OSS-1/STS-3 SHUTTLE INDUCED ATMOSPHERE EXPERIMENT

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SHUTTLE ENVIRONMENT WORKSHOP
OCT 5 - 7, 1982
CALVERTON, MARYLAND

FIRST RESULTS - CHARACTERISTICS OF THE SHUTTLE/SPACELAB INDUCED ATMOSPHERE (SIA)

SPACE ASTRONOMY LABORATORY
UNIVERSITY OF FLORIDA (EXPERIMENT WAS STARTED AT SUNY ALBANY)
GAINESVILLE, FL

TEAM

JERRY WEINBERG	PRINCIPAL INVESTIGATOR
FRANK GIOVANE	CO-INVESTIGATOR
DON SCHUERMAN†	CO-INVESTIGATOR
DICK HAHN	PROJECT ENGINEER

EXPERIMENT OBJECTIVES

- ORBITER ENVIRONMENT	DETERMINE THE OPTICAL PROPERTIES OF THE SHUTTLE INDUCED ATMOSPHERE [BRIGHTNESS, COLOR, POLARIZATION, ANGULAR DEPENDENCE, TIME VARIATIONS], ITS EFFECTS ON DAYTIME ASTRONOMICAL AND EARTH-VIEWING OBSERVATIONS, AND ITS POSSIBLE EFFECTS ON NIGHTTIME INFRARED OBSERVATIONS.
- ASTRONOMY	DETERMINE THE BRIGHTNESS, COLOR, AND POLARIZATION OF THE DIFFUSE ASTRONOMICAL BACKGROUND, WITH EMPHASIS ON THE MILKY WAY AND IN SKY REGIONS CLOSER THAN 90 DEG TO THE SUN. USE THESE DATA TO EXAMINE THE INTEGRATED PROPERTIES OF DUST IN THE SOLAR SYSTEM AND MILKY WAY, INCLUDING A POSSIBLE EVOLUTIONARY SEQUENCE OF INTERSTELLAR (MILKY WAY) GRAINS TO COMETS TO INTERPLANETARY DUST.

† DR. DONALD W. SCHUERMAN WAS KILLED IN AN AUTOMOBILE ACCIDENT ON MAY 19, 1982.

