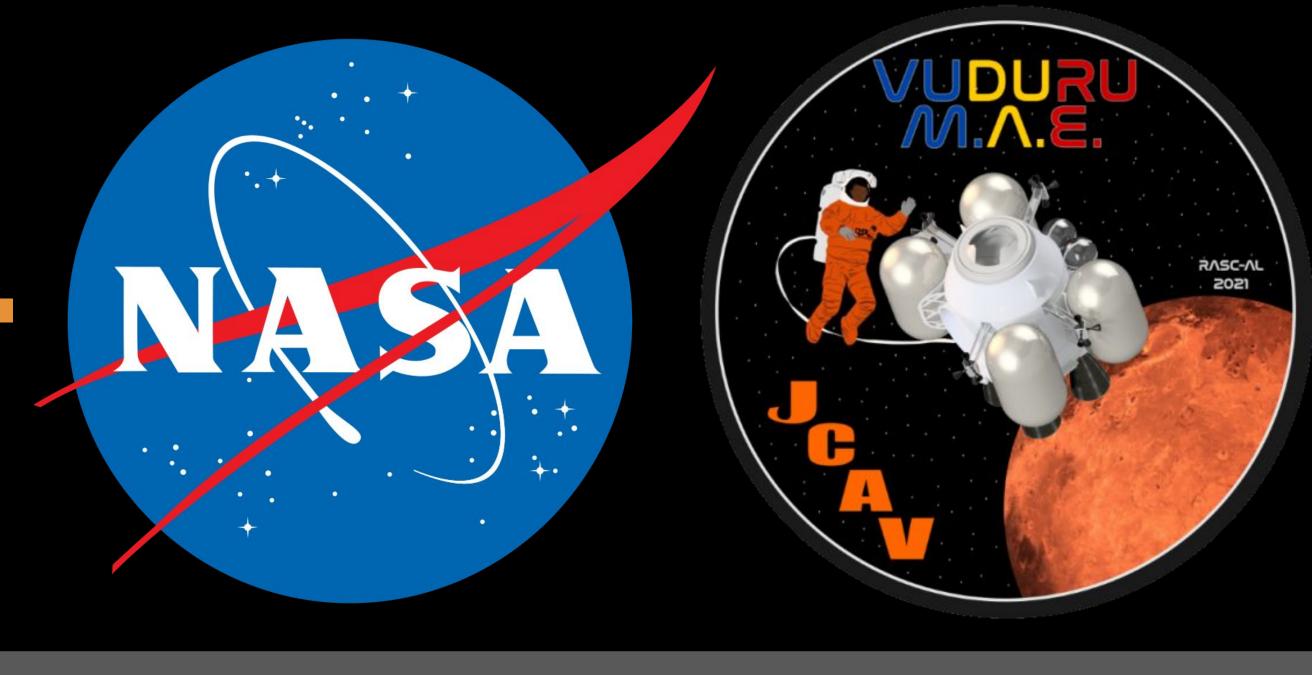


VUDURU M.A.E Jemison Crewed Ascent Vehicle (JCAV)

Villanova University, Drexel University & Rutger



Human Factors

Basic crew information:

- Selected suit is IVA (Intra-Vehicular Activity)
- Two recumbent seats inside the cabin

Crew Provisions:

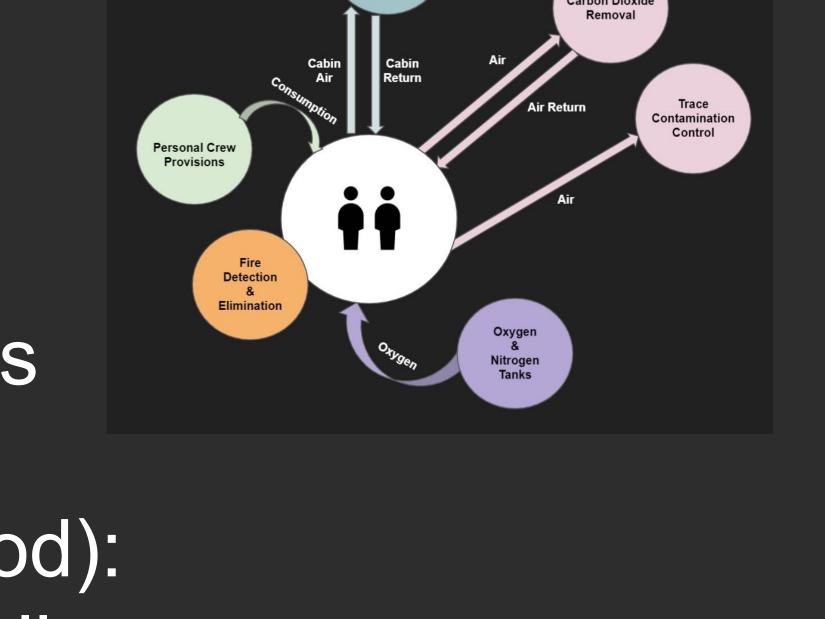
- Maximum Absorbency Garment (MAG) worn under IVA
- Crew provided with food, water, first aid, and hygiene kits

