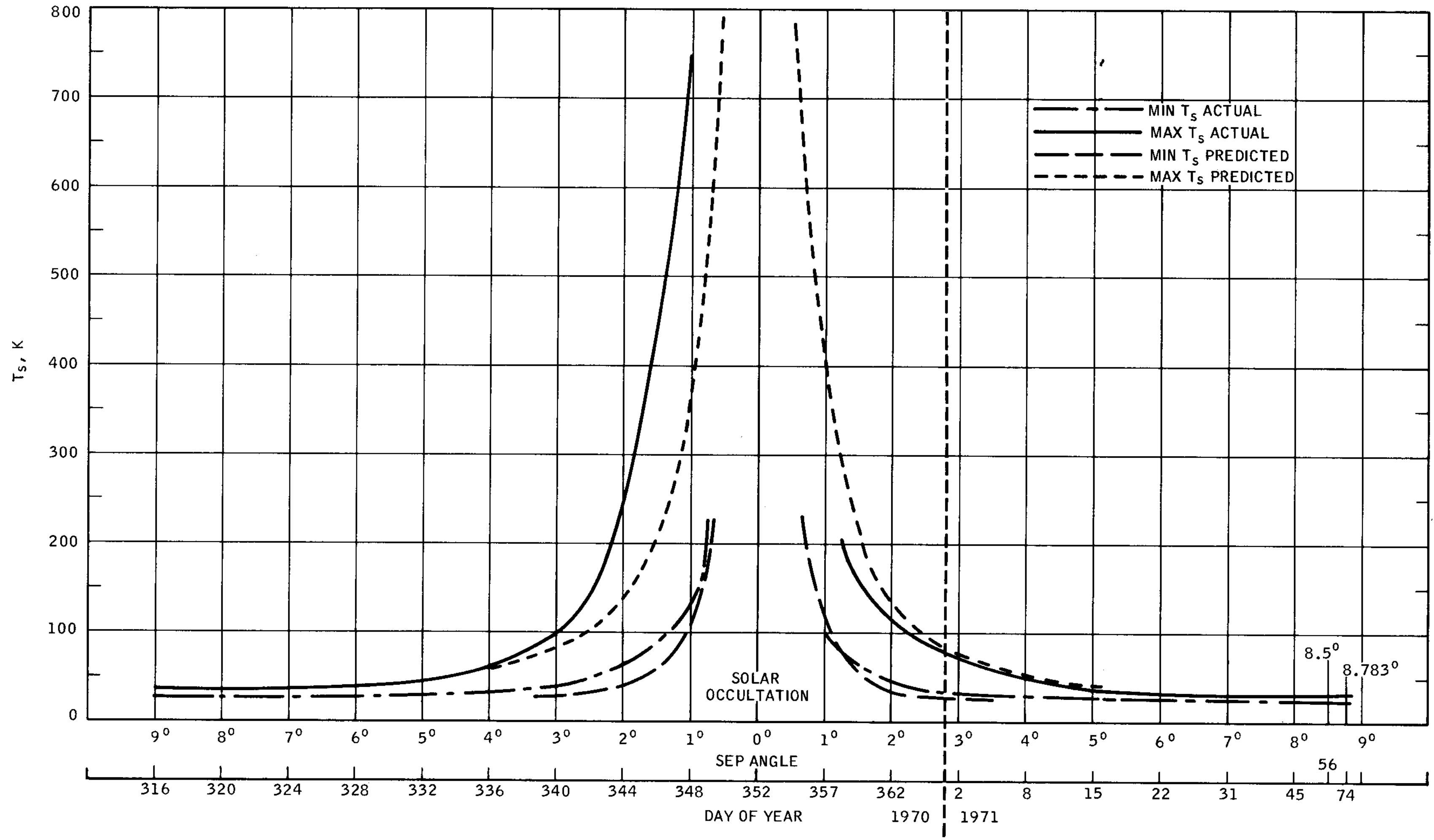

Fig. 1. DSS 14 Actual and predicted system temperature T_S versus sun–earth–probe (SEP) angle and day of year (DOY) for *Pioneer 9* occultation