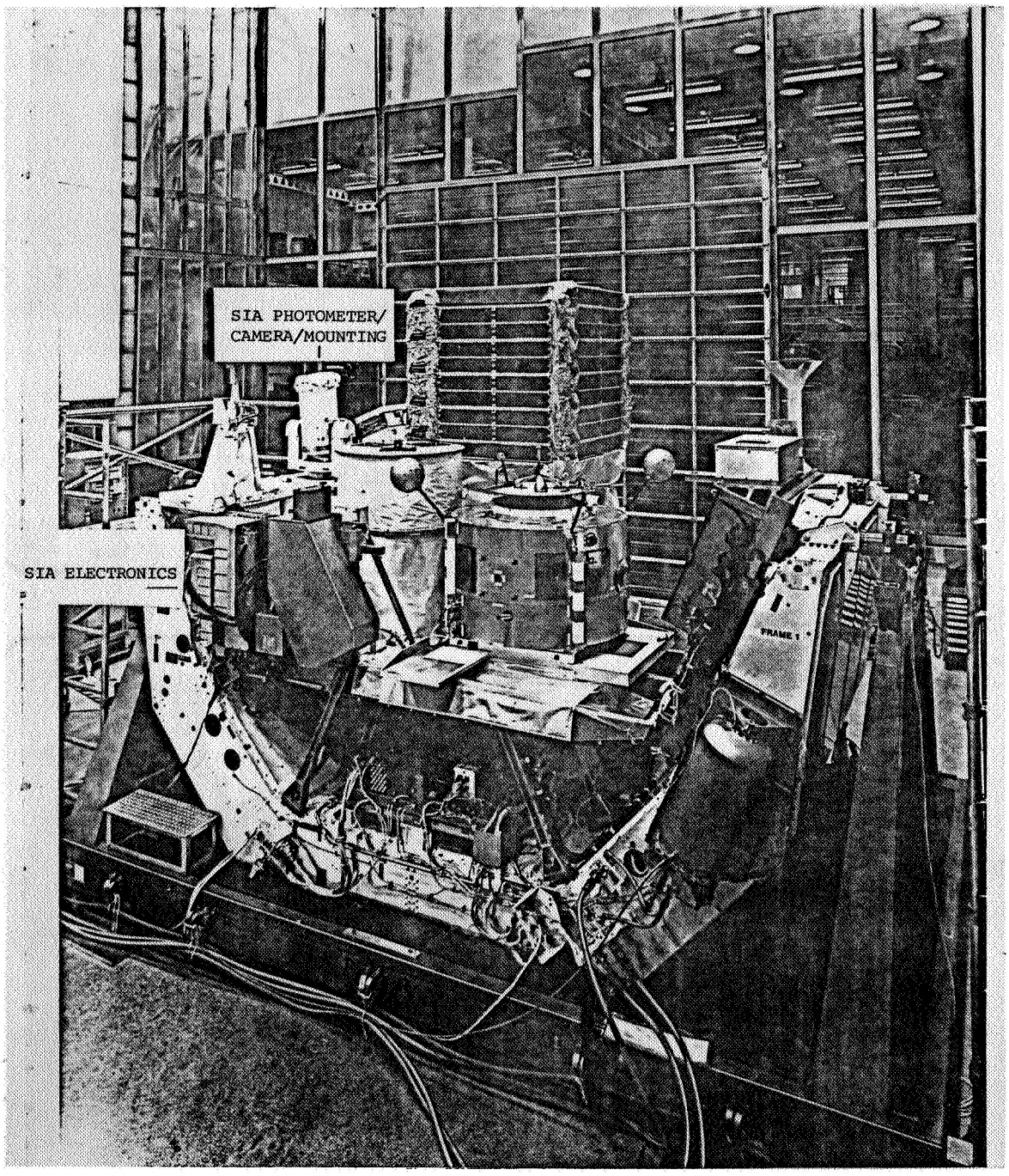
STS-3 OPTICAL ENVIRONMENT

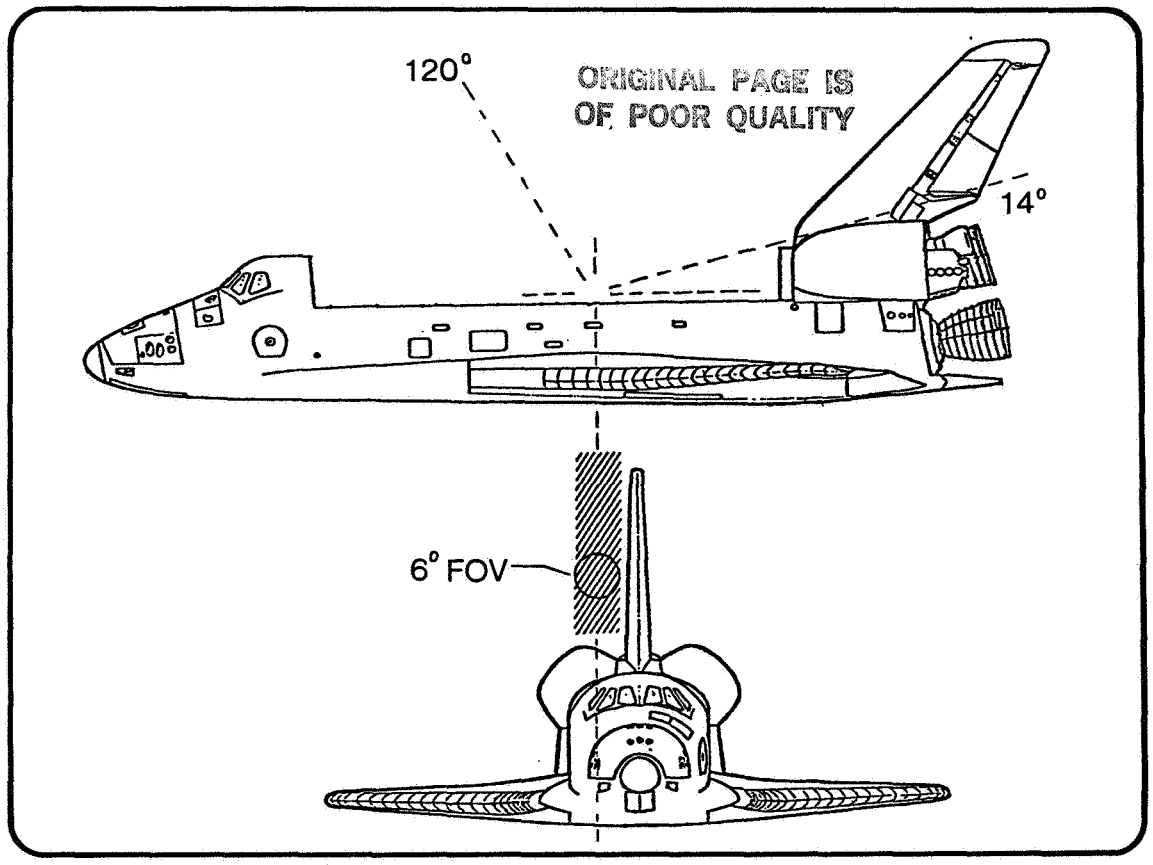
RELATIVE* BRIGHTNESS	SOURCE
2×10^{15}	- SUN
4×10^{9}	- FULL MOON
VARIED	- PLANETS
	- ASTRONOMICAL BACKGROUND RADIATION
50^{i} - 2200^{ii}	INTERPLANETARY (ZODIACAL LIGHT)
VARIED	MILKY WAY - DISCRETE STARS
30 - 1000	- BACKGROUND STARLIGHT
1	EXTRAGALACTIC SOURCES
	- TERRESTRIAL
	SUNLIT EARTH (DAY)
	TWILIGHT
	ATMOSPHERIC EMISSIONS (AIRGLOW, AURORA)
	"DARK" EARTH
	- "LOCAL"
	BAY LIGHTS
	CABIN LIGHTING
	FPEG FILAMENT
	FPEG ELECTRON BEAM
	SUNLIGHT THROUGH CABIN BAY WINDOWS WHEN IN NOSE-SUN ATTITUDE (?)
	THRUSTER FIRINGS AND ASSOCIATED PHOTOCHEMICAL REACTIONS
	PHOTOCHEMICAL REACTIONS ON ORBITER SURFACES
	ORBITER/PAYLOAD-INDUCED GASEOUS MATERIAL
	ORBITER/PAYLOAD-INDUCED PARTICULATE MATERIAL
	DIRECTLY- AND INDIRECTLY-ILLUMINATED ORBITER/PAYLOAD SURFACES FROM ALL OF THE ABOVE

