Mars Orbiter Mission

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Mission Objectives

Mission objectives

Technological objectives:

- Design and realisation of a Mars orbiter spacecraft with a capability to survive and perform Earth bound manoeuvres, cruise phase, Mars orbit insertion and capture, and on-orbit phase around Mars.
- Deep space communication, navigation, mission planning and management.
- Incorporate autonomous features to handle contingency situations

Scientific objectives:

- Exploration of Mars surface features, morphology, mineralogy and Martian atmosphere by indigenous scientific instruments.

Launch Vehicle

- A high performance variant of the four-stage Polar Satellite Launch Vehicle(PSLV-XL) developed primarily for launching remote sensing satellites of 1700kg class in Sun-Synchronous Polar Orbit.
- 3.5 meter diameter and 44 meters tall .
- Lift-off mass of 320 ton.
- The first and third stages use solid motors.
- The second stage employs turbo pump fed bi-propellant VIKAS engine.
- Fourth stage employs pressure fed high performance bipropellant liquid engines.
- Long coasting of vehicle carried out before the separation of satellite to get the required Argument of Perigee, one of the critical orbital elements.

Launch

Launched on November 05, 2013 during the minimum energy transfer opportunity to Mars, which occurs once in 26 months.

Launch parameters

Spacecraft mass	1337 kg
Launch date	Nov 5, 2013
Lift-off Time	14:38:26 IST
Separation time	15:22:43 IST
Perigee	248 km
Apogee	23,550 km
Inclination	19.27 degrees
Orbital Period	6.831 Hours
Argument Of Perigee	284.4 degrees

Launch

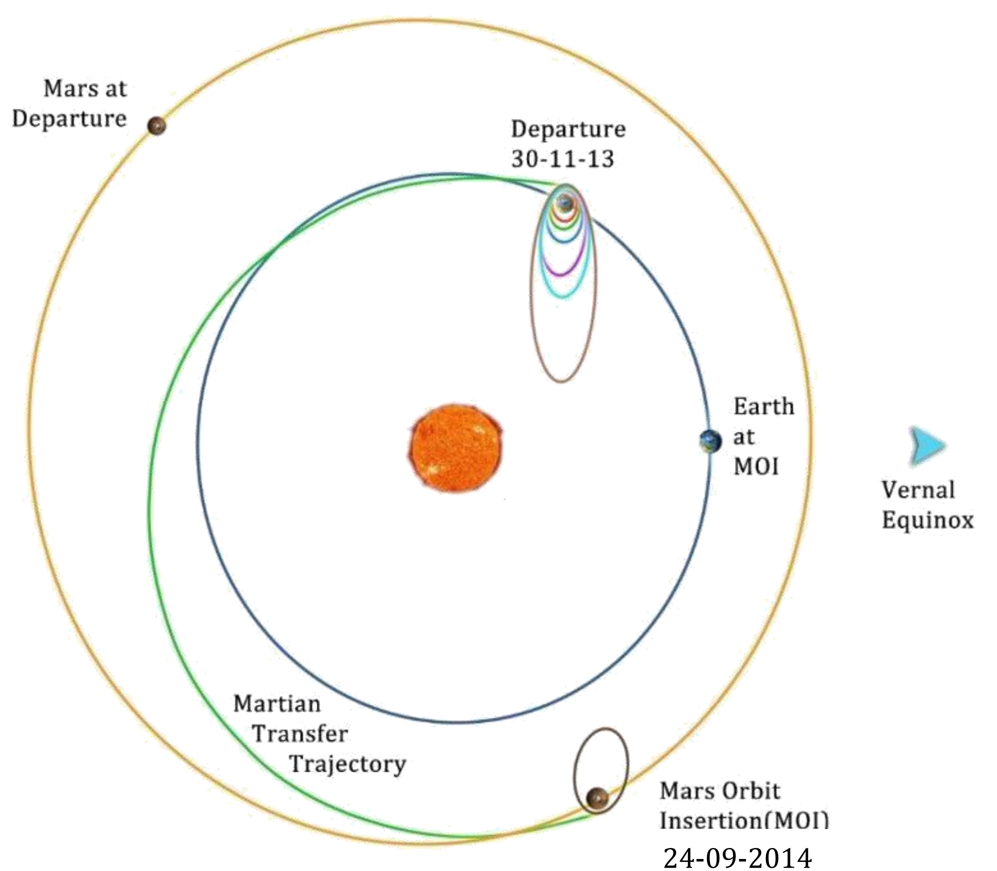
Mars Orbiter Mission

Present Status

Mars Orbiter Mission

- Presently travelling at a velocity of 29.8 km/s with respect to Sun, chasing Mars which is travelling at a velocity of 24.1 km/s
- MOM has reached a distance of 19.5 million km so far.
- It takes about 61 seconds for a communication signal to reach MOM.
- Overtaking Mars in its orbit, on May 12, 2014, MOM will embrace the red planet in a science orbit on September 24, 2014.

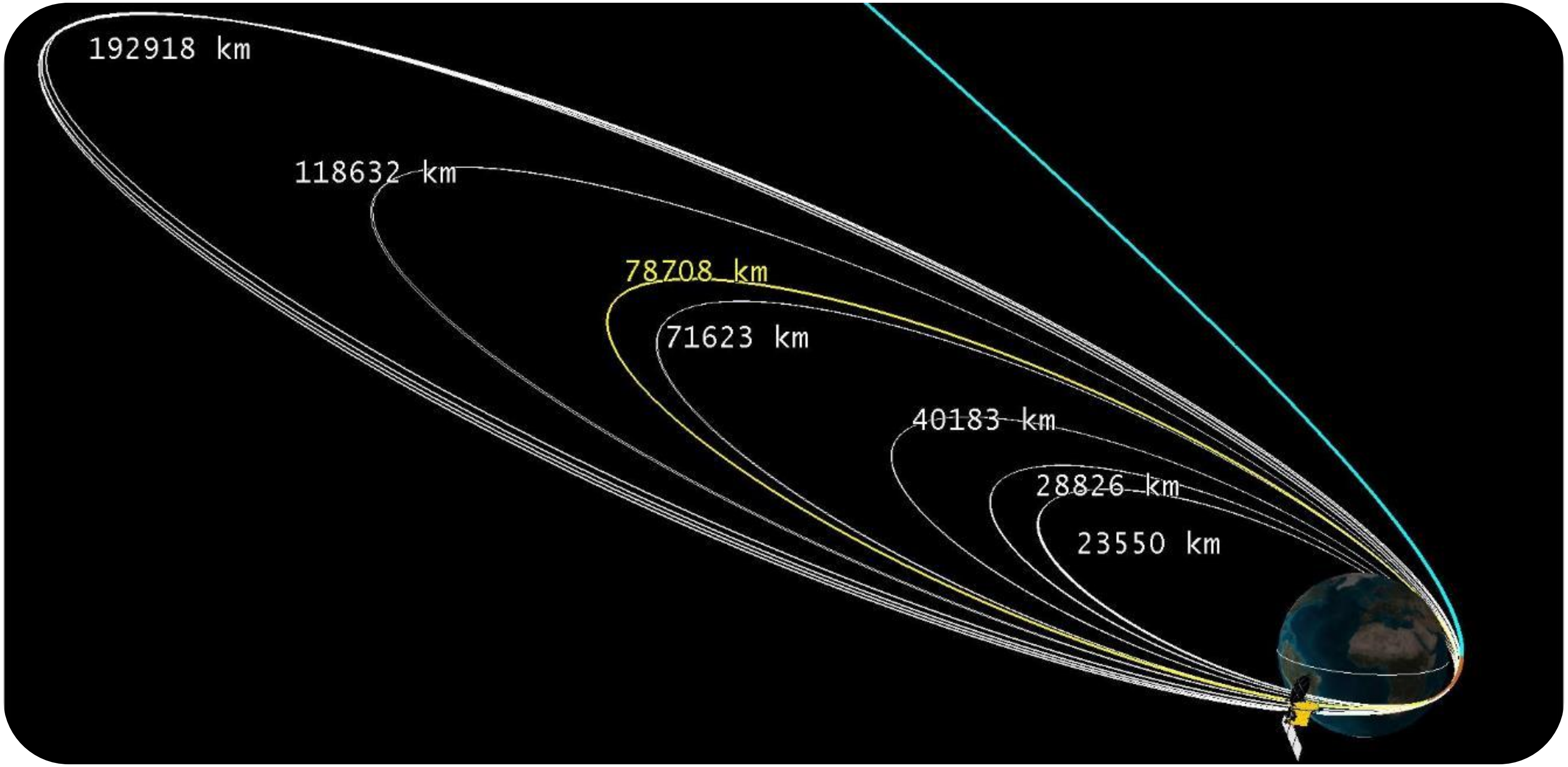
- Six Liquid Engine Burns take the spacecraft gradually into a departure hyperbolic trajectory. S/C escapes from the Earth's Sphere Of Influence (SOI) with Earth's orbital velocity + ΔV boost.
- Spacecraft leaves Earth in a direction tangential to Earth's orbit around sun. Encounters Mars tangentially to its orbit around sun. The flight path is roughly one half of an ellipse around sun.
- The spacecraft arrives at Mars' SOI in a hyperbolic trajectory. When the spacecraft reaches Mars Periapsis, it is captured into the planned orbit around Mars by imparting ΔV retro.