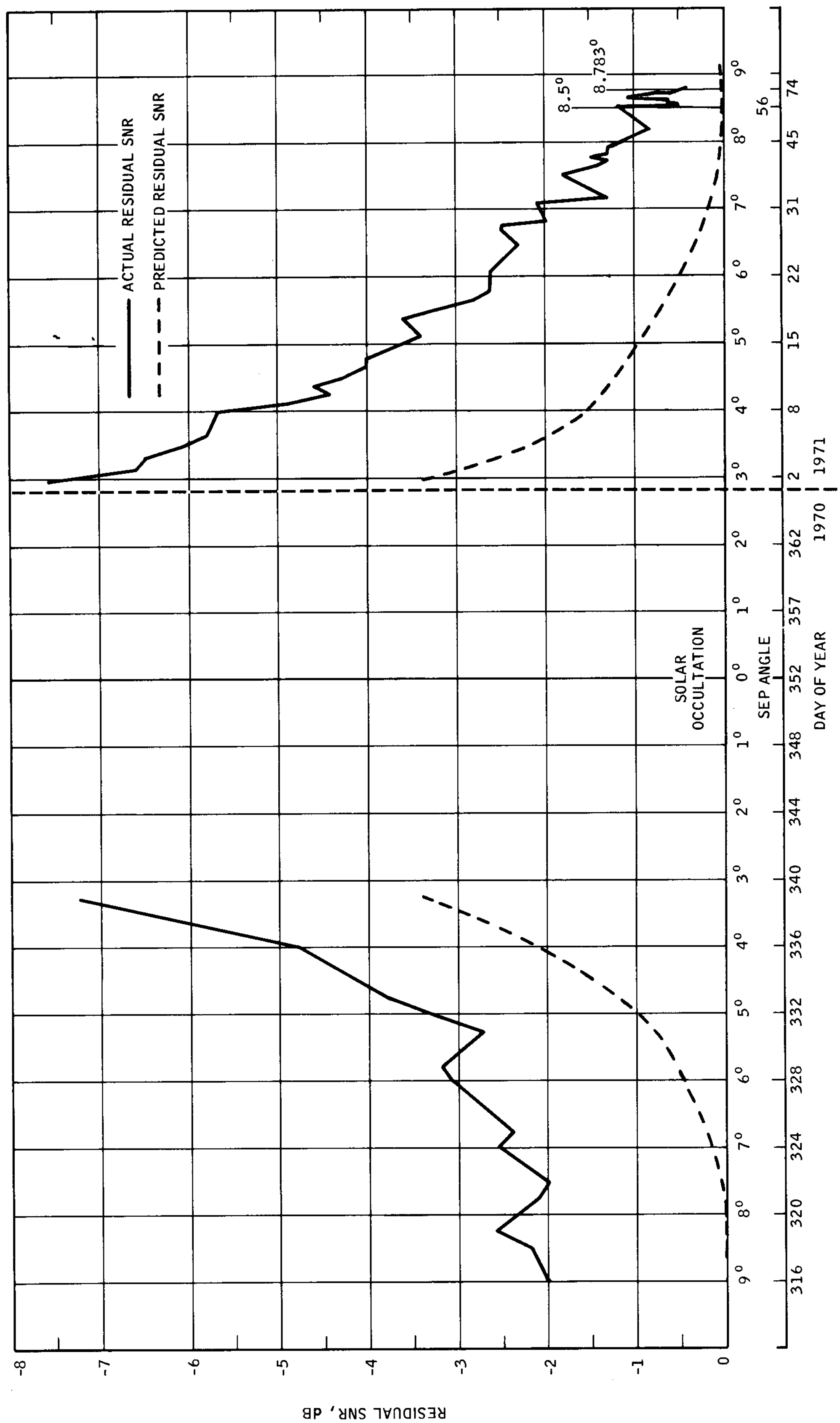

Fig. 2a. DSS 14 Actual and predicted residual signal-to-noise ratio (SNR) versus sun–earth–probe (SEP) angle and day of year (DOY) for *Pioneer 9* occultation

