DSES OMOTENASHI CUBE SAT MISSION AND TRANSMISSION ACQUISITION

By Bill Miller, Ray Uberecken, & Gary Agranat of the Deep Space Exploration Society

OMOTENASHI CUBESAT DESCRIPTION

(OUTSTANDING MOON EXPLORATION TECHNOLOGIES DEMONSTRATED BY NANO SEMI-HARD IMPACTOR) Mission is a JAXA (Japan Aerospace Exploration Agency) and the University of Tokyo technology demonstration mission.

The OMOTENASHI spacecraft is a 6U CubeSat that will make a semi-hard survivable landing on the moon with the primary objective of testing the technologies and trajectory maneuvers that allow for such a landing. It will also be measuring the radiation environment beyond low-earth orbit. OMOTENASHI is scheduled to launch on the Artemis 1 mission as a ride-on secondary satellite on the space launch system (SLS) block 1 in 2022.

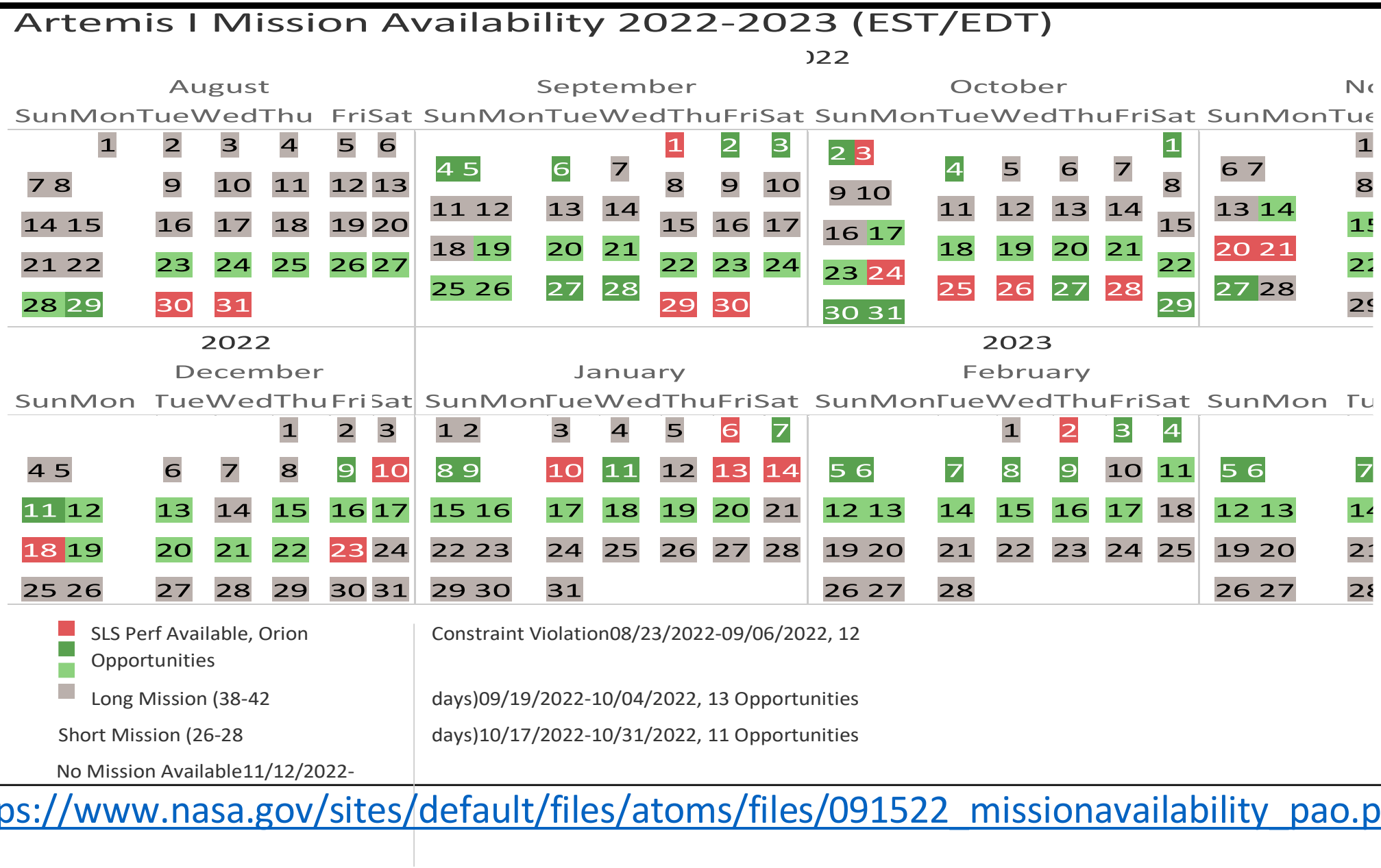
NASA's Artemis 1 The Space Launch System