$$\Delta V_{total} = \Delta V_{boost} + \Delta V_{retro}$$

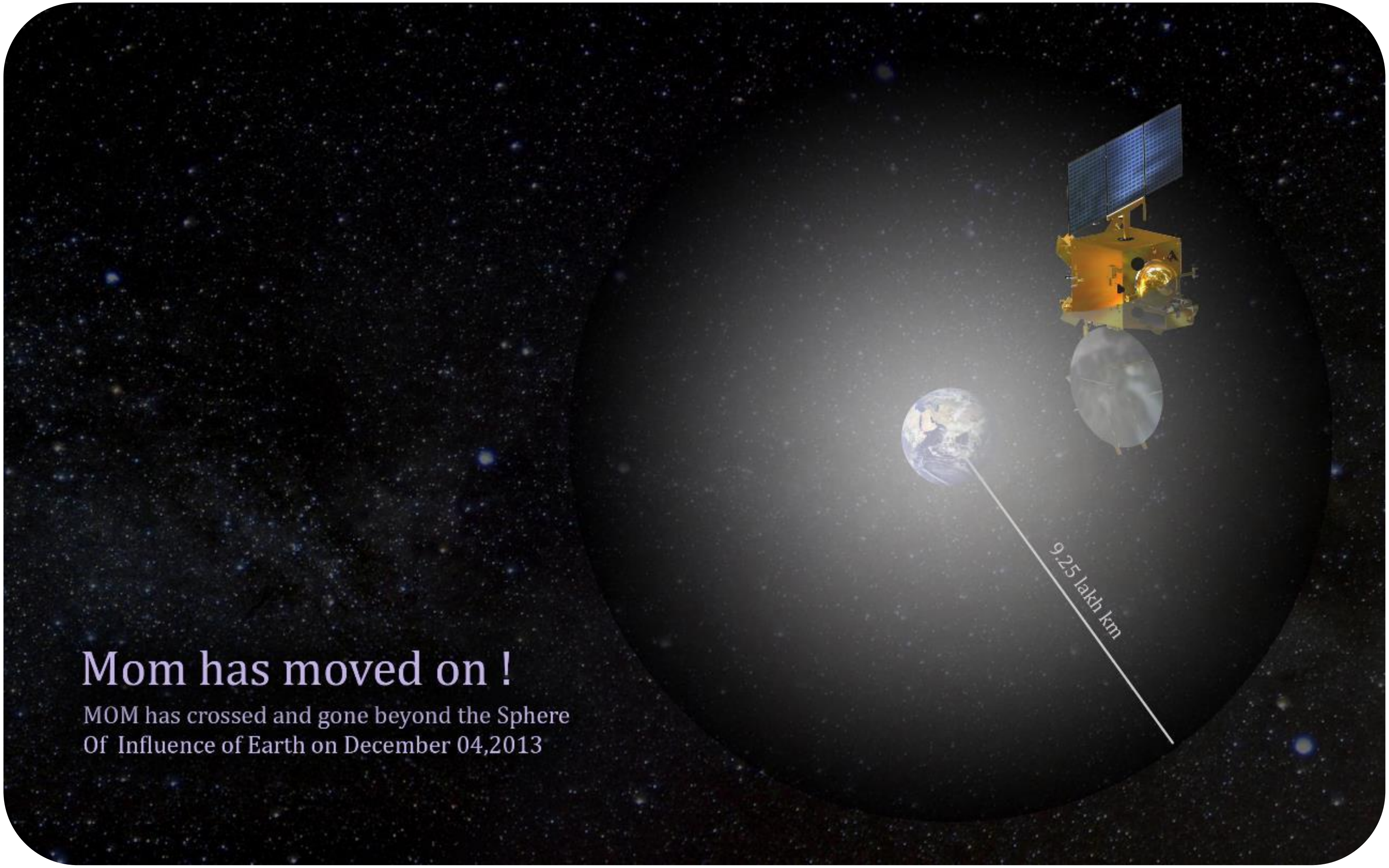
Earth Bound Manoeuvers and Escape

Mars Orbiter Mission



Manoeuvres Realized till Trans Mars Injection

MVR No.	PRG No.	MVR start time (U T)	Burn Dur. (sec)	delta-V (m/s)	Prop. (kg)
EBN#1	6	2013 11 06 19 47 28	416.51	138.64	60.37
EBN#2	9	2013 11 07 20 48 52	574.53	201.87	83.07
EBN#3	11	2013 11 08 20 40 43	711.42	271.44	103.19
EBN#4	13	2013 11 10 20 37 52	249.73	35.00	14.47
EBN#4A	14	2013 11 11 23 33 50	308.74	124.95	43.79
EBN#5	16	2013 11 15 19 57 17	243.52	101.53	34.01
TMI	20	2013 11 30 19 19 24	1328.90	648.08	192.05
Total			3583.616	1521.51	530.95

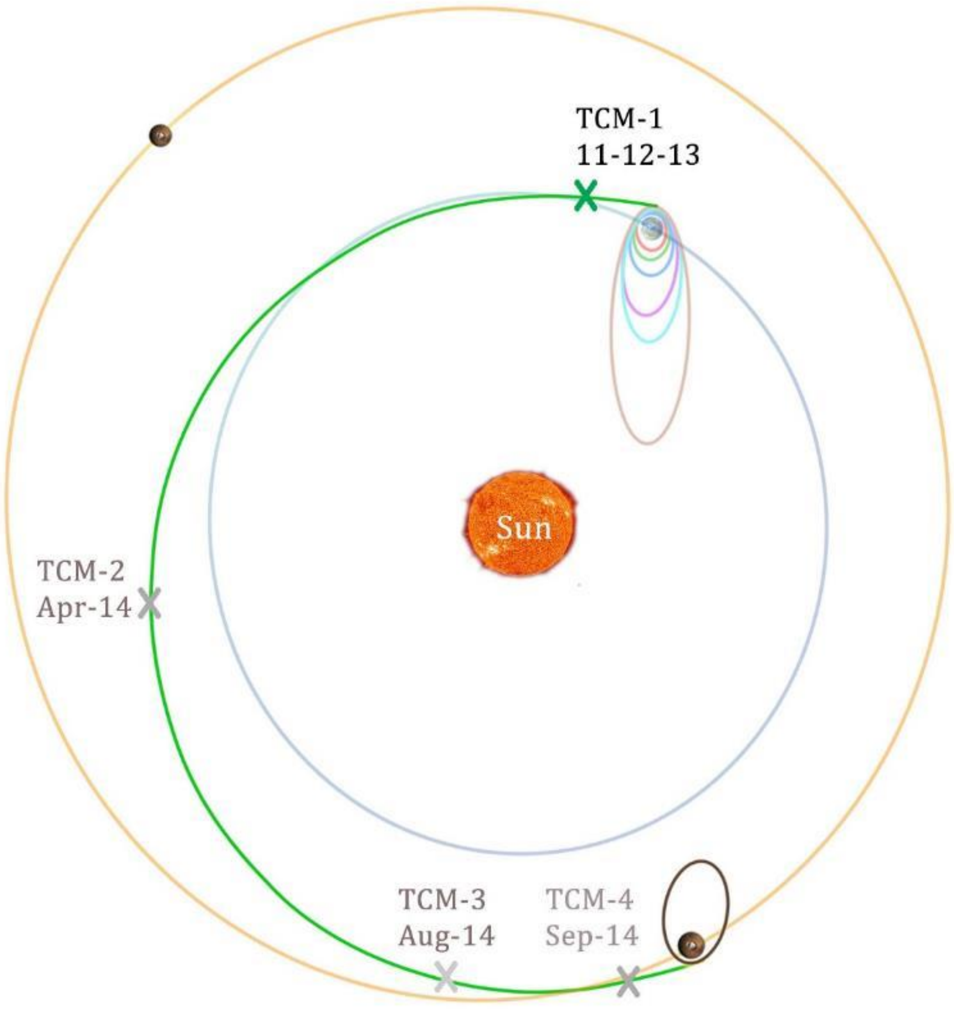

Mom has moved on !
MOM has crossed and gone beyond the Sphere
Of Influence of Earth on December 04,2013
9.25 lakh km

Trajectory Correction Manoeuvers(TCMs)

Mars Orbiter Mission

TCM-1	
Date	Dec 11,2013
Duration	40.5s
Distance	2.9 m km

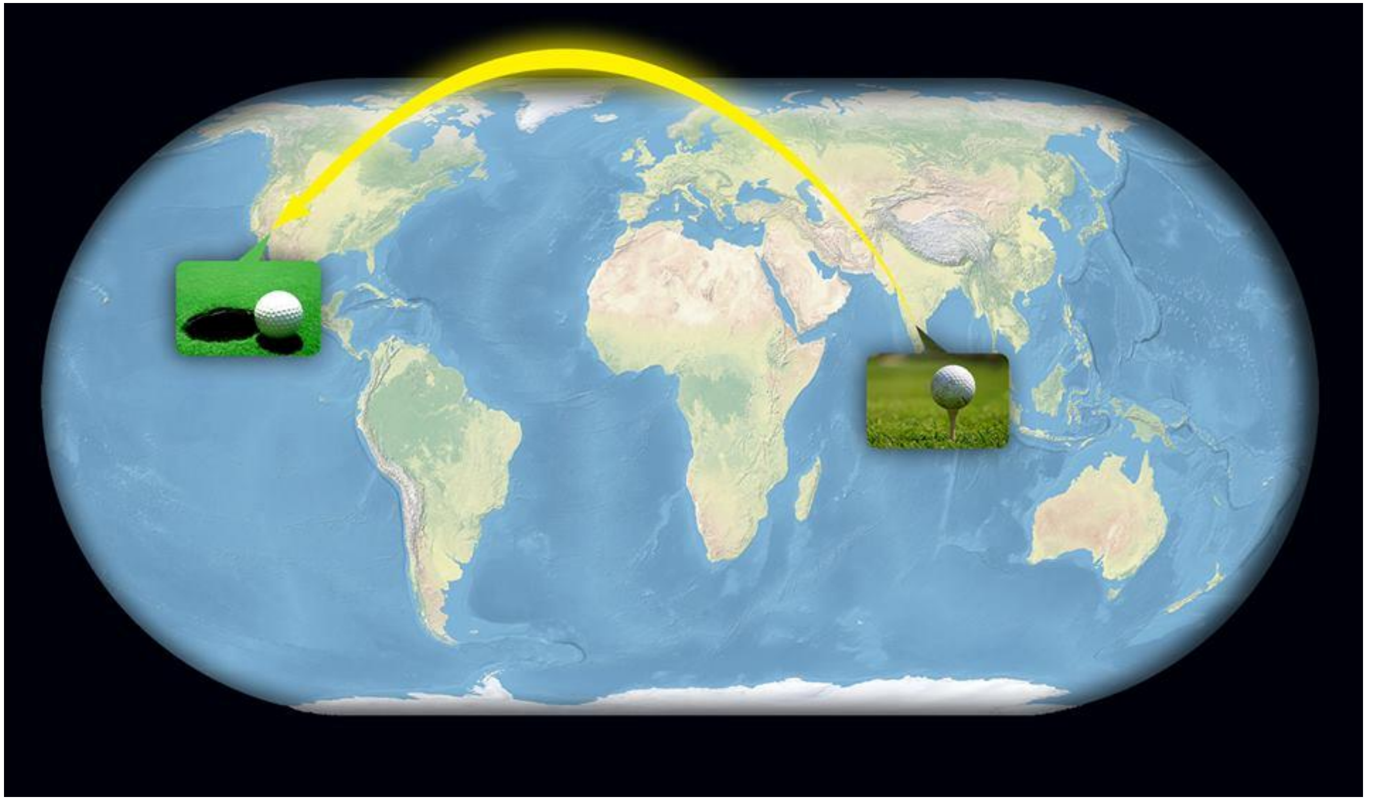
Future TCMs will be planned to reach a target orbit around Mars 375 km x 80000 km depending upon the output of orbit propagation models.



How challenging is to reach Mars !

"If you go outside and hit a golf ball towards Los Angeles, the golf ball has to come straight into the cup, exactly to the hole, that's how accurate you have to come in. And to make it a little bit more challenging; the hole is moving."