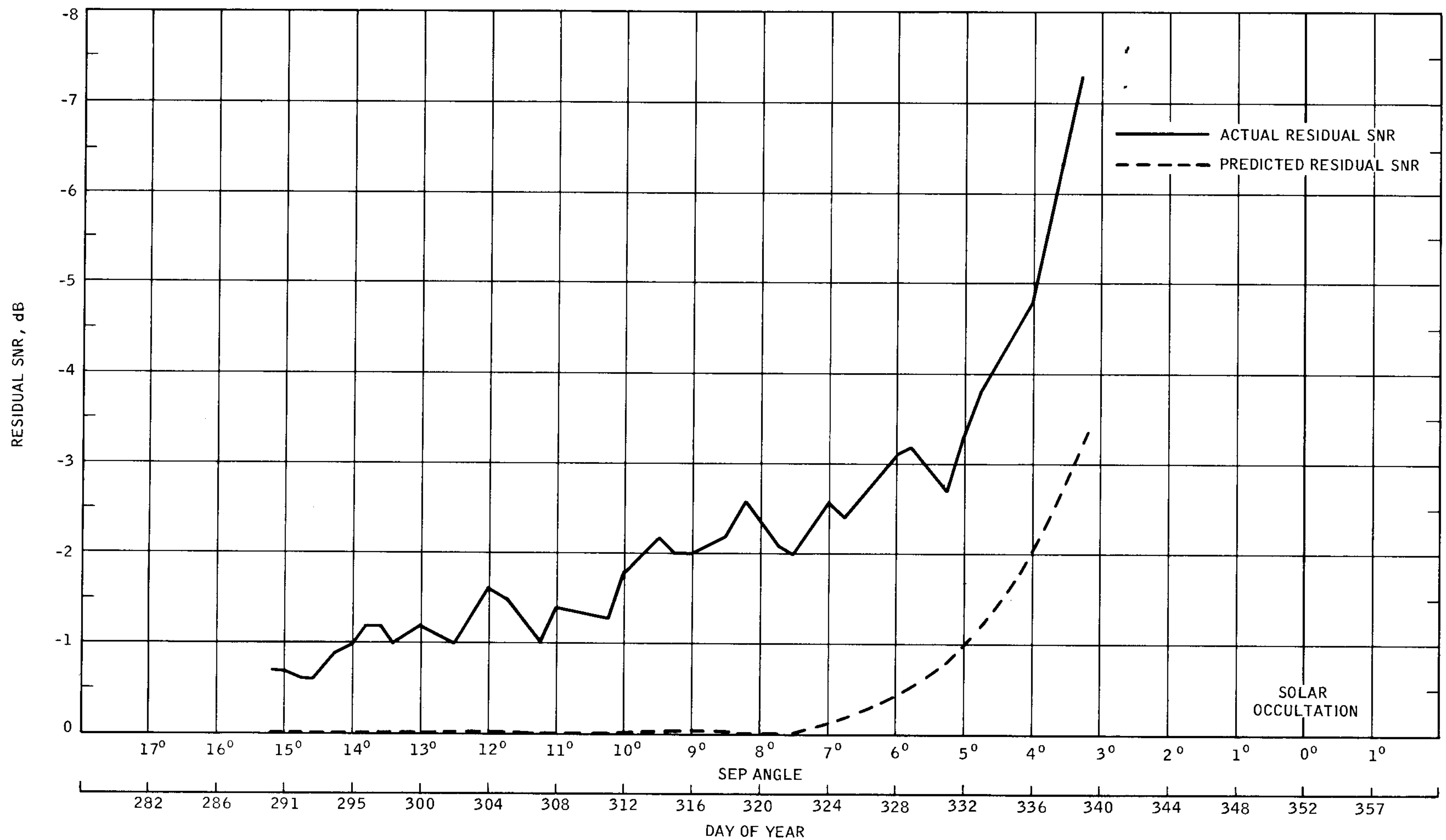

Fig. 2b. DSS 14 Actual and predicted residual signal-to-noise ratio (SNR) versus extended sun–earth–probe (SEP) angle and day of year (DOY) for *Pioneer* 9 occultation