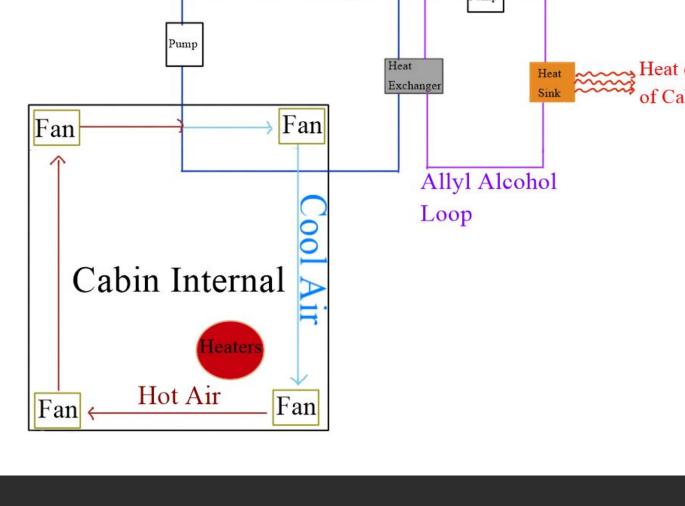
Thermal / Temperature Control (Active and Passive Method):

- Active heating via heat patches attached to the cabin wall
- Passive heating via Multi Layered Insulation for insulation and radiation control

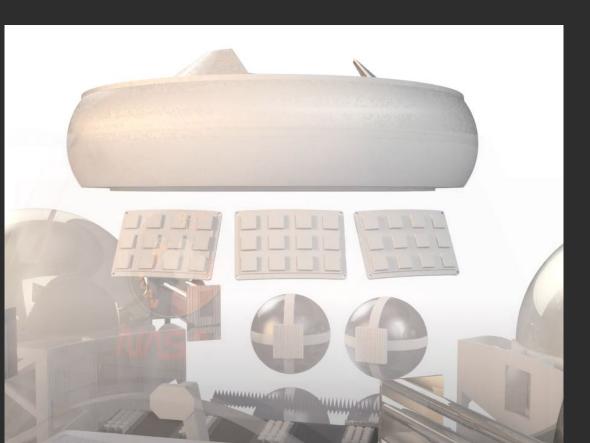
Heat Rejection:

- Heat transfer via a series of tubes in the cabin wall that use alcohol & water
- Fans circulating the cabin air provide temperature stabilizaton