NASA's Artemis 1 The Space Launch System moon rocket is 'on track' to roll out to pad Friday (Nov. 4) ahead of a planned Nov. 14 launch.

Artemis 1 will be the first test flight of the agency's new Space Launch System megarocket and the Orion crew capsule. The SLS rocket will launch the uncrewed Orion spacecraft on an approximately 42-day mission, during which it will orbit the moon before returning to Earth.

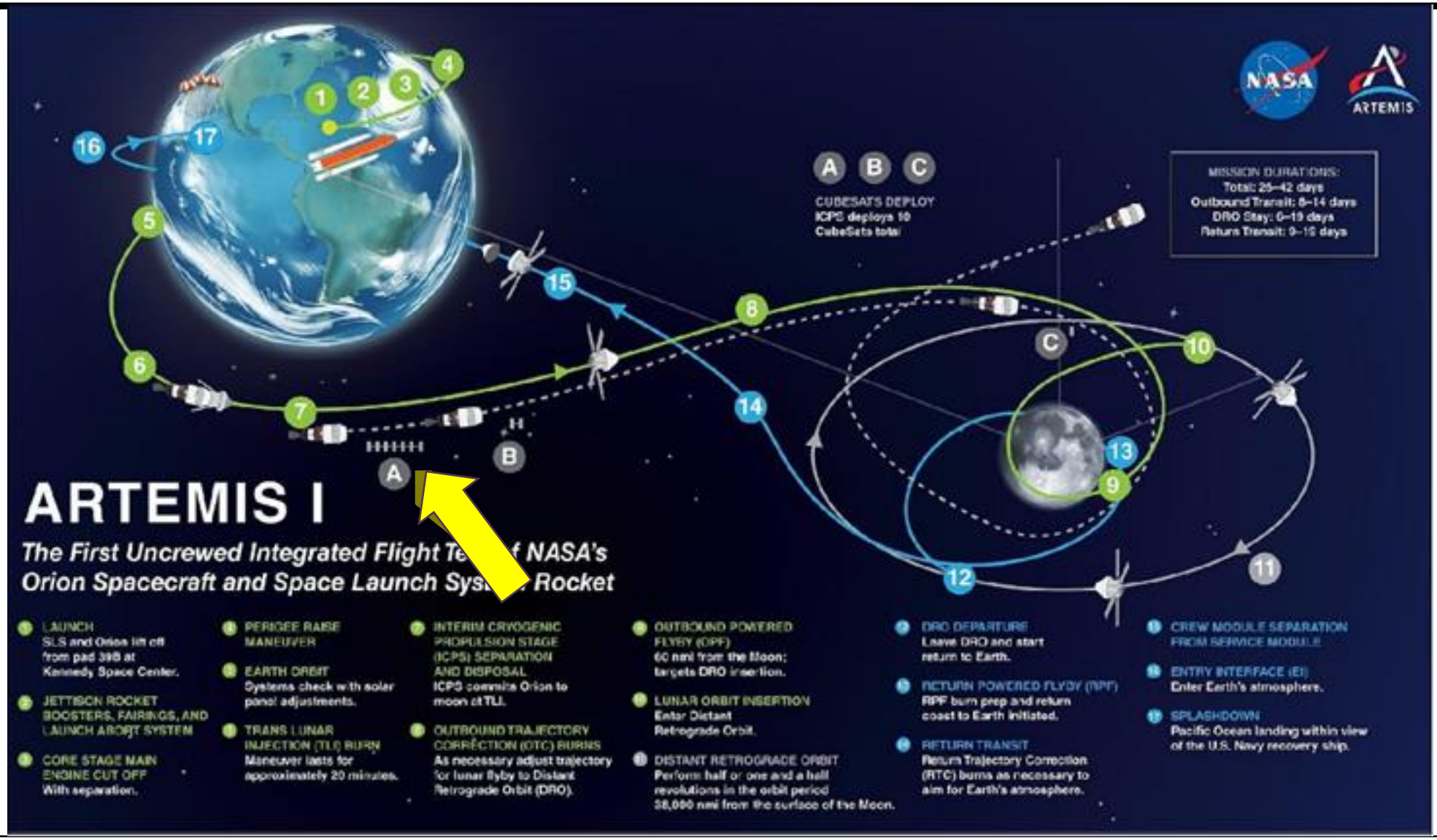
Artemis 1 will also carry 10 CubeSats, one of which is the Omotenashi Spacecraft. The DSES plans to receive and record the 437MHz telemetry downlinks from the CubeSat and send them to the amateur radio enthusiasts working on the program

