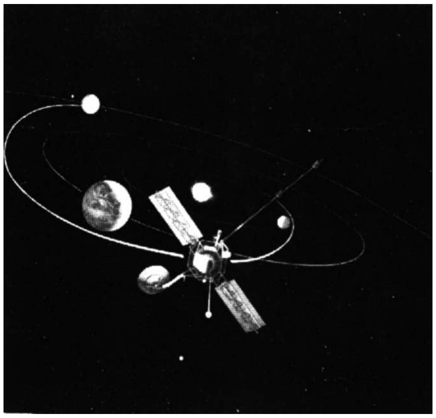


MARINER VENUS / MERCURY 1973

STATUS BULLETIN

Mariner 10 Trajectory Correction Maneuver (TCM-2) Scheduled for Friday 18 January

Mariner 10 is now 16¾ million miles from Earth and 9½ million miles and 20 days from Venus.

On 16 January some of the preliminary commands for the trajectory correction maneuver were sent and stored in Mariner's central computer and sequencer. On 17 January the final commands will be sent and stored for automatic execution on 18 January.

The rocket motor firing will be a short one—about 2.6 seconds—which will change Mariner's speed about 2 mph.

This will bring Mariner's target point 1500 miles closer to Venus and change its arrival time to 3 minutes earlier.

The Mariner 10 should then pass through a 248-mile diameter hole in the sky which lies about 10,500 miles to the right and in front of Venus. From there the planet's gravity will bend Mariner's course in to within 3600 miles of the Venus surface about 10:00 a.m. PDT on 5 February.

The Navigation Team has re-determined the orbit following the trajectory correction maneuver (TCM-1) performed shortly after launch (14 November). The determination has been accomplished by processing over sixty days of tracking data consisting of 2600 measurements of the Earth-probe relative velocity and 2000 measurements of the Earth-probe distance. In the impact plane of Venus, Figure 1, the first TCM has been shown to have over-corrected by 1500 km. If left uncorrected, this error would result in a miss at Mercury of approximately 1.5 million km. To correct the 1500 km miss at Venus will require a trajectory correction maneuver of approximately 0.94 m/sec.

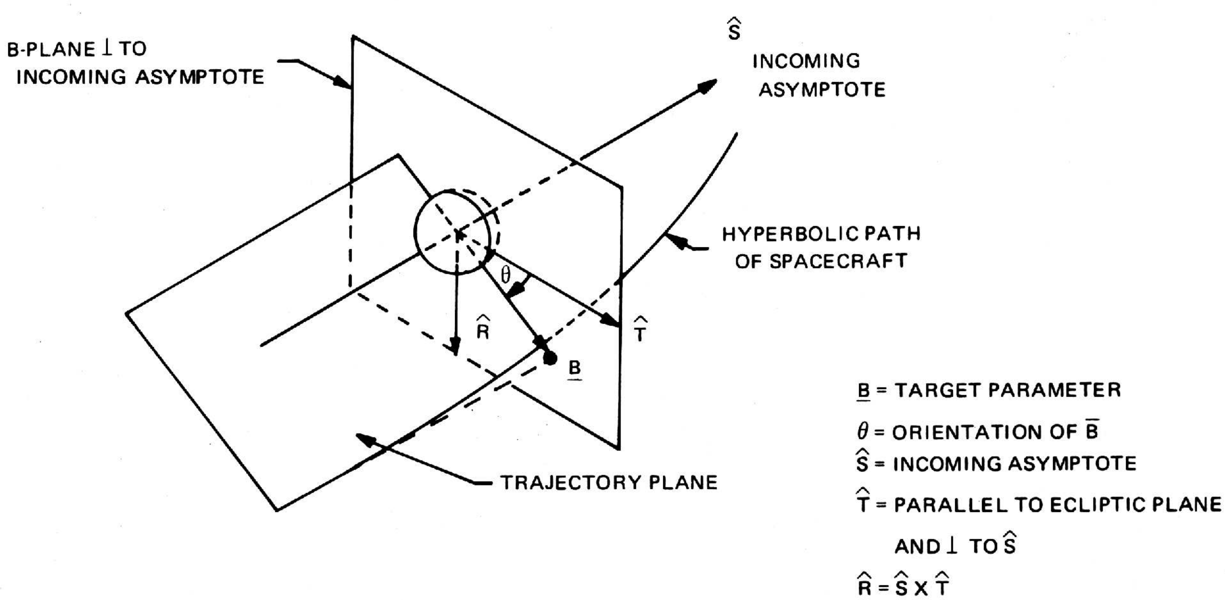


Figure 1. Encounter R—S—T Coordinate System

The hyperbolic encounter coordinate system used is known as R—S—T Coordinate System. As shown in Figure 1, the coordinate frame is centered at the planet being encountered with S parallel to the incoming asymptote of the spacecraft, T parallel to the ecliptic plane and perpendicular to S, and R in the southern celestial hemisphere completing the right-handed system.

