Principal Investigators Data Package for Project Initiation Conference (PIC)

November 16, 1993

EUVS Sounding Rocket #36.117CL

Target: Venus

Principal Investigator

Dr. S. Alan Stern

SOUTHWEST RESEARCH INSTITUTE

SAN ANTONIO HOUSTON

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont'd.)

LIST OF FIGURES

1.0 EXPERIMENT DESCRIPTION

1.1 GOALS

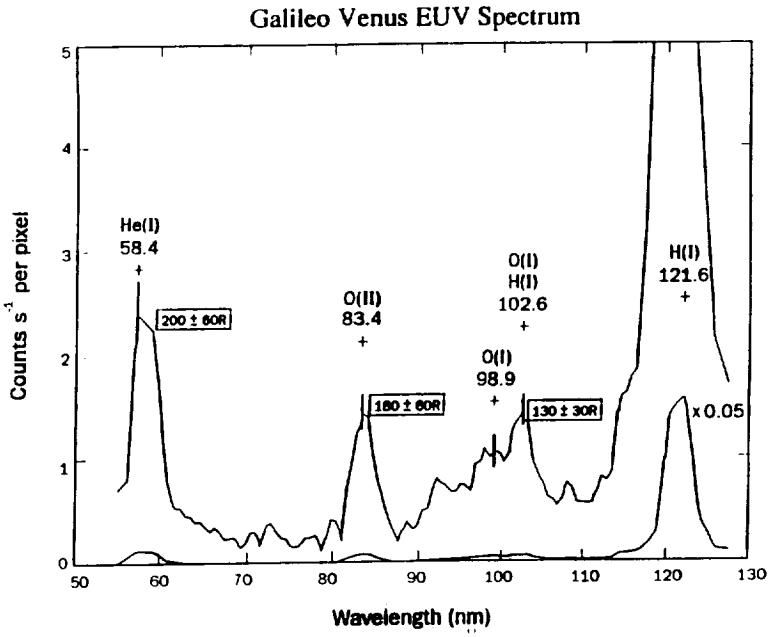
The region of the UV between 500 and 1200 Å is a rich one for the study of planetary and astrophysical targets. EUV atmospheric spectroscopy opens up an important window on ion and neutral nitrogen, oxygen, and noble gas emissions. Recent reviews describe this potential (e.g., Bowyer and Malina 1991; Feldman and Bagenal 1991). We now describe the specific scientific background and motivations for this Venus EUV rocket observation:

The EUV spectrum of Venus has not yet been studied at high spectral resolution. The only data obtained to date have been (i) spectrophotometer measurements made in 7 broad (~40 Å) bandpasses by Venera 11 and 12 (Bertaux et al. 1981), and (ii) a low-resolution (≈35 Å) spectrum made by the Galileo UVS (Hord et al. 1991). Hord et al. (1991) showed Venus' brightest dayside features in the 800-1050 Å spectral range are OII 834 Å (180 R), OI 989 Å (130 R), and a blend of HI Lyman β 1025 Å and OI 1027 Å (270 R). At the crude spectral resolution of the Galileo instrument it was not possible to search for fainter emissions.

The proposed EUVS flight will obtain a spectrum of Venus with 5-6× higher spectral resolution than either previous EUV observation. Figure 1 shows the Galileo EUV spectrum of Venus (Hord et al. 1991); for comparison Figure 1 also shows high-resolution terrestrial EUV dayglow spectra (Gentieu et al., 1981). The advantage of the higher resolution spectrum is obvious. The EUVS Venus rocket experiment will obtain a spectrum with 7 Å resolution, similar to the terrestrial spectra in Figure 1. We plan to address several important objectives about Venus with this spectrum including:

- Determining what undiscovered spectral emissions lie in Venus' 820-1130 Å dayglow, for use as probes of Venus' ionosphere and thermosphere;
- Resolving the spectrum around Venus' Ar I lines at 869 and 1048 Å: At present Pioneer Venus in situ entry probe noble gas measurements are in severe disagreement with the Bertaux et al. (1981) Venera 11/12 results. As suggested by Bertaux et al., a spectral resolution near 7 Å is required to separate Ar I from the contaminating background N I, N II, O II, and N_2 emissions in Venus EUV spectrum;
- Better isolating the individual H I Lyman-β (1025 Å) and OI (989 Å) emission brightnesses;
- Bringing the spectral resolution of Venus EUV observations to a par with the terrestrial EUV spectra in order to advance comparative spectroscopy of planetary atmospheres.

These issues and others cannot be addressed without a higher resolution EUV spectrum of Venus. However, the only other EUV flight instruments (aboard the EUVE satellite, Galileo, and the ASTRO Spacelab HUT payload) cannot observe objects within 1 AU of the Sun



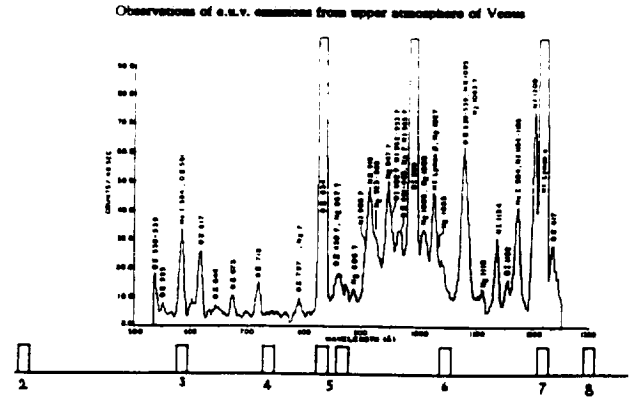


FIG. 19. THE E.U.V. SPECTRUM RECORDED IN THE TERRESTRIAL DAYGLOW BY A ROCKET BORNE INSTRUMENT (AFTER GENTIEU, FELDMAN and MEIER, 1979).

The position of detectors Nos. 2–8 of our VENERA e.u.v. spectrophotometers is indicated, as well as the wavelength bandpass of each of them.

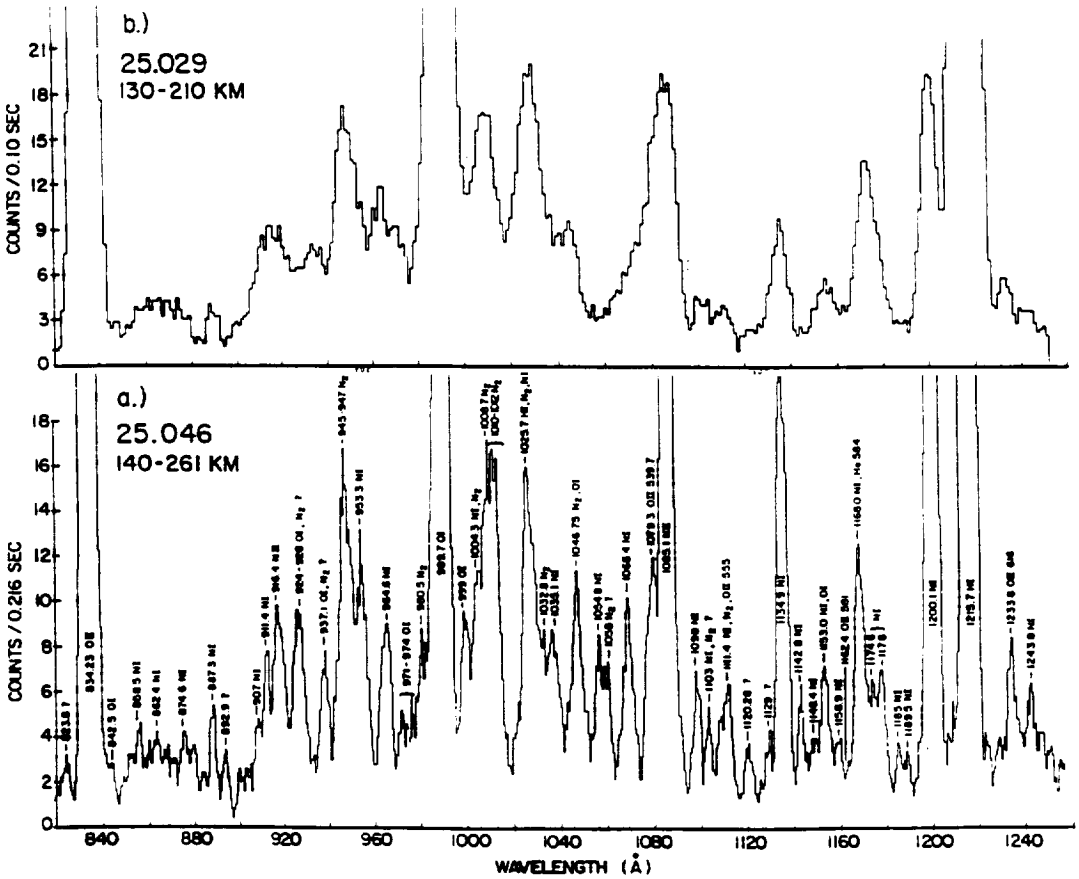


Fig. 1. The lower spectrum is a coherent sum of side viewing data between 140 and 261 km obtained with 3.5Å resolution on 27 June 1980. The upper spectrum was obtained with 6.5Å resolution on 9 January 1978. The apparent continuum between 850 and 1150Å in the upper spectrum is partially resolved in the 1980 observations into a large number of weak NI, OI, and N_2 transitions.

FIGURE 1. SPECTRA

(also, EUVE cannot observe longward of 770 Å). Since Venus is at 0.7 AU, our proposed rocket observation will fill a unique niche.

1.2 THE EXPERIMENT

Figure 2 is a layout of the Extreme Ultraviolet Spectrograph (EUVS) and its optical path. The telescope and electronics section have flown on previous flights. A grazing incidence telescope from previous rocket payloads, 36.067 for example, is used to collect light with a high efficiency. The converging f/15 beam focuses onto a 0.5 × 10 mm slit, which is the entrance to the Rowland circle spectrograph. Post-slit, the light is diffracted by a grating onto the MCP detector.

Light that falls outside the slit is reflected and re-imaged onto the Fine Guidance Camera (FGC). This will be a NASA provided low light level video camera with an achromatic lens. The FGC images will be telemetered down and displayed real time during the flight to aid in the pointing of the instrument. An LED will be installed in the spectrograph section to 1) provide a means to check-out the FGC before launch, and 2) to help determine if the aperture slit moves slightly during launch.

EUV radiation is quickly attenuated by any intervening matter. This necessitates the MCP detector have an exposed face, so it is sensitive to the EUV radiation. However, MCP detectors with exposed faces can only be operated at pressures below 1×10^{-4} Torr. For this reason we have taken several steps to provide the required low pressure environment. Two high speed vacuum pumps will maintain a pressure of 1×10^{-6} Torr in the vacuum sections. The spectrograph and telescope sections are isolated from the rest of the payload by a vacuum tight bulkhead. The telescope section will use a NASA provided vacuum door which will open at a specific time and close before re-entry. The two getter pumps are located in proximity to the MCP detector to ensure it has the highest quality vacuum. An ion pump, while providing extra pumping capacity on the ground, is used primarily as a vacuum monitor and will not be used during flight. The telescope and spectrograph sections are evacuated prior to launch by an external turbo pump that is removed at about T-1 hour. By actively pumping out the vacuum section of the payload with getters, we minimize any outgassing that will occur during ascent. Outgassing has compromised previous UV flights because the outgassed material can degrade the vacuum and lead to detector failure.