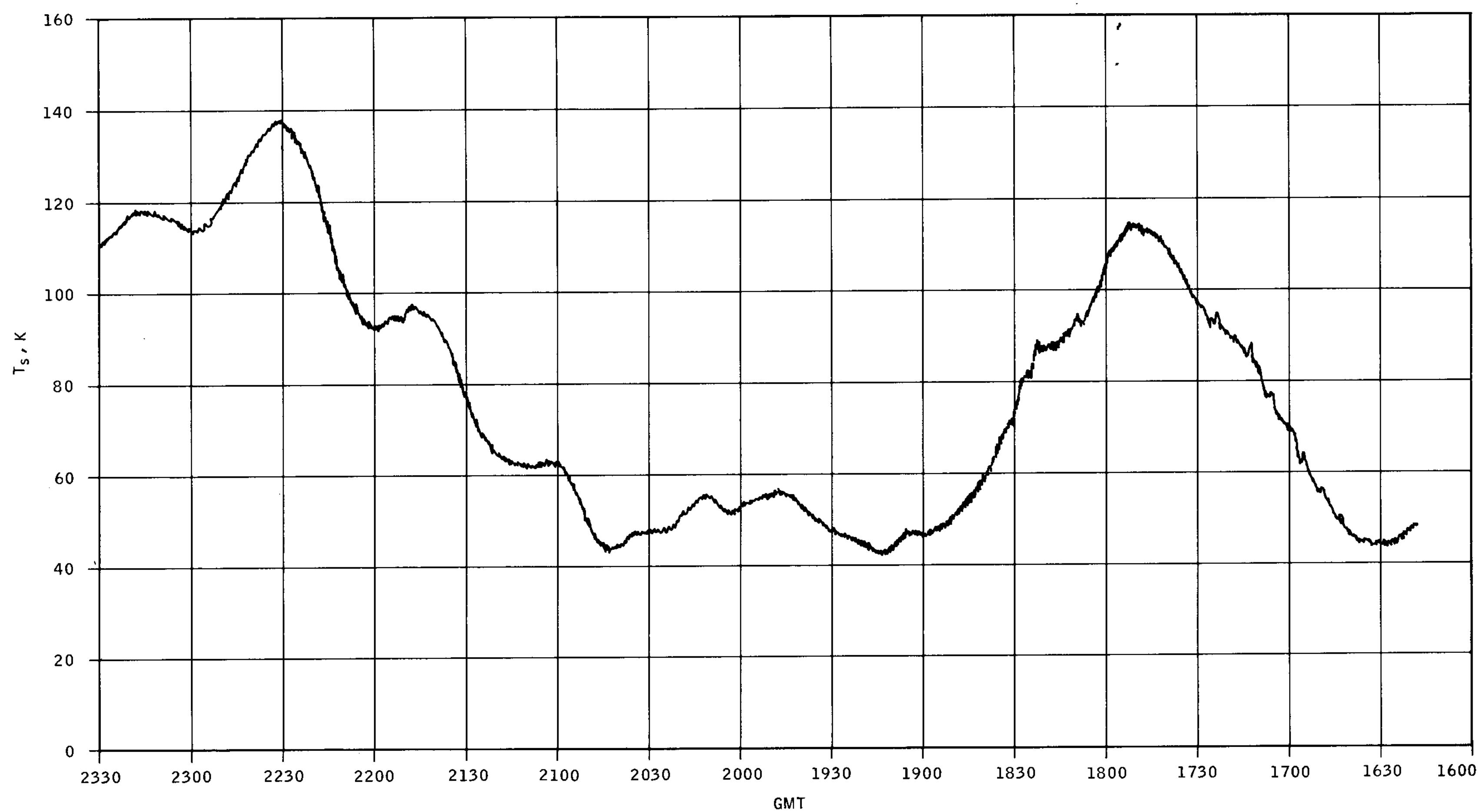

Fig. 3. Normal system temperature T_S versus GMT plot at DSS 14 during *Pioneer* 9 occultation period pass 760, Day 341

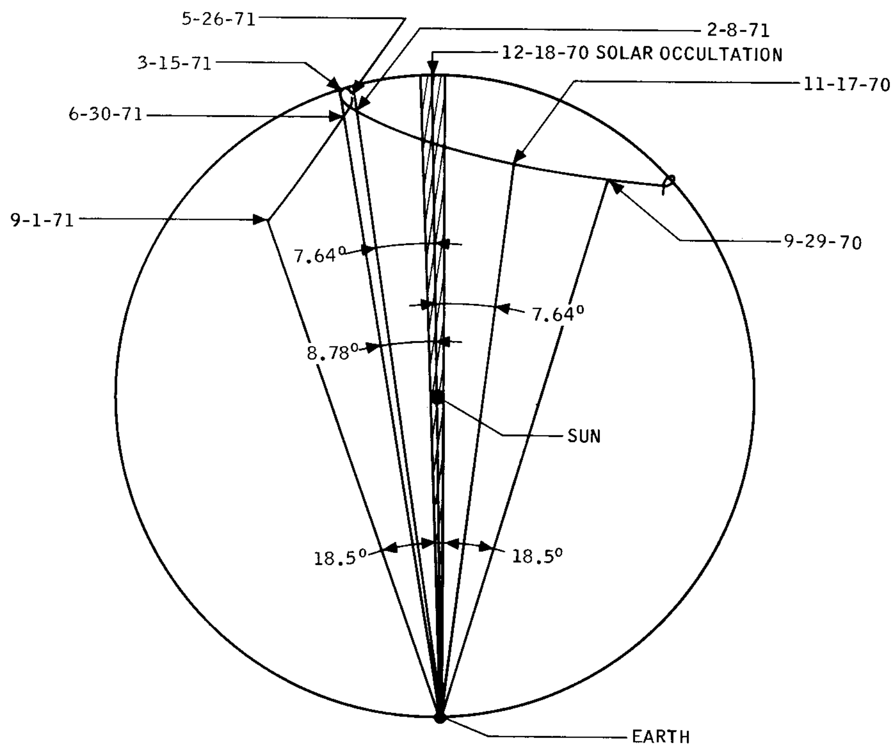

Fig. 4. Sun–earth–probe (SEP) angles for *Pioneer 9* near superior conjunction