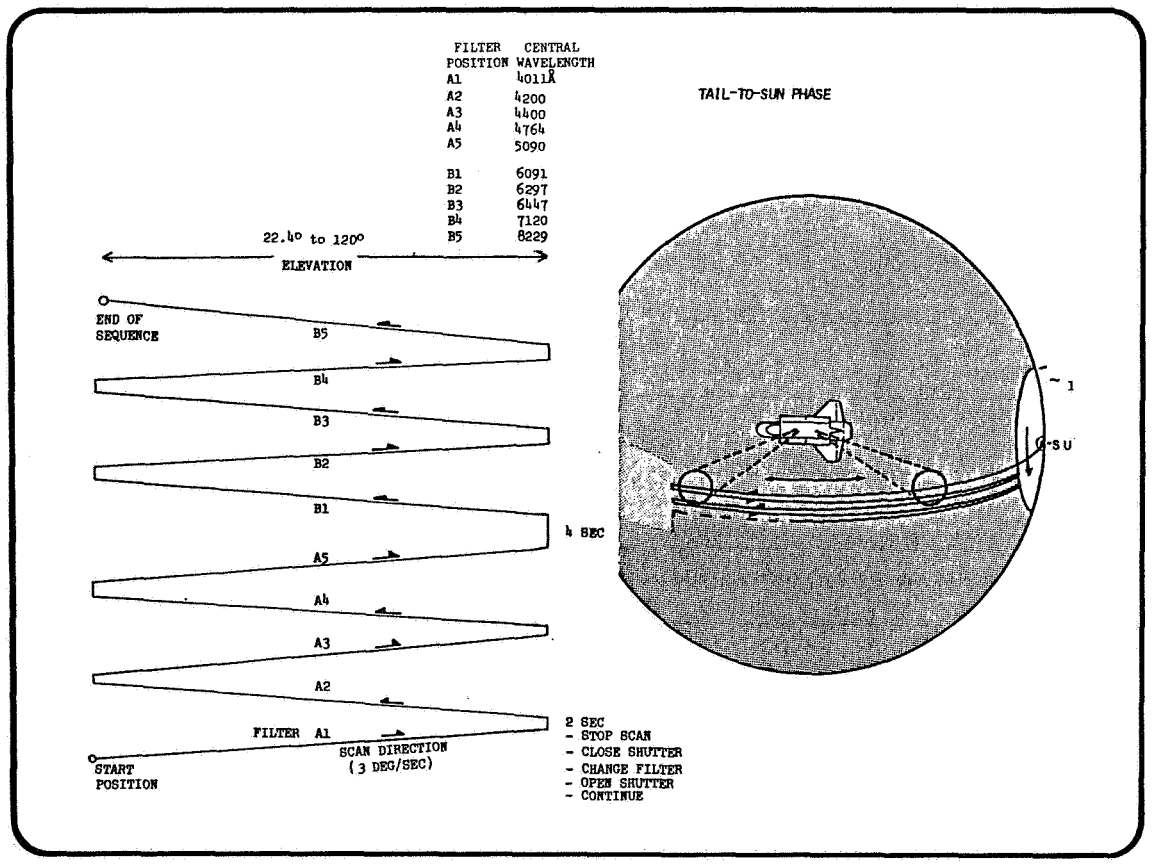
*THESE ARE ALSO ABSOLUTE VALUES, IN UNITS OFTEN USED IN LOW LIGHT LEVEL STUDIES:
EQUIVALENT NUMBER OF 10th MAGNITUDE STARS OF SOLAR TYPE PER SQUARE DEG [S_{10}(V) UNITS]