We will rely on the NASA provided Attitude Control System (ACS) for pointing. The nominal plan for the pointing of the EUV payload will include:

1. Launch
2. Using the ACS, maneuver to Venus
3. Lock on Venus with the Star Tracker
4. Update the payload pointing to get the North-South image of Venus directly on the aperture slit as shown by the FGC video. This will be done using joystick commands uplinked to the ACS
5. Take data
6. No maneuvers during observation

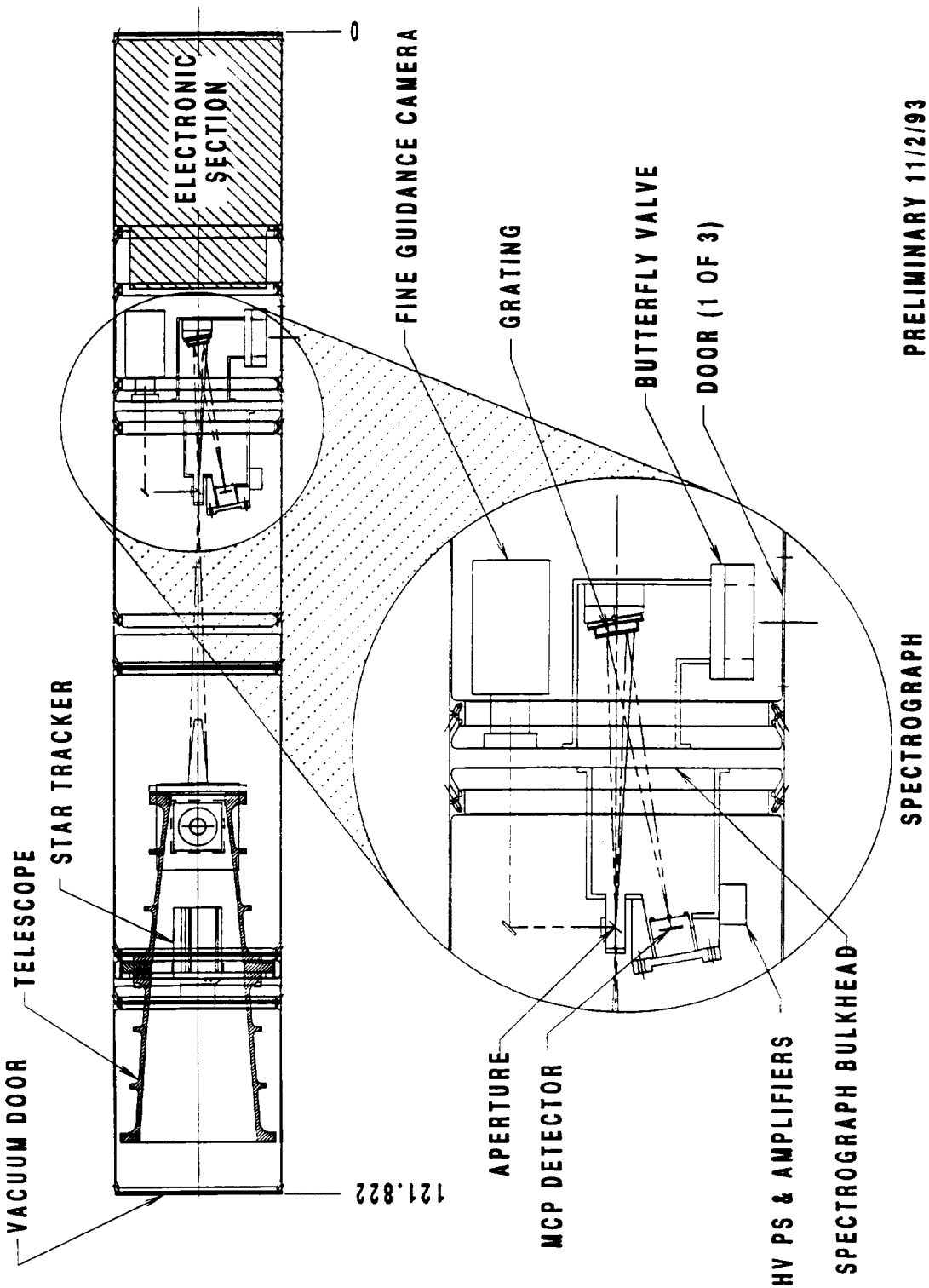


FIGURE 2. EUVS LAYOUT

7. Maneuver to calibration star
8. Update the payload pointing to get the image of cal star directly on the aperture slit as shown by the FGC video. This will be done using joystick commands uplinked to the ACS
9. Take data (~5 sec)
10. Re-Entry

An alternative plan would have the payload pointing at an update source on the way to Venus. If this is necessary, we would choose that the update source be our calibration star.

2.0 EXPERIMENT HISTORY

Although EUVS is technically a new payload, certain components have flown successfully on previous far ultraviolet (FUV) payloads, 36.067, 27.123, 36.023, 36.027, 36.074, 36.079, 36.089, 36.095, and 36.096. The grazing incidence telescope has flown 7 times; twice in Australia as part of the 1987a supernova campaign, and five times out of White Sands Missile Range. The telescope has survived all flights with no damage. The slit monitor is, in concept, a copy of the zero order monitor (ZOM) that flew in conjunction with the telescope. As with the previous payload, it is vital to maintain an operating pressure of 1×10^{-5} Torr or less for the MCP science detector. In EUVS the techniques to ensure a good vacuum design have been copied from the FUV payload, which never experienced any vacuum problems. The electronics for EUVS have flown on the previously listed payloads. The only new section of the payload is the spectrograph section. The detector and grating have each flown previously and have been repackaged into the new spectrograph. The Ground Support Equipment (GSE) is also the same as used on all previous flights.

3.0 OUTLINE DIAGRAM

Figure 2 shows a cross section of the EUVS payload. As stated, the only new section of the payload is the spectrograph section. The telescope and electronics sections have previous flight history. Also shown are possible locations of access doors. The EUVS payload has no booms, or deployables, and no internal mechanisms other than the vacuum door.

4.0 STRUCTURES AND MECHANISMS

4.1 DESCRIPTION

The mechanical systems of the EUV rocket include the NASA supplied vacuum door, telescope, spectrograph, electronics section, and various support systems. The spectrograph is the only system with no flight heritage. The grazing incidence telescope is mounted to skin sections 1 and 2. The telescope consists of two primary mirror pieces and a secondary mirror all of which are thermally isolated from the skin sections. A star tracker is mounted in the center of the telescope optically aligned to the telescope axis.

The spectrograph is made up of 3 components: the MCP detector, grating and aperture slit. The grating is fixed to an adjustable mount while the slit and MCP detector are both non-adjustable. The spectrograph components are mounted inside of welded vacuum-tight aluminum enclosures, one on each side of the spectrograph bulkhead. The aft enclosure (i.e., the enclosure which houses the grating) has a 6 inch butterfly valve and an ion pump mounted to it. The forward enclosure (i.e., the enclosure with the detector and aperture slit) has two 6 inch blank off ports which will be closed for lab testing and removed before flight. (They will be removed before integration with the telescope.) The vacuum pumped region of the payload includes all of the sections forward of the spectrograph plus the aft spectrograph enclosure.

The aperture slit is mounted to the slit holder which has provisions for two blank-off ports. The forward blank-off port is made to be transparent to UV for calibration. The side-mounted port needs to only pass visible light. Both ports will be blanked off during bench check-out; they will be removed before integration. The slit is made of highly polished shim stock which will reflect light to the FGC mirror.

The Fine Guidance Camera consists of: 1) a NASA supplied Xybion video camera mounted aft of the spectrograph bulkhead either to the aft enclosure or the bulkhead itself; 2) a vacuum tight transparent flange; and 3) a mirror mounted to either the bulkhead or the forward spectrograph enclosure. The camera is mounted on the "non-vacuum" side of the spectrograph bulkhead to prevent damage to the open-faced MCP from the volatiles which will outgass from the camera. In addition, by placing the camera aft of the bulkhead an additional hermetic feed-through is eliminated.

Other support systems include the detector high voltage supplies, detector amplifiers, getter pumps and ion pumps. The detector high voltage supplies will be mounted to the forward spectrograph enclosure. The amplifiers will either be mounted to the forward enclosure or to the aft enclosure. Hermetic feedthrus to pass low voltage power and signals through the bulkhead will be needed. The pin count is TBD. The getter pumps will be inserted through the spectrograph bulkhead from the rear, sealing against the bulkhead. They will be clocked ±60° from the camera location. The ion pump will be attached to the aft enclosure.

The total payload length is approximately 120 inches not including the vacuum door. There will be three access doors in the 10 inch section which houses the aft spectrograph enclosure. The skin section aft of the spectrograph will also have 3 access doors clocked every 120 °.

4.2 MECHANISMS

There is only one mechanism in this payload other than the NASA supplied vacuum door, the spectrograph butterfly valve. The butterfly valve is used to isolate the vacuum section of the payload from atmosphere when disconnected from the turbo pumping station on the ground. The valve will be manually closed about 1 hour before launch and will remain

closed throughout the flight. An access door will be reinstalled to protect the valve after closing.

4.3 MASS PROPERTIES

The following are only estimates and are subject to change:

The length of the payload is approximately 120 inches.

The estimated weight of the rocket, excluding the vacuum door, is 350 to 400 lbs.

5.0 ENVIRONMENT SENSITIVITY

The EUVS payload is relatively insensitive to the environment in many regards (i.e. magnetics or radio frequency interference in typical levels are not a problem). The payload is, however, sensitive to particulates, hydrocarbons, and moisture, thus the vacuum pumped telescope and spectrograph sections. A clean area (laboratory quality will be adequate) will be required for instrument testing.

6.0 TIME/ALTITUDE EVENT SCHEDULE (Approximate)

The following Time/Altitude/Event schedule was used for previous EUV flights. A more accurate schedule will be calculated once the new spectrograph design is more fully determined.

EVENT	TIME	ALT	PRESSURE (Torr)
Vacuum System Pullaway	ALAP	0	760
Ion Pump Off	ALAP	0	760
Power to Internal	T-180	0	760
Launch	T+0	0	760
TM Int. Reset On	T+47	42	1.81
Payload Separation	T+71	87	2×10^{-3} Torr
Begin Maneuver to Venus	T+71		
Vac Door Open	T+75		
Sci. Det. HV ON	T+85		
FGC Camera ON	T+90		
LED ON	T+90		
LED Off	T+100		
ACS on Venus	T+120	200	1.1×10^{-6} Torr
Apogee	T+280	320	
Leave Venus	TBD		
On Cal Star	T+440		
Shutter close	T+460		7.9×10^{-8} Torr
Experiment HV and LV off	T+470		

7.0 INSTRUMENTATION - TELEMETRY

7.1 MAIN ELECTRONICS UNIT

The payload electronics consist of a computer box, a power distribution box, a battery pack, and detector support electronics. The computer box houses the position computer, which converts the MCP detector output into x and y pairs for each photon event, and the telemetry interface unit. The power distribution box houses all the high current electronics, uplink relays, and power regulators. The battery box has sufficient power for two to three flights. All other electronics reside in a separate section which is at ambient pressure.

