

Apollo 8: Lunar Orbit

HONR 269i

To the Moon and Back: The Apollo Program

[Onboard Audio](#)

Apollo Mission Sequence

As Planned

- A Uncrewed Saturn V
- B Uncrewed LM
- C CSM Earth Orbit
- D CSM/LM Earth Orbit
- E CSM/LM higher Earth Orbit
- F CSM/LM Lunar Orbit
- G Lunar Landing

As Flown

- A Apollo 4, 6
- B Apollo 5
- C Apollo 7
- C' Apollo 8
- D Apollo 9
- F Apollo 10
- G Apollo 11

Apollo Crew Planning

Apollo 7 (C)

CDR: Schirra

CMP: Eisele

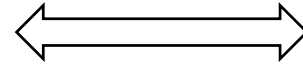
LMP: Cunningham

Apollo 8 (D)

CDR: McDivitt

CMP: Scott

LMP: Schweickart



Apollo 9 (E)

CDR: Borman

CMP: Collins

LMP: Anders

Apollo 10 (F)

CDR: Stafford

CMP: Young

LMP: Cernan

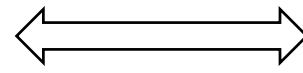
Apollo 11 (G)

CDR: Conrad

CMP: Gordon

LMP: Williams

↑
Bean



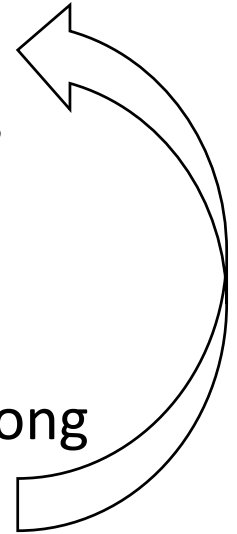
Apollo 12 (H)

CDR: Armstrong

↪ CMP: Lovell

↪ LMP: Aldrin

↑
Haise

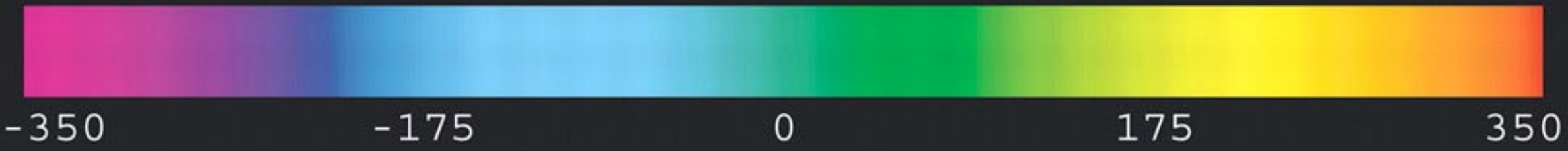
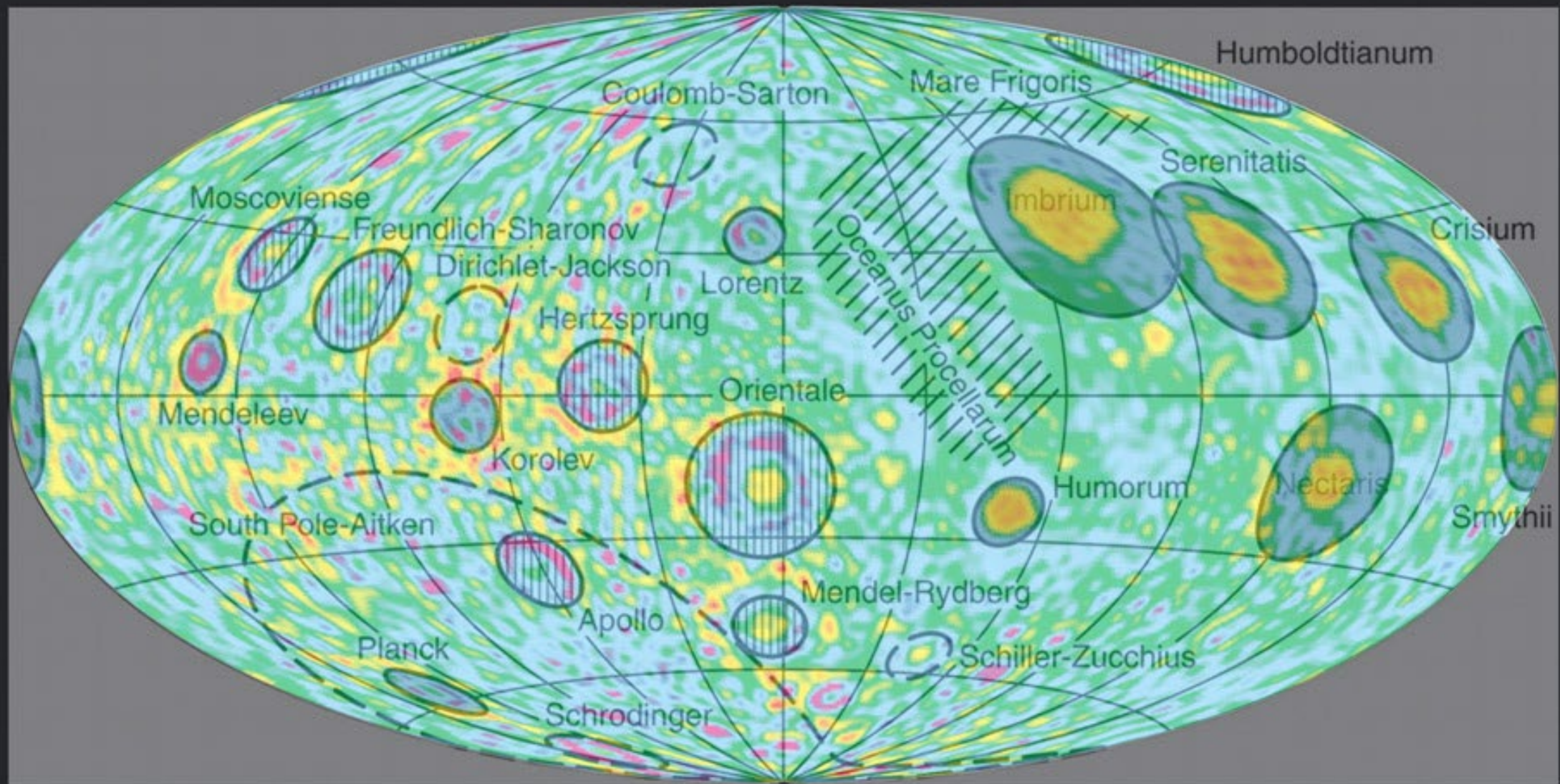