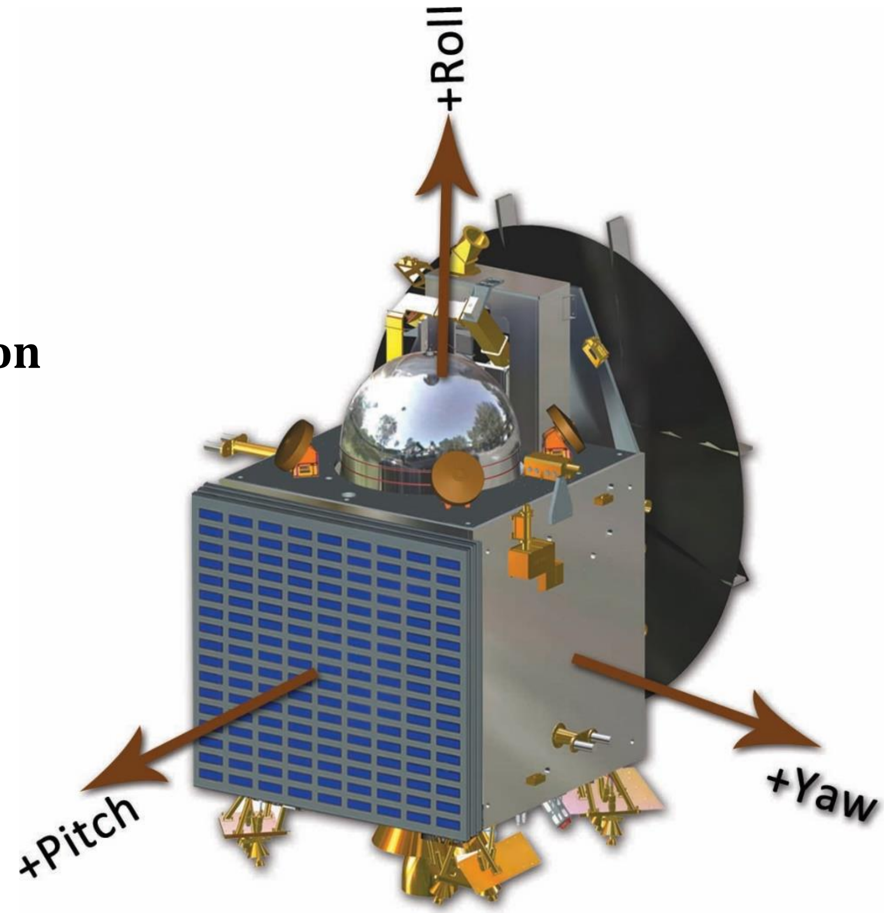
-Dr. Charles Elachi, Director-JPL/NASA



Spacecraft Configuration

- Spacecraft configuration is a balanced mix of design from flight proven IRS/INSAT bus.
- Mission specific systems in the areas of **communication, power, propulsion and Control System**.

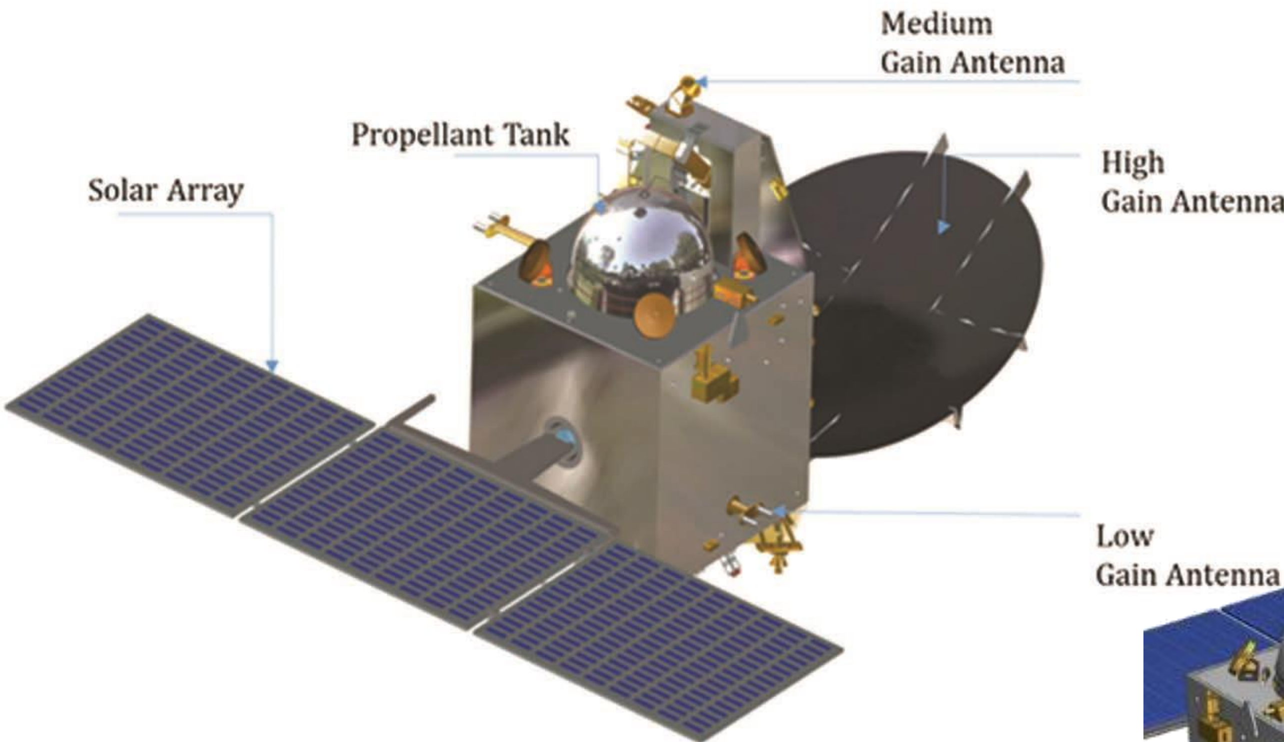
Stowed Configuration

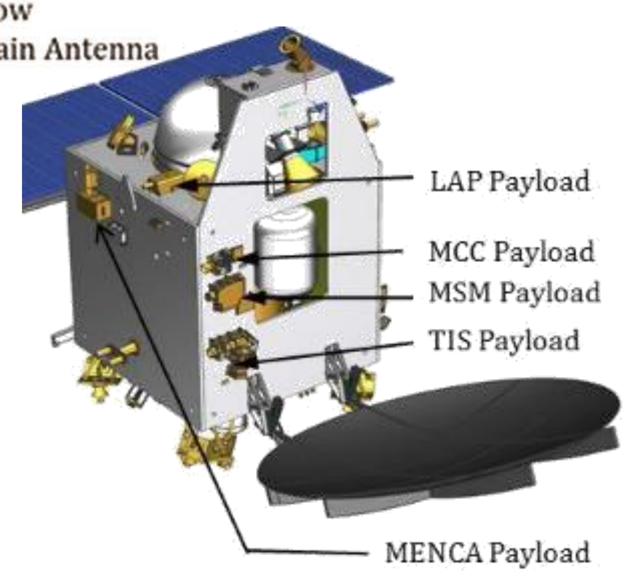


Spacecraft in the Launch configuration

Spacecraft On-orbit Configuration

Mars Orbiter Mission





Spacecraft in Launch Configuration

Science Payloads

Mars Orbiter Mission

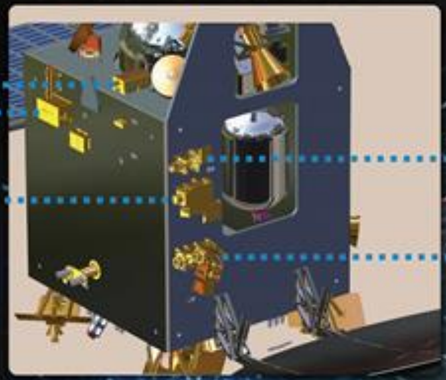
Lyman Alpha Photometer (LAP)

Measures the relative abundance of deuterium and hydrogen from Lyman-alpha emission in the Martian upper atmosphere. allows us to understand especially the loss process of water from the planet.

Methane Sensor for Mars (MSM)

Designed to measure Methane (CH4) in the Martian atmosphere with PPB accuracy and map its sources. Global data is collected during every orbit.

Atmospheric studies



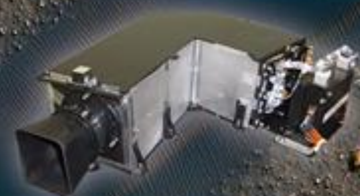
Mars Exospheric Neutral Composition Analyser (MENCA)

A quadruple mass spectrometer capable of analysing the neutral composition in the range of 1 to 300 amu with unit mass resolution.

Plasma and particle environment studies

Mars Color Camera (MCC)

This tri-color camera gives images & information about the surface features and composition of Martian surface. Useful to monitor the dynamic events and weather.



Thermal Infrared Imaging Spectrometer (TIS)

measures thermal emission. Many minerals and soil types have characteristic spectra in TIR region. TIS can map surface composition and mineralogy of Mars.

Surface Imaging Studies

Salient features of the Spacecraft

Mars Orbiter Mission

Features	Specifications
Mass	1337 kg
Structures	Aluminum and Composite Fiber Reinforced Plastic (CFRP) sandwich construction-modified I-1 K Bus.
Mechanism	Solar Panel Drive Mechanism (SPDM), Reflector & Solar panel deployment
Propulsion	Bi propellant system (MMH + N_2O_4) with additional safety and redundancy features for MOI. Propellant Loading : 852 kg
Thermal System	Passive Thermal Control System with heat pipe for TWTA panels.
Power System	Single Solar Array-1.8m X 1.4m; 3 panels - 840 W Generation (in Martian orbit),Battery: 36AH Li- ion.
Attitude and Orbit Control System	AOCE (Attitude and Orbit Control Electronics): with MAR31750 Processor. Sensors: Star sensor (2Nos), Solar Panel Sun Sensor (SPSS)-1No, Coarse Analogue Sun Sensor (CASS)-9 Heads, and Inertial Reference Unit and Accelerometer Package (IRAP) Actuators: Reaction Wheels (5Nms, 4Nos), Thrusters (22N-8Nos), 440N Liquid Engine
TTC Baseband and RF System	Telemetry (TM) and Telecommand (TC): CCSDS Compatible Baseband Data Handling (BDH) and Solid State Recorder (SSR) :16+16 Gb Communication (RF) Systems: S-Band for both TTC and Data Antennae: Low Gain Antenna (LGA), Mid Gain Antenna (MGA) and High Gain Antenna (HGA)