7.2 OTHER ELECTRONIC UNITS

The detector support electronics consist of two high voltage power supplies and a preamplifier, which reside in the vacuum environment with the detector. The two detector high voltage power supplies will be configured to be redundant. If the main supply fails, the backup will supply power to the detector through a diode mixing circuit. Charge amplifier units and the high voltage power supplies are located near the detectors.

The Venus EUV payload relies on a NASA supplied star tracker for attitude determination. There are no additional aspect sensors or magnetometers.

7.3 POWER REQUIREMENTS

The electronics have their own battery pack. The Fine Guidance Camera will need power from the NASA provided battery pack.

7.4 ENVIRONMENTAL AND ELECTRICAL PROTECTION

Packaging techniques to prevent circuit board or component movement during launch vibration and shock will be used. Power distribution modules use isolation transformers and input and output transient absorbers to prevent coupling of external electrical discharges. Optoisolators are used at all telemetry, timer, and ACS signal interfaces.

7.5 GROUND SUPPORT EQUIPMENT

The ground support equipment (GSE) consists of a single unit, which acts as a flight simulator and provides power and the command interface during testing and pre-launch activities. This unit only supports analog electronics. To test the digital outputs, we use another unit which takes the serial digital outputs from the telemetry board.

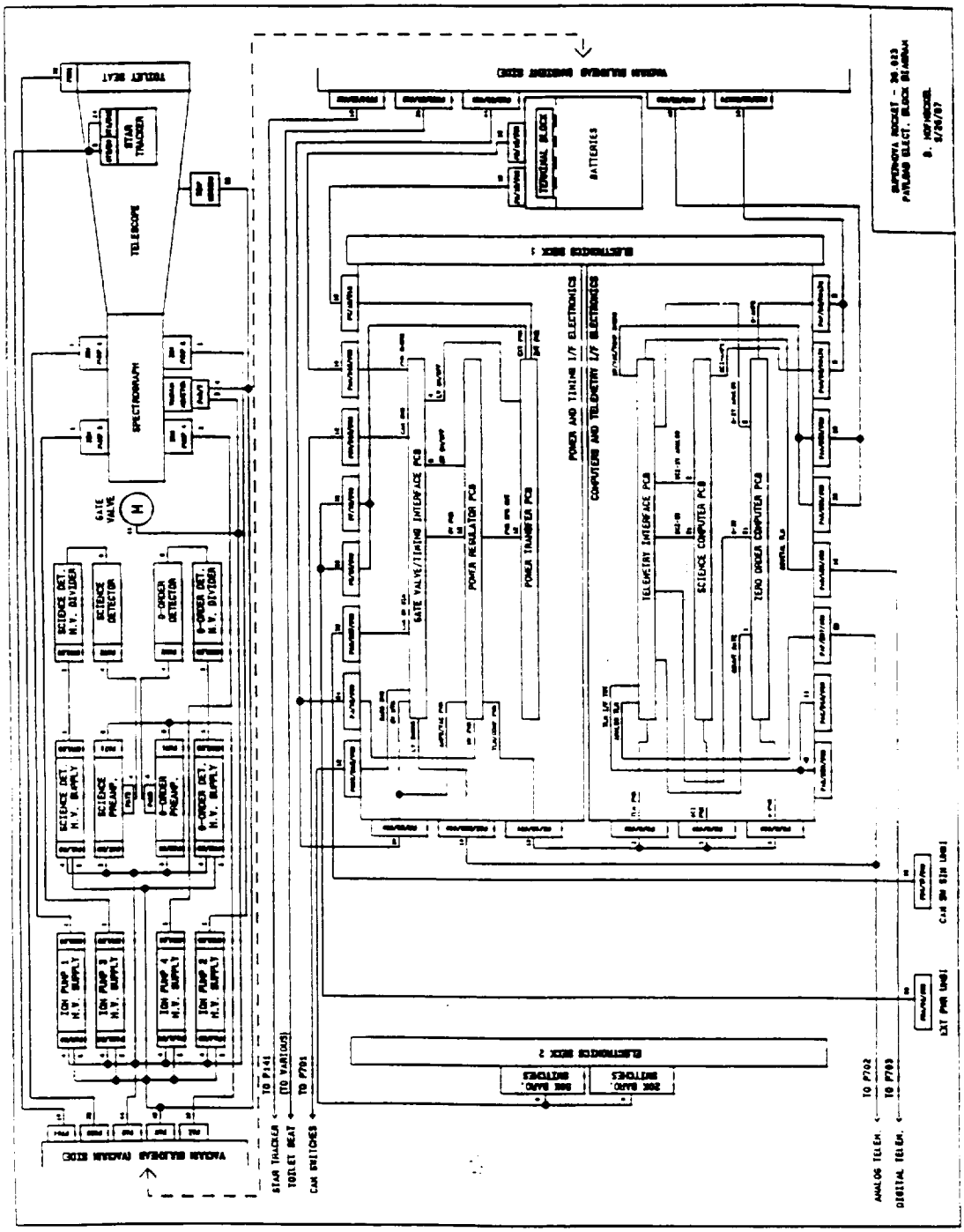


FIGURE 3. ELECTRONIC BLOCK DIAGRAM

7.6 IN-FLIGHT EVENT TIMER

Approximately nine switch closures will be needed to sequence the following experiment functions: (1) Science detector HV on, (2) FGC on, (3)FGC off, (4) Vacuum Door open, (5) Vacuum Door close, (6) LED on, (7) LED off, (8) Experiment shutdown, (9) Spare.

7.7 UPLINK COMMANDS

Three commands are needed for control of payload functions: (1) System reset, (2) LED on/off, and (3) High Voltage on/off. Using the SPARCS command uplink unit, the first command should be a momentary contact switch, and the last two should be latching relay closures. (For pointing requirements, see section 8.2.)

7.8 LAND LINES AND UMBILICALS

We will require the same land lines and umbilicals as used on the previously listed payloads.

7.9 PRELIMINARY MEASUREMENT LIST

Description	Samples per Second
Exper Skin Temp 1	60
Science HV	60
15V	60
-15V	60
5V	60
10V	60
5V Ref	60
-5.2V	60
28V	60
-28V	60
24/20V	60
18/15V	60
12/10V	60
-12/-10V	60
-24/-20V	60
Sig Common	60
50K Barrow	60
20K Barrow	60
Science X1	11428
Science Y1	11428
Science Rate	60
LED Status	60
FGC	Video

8.0 VEHICLE

8.1 PERFORMANCE

To meet the minimum success criteria, the EUVE payload must attain an altitude in excess of 200 km for a least 100 seconds. The payload must not be spinning while locked on Venus.

8.2 POINTING REQUIREMENTS

The instrument will be despun and separated from the nose cone and booster. The payload is not roll sensitive. The telescope will be pointed towards Venus by 120 seconds. Acquisition of Venus should be within ±20 arcseconds. As stated previously, the nominal plan is to point the payload immediately at Venus with no update source. If possible, the star tracker will lock directly on Venus. At that time, the video image from the FGC showing the location of Venus on the aperture slit will be downlinked. Using real-time joystick uplinked commands, we will trim the payloads attitude to put Venus' image in the center of the slit. No maneuvers will be required during observation of Venus. The entrance aperture is 23 arcseconds wide. Once Venus is acquired, the pointing jitter must be less than 3 arcseconds with a period of 5 seconds or less.

After observing Venus, the payload will maneuver to the calibration star for in-flight calibration. The timing of this maneuver will be determined real-time on the ground based on the quality of the Venus observation.

9.0 FLIGHT QUALIFICATIONS

9.1 GO/NO-GO LAUNCH CRITERIA

Master Check Off at SwRI which includes:

The instrument must be functioning properly. All vacuum doors and high voltage connections shall be tested prior to integration.

Test instrument performance

Calibrate experiment throughput

Test electronics through to Wallops/SwRI interface

Test all HV systems for corona

Master Field Check Off at WSMR which includes:

A failure of any system: Experiment, TM, ACS, ORSA, or Launch Vehicle would constitute a NO GO.

At least two TM ground stations and two radar tracking stations are required for GO.

Rain or predicted rain in the impact area or launch pad would constitute a NO GO.

9.2 PRE-FLIGHT CHECKS AND UPLINK COMMANDS

Pre-flight checks will include the following items. The checkout will be carried out approximately one hour prior to launch:

Check experiment housekeeping data

Turn on FGC - Confirm that data is passed correctly by TM

Turn on LED - Confirm that data is passed correctly by TM

Turn on Detector (provided the vacuum is sufficient for detector operation) - Confirm that data is passed correctly by TM

Turn off LED

9.3 REQUIREMENTS FOR A SCRUBBED MISSION

Vacuum in the instrument is maintained by chemical, ion, and turbo pumps. In the event that vacuum were to degrade due to delay of launch after the pump is disconnected, then the pump will have to be reconnected and the vacuum reestablished prior to the next launch attempt.

9.4 POST FLIGHT REQUIREMENTS

Class 1 helicopter recovery.

Normal quick look and permanent data tapes.

Digital data tape.

Radar record of Altitude vs Time.

ACS data as it becomes available.

2 SwRI personnel should accompany the payload during recovery operations.

10.0 RESTRICTIONS AND PRECAUTIONS

There are no restrictions, precautions, special requirements or limitations for the environmental testing of the integrated payload which are out of the ordinary. The two concerns, already stated, are (i) the need to maintain a vacuum in the telescope and spectrograph sections of the payload, and (ii) our concerns over cleanliness.

11.0 SUPPORT REQUIREMENTS

We request the launch vehicle include an S-19 Boost Guidance System.

We require telemetry as specified in the previous section.

A clean area (laboratory quality will be adequate) will be required for instrument testing. No special equipment will be required for this operation.

We require a collimated beam of visible light for checking the alignment of the star tracker with the FGC during integration.

For proper handling, the rail area should be maintained at 55-80°F while the rocket is on the rail.

We will need to vacuum pump the payload while it is on the rail and post-recovery. We will manually disconnect the pump as close to launch as is practical (typically, T-1 hour). In order to run the vacuum pump and operate a heater to regenerate the getter pumps, we will need switched 120V AC at the rail.

We will need access to the pad several hours prior to launch to activate the spectrograph canister getters. This schedule is subject to change depending upon measured vacuum performance.

12.0 LAUNCH CONDITIONS

The Venus EUVE sounding rocket will be launched from the White Sands Missile Range. Based on a 30° SEA, the Venus launch window opens May 18, 1994 and continues to October 10, 1994. In this time period, the astronomical magnitude of Venus goes from -3.9 to -4.6, a ratio of 1.6. The following days are eliminated due to possible star or moon interference (i.e. EUV hot stars near the entrance aperture and the moon with less than a 30° separation with Venus).

Dates with star interference - 1994

July 7	Yale #1237
July 28	Zeta Tauri
Aug 2	Yale #2116
Aug 12	Yale #2529

Aug 22	Yale #2991
Aug 23	Yale #2991
Sep 14	Yale #3818

Dates with Moon interference - 1994

Window Closes (UT)		Window Opens (UT)	
May 10	06:25	May 15	18:25
June 9	21:45	June 14	21:45
July 9	20:05	July 14	14:05
Aug 8	13:05	Aug 13	03:05
Sep 6	20:25	Sep 11	02:25
Oct 5	11:25	Oct 9	11:25

For programmatic reasons, we propose a launch window opening July 14, 1994. (See Appendix A - Launch Window Calculations.)

We also require that:

Venus	≤	90° ZE
Sun	>	3° below the depressed horizon

13.0 UNIQUE OR SPECIAL RANGE REQUIREMENTS

There are no unique or special range requirements.