Astronaut Math in mid-1967

- 30 astronauts in first 3 (of 5) astronaut groups
 - The Original 7, The New 9, The 14
- 10 of 30 were no longer available
 - 2 grounded, 3 retired, 5 dead (2 in the Apollo 1 fire, 3 in airplane crashes)
- 18 of 20 needed to fill 6 crews
 - Cooper and Bean were not assigned
- 13 of 18 had flight experience
 - 6 of 9 Gemini commanders as CDR
 - 5 of 7 as CMP (4 with rendezvous experience)
 - 2 as LMP
- 5 rookies were therefore needed
 - 1 as CMP (Eisele), 4 as LMP

Arguments in Favor of a Lunar Orbit Mission

- Provide valuable operational experience ... This will enhance the probability of success of subsequent more complex lunar missions
- Provide an opportunity to evaluate ... MSFN and onboard navigation ...
- Permit validation of communications ... at lunar distance
- ... improve consumables requirements prediction ...
- ... verification of ground support elements and the onboard computer program
- Increase the depth of understanding of thermal conditions ...
- Confirm astronauts' ability to see, use and photograph lunar landmarks ...
- ... an opportunity for additional photographs ... for training crewmen ...



Arguments Against a Lunar Orbit Mission

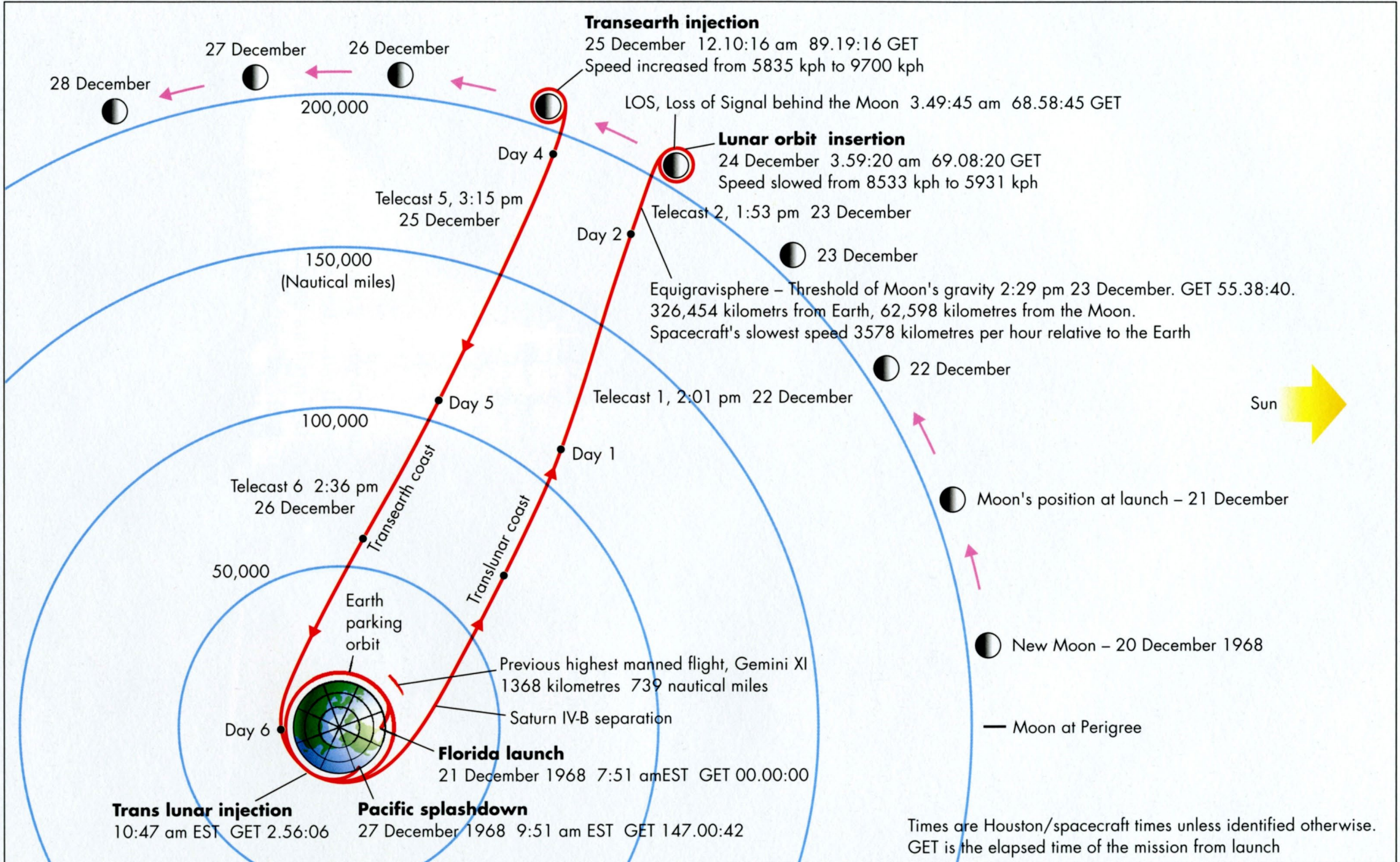
- Marginal design conditions in the Block II CSM may not have been uncovered with only one manned flight
- The life of the crew depends on the successful operation of the Service Propulsion System during the Transearth Injection maneuver
- The three days endurance level required of backup systems in the event of an abort is greater than from an Earth orbit mission
- Only landmark sightings and lunar navigation require a lunar mission ...