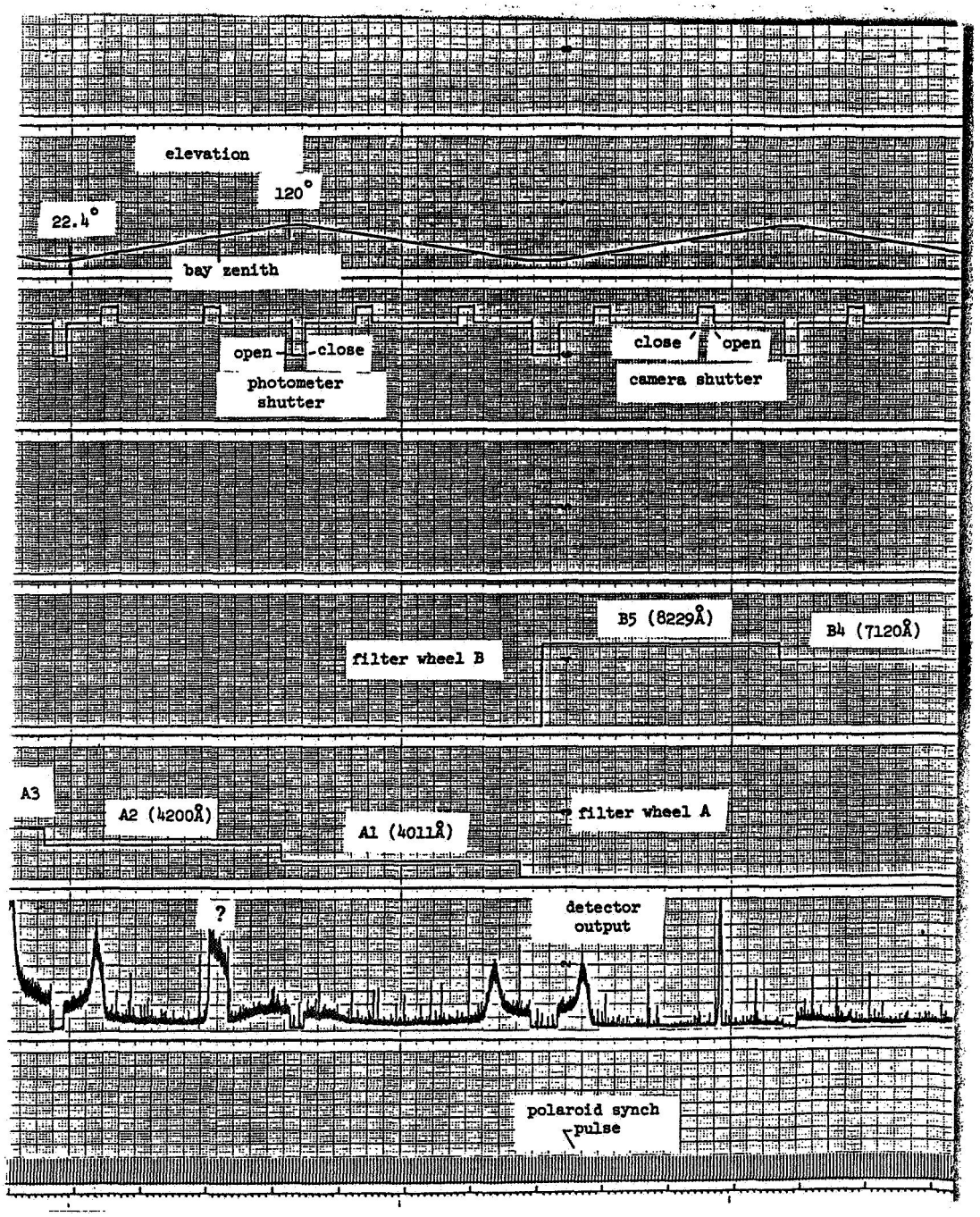
[i]NEAR THE ECLIPTIC POLES

[ii]AT 30 DEG FROM THE SUN IN THE ECLIPTIC

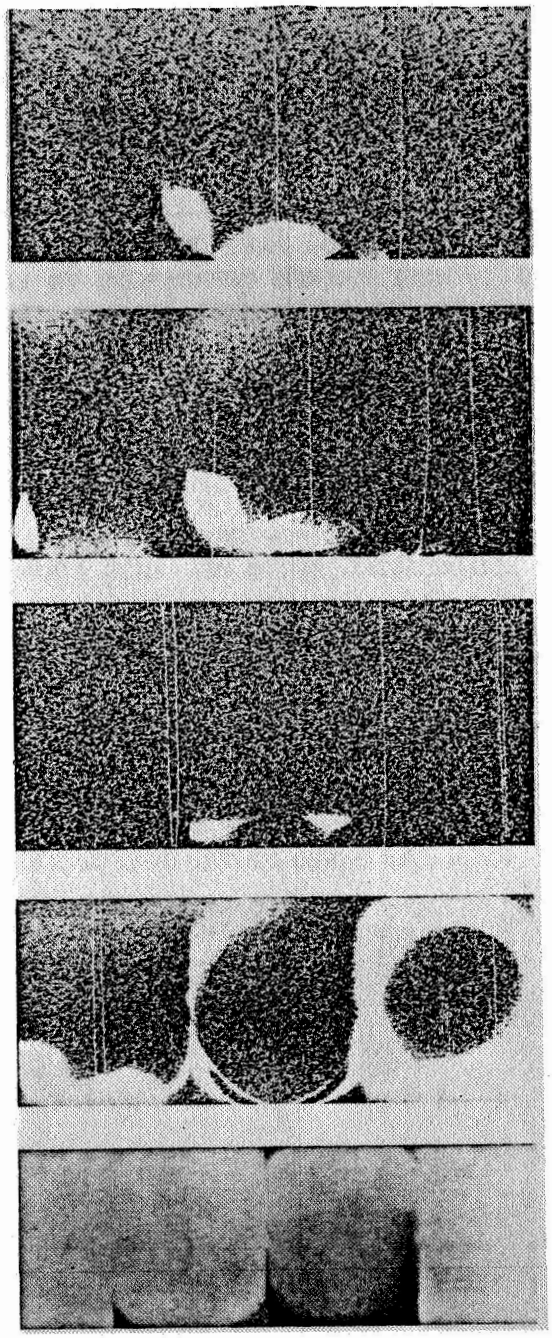



120°
ORIGINAL PAGE IS
OF POOR QUALITY
14°
6° FOV


FILTER POSITION
CENTRAL WAVELENGTH
A1 4011Å
A2 4200
A3 4400
A4 4764
A5 5090
B1 6091
B2 6297
B3 6447
B4 7120
B5 8229
TAIL-TO-SUN PHASE
22.4° to 120°
ELEVATION
END OF SEQUENCE
B5
B4
B3
B2
B1
A5
A4
A3
A2
FILTER A1
SCAN DIRECTION
(3 DEG/SEC)
START POSITION
4 SEC
2 SEC
- STOP SCAN
- CLOSE SHUTTER
- CHANGE FILTER
- OPEN SHUTTER
- CONTINUE
~1
G-SU



RUN	ORBIT OF START	NOMINAL ATTITUDE	GMT START				GMT END				
			d	h	m	s	d	h	m	s	
1	4	PTC	81	21	04	34	81	22	38	34	
2	5	VARIOUS	81	22	41	15	82	00	15	15	
3	6	VARIOUS (DRIFT,IH)	82	00	25	00	82	01	59	00	
4	7	VARIOUS IH;TS	82	02	00	00	82	03	34	00	
5	8	TAIL-SUN	82	03	42	00	82	05	15	00	
6	-		NOT RUN								
7	10	TAIL-SUN	82	06	43	00	82	08	17	00	
8	12	TAIL-SUN	82	08	51	00	82	10	25	00	
9	13	TAIL-SUN	82	10	30	01	82	12	03	56	
10	14	TAIL-SUN	82	12	10	21	82	13	44	21	
11	-		NOT RUN								
12	19	TAIL-SUN	82	19	00	00	82	20	34	00	
13	20	TAIL-SUN	82	20	36	02	82	22	10	02	
14	24	PTC	83	03	00	00	83	04	34	00	
15	25	PTC	83	04	38	14	83	06	12	14	
16	26	PTC	83	06	23	00	83	07	57	00	
17	28	PTC	83	07	59	58	83	09	33	58	
18	31	PTC/NOSE-SUN	83	12	36	45	83	14	10	45	
19	32	NOSE-SUN	83	14	14	04	83	15	48	04	
20	44	NOSE-SUN	84	07	46	59	84	09	20	59	
21	66	NOSE-SUN	85	17	40	01	85	19	14	01	
22	71	NOSE-SUN/RCS BURN ATT	85	23	45	00	86	01	19	00	
22a	72	IH/NOSE-SUN	86	01	56	46	86	03	30	38	
23	75	NOSE-SUN	86	05	46	10	86	07	20	02	
24	104	PTC	88	01	32	01	88	03	10	00	
25	105	PTC	88	03	10	00	88	04	44	19	
26	106	PTC	88	04	45	00	88	06	19	20	
27	107	PTC	88	06	20	01	88	07	54	21	
28	108	PTC	88	07	55	00	88	09	29	20	
29	109	PTC/IMU IH	88	09	30	01	88	11	04	20	
30	110	IMU IH/PTC	88	11	05	00	88	12	39	20	
31	111	PTC/TAIL-SUN	88	12	40	01	88	14	00	54	(this run was shut down early)



Representative frames, SIA/STS-3, 16 mm Maurer camera

REPRESENTATIVE CAMERA FRAMES

THE 16MM CAMERA FRAMES ARE REPRESENTATIVE OF THE LIGHTING CONDITIONS/SOURCES THAT WERE ENCOUNTERED DURING STS-3. EACH OF THE FIVE SETS CONTAINS SEVERAL FRAMES. SETS 1 AND 2 ARE PRINTED IN REVERSE, BUT THIS DOES NOT AFFECT THE RESULTS. THE VERTICAL LINES ON SETS 1 THROUGH 4 ARE DUE TO FILM CRACKS. THE DIFFUSE GLOWS IN 2 AND 4 ARISE FROM ELECTROSTATIC FOGGING.

SUMMARY:

1 & 2. THE FRAMES NEAR CENTER SHOW PART OF THE ILLUMINATED TAIL ASSEMBLY AND ENGINE POD. THESE FRAMES CORRESPOND TO EXPOSURES STARTED AT ELEVATION 45 DEG AS THE INSTRUMENT SCANNED TOWARD THE TAIL; I.E., THE SHUTTER WAS STILL OPEN WHEN THE ORBITER ENTERED THE FIELD OF VIEW OF THE CAMERA/SUNSHIELD.