Major Mission Specific Changes

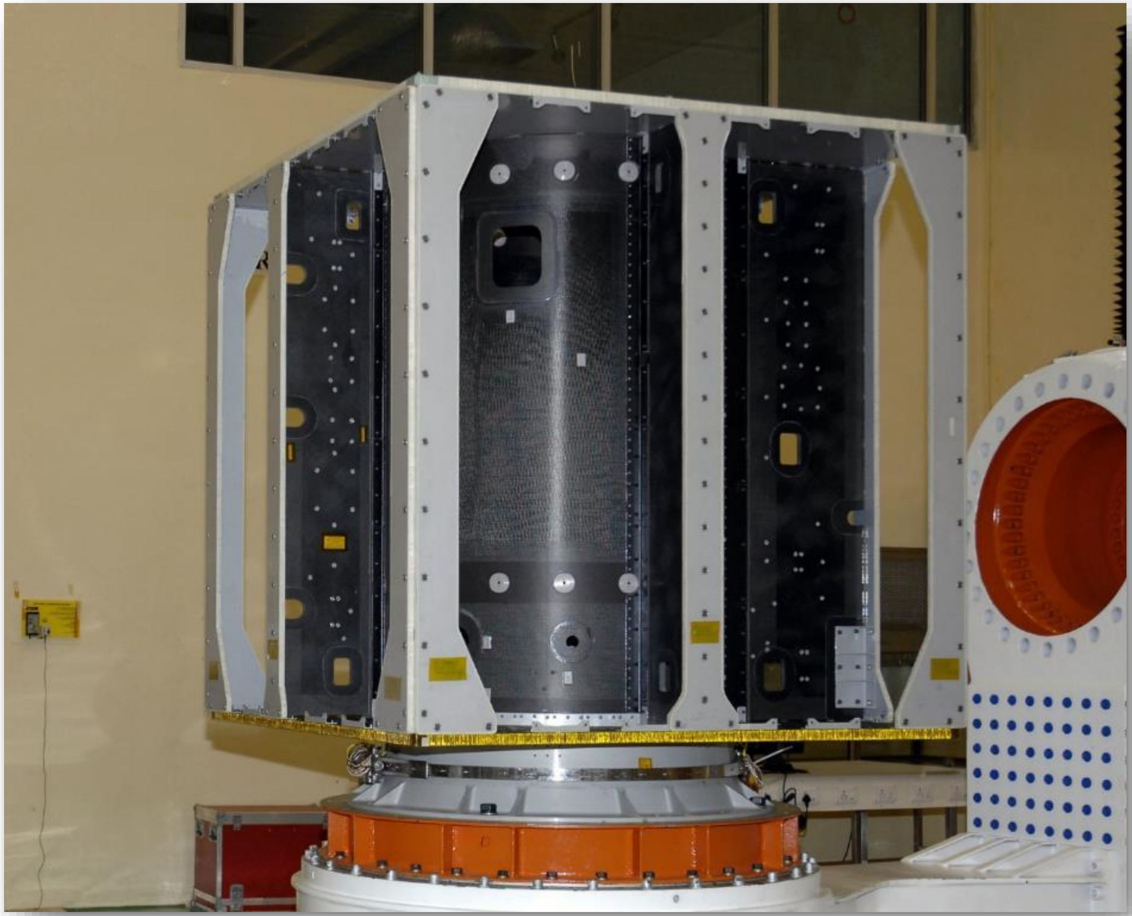
Mars Orbiter Mission

No	Sub System	Mass (kg)
1	Payloads	13.4
2	Power Systems	58.2
3	TTC Baseband Systems	14.5
4	AOCS Elements	60.3
5	Propulsion Systems	87.3
6	Data Handling System	6.0
7	RF Systems	61.7
8	Thermal Control Systems	29.2
9	Spacecraft Mechanisms	17.1
10	Structures	98.4
11	Assembly Integration and Testing Elements	36.4
	Total Dry Mass Of The Spacecraft	**482.5**
	Pressurant	2.7
	Propellant	852.0
	Lift-Off Mass of the Spacecraft	**1337.2**

Major Mission Specific Changes

Mars Orbiter Mission

Primary Structure : 1.5m X 1.53m X 1.56m Cuboid with the central thrust cylinder made of CFRP.

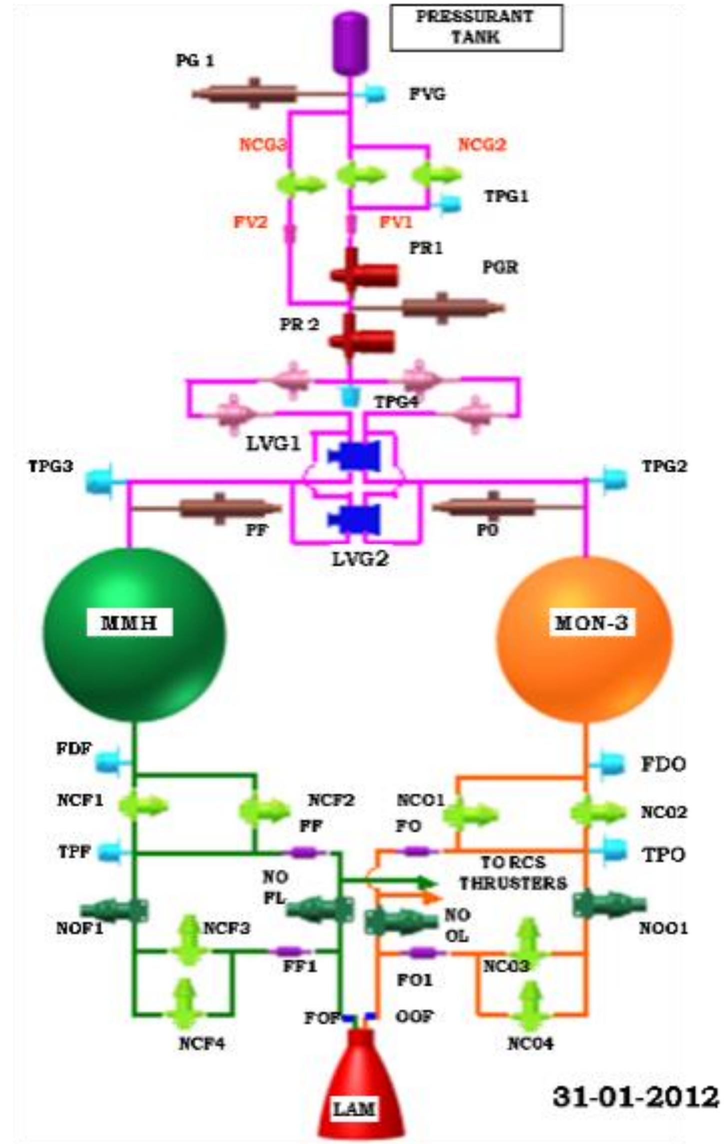


Major Mission Specific Changes

Propulsion System

- Liquid Engine to be restarted after 10 months for Martian Orbit Insertion (MOI) manoeuvre.
- To improve safety and redundancy second LVG is provided.
- Additional pyros provided for MOI manoeuvres.
- Component heritage maintained from INSAT/IRNSS/Chandrayaan-1 missions.
- Heaters on gas lines incorporated.

- **Two Liquid Engines are subjected to mission simulation tests in HATF.**
- **Seal level test (immersion)**
- **LAM injector(2 nos) tests at TERLS test stand under sea level conditions conducted**



Major Mission Specific Changes

Mars Orbiter Mission

Propulsion System features:

- 390 litres propellant tanks accommodates a maximum of 852kg of propellant.
- A Liquid Engine of 440N thrust to be used for orbit raising, Trans Mars Injection (TMI) and Martian Orbit Insertion (MOI).
- 8 numbers of 22N thrusters for wheel de - saturation and attitude control during manoeuvres.

Assembling propellant tanks to structure

Liquid Engine Tests in progress

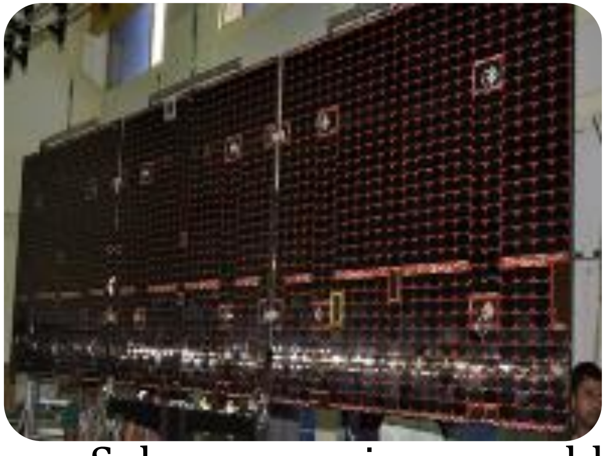
Major Mission Specific Changes

Power Systems

- Reduction in Solar power generation by a factor of 1/3 at Martian orbit.
- Very low temperature of solar panels during eclipse periods (-185°C).

	Perihelion		Aphelion		Mean	
	Mars	Earth	Mars	Earth	Mars	Earth
Direct solar (W/m2)	717	1414	493	1323	589	1367.5

- **The array designed for maximum performance at minimum solar flux conditions at Mars ensuring minimum of 765 W.**



Solar array wing assembly

Battery

Major Mission Specific Changes

Communication system

- Communication management in Earth bound phase, cruise phase, MOI and Martian orbit phase.
- The maximum range is 375 million Km (Range of Mars after 6 months)
- S-Band deep space frequencies for both TTC and Data transfer
- Two coherent transponders with two 230 W TWTAs and 2.2 meter diameter reflector antenna to increase on board EIRP
- Sensitive receiver with -135 dBm carrier acquisition threshold with "Sequential ranging " compatibility (500 KHz tone).
- Integrated Doppler provision is provided .
- Selectable data rates of 5/10/20/40 kbps (without turbo coding).

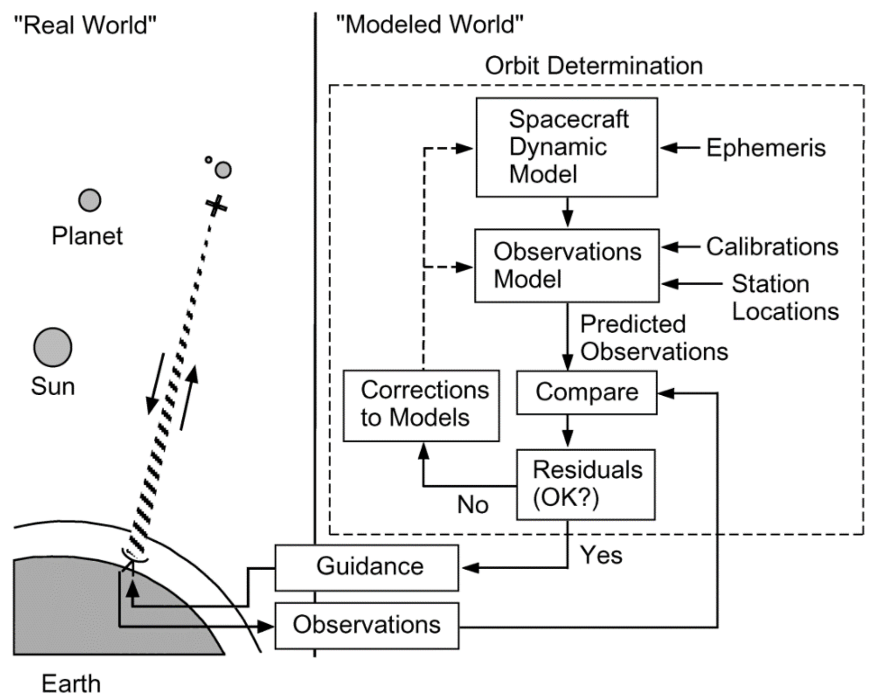
Antenna	Beam width	Peak Gain	Polarization	TM Support (km)/margin (dB)	TC Support (km)/ margin (dB)
LGA	± 90°	0dB	LCP&RCP	1.4 million /2.4 dB	30 million /2 dB
MGA	± 40°	7dB; 3dB @ ±40°	RCP	40 million /2.4 dB	110 million /2.3 dB
HGA	± 2°	31dB	RCP	400 million /5.4 dB	400 million /10 dB