Missing Redundancy

- No “LM Lifeboat” for consumables or communication between TLI and TEI
- No option for LM DPS TEI in the event of an SPS failure during LOI

Primary Mission Objectives

- Demonstrate crew/space vehicle/mission support facilities performance during a manned Saturn V mission with CSM
- Demonstrate performance of nominal and selected backup Lunar Orbit Rendezvous (LOR) mission activities, including: Trans-Lunar Injection; CSM navigation, communications, and midcourse corrections; CSM consumables assessment, and passive thermal control



Transearth injection

25 December 12.10:16 am 89.19:16 GET
 Speed increased from 5835 kph to 9700 kph

Lunar orbit insertion

24 December 3.59:20 am 69.08:20 GET
 Speed slowed from 8533 kph to 5931 kph

Florida launch

21 December 1968 7:51 am EST GET 00.00:00

Trans lunar injection

10:47 am EST GET 2.56:06

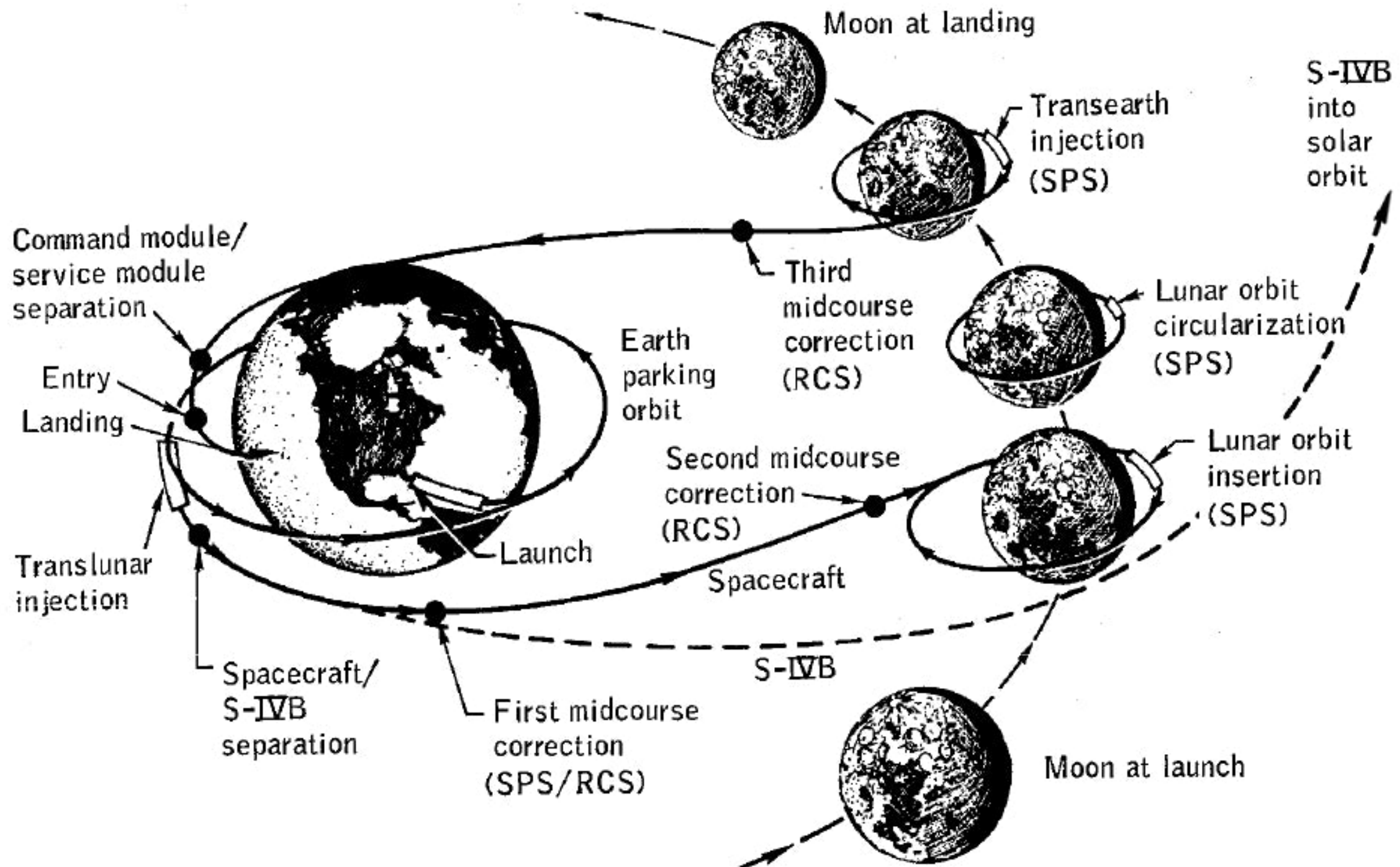
Pacific splashdown

27 December 1968 9:51 am EST GET 147.00:42

LOS, Loss of Signal behind the Moon 3.49:45 am 68.58:45 GET

Equigravispere – Threshold of Moon's gravity 2:29 pm 23 December. GET 55.38:40.
 326,454 kilometres from Earth, 62,598 kilometres from the Moon.
 Spacecraft's slowest speed 3578 kilometres per hour relative to the Earth

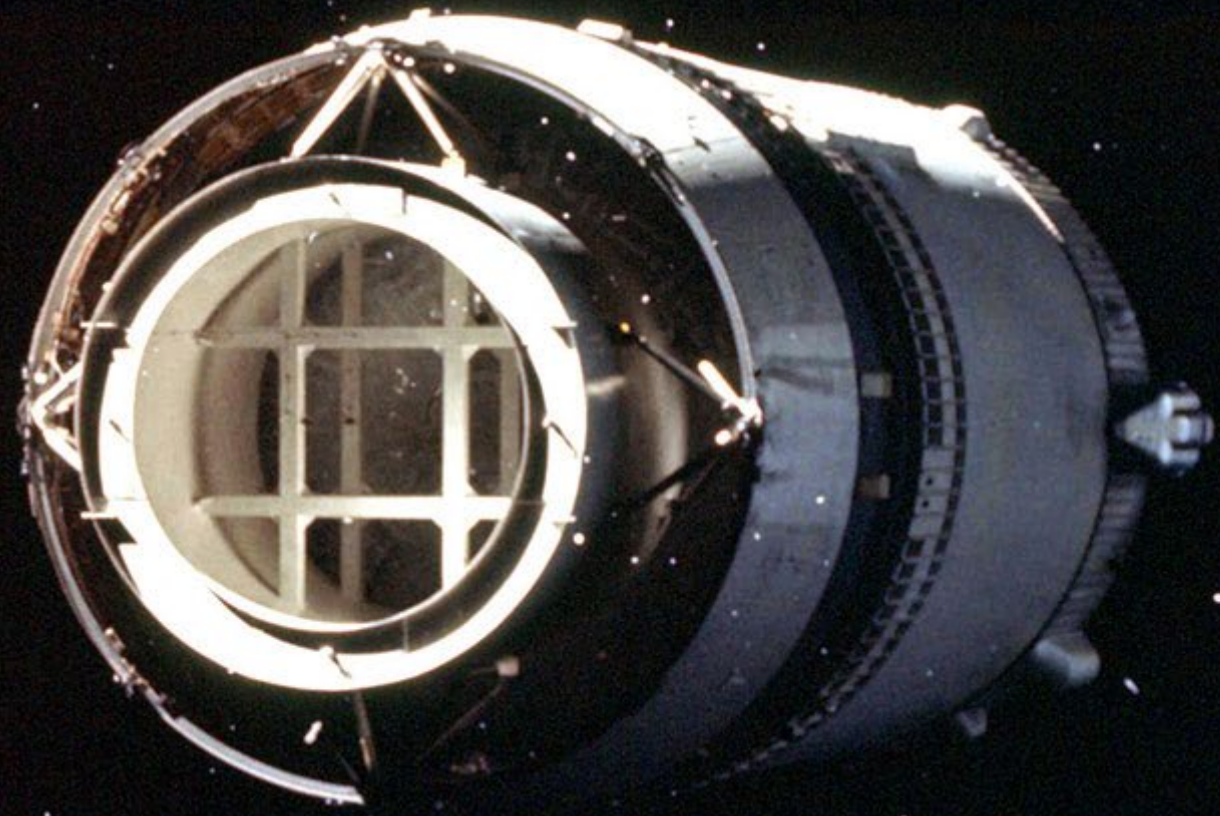
Times are Houston/spacecraft times unless identified otherwise.
 GET is the elapsed time of the mission from launch