Launch & Orbital Comms

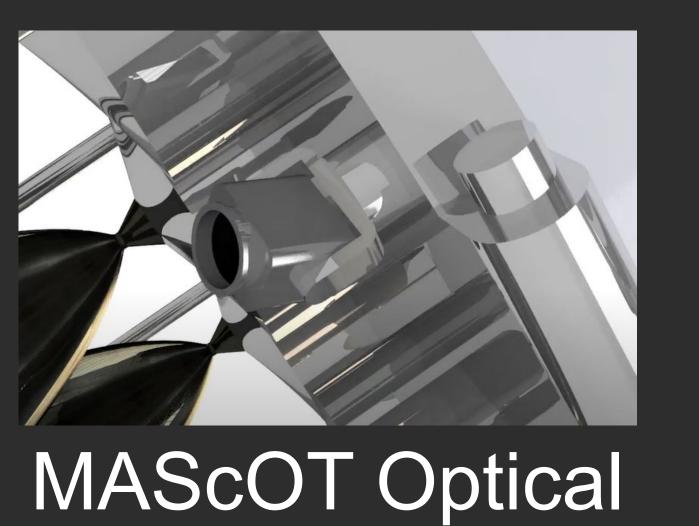


Conformal

S-Band PAA

from

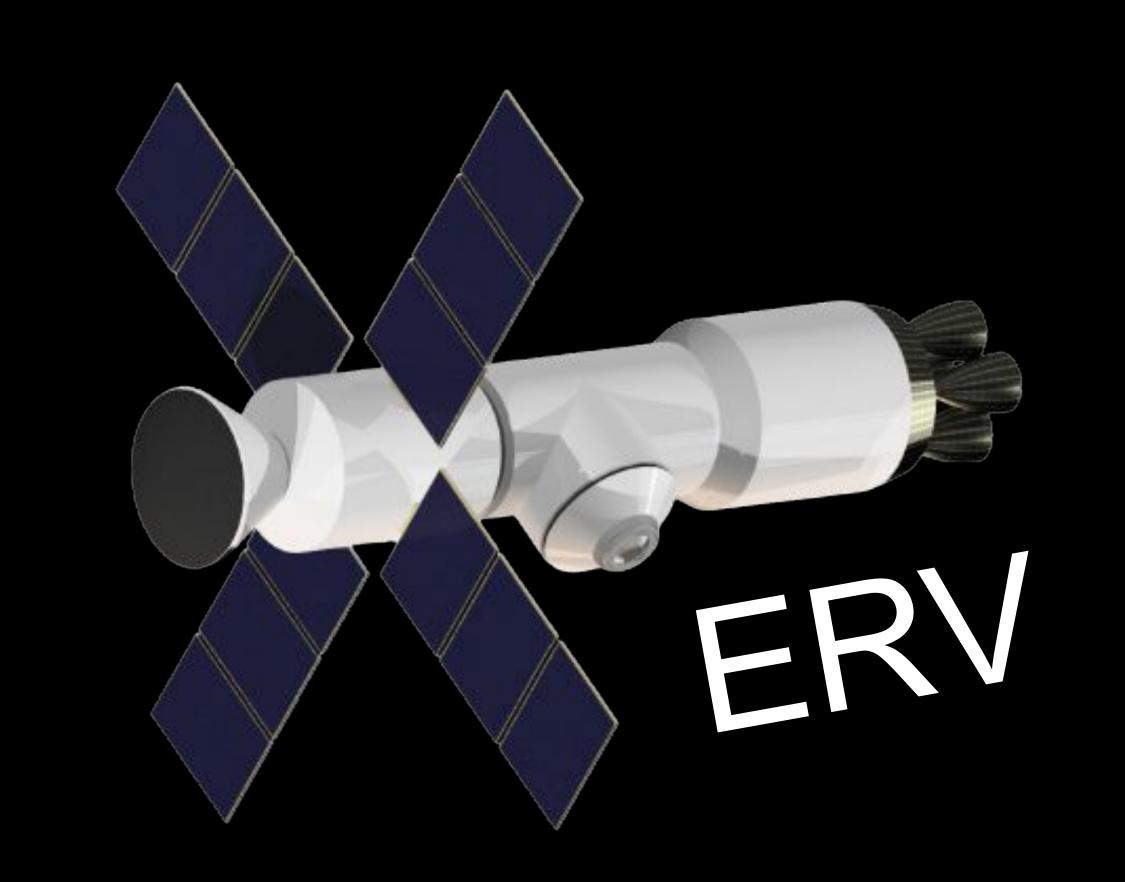
to &



Comms

optical relay with future orbiter or direct to DSN





Orbital Considerations

Launch:

- Orbital Inclination: 18.154°
- Launch Azimuth: 90°
- Launch Time: When ERV at True Anomaly at 14.1°
- Ascent Delta V: 3754.1 m/s

125 km to 125km x 200km Orbit:

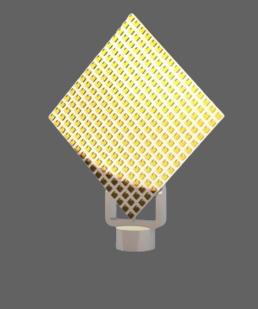
Delta V: 19.2 m/s

125 x 200 km to 200 km orbit:

Delta V: 18.3 m/s

Total Time From Launch to Entering ERV: 5.5 - 9.5 hours Minimum Total Delta V used: 3791.94 m/s

Surface Comms



KA Band HGA

- TX @ 405 MHz to
- from MRO



MRO (uplink) RX from DSN • RX @ 450 MHz X capability)



- RX @ 450 MHz from MRO (downlink)

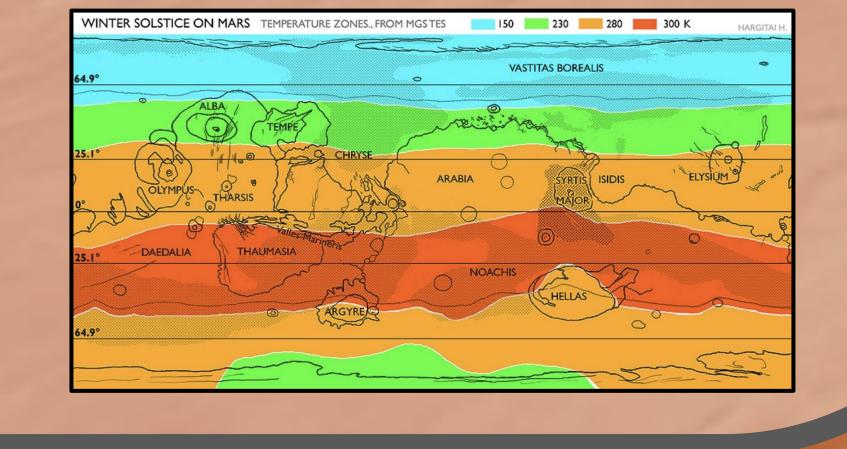
WHE

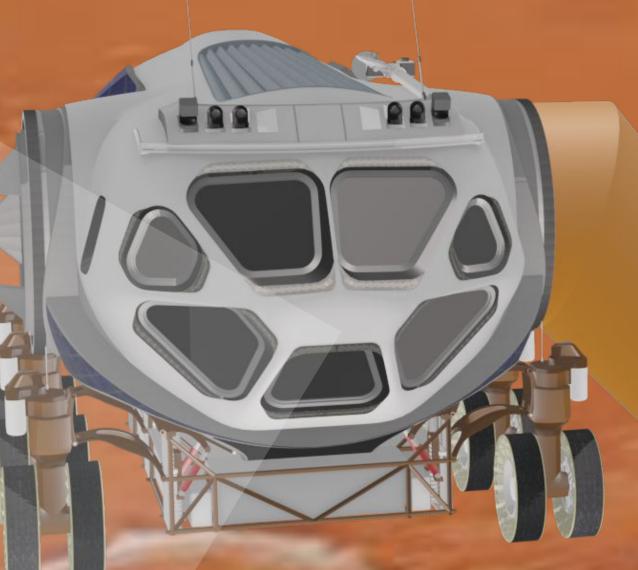
- TX @ 405 MHz to MRO

Surface Operations

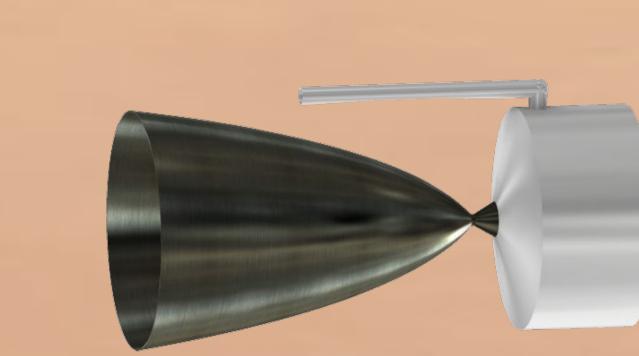
- 16.76 km between NE Syrtis and launch site
- NE Syrtis has
- o Iron and magnesium clay & layered sulfates
- Olivine-carbonate formations & crater-retaining mafic capping rocks
- Low-calcium & pyroxene-bearing mounds
- Low albedo, flat region, end of dust storm season
- Average yearly temp is -55 °C
- Average max temp is 18 °C