Communication system

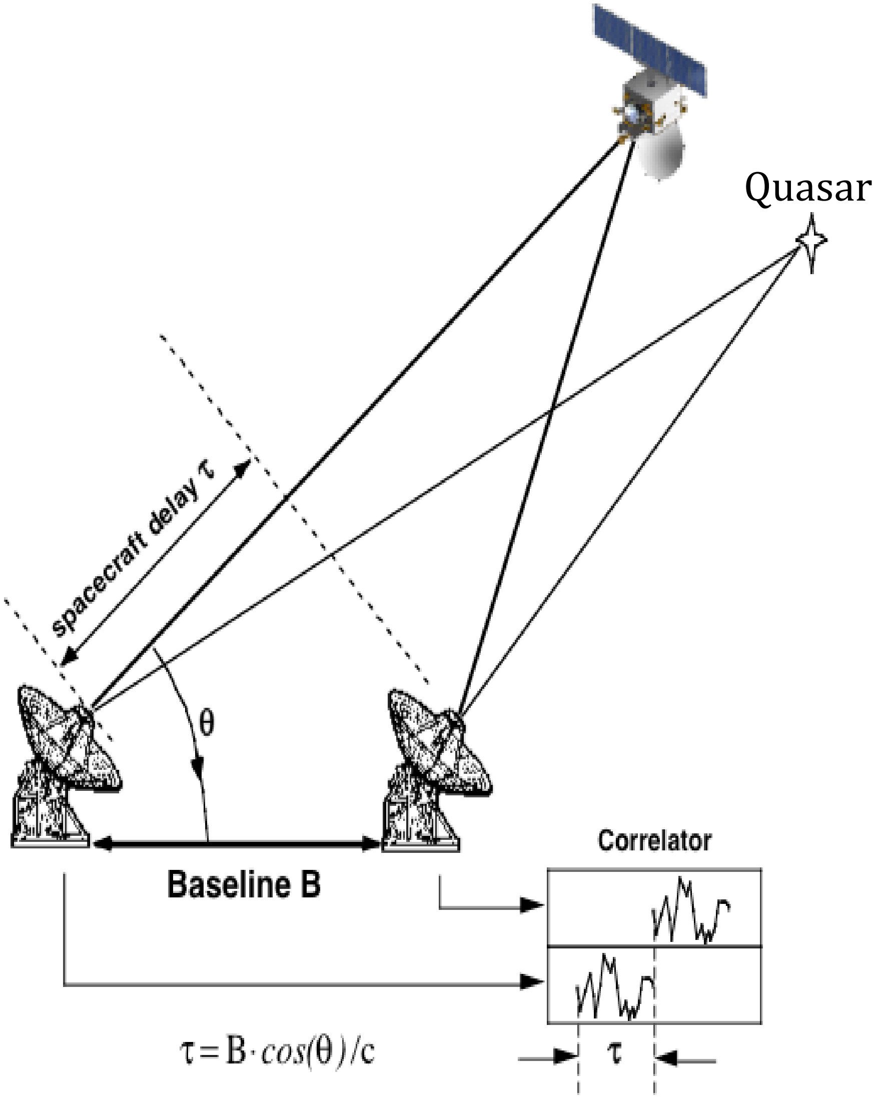
- **Ranging:**
- Line of sight range measurements (**position** from earth) and range rate measurements (**velocity** away from earth)
- Plane of sky measurements (location in earth's sky) which is specific to deep space mission is the knowledge of the **declination** of the plane of travel.
- **The accuracy of measurement of position is 1 cm , velocity : 0.1 mm/sec and the angular accuracy is 5 nano-radians(2.87x 10^{-7} deg)**

  (imagine holding your hand one meter apart , bring them together at a rate of 0.1mm /sec, will take 2.7 hrs)

- S-Band Δ-DOR transmitters for improving the Orbit Determination accuracy.



Major Mission Specific Changes



Δ-DOR (Differential Delta One-way Ranging)

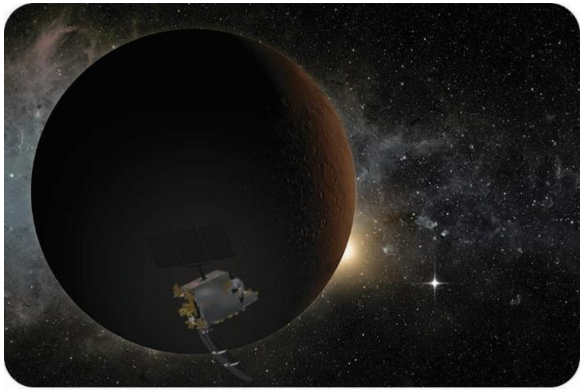
- Improves angular accuracy of ranging which is essential for deep space missions to have plane of sky measurements of Right Ascension and declination.
- VLBI based Technique, direct plane-of-sky measurement, large baselines in east – west and north-south directions.
- Plane waves are received from remote source and difference in time of arrival (DOR) corresponds to angle between the baseline and the remote source.
- Delta DOR makes use of natural calibration source like a quasar. The two DOR measurements are then compared to give the final Δ-DOR measurement.
- Two Δ-DOR packages are employed to generate ranging tones.

Major Mission Specific Changes

Spacecraft autonomy

- Maximum Earth to Mars Round-trip Light Time (RLT) 42 minutes during the mission. Impractical to Micromanage the mission from Earth with ground intervention.
- On-board autonomy is implemented thro autonomous **Fault Detection, Isolation and Reconfiguration (FDIR) logics** and executed by AOCE and TMTC packages.
- Continuous Watch, Fault Detection, Isolation and Reconfiguration without disturbing the Earth Pointing attitude
- Essential during Communication Interruptions during eclipse, whiteouts, blackouts.
- Safeguard the spacecraft during MOI, TWTA duty cycling and sun pointing safe mode.

- **The mission requirements resulted in development of 22 new software modules, modification of 42 modules and usage of 19 existing modules. These modules were extensively tested using simulation and flight hardware in OILS and HILS tests**



Major Mission Specific Changes

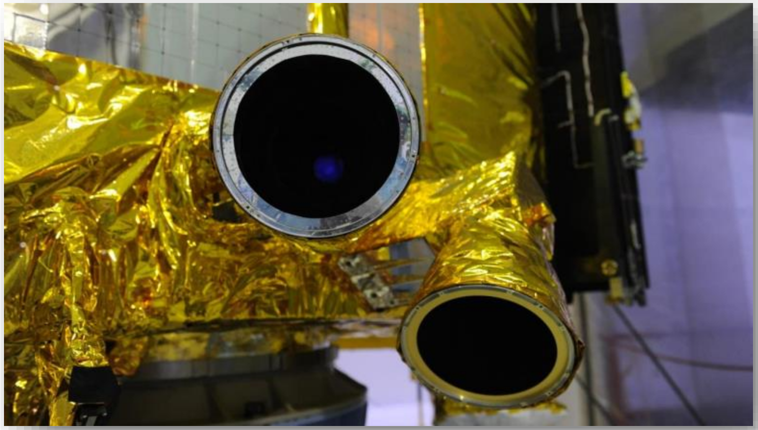
Spacecraft autonomy (Contd.)

Step-1: Continuous Watch On Major S/Ss	Step2: Automatic Reconfiguration on Occurrence of failure detection	Step 3: Fault Analysis after receiving TM data
• Sensors • Actuators • Transmitter/TWTA/TM/TCP/Power • SADA (For Power Generation	• Wheels to Thruster • Star Sensor-1 to Star Sensor-2 or vice-versa • Selected Gyro to Non-sel. Gyro • Thruster Block-1 to Block-2 or Combination of Thruster • Transmitter/TWTA/TM/TCP Change over from one system to other. • Battery charge monitoring • SADA (Main to Redundant)	Once House Keeping data is downloaded, fault analysis is to be performed to verify the onboard actions and ensuring the faulty chain is isolated completely

Major Mission Specific Changes

Sensors

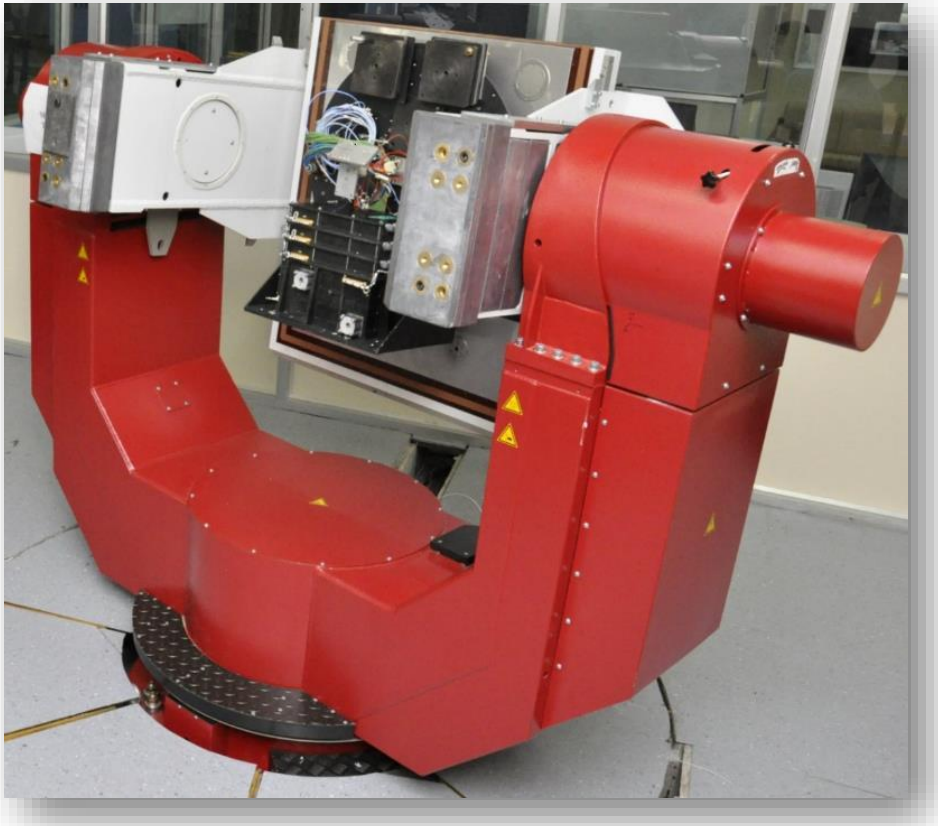
- **Star sensors:** provide the inertial attitude knowledge thro identification of star patterns in all phases of mission. Mission dependence on the star sensor is very crucial
- Due to the reduction in the solar irradiance in the Martian orbit as compared to Geo-centric orbit, there is a large variation in the input signals of Coarse Analogue Sun Sensor (CASS) and Solar Panel Sun Sensor (SPSS). In the signal processing of CASS and SPSS, the pre amplifier gain and sun presence threshold values were optimized.
- CASS and SPSS performance were verified with illumination checks and polarity checks at spacecraft level



Major Mission Specific Changes

Accelerometers : For measuring the precise incremental velocity (ΔV) and for precise burn termination

Gyros : For measuring rotation in an inertial reference frame . Gyro signal is continuous and independent of external sources.