A convenient method for describing the spatial miss at the planet in this system is to consider where the spacecraft would penetrate the R,T plane (or as it is more commonly called, "the B-plane") for a massless planet.

The vector from the planetary center to the penetration point is denoted by B. The vector B is parameterized by either (B·T, B·R) or (B, θ). In the latter case, B is the magnitude of B and the angle θ is measured from the positive T direction toward the positive R direction.

An interesting feature of the maneuver, which will be performed on 18 January, is that it has been designed to bias the arrival time. at Venus away from that time which will yeild the desired Mercury encounter by $2\frac{1}{2}$ minutes. This bias, which will result in arriving 20 minutes early at Mercury, has been included in order that the telemetry received over the low-gain antenna during the maneuver will have a small bit-error rate. High quality telemetry is important to the reduction of spacecraft system performance in preparation for TCM-3, nominally expected to be the largest TCM. The TCM-3 will be performed four days after Venus encounter.

MARINER 10 OBSERVATIONS OF KOHOUTEK

Even though Comet Kohoutek, 1973f, is 4 magnitudes (1/40) dimmer than expected, it still is the object of the most extensive coordinated program of research on any comet in history. Mariner 10 is taking part in this program by observing Kohoutek with the Ultraviolet Air Glow Spectrometer (UVSAG) and the Television System.

Prime objectives of Mariner 10 observations are to obtain unique data in the extreme UV region of the spectrum which cannot be obtained from the Earth due to UV absorptions in the atmosphere. In addition, the fact that Mariner 10 is well outside the Earth's own hydrogen corona will allow further unique UV observations. The separation angle of 12° from Earth may allow stereoscopic comparison of TV images taken on the ground and by Skylab with those taken on-board Mariner 10.

Observations of Kohoutek from Mariner 10 are beginning with passive UV measurements of the tail on January 9 and finally the passage of the nucleus through the UV field of view on January 17. Active UV scanning and TV operations will occur on January 19, 22, and 24. At this time Kohoutek will be leaving the Sun and will be about 100 million km from the spacecraft (see chart on other side). Each of the three active observing days are divided into a UVSAG prime observing period and a TV prime observing period. The UVSAG prime time occurs from 1500 GMT to 2300 GMT and the TV prime observing period occurs from 2300 GMT to 0700 GMT the next day; during this time ground-based observers in the Western United States, Chile, and Hawaii will be photographing the comet simultaneously with Mariner 10.

Various ground-commanded science sequences will be executed for the imaging and UV experiments. Five sequences have been developed, four for the UVSAG and one for the TV.

The UVSAG limit-cycle scan will cause the UVSAG slit to scan across a 3.0° x 0.6° region centered about the exact nucleus position.The UVSAG slit (3.0° x 0.13°) is positioned at the expected comet position, and the inherent slow spacecraft wobble or limit cycle of +0.25° in all axes does the work of scanning the comet. The limit-cycle scan will allow collection of data from the expected most intense source of any radiation. If emissions from helium, argon or neon are to be found anywhere in the comet they will be found at the nucleus. Limit-cycle scanning occurs during quiet periods between observing days and between TV mosaics.

The UVSAG hydrogen corona scan sequence, which occurs twice each observing day, is a 15° clock x 20° cone mosaic which will allow a fast look at the expected Lyman-Alpha radiating hydrogen cloud surrounding the comet (see Figure 1) and will provide a quick determination of the distribution of other elements if detected.