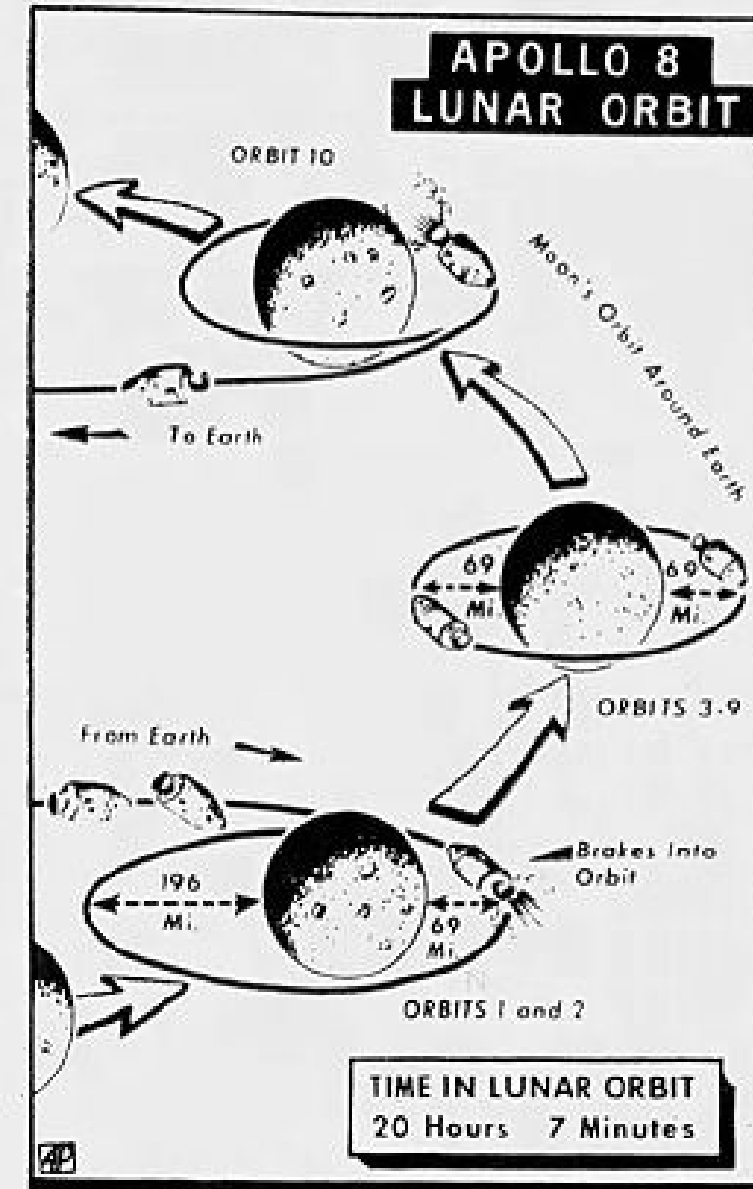
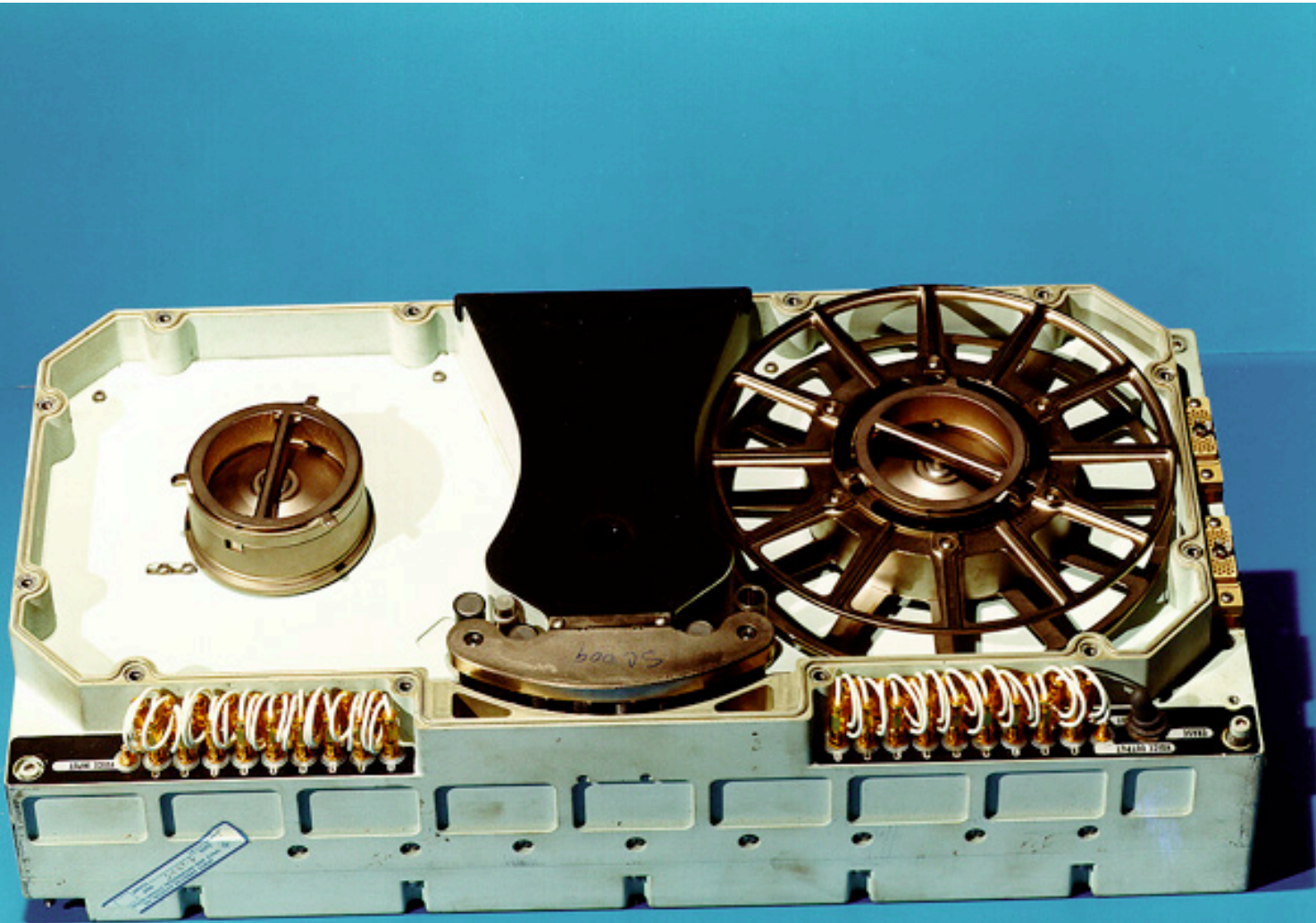