While Scheduled for Nov. 14th there are alternate windows of launch opportunity

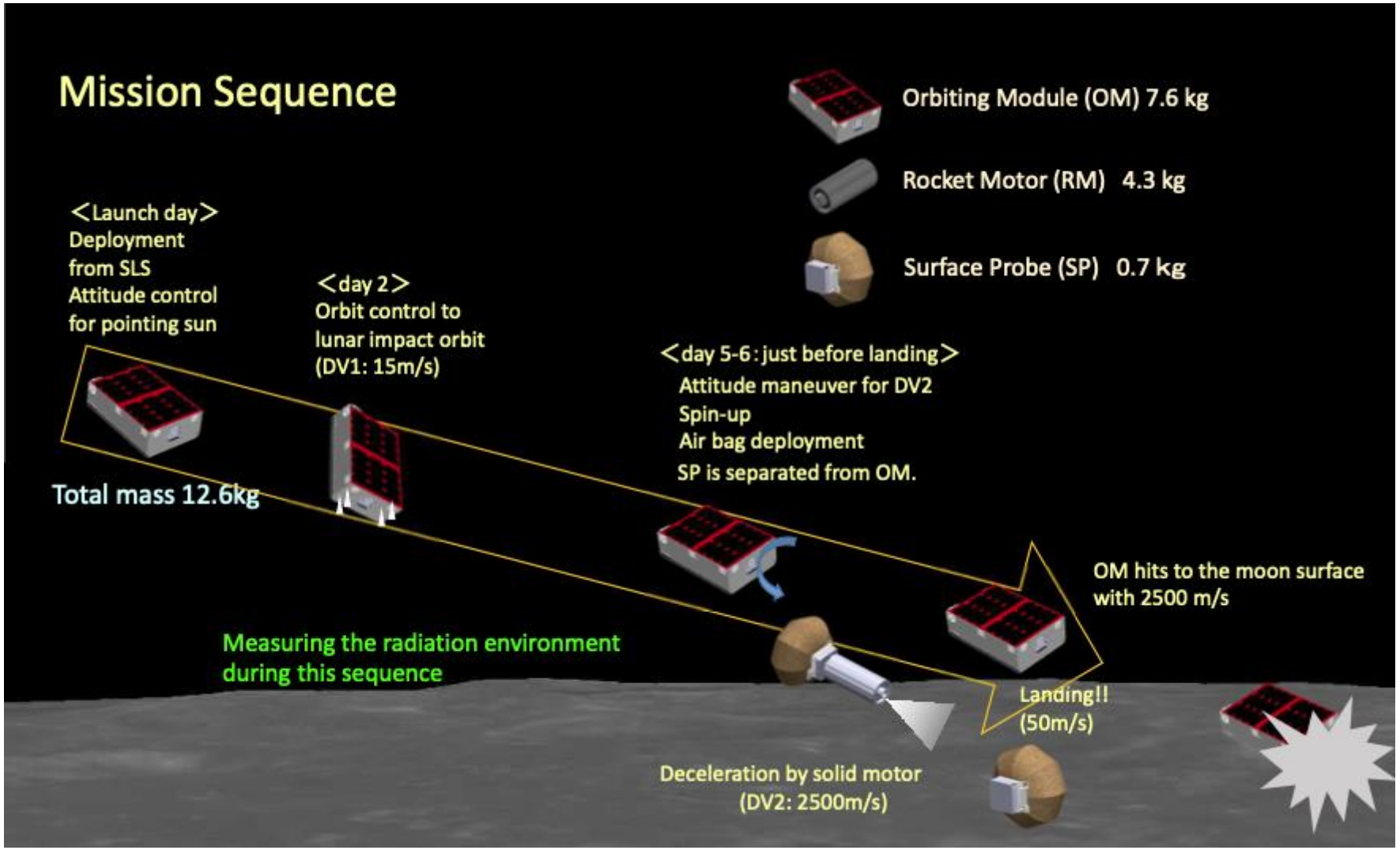