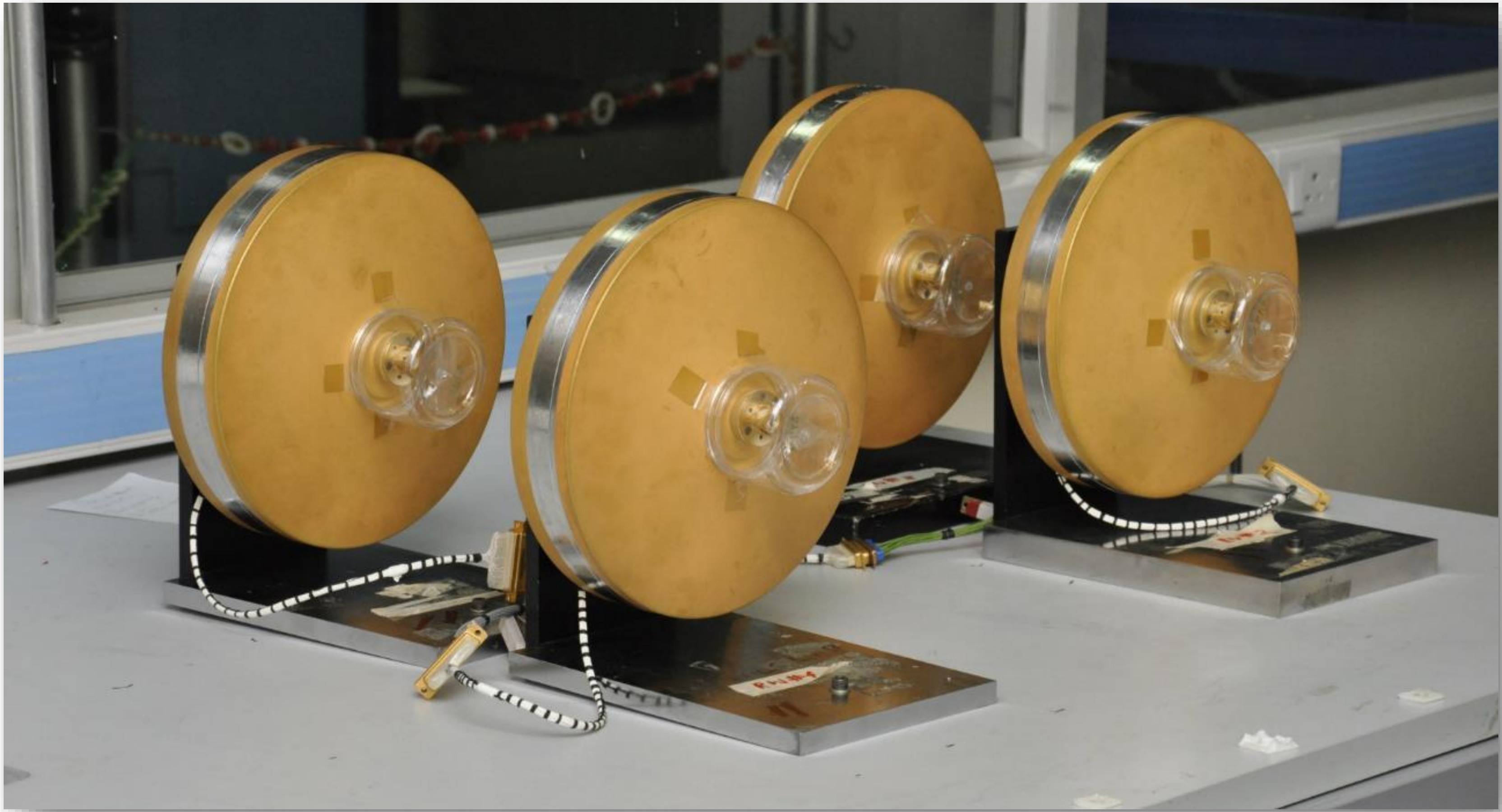


Inertial Referencing and Accelerometer package under Hardware In-loop Simulation

Major Mission Specific Changes

Mars Orbiter Mission

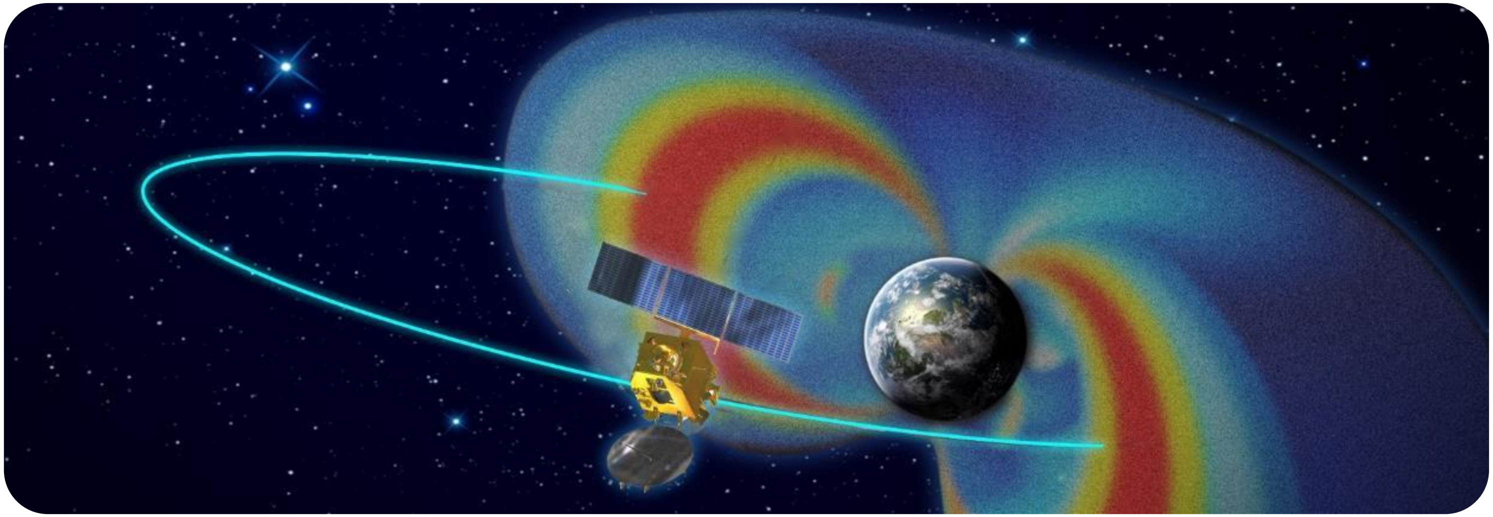
Reaction wheels: meant for controlling the orientation of the spacecraft.



Major Mission Specific Changes

Radiation Environment:

- Designed for interplanetary missions, capable of operating in Earth Burn Manoeuvres (EBN) for the Van Allen belt crossings , Mars Transfer Trajectory (MTT) and Martian Orbit (MO) environments.
- Components are selected with respect to a accumulated dose of 9 krads for packages inside the cuboid and 15krads for outside mounted packages. Bus parts are latch up immune with a Minimum threshold value LET:
  - **For Single Event Upset (SEU)** **LET > 40 Mev.cm^2.mg^{-1}**
  - **For Single Event Latch ups (SEL)** **LET > 80 Mev.cm^2.mg^{-1}**



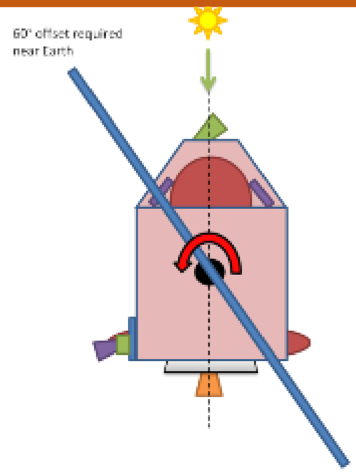
Major Mission Specific Changes

Thermal Environment:

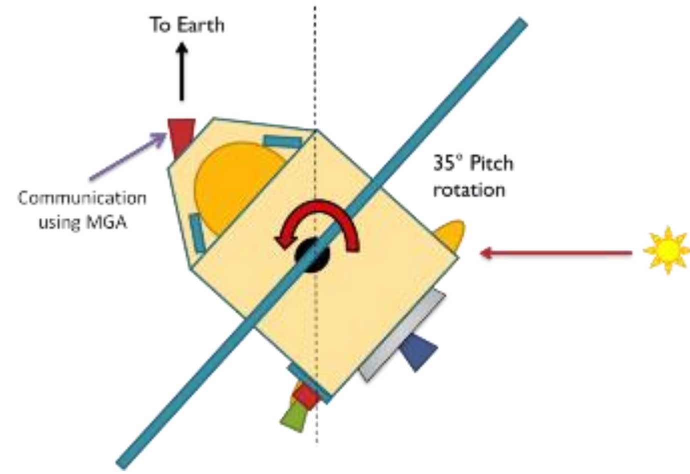
- The spacecraft needs to cope with a wide range of thermal environment, from Near Earth conditions with Sun and Earth contributions (hot case) to Mars conditions where reduced solar flux and longer eclipses give rise to cold case.
- The average solar flux at Mars orbit is 589 W/Sq.m, or about 42% of what is experienced by an Earth-orbiting spacecraft.
- As a result of the eccentricity of Mars's orbit, however, the solar flux at Mars varies by +/- 19% over the Martian year, which is considerably more than the 3.5% variation at Earth.
- Albedo fractions are similar to Earth's, being around 0.25 to 0.28 (average).

Entity	Perihelion	Aphelion	Mean
Direct solar (W/sq.m)	717	493	589
Albedo (sub-solar peak)	0.25	0.25	0.25
Planetary IR			
Maximum (W/m ^{2}) (near sub solar)	417	315	390
Minimum (W/m ^{2}) (polar caps)	30	30	30

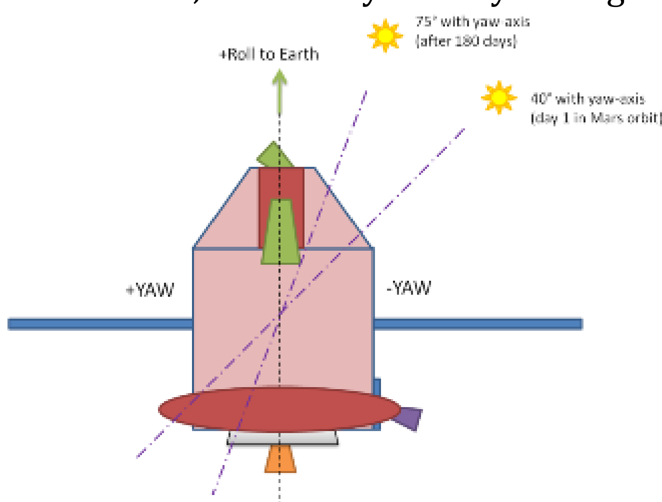
Attitudes during different phases of the mission for Thermal management



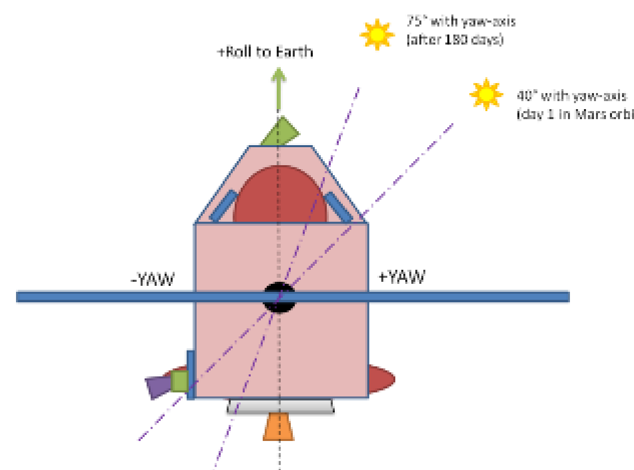
Earth bound orbits
(+Roll sun-pointing)
TWTA is OFF, solar array bias by 60 deg



Heliocentric phase (first 70 days, ~15 million km)
Beyond 15 million km, natural sun-earth geometry reduces solar load on thermal radiators



Mars orbit (+Roll and –Yaw receive sun load)



Mars orbit (+Roll flip to avoid star-sensor occultation)