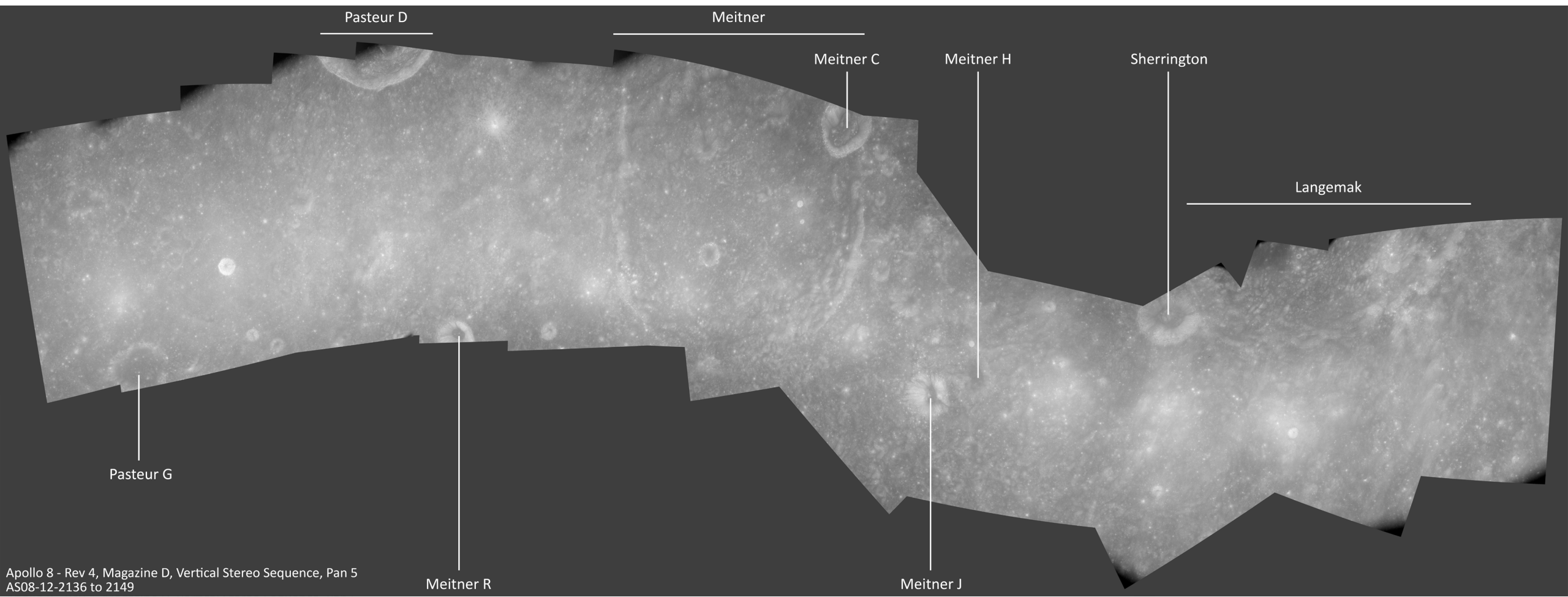
Lunar Orbit Insertion



Spacecraft's Orbit

This artist's conception diagrams the lunar orbital phase of the Apollo 8 mission. Drawings show the capsule entering orbit, bottom, circling the moon, and breaking from lunar orbit and heading back to earth. (AP Wirephoto)