3. THE FRAME NEAR CENTER SHOWS THE EARTH'S LIMB BEHIND AND TO EITHER SIDE OF THE DARK ENGINE POD.

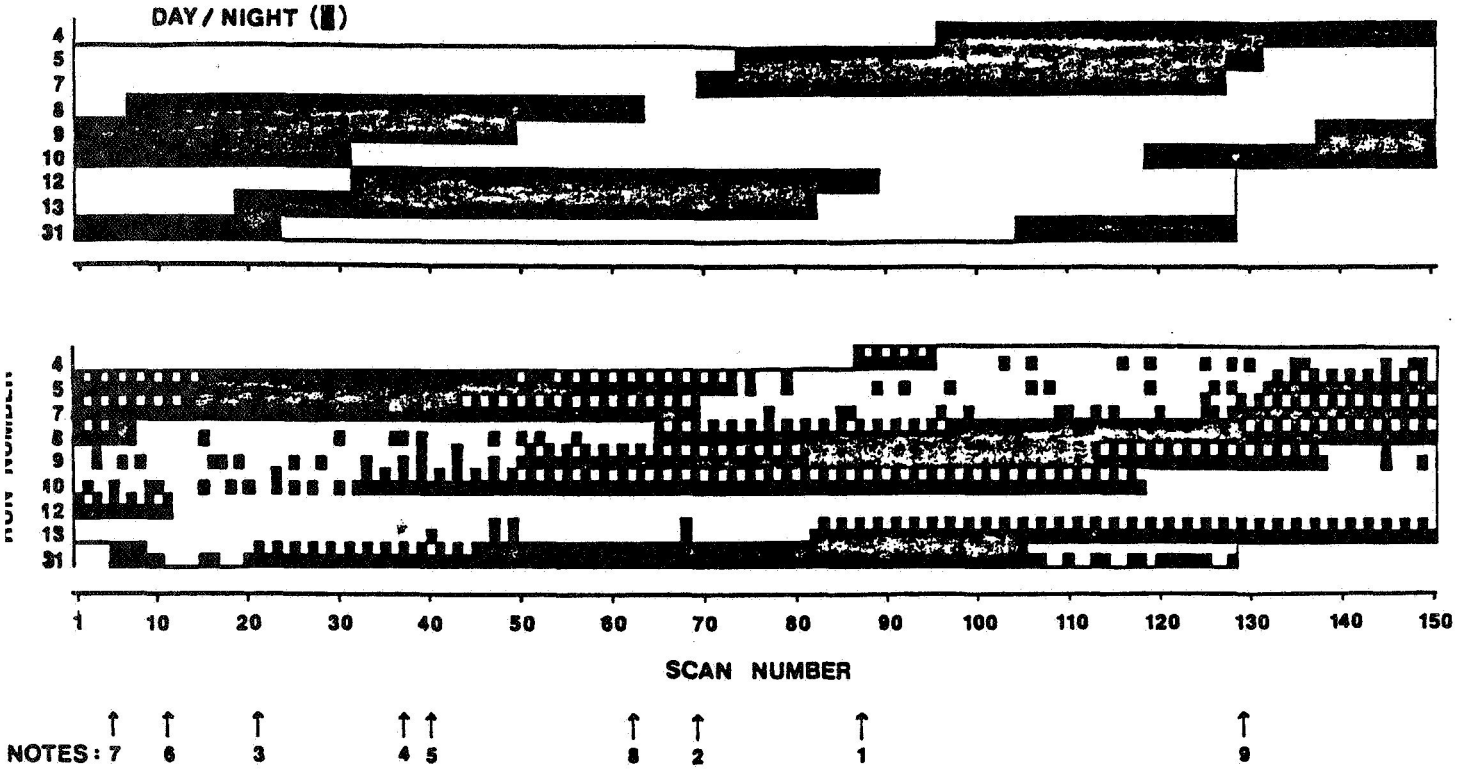
4. THE TWO RIGHT-MOST FRAMES SHOW DARK SKY WITH THE CAMERA SUNSHIELD BAFFLES BEING ILLUMINATED BY AN OFF-AXIS SOURCE OF LIGHT.

5. FRAMES 1 AND 4 ARE COMPLETELY OVEREXPOSED. THE SUNSHIELD IN FRAME 3 IS DARK, THEREBY RULING OUT OFF-AXIS STRAYLIGHT. THE BRIGHT CENTRAL REGION CORRESPONDS TO THE SKY ITSELF BEING BRIGHT.

PHOTOGRAPHS SUCH AS THESE ARE AN IMPORTANT DIAGNOSTIC TOOL IN EVALUATING LIGHTING CONDITIONS AS SEEN FROM THE SIA'S PALLET-MOUNTED POSITION AND IN EVALUATING MEASUREMENTS WITH THE BORESIGHTED PHOTOPOLARIMETER.