14.0 RADIOACTIVE SOURCES

The EUVS does not use any radioactive sources.

15.0 MISSION SUCCESS CRITERIA

15.1 COMPREHENSIVE MISSION SUCCESS CRITERIA

The comprehensive goal of the mission is to obtain publishable, high quality data on the Venus FUV spectrum (830-1130 Å).

The instrument must operate properly with the vacuum door open, and the high vacuum maintained.

The ACS must acquire and track the target with an unvignetted Venus image centered on the spectrograph entrance aperture.

The telemetry system must function properly, producing a digital tape of sufficient quality to be read by a computer.

We need at least 300 seconds of data above 200 km to get the full, undegraded data set.

Also need in-flight cal on a standard FUV source.

15.2 MINIMUM SUCCESS CRITERIA

Minimum success will have been achieved if we obtain data of sufficient quality to support publication. This translates approximately into the following functional requirement:

One hundred seconds of good data with the slit stable on Venus from above 200 km would constitute publishable quality results.

This in turn requires the following functions to operate:

1) The vacuum door must open.

2) The experiment electronics must function.

3) Venus must be acquired by the ACS and held on the entrance slit for 100 seconds above 200 km.

4) A good quality digital recording of the telemetry must be obtained.

16.0 LIST OF CONTACTS

Dr. Alan Stern
Principal Investigator
Southwest Research Institute
P.O. Drawer 28510
San Antonio, TX 78228-0510
Phone 210/522-5127
FAX 210/647-4325
E-mail:
alan@everest.space.swri.edu

John Scherrer
Principal Engineer
Southwest Research Institute
P.O. Drawer 28510
San Antonio, TX 78228-0510
Phone 210/522-3363
FAX 210/647-4325
E-mail:
jrs%spacesci%swri15@d15vs178a.space.swri.edu

Dr. Erik Wilkinson
Co-Investigator
University of Colorado at Boulder
Campus Box 389
Boulder, CO 80309-0389
Phone 303/492-7645
FAX 303/492-4052
E-mail:
wilkie@34278.span.nasa.gov

REFERENCES

Bartaux, J.L., et al., 1981. VENERA 11 and VENERA 12 Observations of E.U.V. emissions from the upper atmosphere of Venus, *Planet. Space Sci.*, **29**, 149.

Feldman, P.D., et al., 1991, HUT Observations of Comet Levy (1990c), *Ap. J. Lett.*, **379**, L37.

Gentieu, E.P. Feldman, P.D., Eastes, R.W., and Christensen, A.B., 1981. Spectroscopy of the Extreme Ultraviolet Airglow during Active Solar Condition, *GRL*, **8**, 1242.

Hord, C.W., et al., 1991. Galileo ultraviolet spectrometer experiment: Initial Venus and Interplanetary Cruise Results, *Science*, **253**. 1548.

APPENDIX

LAUNCH WINDOW DATA

Hi Alan,

OK, I finally got a free moment and looked at your questions regarding EUV and FUV fluxes from O, B, ... stars. As you might expect O and B stars have significant FUV flux, therefore you should avoid them. A stars will also have FUV flux, although not nearly as much, and therefore you should avoid them as well.

With this in mind I tracked Venus through the sky keeping track of all stars with Vmag > 8. I found 6 stars which you may want to avoid. The stars are:

1) Yale# 1237 - B9V - 9100K - RA 4:00.2 - DEC 17:17 - Mag 6.28
gets to within 33' on 7/7/93

2) Zeta Tauri - B2VJ - 26000K - RA 5:37.2 - DEC 21:09 - Mag 2.92
gets to within 19' on 7/28/93

3) Yale# 2116 - B8V - 19000K - RA 06:01.3 - DEC 22:24 - Mag 6.23
gets to within 42' on 8/2/93

4) Yale# 2529 - A2V - 13000K - RA 06:51.1 - DEC 21:46 - Mag 5.23
gets to within 15' on 8/12/93

5) Yale# 2991 - A0V - 10000K - RA 07:44.8 - DEC 20:20 - Mag 6.26
gets to within 42' on 8/22-23/93

6) Yale# 3818 - A1V - 9600K - RA 09:35.5 - DEC 14:24 - Mag 6.36
gets to within 33' on 9/14

These stars really shouldn't be too much of a problem, but you should be aware of them.

I also went throught the EUVE bright source list and found only no star which would contribute significant EUVE flux during the observation of Venus.

Finally, as I played with the launch windows I noticed that you had not blocked out anytime for when the Moon is close to Venus (for instance the Moon is only 8 deg. from Venus on 7/15!). You will want to add that to your launch windows program. We generally use 60 deg. separation as our Moon constraint.

Well, that is all for now. How is the PIC datapac coming? Has the PIC been scheduled yet and when might I get the PIC datapac to review? For my scheduling it is better to get stuff to me early so I have time for a thorough review (I know that this is not always possible). Well, I look forward to hearing from you in the near future. Take care and keep smiling

Erik

Post-it™ brand fax transmittal memo 7671	# of pages ▸
To Alan Stern	From E. Kilkawan
Co. SwRI	Co.
Dept.	Phone # 303-492-6812
Fax #	Fax #

Conjunctions from 1994 to 1994 Separation: 10.0° or less

Venus Moon

01/11/1994	19:45	3.8°	
02/11/1994	04:45	6.2°	*
03/13/1994	12:25	4.3°	*
04/13/1994	00:05	0.7°	
05/13/1994	06:25	4.3°	*
06/12/1994	09:45	7.4°	*
07/12/1994	08:05	7.2°	*
08/10/1994	19:05	3.5°	
09/09/1994	02:25	1.4°	
10/07/1994	11:25	6.5°	*
11/03/1994	10:25	4.5°	*
11/30/1994	11:05	2.3°	*
12/29/1994	04:05	3.2°	*

U.S. NAVAL OBSERVATORY
ASTRONOMICAL APPLICATIONS DEPARTMENT
WASHINGON, DC 20392

TELEPHONE: 202-653-0020 (VOICE)

FAX COVER SHEET

DATE: 5/11/92

TO: ALAN STERN

Institution: UNIV. OF COLORADO

FAX No. 512-647-4325

FROM: JOHN BANGERT 202-653-1516

NO. OF PAGES 9 (INCLUDING COVER SHEET)

MESSAGE: (1) PRESENT OF PP. 10-11 OF ASTRONOMICAL PHENOMENA FOR 1994

(2) PRESENT (GEOCENTRIC) COORDINATES OF VENUS + MARS @ 2-DAY INTERVALS FROM EARLY ALMANAC FOR 1994

IF YOU DO NOT RECEIVE LEGIBLE PAGES, PLEASE CONTACT THE TELEPHONE NUMBER LISTED IN THE LETTERHEAD.

ELONGATIONS AND MAGNITUDES OF PLANETS AT 0h UT

Date		Mercury		Venus		Date		Mercury		Venus	
		Elong.	Mag.	Elong.	Mag.			Elong.	Mag.	Elong.	Mag.
		°		°				°		°	
Jan.	−2	W. 4	−1·0	W. 5	−3·9	July	2	W. 11	+3·5	E. 40	−4·0
	3	W. 2	1·2	3	3·9		7	16	2·2	40	4·1
	8	E. 3	1·2	2	3·9		12	19	1·2	41	4·1
	13	6	1·1	W. 1	3·9		17	21	+0·4	42	4·1
	18	9	1·0	E. 1	3·9		22	20	−0·2	43	4·1
	23	E. 13	−1·0	E. 2	−3·9		27	W. 17	−0·7	E. 44	−4·1
	28	16	0·9	3	3·9	Aug.	1	13	1·2	44	4·2
Feb.	2	18	0·8	4	3·9		6	8	1·6	45	4·2
	7	18	−0·2	5	3·9		11	W. 3	1·9	45	4·2
	12	15	+1·0	6	3·9		16	E. 4	1·6	46	4·3
	17	E. 8	+3·3	E. 8	−3·9		21	E. 8	−1·1	E. 46	−4·3
	22	W. 5	4·3	9	3·9		26	12	0·7	46	4·3
	27	14	2·3	10	3·9		31	16	0·5	46	4·4
Mar.	4	21	1·2	11	3·9	Sept.	5	19	0·3	46	4·4
	9	25	0·6	12	3·9		10	22	−0·1	45	4·5
	14	W. 27	+0·4	E. 14	−3·9		15	E. 24	0·0	E. 44	−4·5
	19	28	0·2	15	3·9		20	25	0·0	43	4·5
	24	27	+0·1	16	3·9		25	26	+0·1	41	4·6
	29	26	0·0	17	3·9		30	26	0·2	39	4·6
Apr.	3	24	−0·1	18	3·9	Oct.	5	24	0·4	36	4·6
	8	W. 21	−0·3	E. 20	−3·9		10	E. 20	+0·9	E. 32	−4·6
	13	17	0·5	21	3·9		15	13	2·1	27	4·5
	18	13	0·8	22	3·9		20	E. 3	4·8	22	4·4
	23	8	1·3	23	3·9		25	W. 8	3·0	15	4·3
	28	W. 3	1·9	25	3·9		30	16	+0·6	E. 9	4·1
May	3	E. 3	−2·0	E. 26	−3·9	Nov.	4	W. 19	−0·4	W. 5	−4·0
	8	9	1·5	27	3·9		9	18	0·7	10	4·2
	13	14	1·0	28	3·9		14	17	0·8	17	4·3
	18	19	0·6	30	3·9		19	14	0·8	24	4·5
	23	21	−0·1	31	4·0		24	11	0·8	29	4·6
	28	E. 23	+0·3	E. 32	−4·0		29	W. 8	−0·8	W. 33	−4·6
June	2	23	0·8	33	4·0	Dec.	4	6	0·9	37	4·7
	7	21	1·4	34	4·0		9	3	1·1	40	4·7
	12	18	2·2	35	4·0		14	W. 1	1·2	42	4·6
	17	12	3·3	36	4·0		19	E. 3	1·1	44	4·6
	22	E. 5	+4·6	E. 38	−4·0		24	E. 6	−1·0	W. 45	−4·6
	27	W. 5	4·9	39	4·0		29	9	0·9	46	4·6
July	2	W. 11	+3·5	E. 40	−4·0		34	E. 12	−0·9	W. 47	−4·5

MINOR PLANETS

	Conjunction	Stationary	Opposition	Stationary
Ceres	June 8	Dec. 24	—	—
Pallas	Mar. 20	Oct. 7	Nov. 8	—
Juno	Nov. 18	Feb. 23	Apr. 15	June 11
Vesta	Apr. 28	Nov. 6	Dec. 25	—

Window Open — E. May −3.9
15th July −4.1
10 Oct −4.6 — Ratio: 1.6
MAX BRIGHT
Window Close — 10 Oct −4.6