Pasteur D

Meitner

Meitner C

Meitner H

Sherrington

Langemak

Pasteur G

Meitner R

Meitner J

Apollo 8 - Rev 4, Magazine D, Vertical Stereo Sequence, Pan 5
AS08-12-2136 to 2149

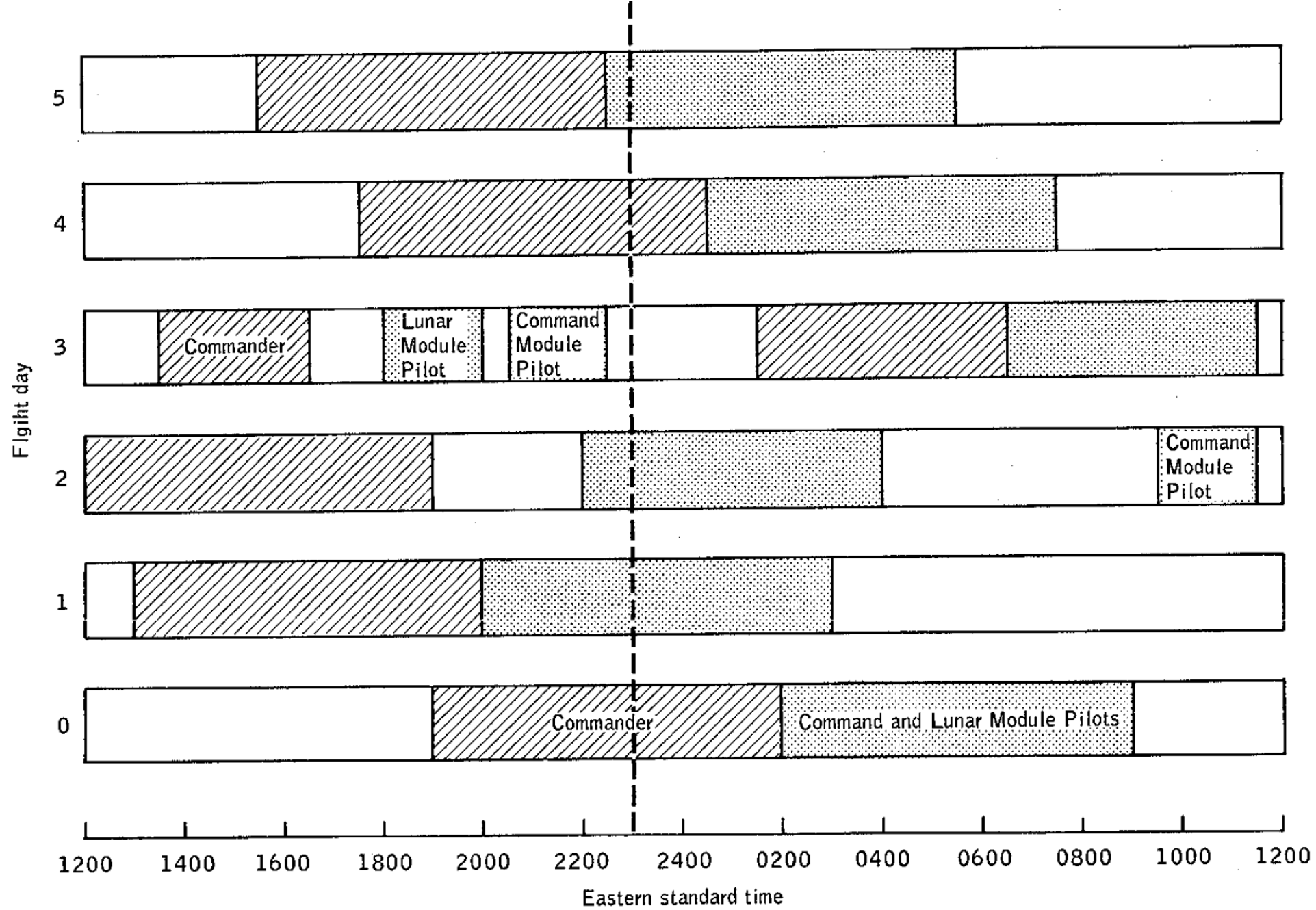


Figure 8-2.- Crew rest cycles.