Propulsion



MAVE Rendering

- Thrust: 20 kN per Engine
- Ground Isp: 326.63s Vacuum Isp: 333.94s
- Chamber Pressure: 1100
- Oxidizer:Fuel Ratio: 2.16:1



RCS Rendering

- Thrust: 490N per Engine
- Oxidizer:Fuel
- Ratio: 2.2:1
- Aluminum Lithium 2195

Propellant Tanks for MPS &

- 4 Nested MPS Tanks
- 4 Nested RCS Tanks
- MEMLI Insulation
- Patch Heaters

MON-25/MMH (0°C Operating Temperature) utilized for both MAVE and RCS

MAV Design



Atmosphere

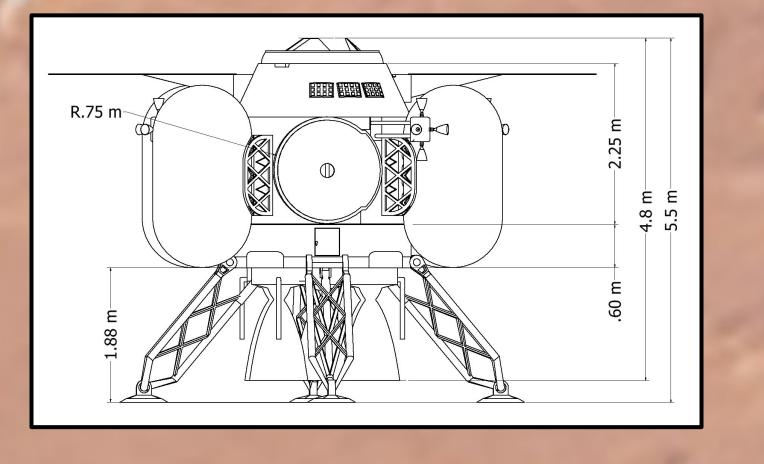
Sample Storage System

- Storage Volume: 0.5 m³
 Wet Mass: 19,136 kg
 Stored over the
 - Prop. Mass: 15,000