ELONGATIONS AND MAGNITUDES OF PLANETS AT 0^h UT

Date		Mars		Jupiter		Saturn		Uranus	Neptune	Pluto
		Elong.	Mag.	Elong.	Mag.	Elong.	Mag.	Elong.	Elong.	Elong.
		°		°		°		°	°	°
Jan.	−2	W. 1	+1·2	W. 58	−1·8	E. 49	+0·9	E. 14	E. 13	W. 42
	8	3	1·2	67	1·9	40	0·9	E. 5	E. 3	52
	18	6	1·2	76	1·9	31	0·9	W. 5	W. 7	61
	28	8	1·2	85	2·0	22	0·9	15	16	71
Feb.	7	10	1·2	94	2·1	13	0·9	24	26	80
	17	W. 13	+1·2	W. 104	−2·1	E. 4	+0·9	W. 34	W. 36	W. 90
	27	15	1·2	114	2·2	W. 5	0·9	43	46	100
Mar.	9	17	1·2	124	2·3	14	0·9	53	55	109
	19	19	1·2	134	2·3	22	1·0	63	65	119
	29	21	1·2	145	2·4	31	1·0	72	75	129
Apr.	8	W. 23	+1·2	W. 155	−2·4	W. 40	+1·0	W. 82	W. 85	W. 138
	18	25	1·2	166	2·5	49	1·1	91	94	147
	28	27	1·2	W. 177	2·5	58	1·1	101	104	156
May	8	29	1·2	E. 172	2·5	66	1·1	111	114	W. 163
	18	31	1·2	161	2·5	76	1·1	121	124	E. 166
	28	W. 33	+1·2	E. 150	−2·4	W. 85	+1·0	W. 130	W. 133	E. 163
June	7	36	1·2	140	2·4	94	1·0	140	143	156
	17	38	1·2	130	2·3	103	1·0	150	153	147
	27	40	1·2	120	2·3	113	0·9	160	163	138
July	7	42	1·2	110	2·2	122	0·9	170	W. 172	129
	17	W. 45	+1·2	E. 101	−2·1	W. 132	+0·8	W. 179	E. 178	E. 120
	27	48	1·2	92	2·1	142	0·7	E. 170	168	111
Aug.	6	50	1·2	83	2·0	152	0·7	160	158	102
	16	53	1·2	75	1·9	163	0·6	150	148	92
	26	57	1·2	66	1·9	W. 173	0·5	140	138	83
Sept.	5	W. 60	+1·1	E. 58	−1·8	E. 176	+0·5	E. 130	E. 129	E. 74
	15	63	1·1	50	1·8	166	0·5	121	119	65
	25	67	1·1	42	1·8	156	0·6	111	109	55
Oct.	5	71	1·0	34	1·7	145	0·6	101	99	46
	15	76	0·9	27	1·7	135	0·6	91	89	37
	25	W. 80	+0·8	E. 19	−1·7	E. 125	+0·7	E. 81	E. 79	E. 29
Nov.	4	86	0·7	11	1·7	114	0·7	72	70	21
	14	91	0·6	E. 3	1·7	104	0·8	62	60	E. 15
	24	97	0·4	W. 5	1·7	94	0·8	52	50	W. 14
Dec.	4	104	0·2	13	1·7	85	0·9	42	40	19
	14	W. 111	−0·1	W. 21	−1·7	E. 75	+0·9	E. 33	E. 30	W. 26
	24	120	−0·2	29	1·7	65	1·0	23	20	35
	34	W. 129	−0·4	W. 37	−1·8	E. 56	+1·0	E. 13	E. 11	W. 44

Magnitudes at opposition: Uranus 5·6 Neptune 7·9 Pluto 13·7

VISUAL MAGNITUDES OF MINOR PLANETS

	Jan. 8	Feb. 17	Mar. 29	May 8	June 17	July 27	Sept. 5	Oct. 15	Nov. 24	Dec. 34
Ceres	8·6	9·0	9·0	8·8	8·5	8·9	8·9	8·7	8·2	7·4
Pallas	10·2	10·0	9·7	9·9	9·8	9·5	8·9	8·2	8·1	8·4
Juno	10·9	10·5	10·0	10·2	10·8	11·3	11·5	11·5	11·4	11·5
Vesta	8·1	8·3	8·2	8·1	8·4	8·4	8·2	7·7	7·0	6·5

Apparent Places of VENUS

Date				Time			RA			Dec			Dist
Julian Date	Year	Mon	Da	h	m	s	h	m	s	°	'	"	AU
2449353.50000	1994	Jan	1	0	00	00	18	28	21.664	- 23	38	45.58	1.7051584
2449355.50000	1994	Jan	3	0	00	00	18	39	20.844	- 23	34	30.52	1.7065193
2449357.50000	1994	Jan	5	0	00	00	18	50	19.045	- 23	27	19.74	1.7077249
2449359.50000	1994	Jan	7	0	00	00	19	01	15.794	- 23	17	14.37	1.7087729
2449361.50000	1994	Jan	9	0	00	00	19	12	10.615	- 23	04	16.15	1.7096611
2449363.50000	1994	Jan	11	0	00	00	19	23	03.032	- 22	48	27.38	1.7103878
2449365.50000	1994	Jan	13	0	00	00	19	33	52.587	- 22	29	50.82	1.7109524
2449367.50000	1994	Jan	15	0	00	00	19	44	38.861	- 22	08	29.65	1.7113552
2449369.50000	1994	Jan	17	0	00	00	19	55	21.487	- 21	44	27.39	1.7115972
2449371.50000	1994	Jan	19	0	00	00	20	06	00.136	- 21	17	47.98	1.7116799
2449373.50000	1994	Jan	21	0	00	00	20	16	34.527	- 20	48	35.90	1.7116046
2449375.50000	1994	Jan	23	0	00	00	20	27	04.429	- 20	16	55.87	1.7113728
2449377.50000	1994	Jan	25	0	00	00	20	37	29.649	- 19	42	52.86	1.7109858
2449379.50000	1994	Jan	27	0	00	00	20	47	50.039	- 19	06	32.10	1.7104450
2449381.50000	1994	Jan	29	0	00	00	20	58	05.494	- 18	27	58.95	1.7097507
2449383.50000	1994	Jan	31	0	00	00	21	08	15.965	- 17	47	18.91	1.7089024
2449385.50000	1994	Feb	2	0	00	00	21	18	21.457	- 17	04	37.63	1.7078983
2449387.50000	1994	Feb	4	0	00	00	21	28	22.003	- 16	20	00.97	1.7067355
2449389.50000	1994	Feb	6	0	00	00	21	38	17.656	- 15	33	35.02	1.7054105
2449391.50000	1994	Feb	8	0	00	00	21	48	08.482	- 14	45	26.01	1.7039201
2449393.50000	1994	Feb	10	0	00	00	21	57	54.576	- 13	55	40.20	1.7022619
2449395.50000	1994	Feb	12	0	00	00	22	07	36.066	- 13	04	23.86	1.7004340
2449397.50000	1994	Feb	14	0	00	00	22	17	13.115	- 12	11	43.23	1.6984354
2449399.50000	1994	Feb	16	0	00	00	22	26	45.919	- 11	17	44.57	1.6962658
2449401.50000	1994	Feb	18	0	00	00	22	36	14.695	- 10	22	34.10	1.6939248
2449403.50000	1994	Feb	20	0	00	00	22	45	39.680	- 9	26	18.05	1.6914128
2449405.50000	1994	Feb	22	0	00	00	22	55	01.130	- 8	29	02.59	1.6887302
2449407.50000	1994	Feb	24	0	00	00	23	04	19.315	- 7	30	53.87	1.6858773
2449409.50000	1994	Feb	26	0	00	00	23	13	34.529	- 6	31	57.92	1.6828548
2449411.50000	1994	Feb	28	0	00	00	23	22	47.094	- 5	32	20.66	1.6796624
2449413.50000	1994	Mar	2	0	00	00	23	31	57.359	- 4	32	07.93	1.6762985
2449415.50000	1994	Mar	4	0	00	00	23	41	05.672	- 3	31	25.58	1.6727600
2449417.50000	1994	Mar	6	0	00	00	23	50	12.369	- 2	30	19.61	1.6690429
2449419.50000	1994	Mar	8	0	00	00	23	59	17.773	- 1	28	56.04	1.6651431
2449421.50000	1994	Mar	10	0	00	00	0	08	22.211	- 0	27	20.88	1.6610571
2449423.50000	1994	Mar	12	0	00	00	0	17	26.014	+ 0	34	19.88	1.6567816
2449425.50000	1994	Mar	14	0	00	00	0	26	29.516	+ 1	36	00.33	1.6523143
2449427.50000	1994	Mar	16	0	00	00	0	35	33.051	+ 2	37	34.54	1.6476533
2449429.50000	1994	Mar	18	0	00	00	0	44	36.948	+ 3	38	56.61	1.6427975
2449431.50000	1994	Mar	20	0	00	00	0	53	41.530	+ 4	40	00.62	1.6377462
2449433.50000	1994	Mar	22	0	00	00	1	02	47.113	+ 5	40	40.65	1.6324992
2449435.50000	1994	Mar	24	0	00	00	1	11	54.009	+ 6	40	50.77	1.6270568
2449437.50000	1994	Mar	26	0	00	00	1	21	02.532	+ 7	40	25.09	1.6214199
2449439.50000	1994	Mar	28	0	00	00	1	30	13.008	+ 8	39	17.78	1.6155893
2449441.50000	1994	Mar	30	0	00	00	1	39	25.771	+ 9	37	23.08	1.6095648
2449443.50000	1994	Apr	1	0	00	00	1	48	41.134	+ 10	34	35.21	1.6033460
2449445.50000	1994	Apr	3	0	00	00	1	57	59.379	+ 11	30	48.22	1.5969267
2449447.50000	1994	Apr	5	0	00	00	2	07	20.759	+ 12	25	56.08	1.5903067
2449449.50000	1994	Apr	7	0	00	00	2	16	45.511	+ 13	19	52.72	1.5834816
2449451.50000	1994	Apr	9	0	00	00	2	26	13.850	+ 14	12	32.08	1.5764486
2449453.50000	1994	Apr	11	0	00	00	2	35	45.966	+ 15	03	48.15	1.5692056
2449455.50000	1994	Apr	13	0	00	00	2	45	22.021	+ 15	53	34.93	1.5617507
2449457.50000	1994	Apr	15	0	00	00	2	55	02.141	+ 16	41	46.45	1.5540832
2449459.50000	1994	Apr	17	0	00	00	3	04	46.415	+ 17	28	16.77	1.5462026
2449461.50000	1994	Apr	19	0	00	00	3	14	34.900	+ 18	13	00.01	1.5381095
2449463.50000	1994	Apr	21	0	00	00	3	24	27.617	+ 18	55	50.33	1.5298052
2449465.50000	1994	Apr	23	0	00	00	3	34	24.562	+ 19	36	42.03	1.5212916
2449467.50000	1994	Apr	25	0	00	00	3	44	25.715	+ 20	15	29.59	1.5125715
2449469.50000	1994	Apr	27	0	00	00	3	54	31.032	+ 20	52	07.72	1.5036475
2449471.50000	1994	Apr	29	0	00	00	4	04	40.427	+ 21	26	31.36	1.4945211