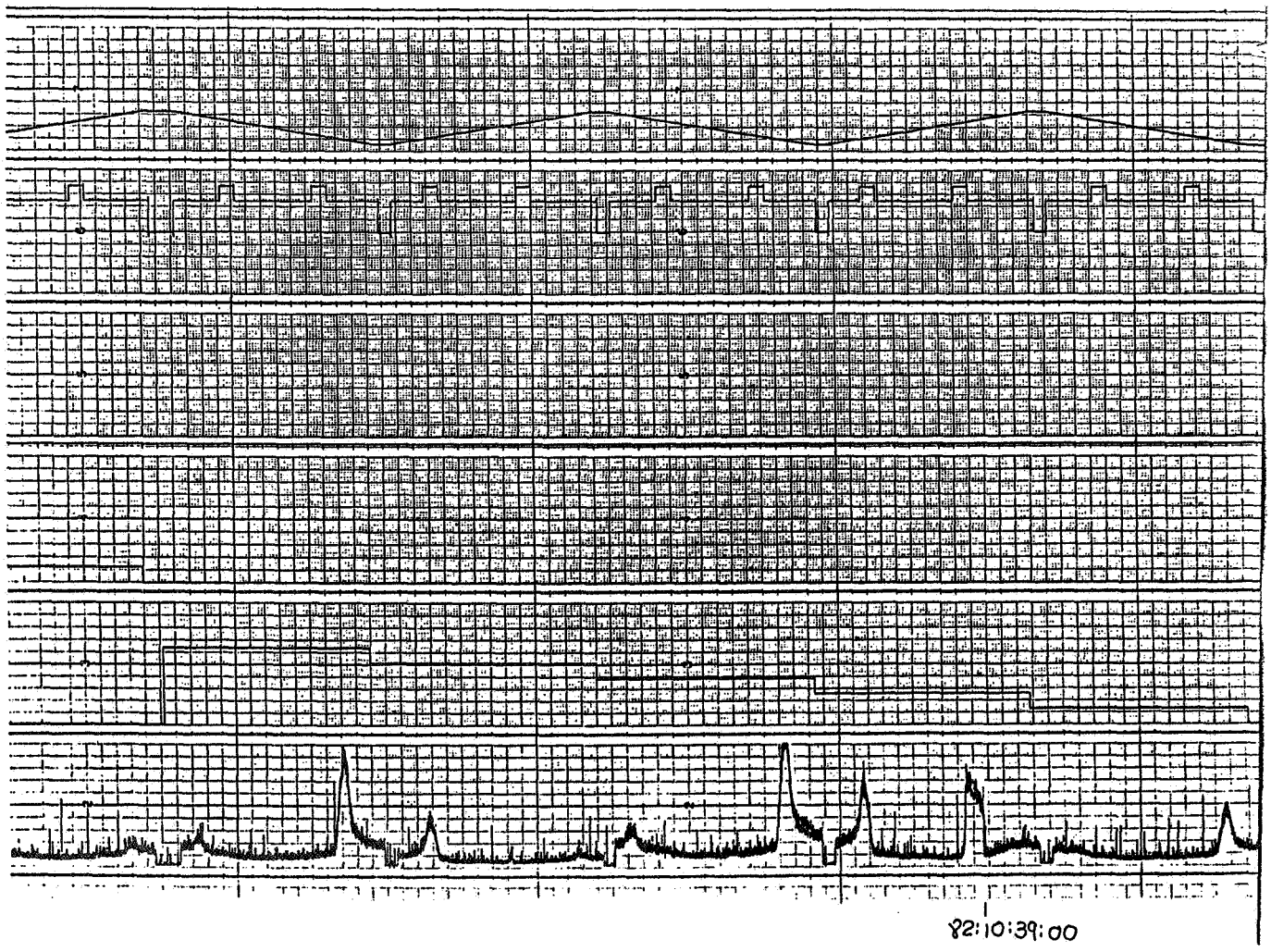
SIA PHOTOMETER PROTECTIVE SHUTTER OPEN/CLOSE (▮) HISTORY *

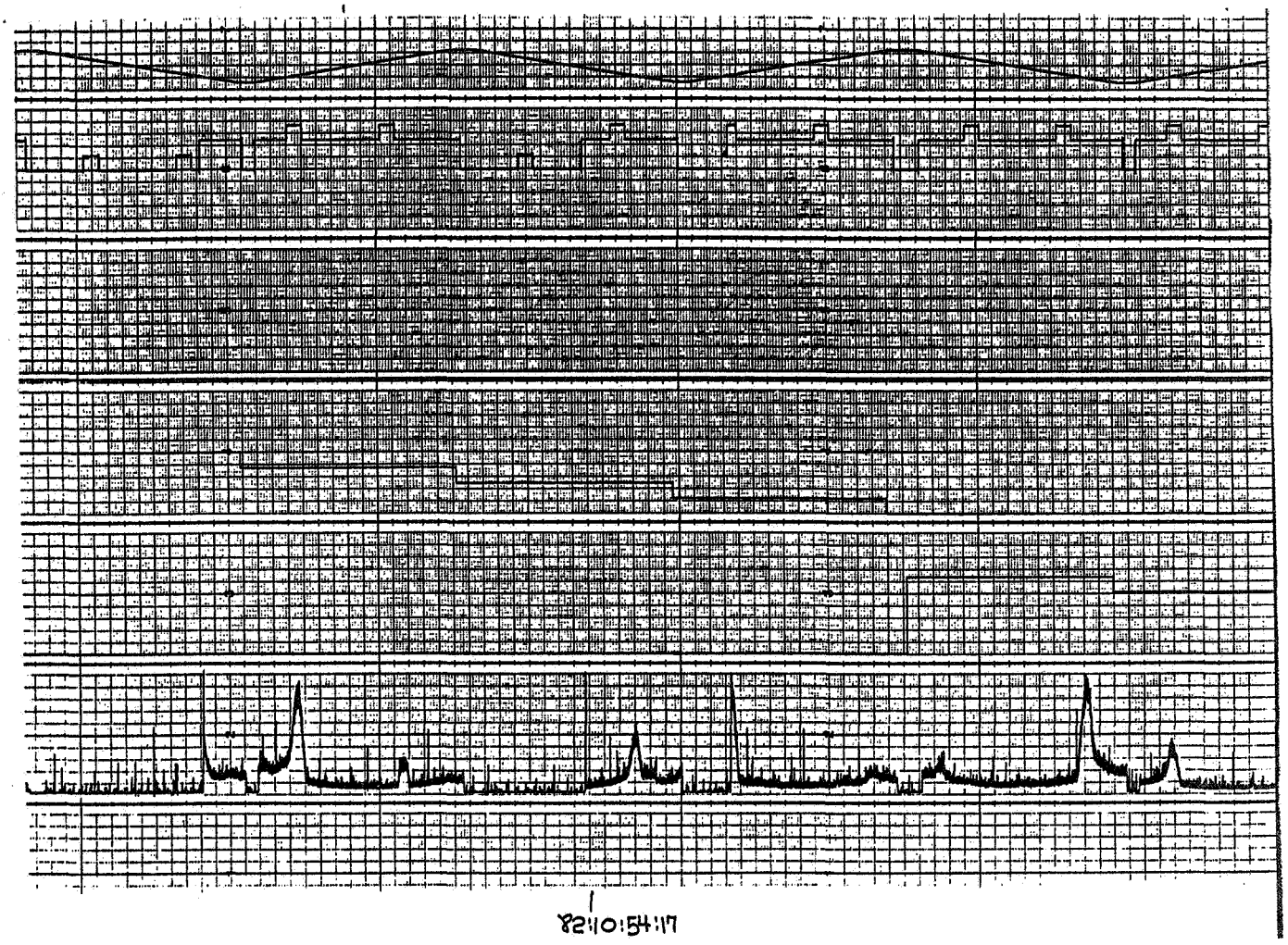
STS-3
TAIL-SUN

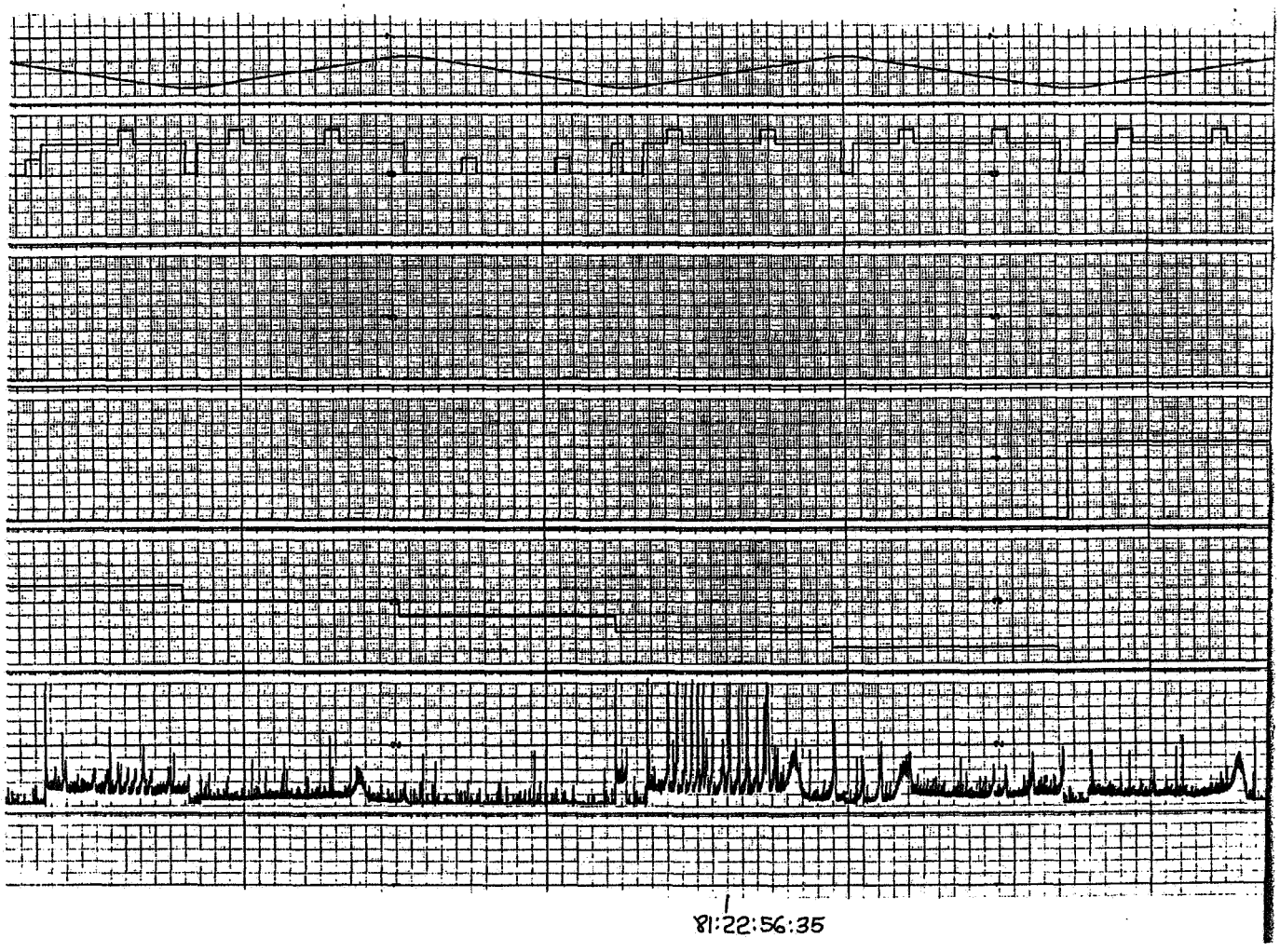


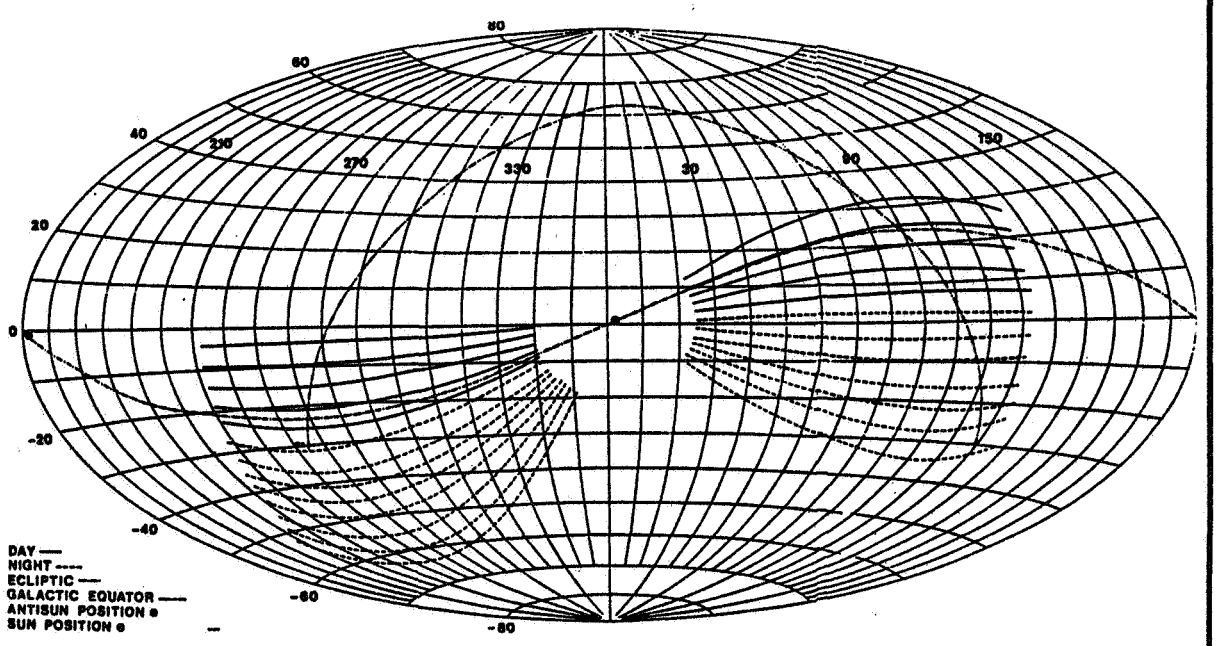
1 RUN 4 TAIL-SUN ATTITUDE FROM SCAN 87 TO SCAN 103
2 RUN 5 SWITCH TRACKS ON FLIGHT RECORDER
3 RUN 10 TLM LOSS
4 RUN 10 TLM LOSS, TRACK SWITCH
5 RUN 10 TLM LOSS
6 RUN 13 FLIGHT RECORDER TRACK SWITCH
7 RUN 31 START OF TAIL-SUN ATTITUDE
8 RUN 31 TAPE DROPOUT, NOT RECOVERABLE
9 RUN 31 END OF RUN