MANEUVER PAD

✓	TEI	10	PURPOSE
✓	SPS	68N	PROP/GUID
✓	+ 455	97	WT N47
✓	- 00	040	P _{TRIM} N48
✓	+ 00	157	Y _{TRIM}
✓	+ 00	089	HRS GETI
✓	+ 00	019	MIN N33
✓	+ 0	1567	SEC
✓	+ 351	86	ΔV _X N81
✓	- 015	12	ΔV _Y
✓	- 005	20	ΔV _Z
✓	X X X	180	R
✓	X X X	007	P
✓	X X X	000	Y
✓	+ NA		H _A N44
✓	+ 001	86	H _P
✓	+ 352	23	ΔVT
✓	X X X	3:18	BT
✓	X	35018	ΔVC
✓	X X X X	42	SXTS
✓	+ 092	40	SFT
✓	+ 253	00	TRN
✓	X X X	SCORPIA DELTA	BSS
✓	X X	D069	SPA
✓	X X X	L45	SXP
✓	+ 007	48	LAT N61
✓	- 165	00	LONG
✓	+ 129	94	RTGO EMS
✓	+ 363	00	V10
✓	14650	05	GET .05G

COMMENTS: Primary SIRIUS
Secondary RIGEL ✓

GDC ALIGN SET STARS

R ALIGN 1 2 9 ✓

P ALIGN 1 5 5 ✓

Y ALIGN 0 1 0 ✓

ULLAGE 4 QUADS 15 SEC ✓

HORIZON/WINDOW Horizon

on 3.2° window line ✓ at Tig-3min

OTHER USE High ✓

Speed Procedure with -mo

87 017 12

Purpose: The PAD is intended for the burn that will return the Apollo 8 crew to Earth at the end of Rev 10.

Systems: The burn will be made using the SPS engine, under the control of the Guidance and Navigation system.

CSM Weight (Noun 47): 45,597 pounds.

Pitch and yaw trim (Noun 48): -0.40° and +1.57°.

Time of ignition (Noun 33): 89 hours, 19 minutes, 15.67 seconds.

Change in velocity (Noun 81), fps: x, +3,518.6; y, -151.2; z, -52.0.

Spacecraft attitude: Roll, 180°; Pitch, 7°; Yaw, 0°. **Expected apogee of resulting orbit (Noun 44):** Not applicable.

Expected perigee of resulting orbit (Noun 44): 18.6 nautical miles (34.4 km).

Delta-V_T: 3,522.3 fps (1,073.6 m/s).

Burn duration or burn time: 3 minutes, 18 seconds.

Delta-V_C: 3,501.8 fps.

Sextant star: Star 42 (Peacock, or Alpha Pavonis)

Boresight star: Dschubba, or Delta Scorpii.

COAS Pitch Angle: Down 6.9°.

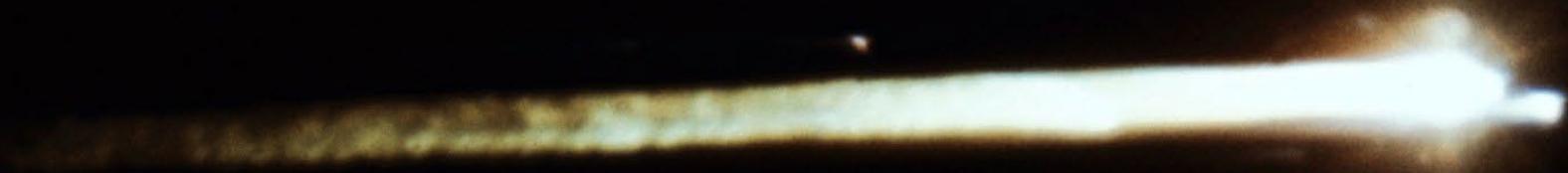
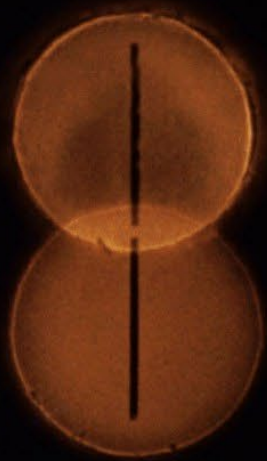
COAS X Position Angle: Left 4.5°.

Expected splashdown point (Noun 61): 7.48° north, 165° west

Range to go at the 0.05 g event: 1,299.4 nautical miles.

Expected velocity at the 0.05 g event: 36,300 fps.

Predicted GET of 0.05 g event: 146 hours, 50 minutes and 5 seconds GET.



Anomalies

1. Preflight: Contamination of spacecraft LOX
2. Launch: S1C camera malfunction
3. Launch: Intermittent operation of S-II power supplies
4. Launch: SII engine oscillations
5. Translunar: Drop in chamber pressure during first SPS burn
6. Throughout: Hatch and side windows obscured
7. Throughout: Obscuration of telescope field of view
8. Throughout: Abnormal shifts in computer readout of optics trunnion angle
9. Throughout: Noisy cabin fans
10. Throughout: Inoperative personal radiation dosimeter
11. Transearth: Erratic potable water quantity measurement
12. Reentry: Entry monitor system malfunctions
13. Landing: Seawater inflow through cabin pressure relief valve
14. Recovery: Inoperative swimmer's interphone
15. Recovery: Failure of CM recovery loop

Discussion Groups

- Kluger Chapter 7
 - How the lunar orbit decision was made
- Chaikin Chapter 3 (“First Around the Moon”)
 - Apollo 8 from the Astronaut’s perspective
- Woods Chapter 15 (“Re-entry”)
 - Reentry into the Earth’s atmosphere from a lunar trajectory
- From the Earth to the Moon video episode 4 (“1968”)
 - An interleaved telling of the story of 1968’s social unrest and Apollo 8