2449473.50000	1994	May	1	0	00	00	4	14	53.756	+	21	58	35.53	1.4851923
2449475.50000	1994	May	3	0	00	00	4	25	10.833	-	22	28	15.42	1.4756501
2449477.50000	1994	May	5	0	00	00	4	35	31.427	+	22	55	26.52	1.4659234
2449479.50000	1994	May	7	0	00	00	4	45	55.266	+	23	20	04.63	1.4559811
2449481.50000	1994	May	9	0	00	00	4	56	22.030	+	23	42	05.93	1.4458329
2449483.50000	1994	May	11	0	00	00	5	06	51.353	+	24	01	27.01	1.4354787
2449485.50000	1994	May	13	0	00	00	5	17	22.826	+	24	18	04.86	1.4249190
2449487.50000	1994	May	15	0	00	00	5	27	55.997	+	24	31	56.92	1.4141549
2449489.50000	1994	May	17	0	00	00	5	38	30.381	+	24	43	01.06	1.4031886
2449491.50000	1994	May	19	0	00	00	5	49	05.471	+	24	51	15.60	1.3920228
2449493.50000	1994	May	21	0	00	00	5	59	40.752	+	24	56	39.36	1.3806615
2449495.50000	1994	May	23	0	00	00	6	10	15.717	+	24	59	11.67	1.3691095
2449497.50000	1994	May	25	0	00	00	6	20	49.863	+	24	58	52.42	1.3573722
2449499.50000	1994	May	27	0	00	00	6	31	22.688	+	24	55	42.04	1.3454544
2449501.50000	1994	May	29	0	00	00	6	41	53.690	+	24	49	41.38	1.3333600
2449503.50000	1994	May	31	0	00	00	6	52	22.386	+	24	40	51.69	1.3210911
2449505.50000	1994	Jun	2	0	00	00	7	02	48.307	+	24	29	14.74	1.3086496
2449507.50000	1994	Jun	4	0	00	00	7	13	11.005	-	24	14	52.81	1.2960369
2449509.50000	1994	Jun	6	0	00	00	7	23	30.047	-	23	57	48.64	1.2832547
2449511.50000	1994	Jun	8	0	00	00	7	33	45.017	+	23	38	05.47	1.2703050
2449513.50000	1994	Jun	10	0	00	00	7	43	55.524	+	23	15	46.93	1.2571897
2449515.50000	1994	Jun	12	0	00	00	7	54	01.196	+	22	50	57.03	1.2439115
2449517.50000	1994	Jun	14	0	00	00	8	04	01.693	+	22	23	40.12	1.2304736
2449519.50000	1994	Jun	16	0	00	00	8	13	56.712	+	21	54	00.79	1.2168800
2449521.50000	1994	Jun	18	0	00	00	8	23	45.998	+	21	22	03.88	1.2031359
2449523.50000	1994	Jun	20	0	00	00	8	33	29.346	+	20	47	54.43	1.1892472
2449525.50000	1994	Jun	22	0	00	00	8	43	06.597	+	20	11	37.68	1.1752211
2449527.50000	1994	Jun	24	0	00	00	8	52	37.630	+	19	33	18.98	1.1610646
2449529.50000	1994	Jun	26	0	00	00	9	02	02.370	+	18	53	03.74	1.1467840
2449531.50000	1994	Jun	28	0	00	00	9	11	20.784	+	18	10	57.34	1.1323842
2449533.50000	1994	Jun	30	0	00	00	9	20	32.886	+	17	27	05.27	1.1178692
2449535.50000	1994	Jul	2	0	00	00	9	29	38.709	+	16	41	33.97	1.1032425
2449537.50000	1994	Jul	4	0	00	00	9	38	38.309	+	15	54	26.41	1.0885072
2449539.50000	1994	Jul	6	0	00	00	9	47	31.754	+	15	05	51.00	1.0736662
2449541.50000	1994	Jul	8	0	00	00	9	56	19.120	+	14	15	52.61	1.0587225
2449543.50000	1994	Jul	10	0	00	00	10	05	00.490	+	13	24	37.02	1.0436790
2449545.50000	1994	Jul	12	0	00	00	10	13	35.953	+	12	32	10.03	1.0285390
2449547.50000	1994	Jul	14	0	00	00	10	22	05.608	+	11	38	37.38	1.0133064
2449549.50000	1994	Jul	16	0	00	00	10	30	29.567	+	10	44	04.76	.9979863
2449551.50000	1994	Jul	18	0	00	00	10	38	47.955	+	9	48	37.77	.9825847
2449553.50000	1994	Jul	20	0	00	00	10	47	00.900	+	8	52	21.97	.9671087
2449555.50000	1994	Jul	22	0	00	00	10	55	08.540	+	7	55	22.79	.9515661
2449557.50000	1994	Jul	24	0	00	00	11	03	11.025	+	6	57	45.51	.9359641
2449559.50000	1994	Jul	26	0	00	00	11	11	08.529	+	5	59	35.24	.9203091
2449561.50000	1994	Jul	28	0	00	00	11	19	01.233	+	5	00	56.96	.9046064
2449563.50000	1994	Jul	30	0	00	00	11	26	49.313	+	4	01	55.66	.8888606
2449565.50000	1994	Aug	1	0	00	00	11	34	32.929	+	3	02	36.32	.8730758
2449567.50000	1994	Aug	3	0	00	00	11	42	12.218	+	2	03	03.93	.8572556
2449569.50000	1994	Aug	5	0	00	00	11	49	47.298	+	1	03	23.50	.8414033
2449571.50000	1994	Aug	7	0	00	00	11	57	18.255	+	0	03	40.05	.8255221
2449573.50000	1994	Aug	9	0	00	00	12	04	45.146	-	0	56	01.34	.8095151
2449575.50000	1994	Aug	11	0	00	00	12	12	07.999	-	1	55	35.61	.7936858
2449577.50000	1994	Aug	13	0	00	00	12	19	26.811	-	2	54	57.73	.7777390
2449579.50000	1994	Aug	15	0	00	00	12	26	41.541	-	3	54	02.66	.7617810
2449581.50000	1994	Aug	17	0	00	00	12	33	52.116	-	4	52	45.39	.7458192
2449583.50000	1994	Aug	19	0	00	00	12	40	58.437	-	5	51	00.96	.7298621
2449585.50000	1994	Aug	21	0	00	00	12	48	00.390	-	6	48	44.51	.7139183
2449587.50000	1994	Aug	23	0	00	00	12	54	57.852	-	7	45	51.32	.6979962
2449589.50000	1994	Aug	25	0	00	00	13	01	50.672	-	8	42	16.76	.6821038
2449591.50000	1994	Aug	27	0	00	00	13	08	38.656	-	9	37	56.18	.6662483
2449593.50000	1994	Aug	29	0	00	00	13	15	21.553	-	10	32	44.88	.6504369
2449595.50000	1994	Aug	31	0	00	00	13	21	59.044	-	11	26	38.10	.6346763
2449597.50000	1994	Sep	2	0	00	00	13	28	30.741	-	12	19	30.98	.6189734

2449599.50000	1994	Sep	4	0	00	00	13	34	56.173	-	13	11	18.56	.6033350
2449601.50000	1994	Sep	6	0	00	00	13	41	14.776	-	14	01	55.73	.5877682
2449603.50000	1994	Sep	8	0	00	00	13	47	25.882	-	14	51	17.26	.5722807
2449605.50000	1994	Sep	10	0	00	00	13	53	28.705	-	15	39	17.76	.5568821
2449607.50000	1994	Sep	12	0	00	00	13	59	22.328	-	16	25	51.61	.5415845
2449609.50000	1994	Sep	14	0	00	00	14	05	05.715	-	17	10	52.96	.5264022
2449611.50000	1994	Sep	16	0	00	00	14	10	37.735	-	17	54	15.74	.5113520
2449613.50000	1994	Sep	18	0	00	00	14	15	57.168	-	18	35	53.70	.4964524
2449615.50000	1994	Sep	20	0	00	00	14	21	02.706	-	19	15	40.36	.4817231
2449617.50000	1994	Sep	22	0	00	00	14	25	52.935	-	19	53	28.90	.4671852
2449619.50000	1994	Sep	24	0	00	00	14	30	26.322	-	20	29	12.02	.4528608
2449621.50000	1994	Sep	26	0	00	00	14	34	41.205	-	21	02	41.80	.4387738
2449623.50000	1994	Sep	28	0	00	00	14	38	35.806	-	21	33	49.51	.4249498
2449625.50000	1994	Sep	30	0	00	00	14	42	08.211	-	22	02	25.51	.4114167
2449627.50000	1994	Oct	2	0	00	00	14	45	16.413	-	22	28	19.07	.3982046
2449629.50000	1994	Oct	4	0	00	00	14	47	58.314	-	22	51	18.21	.3853466
2449631.50000	1994	Oct	6	0	00	00	14	50	11.749	-	23	11	09.57	.3728791
2449633.50000	1994	Oct	8	0	00	00	14	51	54.521	-	23	27	38.18	.3608434
2449635.50000	1994	Oct	10	0	00	00	14	53	04.485	-	23	40	27.42	.3492866
2449637.50000	1994	Oct	12	0	00	00	14	53	39.706	-	23	49	19.11	.3382624
2449639.50000	1994	Oct	14	0	00	00	14	53	38.643	-	23	53	54.01	.3278297
2449641.50000	1994	Oct	16	0	00	00	14	53	00.321	-	23	53	52.58	.3180520
2449643.50000	1994	Oct	18	0	00	00	14	51	44.504	-	23	48	55.98	.3089960
2449645.50000	1994	Oct	20	0	00	00	14	49	51.846	-	23	38	47.44	.3007304
2449647.50000	1994	Oct	22	0	00	00	14	47	24.044	-	23	23	13.97	.2933243
2449649.50000	1994	Oct	24	0	00	00	14	44	23.946	-	23	02	08.43	.2868453
2449651.50000	1994	Oct	26	0	00	00	14	40	55.598	-	22	35	31.68	.2813575
2449653.50000	1994	Oct	28	0	00	00	14	37	04.205	-	22	03	34.71	.2769184
2449655.50000	1994	Oct	30	0	00	00	14	32	55.984	-	21	26	40.11	.2735771
2449657.50000	1994	Nov	1	0	00	00	14	28	37.907	-	20	45	22.74	.2713710
2449659.50000	1994	Nov	3	0	00	00	14	24	17.346	-	20	00	29.08	.2703246
2449661.50000	1994	Nov	5	0	00	00	14	20	01.696	-	19	12	55.37	.2704497
2449663.50000	1994	Nov	7	0	00	00	14	15	58.035	-	18	23	44.67	.2717440
2449665.50000	1994	Nov	9	0	00	00	14	12	12.877	-	17	34	03.50	.2741926
2449667.50000	1994	Nov	11	0	00	00	14	08	51.948	-	16	44	58.24	.2777667
2449669.50000	1994	Nov	13	0	00	00	14	05	59.988	-	15	57	31.35	.2824248
2449671.50000	1994	Nov	15	0	00	00	14	03	40.631	-	15	12	38.24	.2881145
2449673.50000	1994	Nov	17	0	00	00	14	01	56.382	-	14	31	05.04	.2947748
2449675.50000	1994	Nov	19	0	00	00	14	00	48.690	-	13	53	27.44	.3023391
2449677.50000	1994	Nov	21	0	00	00	14	00	18.077	-	13	20	10.66	.3107376
2449679.50000	1994	Nov	23	0	00	00	14	00	24.288	-	12	51	30.09	.3199000
2449681.50000	1994	Nov	25	0	00	00	14	01	06.465	-	12	27	32.43	.3297568
2449683.50000	1994	Nov	27	0	00	00	14	02	23.296	-	12	08	17.21	.3402411
2449685.50000	1994	Nov	29	0	00	00	14	04	13.160	-	11	53	38.21	.3512897
2449687.50000	1994	Dec	1	0	00	00	14	06	34.235	-	11	43	24.89	.3628441
2449689.50000	1994	Dec	3	0	00	00	14	09	24.595	-	11	37	23.65	.3748516
2449691.50000	1994	Dec	5	0	00	00	14	12	42.308	-	11	35	18.89	.3872659
2449693.50000	1994	Dec	7	0	00	00	14	16	25.534	-	11	36	53.95	.4000461
2449695.50000	1994	Dec	9	0	00	00	14	20	32.584	-	11	41	51.76	.4131560
2449697.50000	1994	Dec	11	0	00	00	14	25	01.920	-	11	49	55.23	.4265622
2449699.50000	1994	Dec	13	0	00	00	14	29	52.126	-	12	00	47.37	.4402339
2449701.50000	1994	Dec	15	0	00	00	14	35	01.895	-	12	14	11.45	.4541423
2449703.50000	1994	Dec	17	0	00	00	14	40	30.024	-	12	29	51.07	.4682610
2449705.50000	1994	Dec	19	0	00	00	14	46	15.403	-	12	47	30.28	.4825652
2449707.50000	1994	Dec	21	0	00	00	14	52	17.013	-	13	06	53.60	.4970320
2449709.50000	1994	Dec	23	0	00	00	14	58	33.913	-	13	27	46.05	.5116399
2449711.50000	1994	Dec	25	0	00	00	15	05	05.240	-	13	49	53.19	.5263687
2449713.50000	1994	Dec	27	0	00	00	15	11	50.193	-	14	13	01.16	.5411999
2449715.50000	1994	Dec	29	0	00	00	15	18	48.025	-	14	36	56.69	.5561170
2449717.50000	1994	Dec	31	0	00	00	15	25	56.025	-	15	01	27.09	.5711054