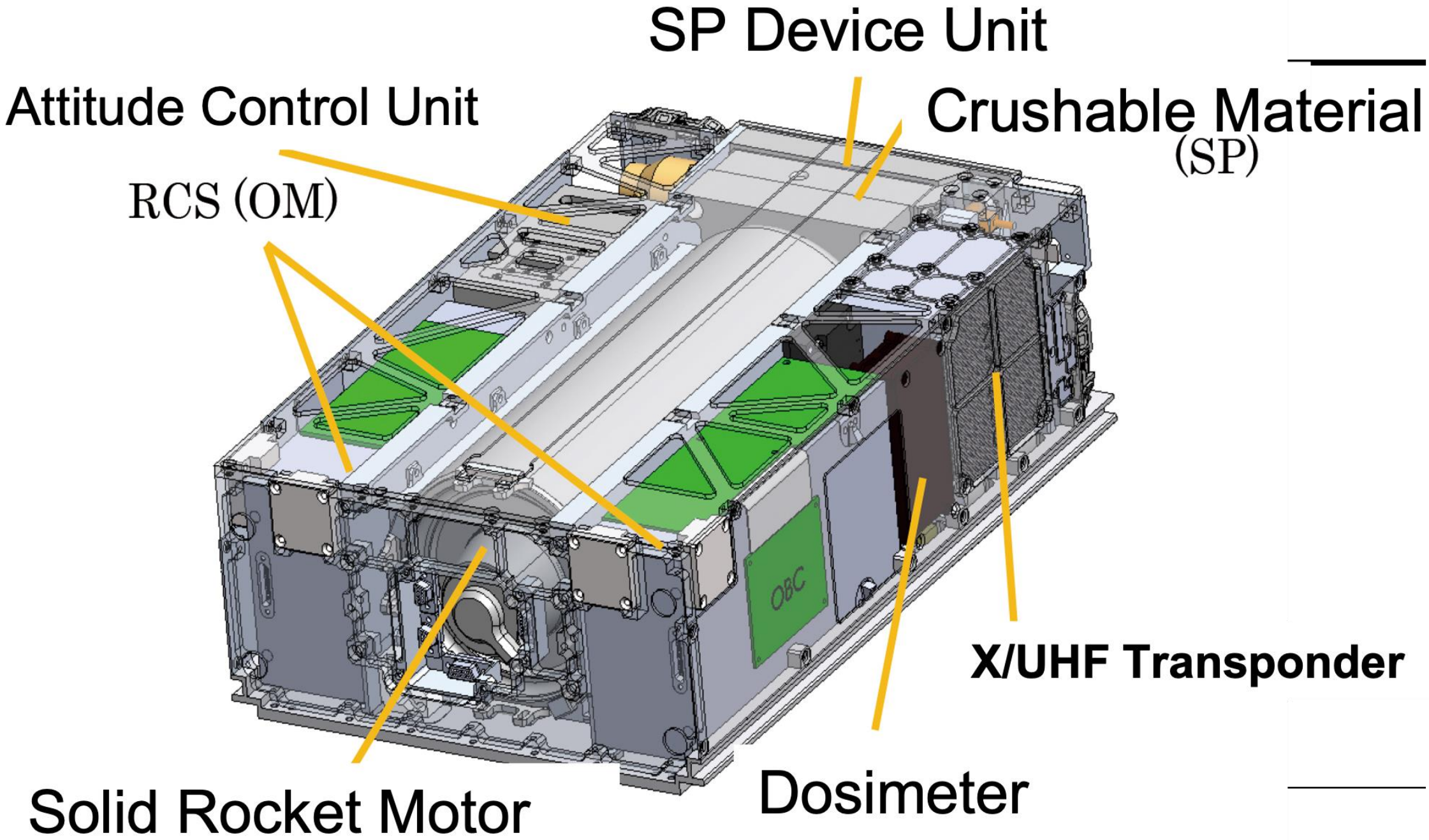
https://www.nasa.gov/sites/default/files/atoms/files/091522_missionavailability_pao.pdf