Tests Conducted

Mars Orbiter Mission

Functions Tested	DIS-ASM	ASM	TVAC
Power System			
TCR Voltage & Current Calibration	✓	✓	✓
TCR String Inclusion / Exclusion	✓	✓	✓
Emergency logic & Manual Operation of Relay	✓	✓	✓
K-Relay Test	✓	✓	✓
Bat Charging using GC charger	✓	✓	✓
Load Current Measurements	✓	✓	✓
EED events	✓	✓	✓
AOCE			
AOCE Memory Checks	✓	✓	✓
FDI Logic check	✓	✓	✓
Thruster driver Checks	✓	✓	✓
LE Driver test with AOCE-1 & 2	✓	✓	✓
15553B Logic Test	✓	✓	✓
Wheel Speed limit Logic	✓	✓	-
Remote Programming feature	✓	✓	✓
Programmable TM	✓	✓	✓
SPDM Driver test	✓	✓	✓

Tests Conducted

Mars Orbiter Mission

Functions Tested	DIS-ASM	ASM	TVAC
AOCS Modes			
Safe Modes	✓	✓	✓
On-orbit modes	✓	✓	-
Momentum dumping through Thrusters	✓	✓	-
AOCE Software			
Launcher Phase	✓	✓	✓
LEB Sequencer	✓	✓	-
Image Sequencer	-	✓	-
FDIR Logics	✓	✓	-
Reset Handling Logic	✓	-	-
Master recovery Scheme	✓	✓	-
LPD software logic	✓	-	-
Telemetry Tests			
TM Regulator Selection & TM ON/OFF Check	✓	✓	✓
Turbo Ena/Dis and TM variable rates selection	✓	✓	✓
TM1/2 Reset through both decoders	✓	✓	✓
Programmable Telemetry	✓	✓	✓
1553B Logic Test	✓	✓	✓

Tests Conducted

Mars Orbiter Mission

Functions Tested	DIS-ASM	ASM	TVAC
Telecommand Tests			
TT Differential& OBT mode	✓	✓	-
AOCE Autonomy	✓	✓	✓
MACRO Block execution Test	✓	✓	✓
TCP Auto Change over Logic & TM switchover	✓	✓	✓
Event Based Command(EBC) Test	✓	✓	✓
Configurable Command Block(CCB) test	✓	✓	✓
TC decoder reset & TCP ON/OFF	✓	✓	✓
BD Mode Commanding	✓	✓	✓
AD Mode Commanding	-	✓	-
RT through TCP	✓	✓	✓
TC History comparison	✓	✓	✓
TM Data Transfer to AOCE	✓	✓	✓
1553B Logic Test	✓	✓	✓
TCP Remote programming	-	✓	✓

Tests Conducted

Mars Orbiter Mission

Functions Tested	DIS-ASM	ASM	TVAC
IRAP Tests			
DTGs ON, Health checks& 1553B Logics	✓	✓	✓
Verification of Cluster Main &Redt Heaters	✓	✓	✓
DTG Drift Rate Test	✓	✓	✓
DTG Drift rate compensation using both AOCE	✓	✓	✓
Accelerometer ON &Health Check	✓	✓	✓
Accelerometer Thermal Drift compensation Test.	✓	✓	✓
IRAP Polarity Test	-	✓	-
Reaction Wheel Tests			
Wheels and bearing heaters test	✓	✓	✓
4RW/3RW configurations	✓	✓	✓
Friction torque estimation	✓	✓	✓
Bias Torque Measurement with DFC enable/ disable checks @ both AOCE and Wheel	✓	✓	-
Long term and continuous running of wheel	-	✓	✓
WH1, WH2, WH3 & WH4 Identification & polarity	-	✓	-

Tests Conducted

Functions Tested		DIS-ASM	ASM	TVAC
Propulsion Systems				
LVG operations & ILV operations TC DEC1 & DEC2	LVG: Open & Close coil in all combinations	✓	-	-
	LVG: Only Nor-Nor combination	-	✓	✓
ILV Auto operations		Part of SNAP actions verified		
Pressure sensors stability				
Attitude Sensors				
CASS +ve, -ve and Zero settings	CASS +ve, -ve and Zero settings	✓	✓	✓
CASS Full Range	CASS Full Range	✓		
CASS Stability Test	CASS Stability Test	✓	✓	✓
SPSS Full Range	SPSS Full Range	✓	✓	✓
SPSS Stability	SPSS Stability	✓	✓	✓
Star Sensor Health Checks	Star Sensor Health Checks	✓	✓	✓
SS Storage & Playback Checks	SS Storage & Playback Checks	✓	✓	✓
SS Storage & Playback Checks	SS Storage & Playback Checks	✓	✓	✓
1553 Interface Logic test	1553 Interface Logic test	✓	✓	✓

Tests Conducted

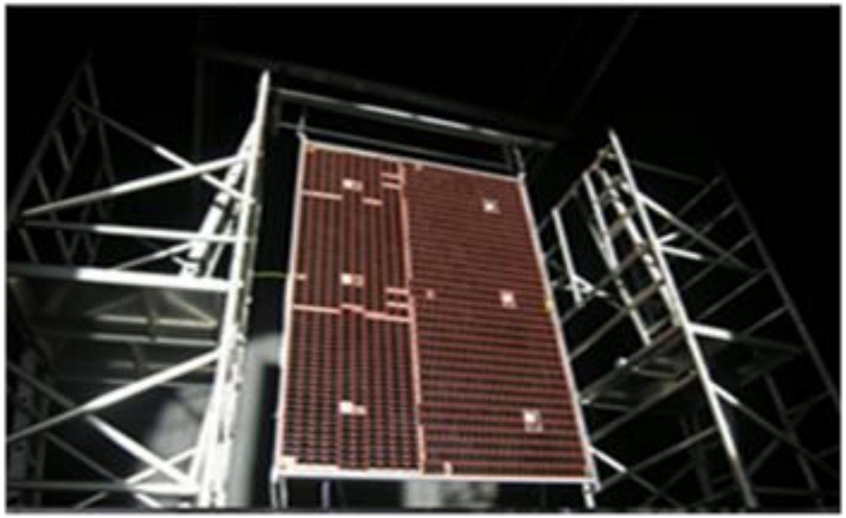
Mars Orbiter Mission

Functions Tested		DIS-ASM	ASM	TVAC
Thermal Control System				
Identification of Heaters & Temperature sensors	Identification of Heaters & Temperature sensors	✓	✓	-
Heater current measurements	Heater current measurements	✓	✓	-
Group enable/ disable logic	Group enable/ disable logic	✓	✓	-
Execution of all commands through Dec-1& 2	Execution of all commands through Dec-1& 2	✓	✓	✓
PATC functionality & Memory dump of limits & sensor table	PATC functionality & Memory dump of limits & sensor table	✓	✓	✓
Monitoring of all Temperature Sensors	Monitoring of all Temperature Sensors	✓	✓	✓

Solar Panel Tests

Mission Specific testing of solar panels for Mars

- To test the survivability of materials and process, a Coupon with UTJ rev solar cells and were subjected for 3 cycles between 0 ^{0}C and -210^0 C.
- Single CFRP solar panel with UTJ solar cells was subjected for 515w/m^2 and -20^0 C. IV characteristics were traced at 515w/m^2 between – 30 to + 20 ^{0} C. This test was performed to check that there is no anomalous behaviour of solar cells under Martian Orbit conditions.
- In orbit test at 478 Watts /m^2 and -20°C was conducted on GSAT 10 north solar array.