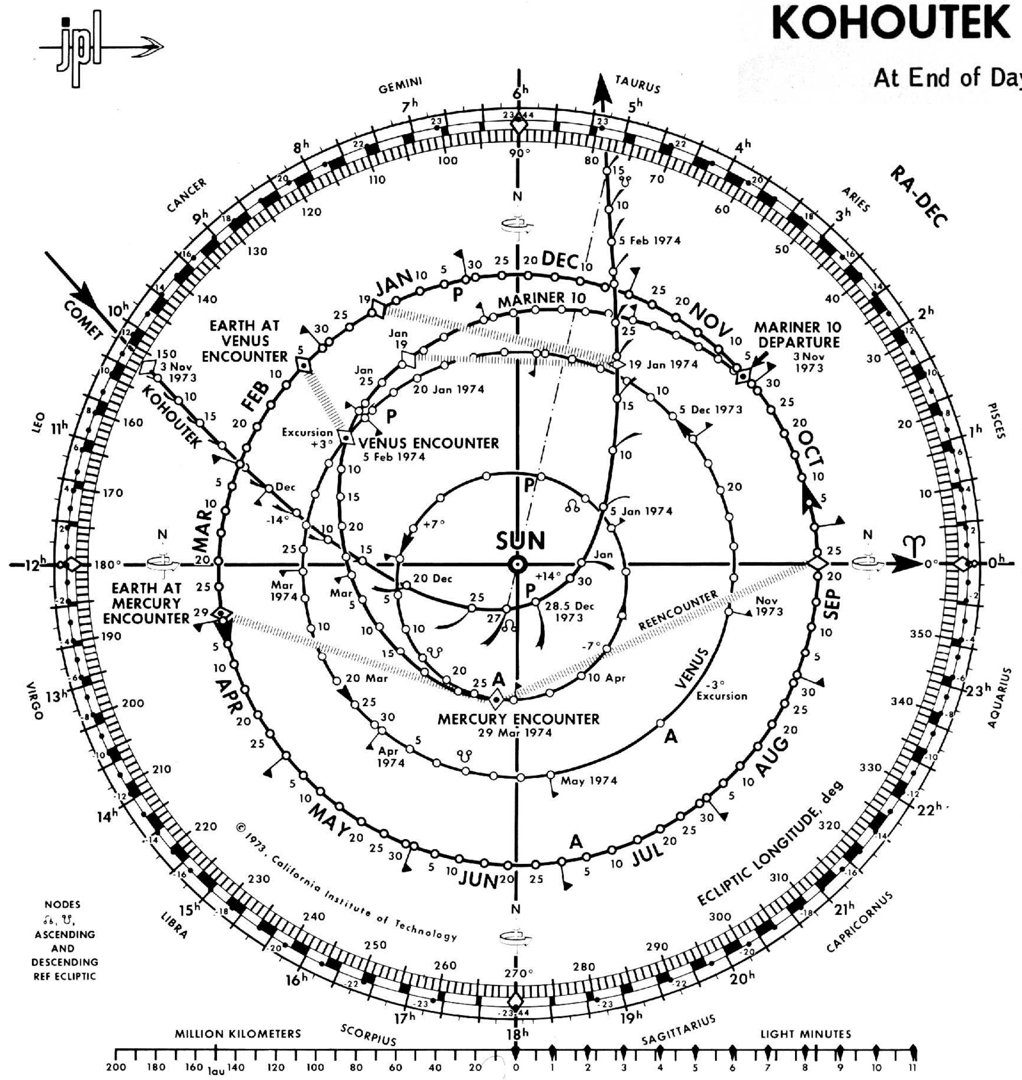
The UVSAG coma scan sequence, which occurs once each observing day, is essentially a smaller corona scan. A 7° x 6° region is scanned with 20 slews. Four slews each will scan a 3° x 6° region with a 1° offset between each slew set. Coma scans will be used to observe time and space variations of rare gases in the comet coma region, if they are seen, or to measure the hydrogen corona if it is smaller than predicted.

The tail scan sequence, which occurs twice each observing day, allows the UVSAG slit to slowly scan 3° x 4° regions near the comet in 0.13° per minute increments. Slow scanning of the region of the comet is especially important if any of the rare elements are found during the other sequences. The slow scan mode allows collection of approximately 100 data points per 0.13° increment. The integration of the data at each increment will substantially increase the effective signal-to-noise ratio of the data.

The TV mosaic cyclic block is designed (Figure 2) to obtain one 2 x 2 mosaic of the comet once every hour between 2300 and 0700 GMT on the three comet observation days. It is planned to record 37 pictures on each of the three days, though TV operations might be curtailed after the first day if the comet's less-than-expected brightness makes useful TV data impossible to obtain.

MARINER 10 AND COMET KOHOUTEK ORIENTATIONS

At End of Day on Indicated Dates



At the Orbit Chart perimeter, a body's celestial location or RA-DEC angles on a given date may be found by extending a line out from the Sun parallel to line-of-sight from Earth or from Mariner 10. The reading for Declination of the Ecliptic should be adjusted for apparent excursion above or below the Ecliptic plane. Mark the body with a color dot on the Star Map (below) for the given date.

On the Star Map, a rolled-out Horizon line for 35°N Latitude depicts the western (W) view-field AZ-EL angles at sunset and Mariner 10's end of track on 19 January. The field at the right of the Horizon line also represents the morning sky at Mariner 10's start of track for 35°S Latitude. A symmetrical overlay Horizon Grid may be traced on transparent plastic to be traversed eastward (right-to-left) across the Map so as to visualize a body's hourly AZ-EL angles during its view period. The Sun's location for the given date should be marked in color on the Map. Along the overlay's Equator, the hourly ticks should be labeled left to right, starting with 6 at the East (E) through 12 (noon) at the N-S Meridian and to 18 at W. Standard or Daylight Time would be offset either left or right by the degrees Long that the Time Zone centerline is east or west of the observer's station.