Apparent Places of MARS

Date				Time			RA			Dec			Dist
Julian Date	Year	Mon	Da	h	m	s	h	m	s	°	'	"	AU

2449353.50000	1994 Jan 1	0 00 00	18 39 43.568	- 23 57 08.41	2.4215080
2449355.50000	1994 Jan 3	0 00 00	18 46 22.985	- 23 51 11.93	2.4189094
2449357.50000	1994 Jan 5	0 00 00	18 53 02.487	- 23 44 11.28	2.4162328
2449359.50000	1994 Jan 7	0 00 00	18 59 41.970	- 23 36 06.61	2.4134784
2449361.50000	1994 Jan 9	0 00 00	19 06 21.314	- 23 26 58.26	2.4106464
2449363.50000	1994 Jan 11	0 00 00	19 13 00.381	- 23 16 46.65	2.4077377
2449365.50000	1994 Jan 13	0 00 00	19 19 39.026	- 23 05 32.24	2.4047542
2449367.50000	1994 Jan 15	0 00 00	19 26 17.118	- 22 53 15.53	2.4016993
2449369.50000	1994 Jan 17	0 00 00	19 32 54.540	- 22 39 57.07	2.3985771
2449371.50000	1994 Jan 19	0 00 00	19 39 31.190	- 22 25 37.49	2.3953921
2449373.50000	1994 Jan 21	0 00 00	19 46 06.974	- 22 10 17.52	2.3921490
2449375.50000	1994 Jan 23	0 00 00	19 52 41.802	- 21 53 57.97	2.3888523
2449377.50000	1994 Jan 25	0 00 00	19 59 15.589	- 21 36 39.72	2.3855067
2449379.50000	1994 Jan 27	0 00 00	20 05 48.255	- 21 18 23.68	2.3821161
2449381.50000	1994 Jan 29	0 00 00	20 12 19.725	- 20 59 10.78	2.3786839
2449383.50000	1994 Jan 31	0 00 00	20 18 49.944	- 20 39 01.94	2.3752121
2449385.50000	1994 Feb 2	0 00 00	20 25 18.872	- 20 17 58.16	2.3717011
2449387.50000	1994 Feb 4	0 00 00	20 31 46.467	- 19 56 00.57	2.3681505
2449389.50000	1994 Feb 6	0 00 00	20 38 12.675	- 19 33 10.48	2.3645598
2449391.50000	1994 Feb 8	0 00 00	20 44 37.430	- 19 09 29.26	2.3609289
2449393.50000	1994 Feb 10	0 00 00	20 51 00.667	- 18 44 58.28	2.3572587
2449395.50000	1994 Feb 12	0 00 00	20 57 22.335	- 18 19 38.92	2.3535511
2449397.50000	1994 Feb 14	0 00 00	21 03 42.398	- 17 53 32.56	2.3498088
2449399.50000	1994 Feb 16	0 00 00	21 10 00.830	- 17 26 40.64	2.3460350
2449401.50000	1994 Feb 18	0 00 00	21 16 17.617	- 16 59 04.62	2.3422333
2449403.50000	1994 Feb 20	0 00 00	21 22 32.746	- 16 30 45.99	2.3384072
2449405.50000	1994 Feb 22	0 00 00	21 28 46.210	- 16 01 46.28	2.3345603
2449407.50000	1994 Feb 24	0 00 00	21 34 58.007	- 15 32 07.00	2.3306962
2449409.50000	1994 Feb 26	0 00 00	21 41 08.146	- 15 01 49.63	2.3268176
2449411.50000	1994 Feb 28	0 00 00	21 47 16.656	- 14 30 55.59	2.3229260
2449413.50000	1994 Mar 2	0 00 00	21 53 23.580	- 13 59 26.32	2.3190212
2449415.50000	1994 Mar 4	0 00 00	21 59 28.957	- 13 27 23.37	2.3151018
2449417.50000	1994 Mar 6	0 00 00	22 05 32.807	- 12 54 48.44	2.3111659
2449419.50000	1994 Mar 8	0 00 00	22 11 35.140	- 12 21 43.23	2.3072119
2449421.50000	1994 Mar 10	0 00 00	22 17 35.968	- 11 48 09.47	2.3032391
2449423.50000	1994 Mar 12	0 00 00	22 23 35.316	- 11 14 08.81	2.2992475
2449425.50000	1994 Mar 14	0 00 00	22 29 33.214	- 10 39 42.90	2.2952380
2449427.50000	1994 Mar 16	0 00 00	22 35 29.701	- 10 04 53.40	2.2912121
2449429.50000	1994 Mar 18	0 00 00	22 41 24.817	- 9 29 41.96	2.2871715
2449431.50000	1994 Mar 20	0 00 00	22 47 18.601	- 8 54 10.23	2.2831182
2449433.50000	1994 Mar 22	0 00 00	22 53 11.098	- 8 18 19.86	2.2790546
2449435.50000	1994 Mar 24	0 00 00	22 59 02.354	- 7 42 12.48	2.2749828
2449437.50000	1994 Mar 26	0 00 00	23 04 52.425	- 7 05 49.63	2.2709047
2449439.50000	1994 Mar 28	0 00 00	23 10 41.388	- 6 29 12.78	2.2668211
2449441.50000	1994 Mar 30	0 00 00	23 16 29.330	- 5 52 23.36	2.2627311
2449443.50000	1994 Apr 1	0 00 00	23 22 16.330	- 5 15 22.89	2.2586320
2449445.50000	1994 Apr 3	0 00 00	23 28 02.439	- 4 38 13.04	2.2545204
2449447.50000	1994 Apr 5	0 00 00	23 33 47.705	- 4 00 55.48	2.2503932
2449449.50000	1994 Apr 7	0 00 00	23 39 32.176	- 3 23 31.85	2.2462476
2449451.50000	1994 Apr 9	0 00 00	23 45 15.906	- 2 46 03.77	2.2420820
2449453.50000	1994 Apr 11	0 00 00	23 50 58.951	- 2 08 32.80	2.2378953
2449455.50000	1994 Apr 13	0 00 00	23 56 41.367	- 1 31 00.50	2.2336869
2449457.50000	1994 Apr 15	0 00 00	0 02 23.207	- 0 53 28.43	2.2294568
2449459.50000	1994 Apr 17	0 00 00	0 08 04.524	- 0 15 58.15	2.2252054
2449461.50000	1994 Apr 19	0 00 00	0 13 45.368	+ 0 21 28.83	2.2209336
2449463.50000	1994 Apr 21	0 00 00	0 19 25.793	+ 0 58 50.99	2.2166421
2449465.50000	1994 Apr 23	0 00 00	0 25 05.865	+ 1 36 06.91	2.2123317
2449467.50000	1994 Apr 25	0 00 00	0 30 45.665	+ 2 13 15.26	2.2080025
2449469.50000	1994 Apr 27	0 00 00	0 36 25.284	+ 2 50 14.78	2.2036551
2449471.50000	1994 Apr 29	0 00 00	0 42 04.797	+ 3 27 04.14	2.1992901
2449473.50000	1994 May 1	0 00 00	0 47 44.258	+ 4 03 41.85	2.1948789
2449475.50000	1994 May 3	0 00 00	0 53 23.712	+ 4 40 06.45	2.1904447
2449477.50000	1994 May 5	0 00 00	0 59 03.208	+ 5 16 16.47	2.1859735