FROM LAUNCH TO AN EARTH PARKING ORBIT TO A TRANSFER ORBIT TO THE MOON IN THE TRANS LUNAR INJECTION PROFILE. OMOTENASHI WILL SEPARATE FROM ORION AND COAST TO THE MOON



From lunar orbit the CubeSat will separate and send the Surface Probe to impact




SP Device Unit
Attitude Control Unit
Crushable Material
(SP)
RCS (OM)
OBC
X/UHF Transponder
Solid Rocket Motor
Dosimeter

Example of Omotenashi Trans-Lunar UHF Schedule from the August 29th Artemis 1 Launce Attempt

OMOTENASHI UHF Operation Plans and SOE (LEOP/Time-Oriented)

UTC		JST	S+ hh:mm:ss	Event
29th August	12:00	21:00		
	12:15	21:15		
	12:30	21:30	-4:00:00	launch (2022/8/29 12:33-14:33 UTC)
	~	~	~	~
	16:15	1:15		【Day1 first AOS】Visible from DSN Station
	16:30	1:30	0:00:00	separated from SLS (2022/8/29 16:27-18:19 UTC)
	16:45	1:45		Initial check out (except UHF)
~	~	~	~	~
30th August	3:15	12:15		【Day1-2】JAXA station
	3:30	12:30	11:00:00	Visible from JAXA Ground Station
	3:45	12:45		
	~	~	~	~
	11:15	20:15		
	11:30	20:30	19:00:00	checkout UHF
	11:45	20:45		UHF D/Transmit 3 min interval）
	12:00	21:00		UHF D/L end
	12:15	21:15		End of visible from JAXA Ground Station
				Invisible from stations
	12:20	21:20		UHF D/Transmit 10 min interval）
	14:25	23:25		UHF D/L end
~	~	~	~	~

OMOTENASHI UHF Operation Plans and SOE (LEOP/Time-Oriented)

2th September	10:15	19:15		【Day4-2】JAXA station
	10:30	19:30	90:00:00	UHF D/L（3 min interval）
	11:30	20:20		UHF D/L end
	~	~	~	~
	16:15	1:15		【Day4-3】DSN Madrid station
	16:30	1:30	96:00:00	UHF D/L（3 min interval）
	17:30	2:30		UHF D/L end
~	~	~	~	~
3th September	1:15	10:15		【Day5-1】DSN Goldstone station
	3:00	12:00		UHF D/L（3 min interval）
	3:15	12:15		UHF D/L end
~	~	~	~	~
4th September	0:45	9:45		【Day5-3】DSN Goldstone station
	1:00	10:00		
	1:15	10:15		start auto-sequence
	1:30	10:30	129:00:00	
	1:45	10:45		
	2:00	11:00		
	2:15	11:15		
	2:30	11:30	130:00:00	
	2:45	11:45		
	3:00	12:00		turn on SP's UHF transmitter for one minute
	3:15	12:15		
	3:30	12:30	131:00:00	firing Solid Rocket Motor, land on the Moon
	3:45	12:45		Estimated landing time is 2022/9/4 3:15-3:56 UTC
	4:00	13:00		
	4:15	13:15		
	4:30	13:30	132:00:00	