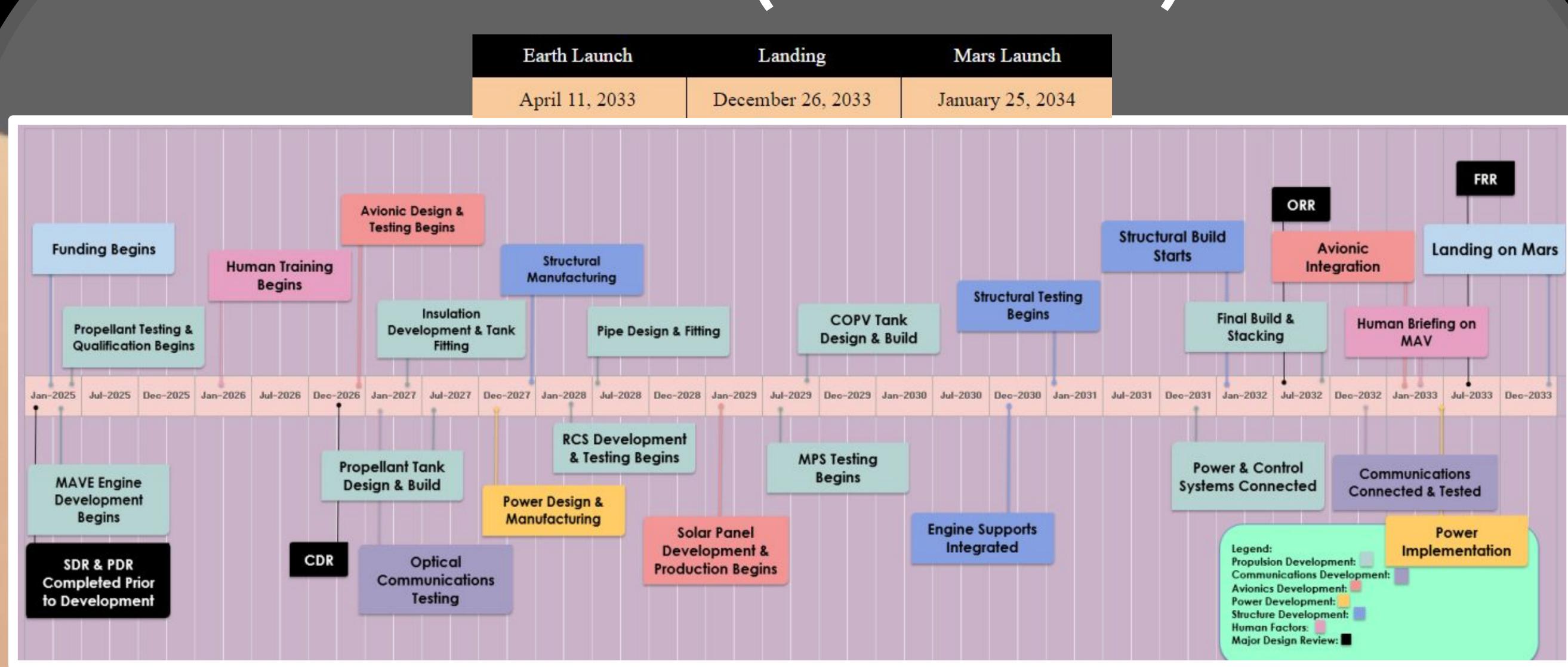


Ingress Tunnel

- Mass: 120 kg
- side hatch
- Pressure differential for dust mitigation



Timeline (2025-2033)



Budgets

JCAV Mission Modes						
Vehicle Element	Mass (kg)	Surface Operations Daytime (Wh)	Attempt 1 (5.7hrs.) Ascent/Orbital (Wh)	Attempt 2 (7.4hrs.) Ascent/Orbital (Wh)	Attempt 3 (9.4hrs.) Ascent/Orbital (Wh)	Surface Sleep / Nightime (Wh)
Propulsion- Thermals & Sensors	20.2	792.2	272.8	354.2	449.9	1,203.2
Propulsion- Gimbals	36.3	0.0	2.0	0.0	2.0	2.0
Avionics	29.7	0.0	2,052.0	2,664.0	3,384.0	0.0
Crew Operations, Life Support Systems, Cabin Essentials	200.0	5,102.4	7,649.2	9,035.8	10,667.1	5,102.4
Power Electronics & Supporting Elements	120.0	2,940.0	1,396.5	1,813.0	2,303.0	2,940.0
Communications- Surface Operations	36.8	592.0	0.0	0.0	0.0	592.0
Communications- Orbital Operations	67.0	0.0	581.0	830.0	996.0	0.0
Totals:	509.9	9426.6	11953.5	14697.0	17802.0	9839.6

Power Budget

Subsystem	Mass (kg)
Crew Cabin and Structures	1,368
Ingress Tunnel	120
Communications	103
Avionics	30
Electronics and Power	735
ECLSS	223
MPS and Empty Tanks	1,199
Crew (2)	197
1.5 Days of Oxygen and O2 (and tanks)	30
IVA suits (2)	31
Samples	100
Dry Mass total	4,136
Propellent	15,000
Fueled MAV total	19,136

Mass Budget

Development [/9]		
RCS Engine Development [79]	\$182	\$19.
Engine Propellant Qualification Testing [80]	\$20	\$2.
Miscellaneous Propulsion Costs [30] [81]	\$95	\$11
Life Support Systems [82]	\$135	\$16
Astronaut IVA Suits [83]	\$ 0.54	\$0.6
Materials Development [81]	\$3,625	\$4,15
Structure Integration and Production [81]	\$1,087	\$1,35
Structure Testing [84]	\$815	\$1,01
Control Systems [81]	\$580	\$72
Power Internals [81]	\$118	\$14
Communications [81]	\$315	\$39
Solar Panels [81]	\$210	\$26
Human Training [85]	\$240	\$30
Ground Processing and Integration [81]	\$1,065	\$1,330
SLS Block 1B Launch Cost [86]	\$876	\$1,09

Monetary Budget

Total Cost Estimate (-10%)	Total Cost Estimate	Total Cost Estimate (+15
\$10,607,196,054	\$11,786,773,394	\$13,554,639,

Power

- Uses two 1323.1 W solar arrays with gallium arsenide triple junction technology
- 12 hours sunlight yields 31,754 kWh
- JCAV consumes 20 kWh per sol
- Utilizes 5 120V/55Ah Li-Ion batteries storing total of 33 kWh
- Power Management & Diversified Bus Unit (PMDBU) provided