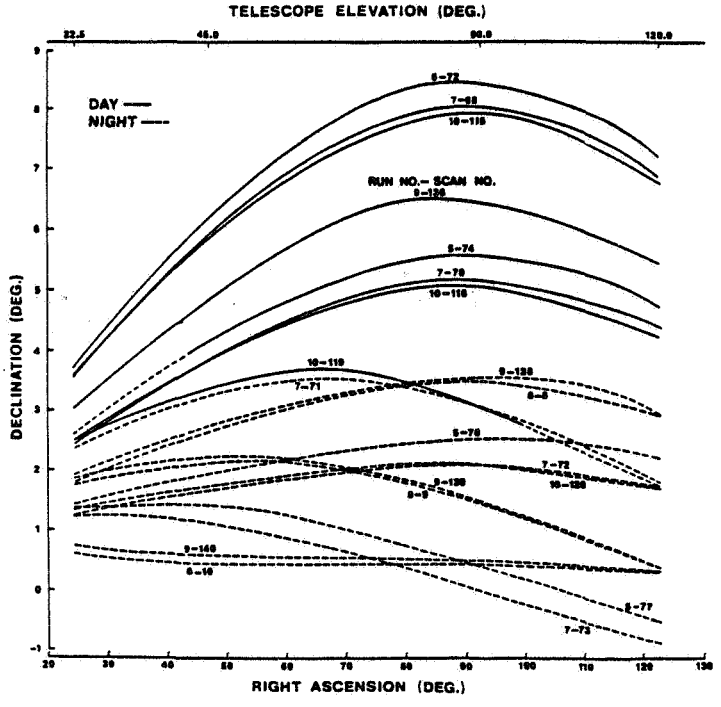
* THE TOP FIGURE SERVES AS A DAY/NIGHT INDICATOR FOR EACH OBSERVING RUN. THE LOWER FIGURE INDICATES FOR WHICH SCANS THE SHUTTER IS OPEN (▯ CLOSED FOR EVEN A FEW DEGREES (▯), OR SHUT DOWN ENTIRELY (▮).











SUMMARY OF FIRST RESULTS
SHUTTLE INDUCED ATMOSPHERE EXPERIMENT

OPTICAL ENVIRONMENT

TWO MAJOR SOURCES OF LIGHT WERE SEEN IN THE BAY DURING SPACECRAFT DAY:
1. DIRECT LIGHT FROM THE SUN AND FROM THE SUNLIT EARTH,
2. INDIRECT LIGHT FROM THESE SAME SOURCES (REFLECTED OFF PART(S) OF THE ORBITER AND ITS PAYLOAD).

TENTATIVE IDENTIFICATION HAS ALSO BEEN MADE OF BRIGHTNESS ARISING FROM SUNLIGHT REFLECTED OFF PARTICULATES ORIGINATING FROM THE ORBITER AND ITS PAYLOAD: I.E., SPACECRAFT CORONA OR INDUCED ATMOSPHERE.

SEVERAL SOURCES OF LIGHT WERE ALSO OBSERVED DURING SPACECRAFT NIGHT:
1. LARGE SCALE DIFFUSE GLOWS ASSOCIATED WITH VERNIER THRUSTER FIRINGS,
2. SURFACE GLOWS ON THE ORBITER IN THE DIRECTION OF ITS ORBITAL MOTION,
3. PERIODIC SKY BRIGHTNESS "STRUCTURES" -OBSERVED PRIMARILY AT 4200Å AND 6300Å - WHICH ARE NOT YET POSITIVELY IDENTIFIED.

PARTICULATE ENVIRONMENT

ON-BOARD TELEVISION IN A SPLIT-SCREEN "STEREOSCOPIC" FORMAT WAS USED IN AN ATTEMPT TO PROVIDE INFORMATION ON SIZES AND TRAJECTORIES OF INDIVIDUAL CONTAMINANT PARTICULATES. DUE TO POOR STATION CONTACT/TERMINATOR TIMING AND LACK OF CREW INVOLVEMENT, THE SELF-CONTROLLED TV MONITORS WERE OVER-POWERED BY LIGHT IN THE BAY AND ONLY A FEW PARTICLES COULD BE SEEN. SOME INFORMATION IS AVAILABLE ON THESE PARTICULATES FROM THE "STANDARD", SINGLE-FRAME TV FORMAT DATA; I.E., THE LARGE NUMBERS OF PARTICULATES SEEN DURING TAIL-SUN.

ASTRONOMICAL BACKGROUND

ASTRONOMICAL DATA WERE OBTAINED FROM MEASUREMENTS OVER LARGE REGIONS OF THE MILKY WAY AND ZODIACAL LIGHT, INCLUDING REGIONS TO WITHIN 35 DEG OF THE SUN AND POSSIBLY CLOSER.

OTHER

COORDINATED AND SOMETIMES SIMULTANEOUS OBSERVATIONS WERE SUCCESSFULLY MADE FROM MT. HALEAKALA , HAWAII AND FROM STS-3 TO PROVIDE UNIQUE INFORMATION ON ATMOSPHERIC SOURCES AND SINKS OF RADIATION.