OM UHF D/L
SP UHF D/L

TELEMETRY DOWNLINK FROM THE SPACECRAFT

Surface Probe

- **Frequency**
  - 437.41MHz
- **Antenna**
  - invert-F antennax4
- **Polarization**
  - LHCP(, RHCP)
- **Modulation**
  - FM, PSK31, PCM-PSK/PM
- **Sync Word**
  - C1 (ASCII code)
- **Power**
  - 30dBm

Orbiter

- **Frequency**
  - 437.31MHz
- **Antenna**
  - SRR antenna
- **Polarization**
  - Linear
- **Modulation**
  - beacon, PSK31
- **Sync Word**
  - C1 (ASCII code)
- **Power**
  - 30dBm

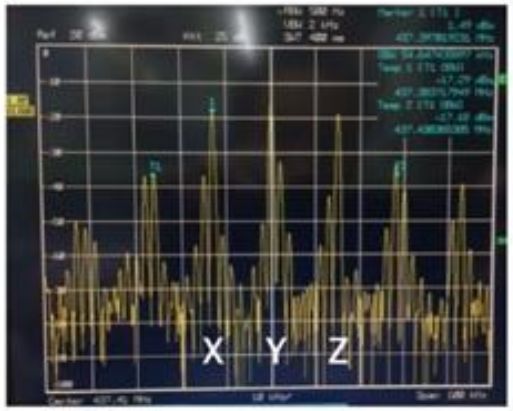
Here is the 437.410 MHz signal we expect to receive from the Surface Probe on Landing.

Sent - Mail - mountain_son@co

connect.xfinity.com/appsuite/#!!&app=io.ox/mail&folder=default0//qjxl3Xlov

Google Visio DSES Sign in to Xfinity TV Go Channels - X... CloseLog In Stocks - Bloomberg Fallacies in Logic Portable Classroom... Other bookmarks

Omotenashi MOdulation Technique.pdf

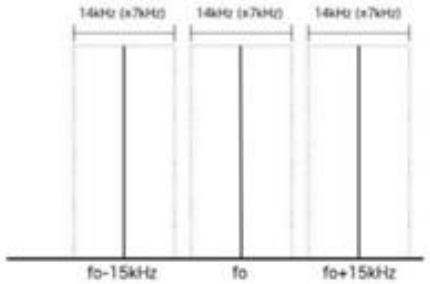


3 axis accelerometer
bandwidth：5~60kHz
Max shock：10,000G

X-axis
Y-axis
Z-axis
through LPF
UHF TRP

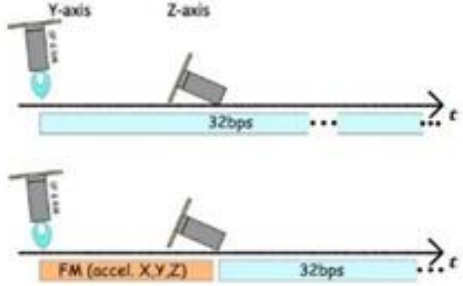
After SP is separated from OM, it run this mode about a few minutes.

Three carrier move independently between ±14kHz



As SP runs with a small primary battery, its total running time is limited.
Digital transfer mode takes long time to D/L the all data of observed data,
and there is possibility that its battery runs out before transmission ends .

FM mode can D/L the all accelerations at the moment they're observed.



Synthesized 437.410 signal in with +/- 1500Hz steps and 3kHz audio received on an SDRPlay1