2449479.50000	1994 May 7	0 00 00	1 04 42.794	+ 5 52 10.50	2.1814619
2449481.50000	1994 May 9	0 00 00	1 10 22.516	+ 6 27 47.19	2.1769071
2449483.50000	1994 May 11	0 00 00	1 16 02.415	+ 7 03 05.16	2.1723071
2449485.50000	1994 May 13	0 00 00	1 21 42.527	+ 7 38 03.06	2.1676602
2449487.50000	1994 May 15	0 00 00	1 27 22.880	+ 8 12 39.55	2.1629655
2449489.50000	1994 May 17	0 00 00	1 33 03.503	+ 8 46 53.29	2.1582226
2449491.50000	1994 May 19	0 00 00	1 38 44.428	+ 9 20 42.98	2.1534314
2449493.50000	1994 May 21	0 00 00	1 44 25.700	+ 9 54 07.41	2.1485918
2449495.50000	1994 May 23	0 00 00	1 50 07.376	+ 10 27 05.45	2.1437034
2449497.50000	1994 May 25	0 00 00	1 55 49.516	+ 10 59 36.06	2.1387644
2449499.50000	1994 May 27	0 00 00	2 01 32.166	+ 11 31 38.16	2.1337715
2449501.50000	1994 May 29	0 00 00	2 07 15.351	+ 12 03 10.54	2.1287194
2449503.50000	1994 May 31	0 00 00	2 12 59.091	+ 12 34 12.00	2.1236028
2449505.50000	1994 Jun 2	0 00 00	2 18 43.407	+ 13 04 41.36	2.1184165
2449507.50000	1994 Jun 4	0 00 00	2 24 28.315	+ 13 34 37.51	2.1131560
2449509.50000	1994 Jun 6	0 00 00	2 30 13.822	+ 14 03 59.38	2.1078175
2449511.50000	1994 Jun 8	0 00 00	2 35 59.928	+ 14 32 45.91	2.1023977
2449513.50000	1994 Jun 10	0 00 00	2 41 46.624	+ 15 00 56.08	2.0968942
2449515.50000	1994 Jun 12	0 00 00	2 47 33.892	+ 15 28 28.85	2.0913052
2449517.50000	1994 Jun 14	0 00 00	2 53 21.713	+ 15 55 23.21	2.0856295
2449519.50000	1994 Jun 16	0 00 00	2 59 10.073	+ 16 21 38.19	2.0798666
2449521.50000	1994 Jun 18	0 00 00	3 04 58.971	+ 16 47 12.91	2.0740162
2449523.50000	1994 Jun 20	0 00 00	3 10 48.415	+ 17 12 06.60	2.0680776
2449525.50000	1994 Jun 22	0 00 00	3 16 38.413	+ 17 36 18.57	2.0620494
2449527.50000	1994 Jun 24	0 00 00	3 22 28.955	+ 17 59 48.10	2.0559285
2449529.50000	1994 Jun 26	0 00 00	3 28 20.019	+ 18 22 34.42	2.0497100
2449531.50000	1994 Jun 28	0 00 00	3 34 11.581	+ 18 44 36.75	2.0433886
2449533.50000	1994 Jun 30	0 00 00	3 40 03.612	+ 19 05 54.38	2.0369587
2449535.50000	1994 Jul 2	0 00 00	3 45 56.077	+ 19 26 26.68	2.0304156
2449537.50000	1994 Jul 4	0 00 00	3 51 48.931	+ 19 46 13.08	2.0237550
2449539.50000	1994 Jul 6	0 00 00	3 57 42.116	+ 20 05 13.03	2.0169732
2449541.50000	1994 Jul 8	0 00 00	4 03 35.564	+ 20 23 26.04	2.0100673
2449543.50000	1994 Jul 10	0 00 00	4 09 29.198	+ 20 40 51.63	2.0030352
2449545.50000	1994 Jul 12	0 00 00	4 15 22.941	+ 20 57 29.32	1.9958756
2449547.50000	1994 Jul 14	0 00 00	4 21 16.724	+ 21 13 18.72	1.9885881
2449549.50000	1994 Jul 16	0 00 00	4 27 10.492	+ 21 28 19.51	1.9811728
2449551.50000	1994 Jul 18	0 00 00	4 33 04.200	+ 21 42 31.50	1.9736296
2449553.50000	1994 Jul 20	0 00 00	4 38 57.797	+ 21 55 54.56	1.9659574
2449555.50000	1994 Jul 22	0 00 00	4 44 51.221	+ 22 08 28.59	1.9581540
2449557.50000	1994 Jul 24	0 00 00	4 50 44.405	+ 22 20 13.43	1.9502157
2449559.50000	1994 Jul 26	0 00 00	4 56 37.283	+ 22 31 08.96	1.9421376
2449561.50000	1994 Jul 28	0 00 00	5 02 29.788	+ 22 41 15.16	1.9339150
2449563.50000	1994 Jul 30	0 00 00	5 08 21.843	+ 22 50 32.08	1.9255433
2449565.50000	1994 Aug 1	0 00 00	5 14 13.360	+ 22 58 59.88	1.9170185
2449567.50000	1994 Aug 3	0 00 00	5 20 04.242	+ 23 06 38.73	1.9083371
2449569.50000	1994 Aug 5	0 00 00	5 25 54.383	+ 23 13 28.89	1.8994964
2449571.50000	1994 Aug 7	0 00 00	5 31 43.668	+ 23 19 30.62	1.8904945
2449573.50000	1994 Aug 9	0 00 00	5 37 31.985	+ 23 24 44.20	1.8813306
2449575.50000	1994 Aug 11	0 00 00	5 43 19.237	+ 23 29 09.96	1.8720051
2449577.50000	1994 Aug 13	0 00 00	5 49 05.342	+ 23 32 48.31	1.8625188
2449579.50000	1994 Aug 15	0 00 00	5 54 50.228	+ 23 35 39.78	1.8528728
2449581.50000	1994 Aug 17	0 00 00	6 00 33.821	+ 23 37 44.95	1.8430673
2449583.50000	1994 Aug 19	0 00 00	6 06 16.041	+ 23 39 04.39	1.8331013
2449585.50000	1994 Aug 21	0 00 00	6 11 56.813	+ 23 39 38.66	1.8229724
2449587.50000	1994 Aug 23	0 00 00	6 17 36.066	+ 23 39 28.35	1.8126775
2449589.50000	1994 Aug 25	0 00 00	6 23 13.732	+ 23 38 34.15	1.8022128
2449591.50000	1994 Aug 27	0 00 00	6 28 49.731	+ 23 36 56.84	1.7915750
2449593.50000	1994 Aug 29	0 00 00	6 34 23.978	+ 23 34 37.28	1.7807611
2449595.50000	1994 Aug 31	0 00 00	6 39 56.375	+ 23 31 36.39	1.7697686
2449597.50000	1994 Sep 2	0 00 00	6 45 26.821	+ 23 27 55.11	1.7585956
2449599.50000	1994 Sep 4	0 00 00	6 50 55.206	+ 23 23 34.41	1.7472411
2449601.50000	1994 Sep 6	0 00 00	6 56 21.426	+ 23 18 35.27	1.7357053
2449603.50000	1994 Sep 8	0 00 00	7 01 45.391	+ 23 12 58.67	1.7239838

2449605.50000	1994 Sep 10	0 00 00	7 07 07.032	+ 23 06 45.66	1.7120972
2449607.50000	1994 Sep 12	0 00 00	7 12 26.284	+ 22 59 57.35	1.7000303
2449609.50000	1994 Sep 14	0 00 00	7 17 43.083	+ 22 52 34.89	1.6877913
2449611.50000	1994 Sep 16	0 00 00	7 22 57.369	+ 22 44 39.37	1.6753809
2449613.50000	1994 Sep 18	0 00 00	7 28 09.089	+ 22 36 11.87	1.6627989
2449615.50000	1994 Sep 20	0 00 00	7 33 18.197	+ 22 27 13.51	1.6500443
2449617.50000	1994 Sep 22	0 00 00	7 38 24.644	+ 22 17 45.49	1.6371155
2449619.50000	1994 Sep 24	0 00 00	7 43 28.376	+ 22 07 49.10	1.6240112
2449621.50000	1994 Sep 26	0 00 00	7 48 29.324	+ 21 57 25.69	1.6107300
2449623.50000	1994 Sep 28	0 00 00	7 53 27.412	+ 21 46 36.65	1.5972715
2449625.50000	1994 Sep 30	0 00 00	7 58 22.554	+ 21 35 23.43	1.5836356
2449627.50000	1994 Oct 2	0 00 00	8 03 14.659	+ 21 23 47.48	1.5698230
2449629.50000	1994 Oct 4	0 00 00	8 08 03.636	+ 21 11 50.22	1.5558357
2449631.50000	1994 Oct 6	0 00 00	8 12 49.406	+ 20 59 33.09	1.5416775
2449633.50000	1994 Oct 8	0 00 00	8 17 31.904	+ 20 46 57.54	1.5273534
2449635.50000	1994 Oct 10	0 00 00	8 22 11.069	+ 20 34 05.09	1.5128689
2449637.50000	1994 Oct 12	0 00 00	8 26 46.839	+ 20 20 57.20	1.4982291
2449639.50000	1994 Oct 14	0 00 00	8 31 19.160	+ 20 07 35.29	1.4834378
2449641.50000	1994 Oct 16	0 00 00	8 35 47.987	+ 19 54 00.77	1.4684977
2449643.50000	1994 Oct 18	0 00 00	8 40 13.277	+ 19 40 15.07	1.4534108
2449645.50000	1994 Oct 20	0 00 00	8 44 34.978	+ 19 26 19.74	1.4381790
2449647.50000	1994 Oct 22	0 00 00	8 48 53.029	+ 19 12 16.37	1.4228038
2449649.50000	1994 Oct 24	0 00 00	8 53 07.349	+ 18 58 06.68	1.4072873
2449651.50000	1994 Oct 26	0 00 00	8 57 17.846	+ 18 43 52.41	1.3916321
2449653.50000	1994 Oct 28	0 00 00	9 01 24.414	+ 18 29 35.36	1.3758411
2449655.50000	1994 Oct 30	0 00 00	9 05 26.935	+ 18 15 17.35	1.3599187
2449657.50000	1994 Nov 1	0 00 00	9 09 25.290	+ 18 01 00.20	1.3438701
2449659.50000	1994 Nov 3	0 00 00	9 13 19.360	+ 17 46 45.73	1.3277026
2449661.50000	1994 Nov 5	0 00 00	9 17 09.030	+ 17 32 35.79	1.3114250
2449663.50000	1994 Nov 7	0 00 00	9 20 54.185	+ 17 18 32.24	1.2950474
2449665.50000	1994 Nov 9	0 00 00	9 24 34.708	+ 17 04 36.89	1.2785794
2449667.50000	1994 Nov 11	0 00 00	9 28 10.494	+ 16 50 51.49	1.2620297
2449669.50000	1994 Nov 13	0 00 00	9 31 41.442	+ 16 37 17.78	1.2454059
2449671.50000	1994 Nov 15	0 00 00	9 35 07.447	+ 16 23 57.58	1.2287151
2449673.50000	1994 Nov 17	0 00 00	9 38 28.383	+ 16 10 52.82	1.2119642
2449675.50000	1994 Nov 19	0 00 00	9 41 44.110	+ 15 58 05.54	1.1951605
2449677.50000	1994 Nov 21	0 00 00	9 44 54.460	+ 15 45 37.87	1.1783116
2449679.50000	1994 Nov 23	0 00 00	9 47 59.247	+ 15 33 32.05	1.1614255
2449681.50000	1994 Nov 25	0 00 00	9 50 58.261	+ 15 21 50.35	1.1445117
2449683.50000	1994 Nov 27	0 00 00	9 53 51.278	+ 15 10 35.13	1.1275804
2449685.50000	1994 Nov 29	0 00 00	9 56 38.060	+ 14 59 48.74	1.1106438
2449687.50000	1994 Dec 1	0 00 00	9 59 18.361	+ 14 49 33.54	1.0937160
2449689.50000	1994 Dec 3	0 00 00	10 01 51.928	+ 14 39 51.91	1.0768133
2449691.50000	1994 Dec 5	0 00 00	10 04 18.503	+ 14 30 46.22	1.0599536
2449693.50000	1994 Dec 7	0 00 00	10 06 37.828	+ 14 22 18.74	1.0431552
2449695.50000	1994 Dec 9	0 00 00	10 08 49.661	+ 14 14 31.62	1.0264355
2449697.50000	1994 Dec 11	0 00 00	10 10 53.763	+ 14 07 27.00	1.0098115
2449699.50000	1994 Dec 13	0 00 00	10 12 49.879	+ 14 01 07.10	.9932997
2449701.50000	1994 Dec 15	0 00 00	10 14 37.733	+ 13 55 34.21	.9769172
2449703.50000	1994 Dec 17	0 00 00	10 16 17.026	+ 13 50 50.70	.9606816
2449705.50000	1994 Dec 19	0 00 00	10 17 47.434	+ 13 46 58.97	.9446114
2449707.50000	1994 Dec 21	0 00 00	10 19 08.610	+ 13 44 01.46	.9287264
2449709.50000	1994 Dec 23	0 00 00	10 20 20.188	+ 13 42 00.55	.9130476
2449711.50000	1994 Dec 25	0 00 00	10 21 21.791	+ 13 40 58.54	.8975982
2449713.50000	1994 Dec 27	0 00 00	10 22 13.036	+ 13 40 57.59	.8824035
2449715.50000	1994 Dec 29	0 00 00	10 22 53.547	+ 13 41 59.60	.8674915
2449717.50000	1994 Dec 31	0 00 00	10 23 22.958	+ 13 44 06.29	.8528928

ATTACHMENT 2

EUVS ROCKET PAYLOAD

11/16/93