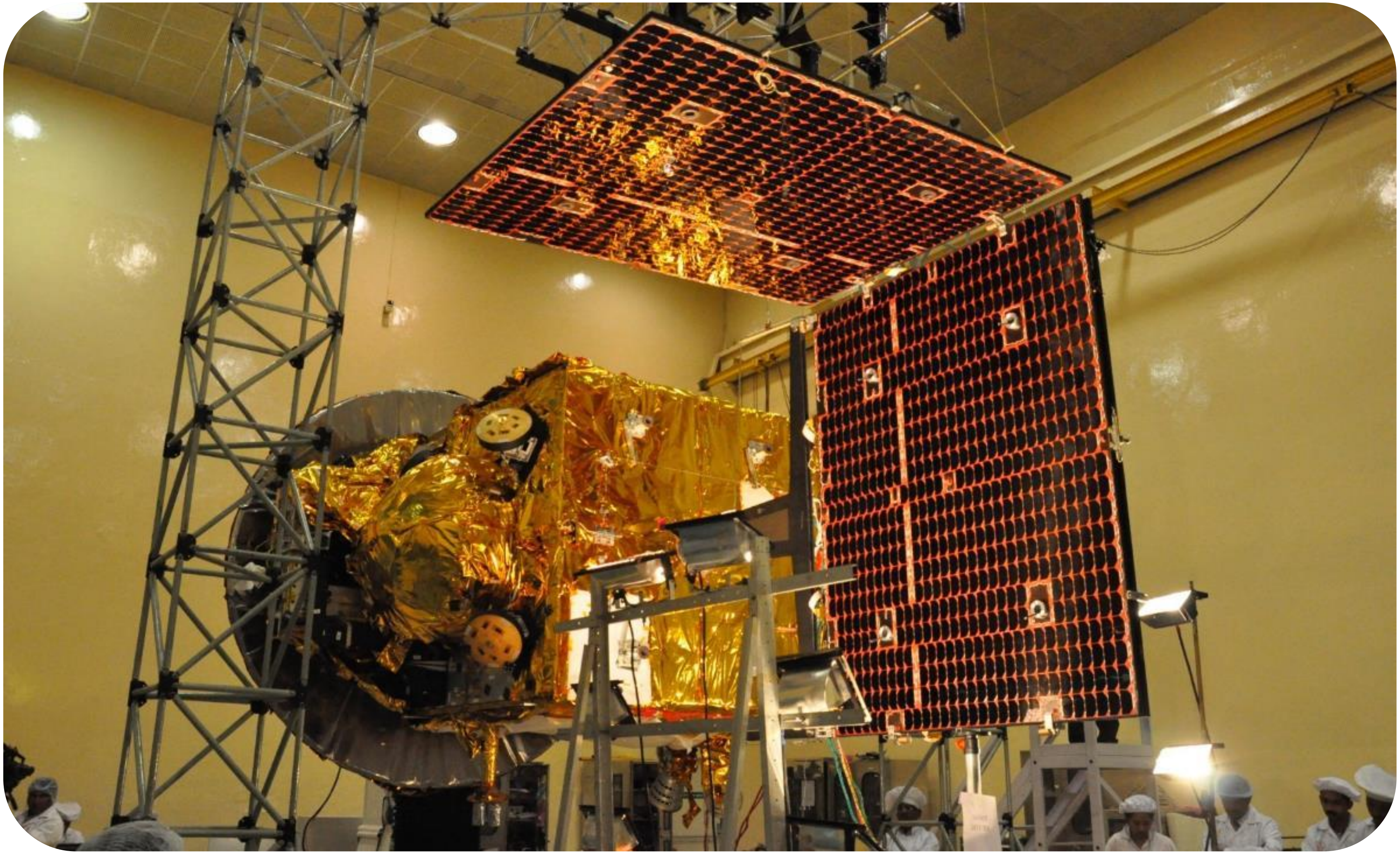


Solar Panel Primary Deployment Test

Mars Orbiter Mission

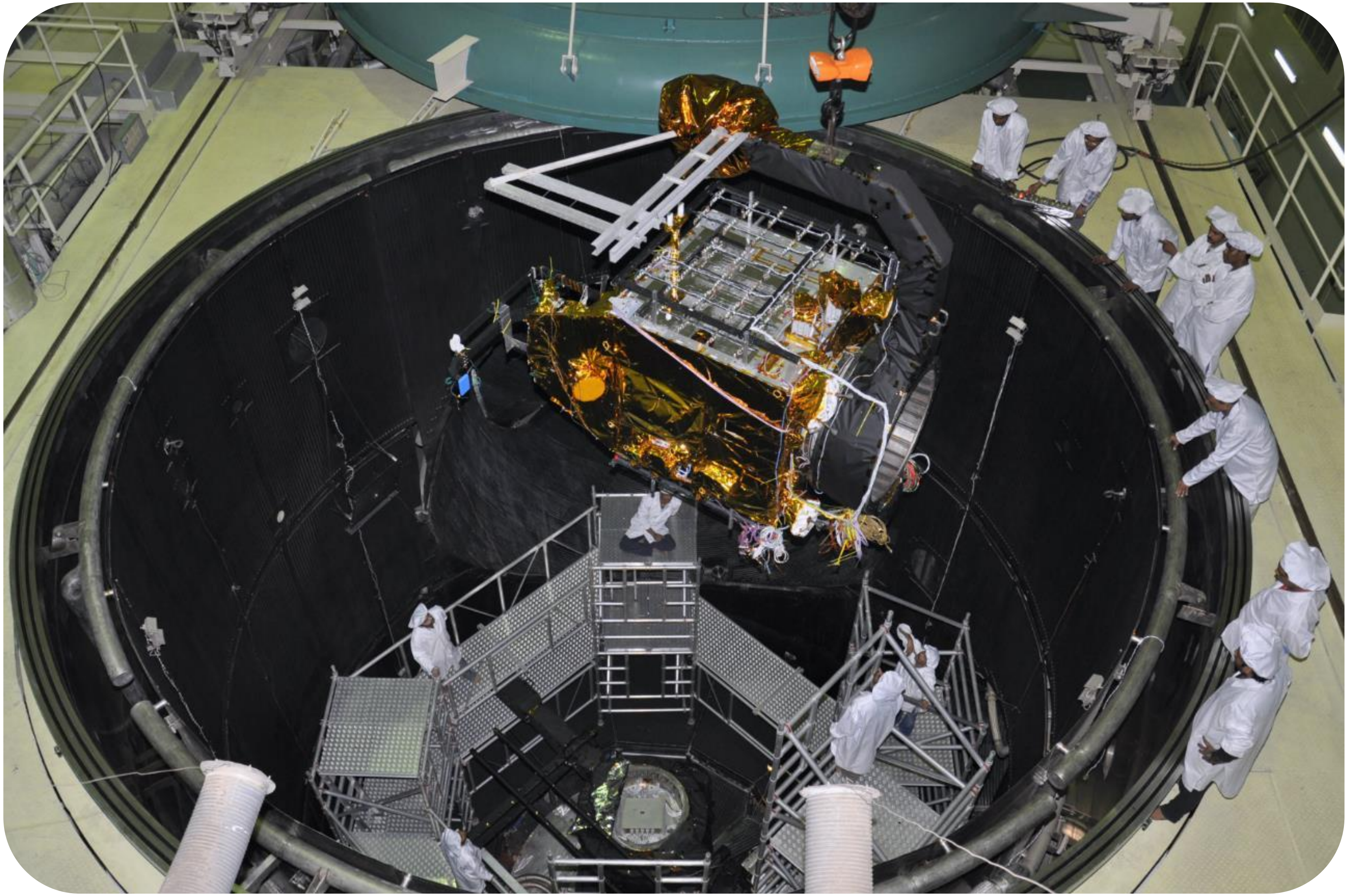
Solar Panel Secondary Deployment Test

Mars Orbiter Mission

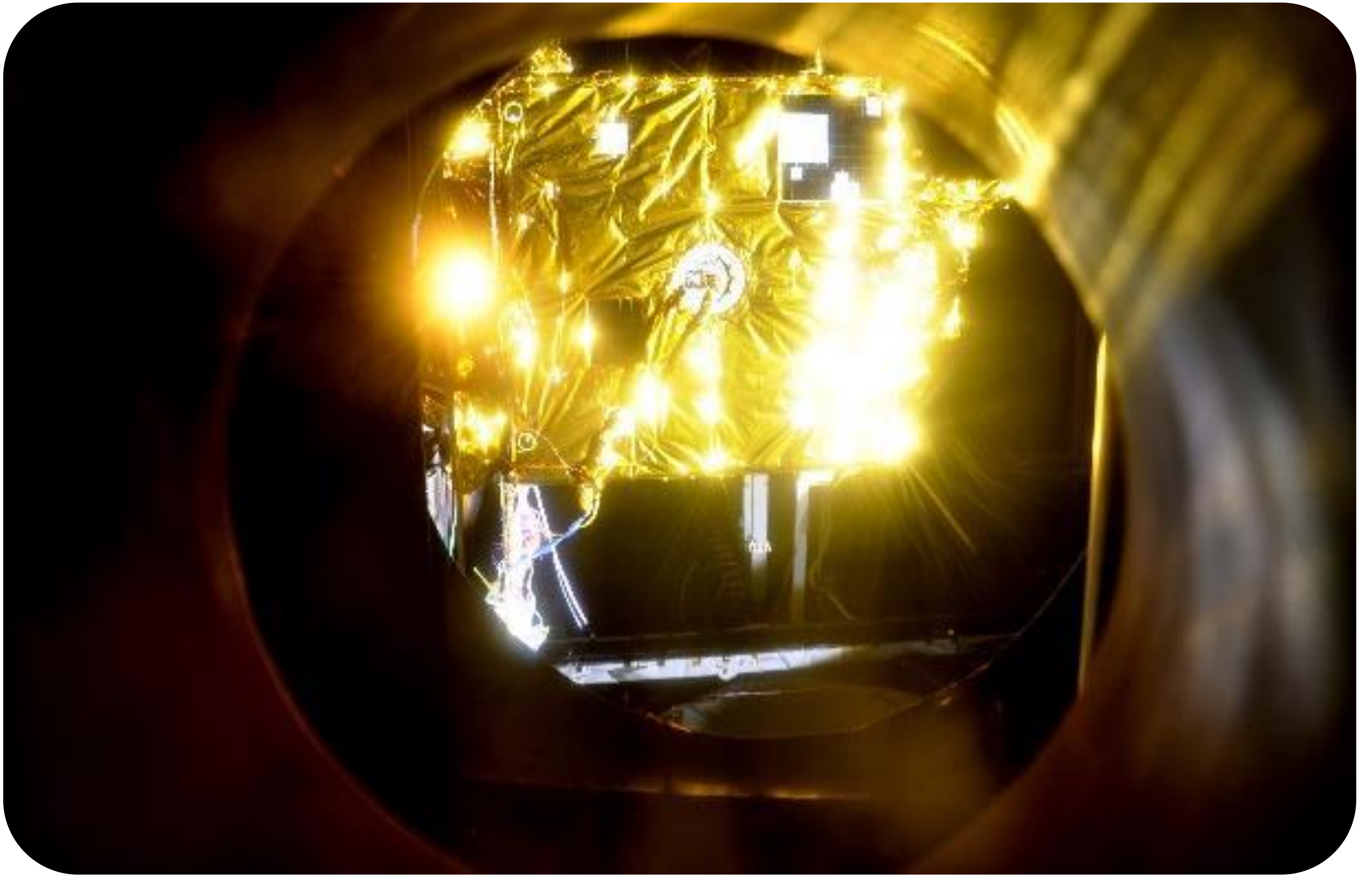


Loading to LSSC for Thermovac test

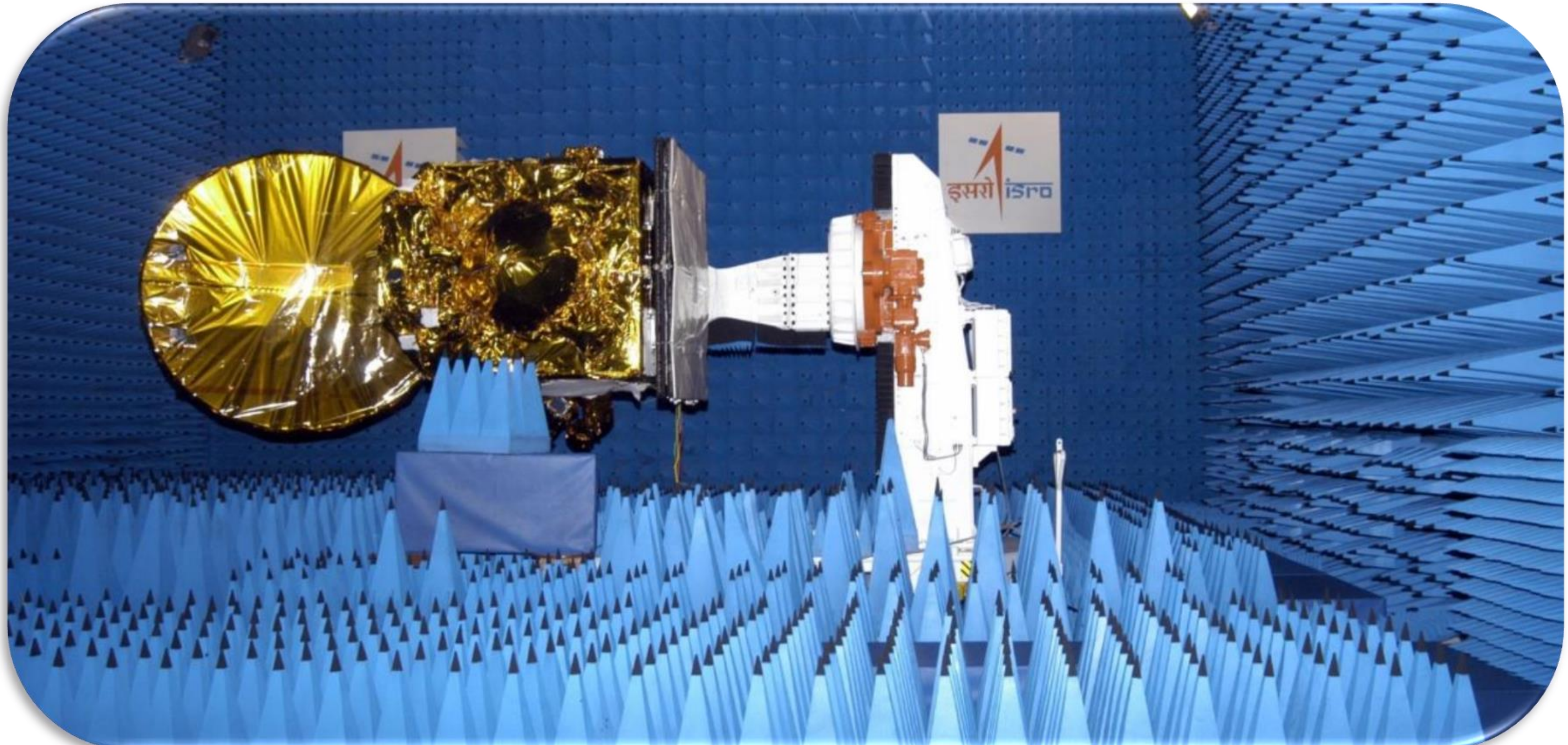
Mars Orbiter Mission



MOM Spacecraft under Thermal Balance Test



EMI/EMC Tests



HGA 2.2m CFRP Reflector deployment tests

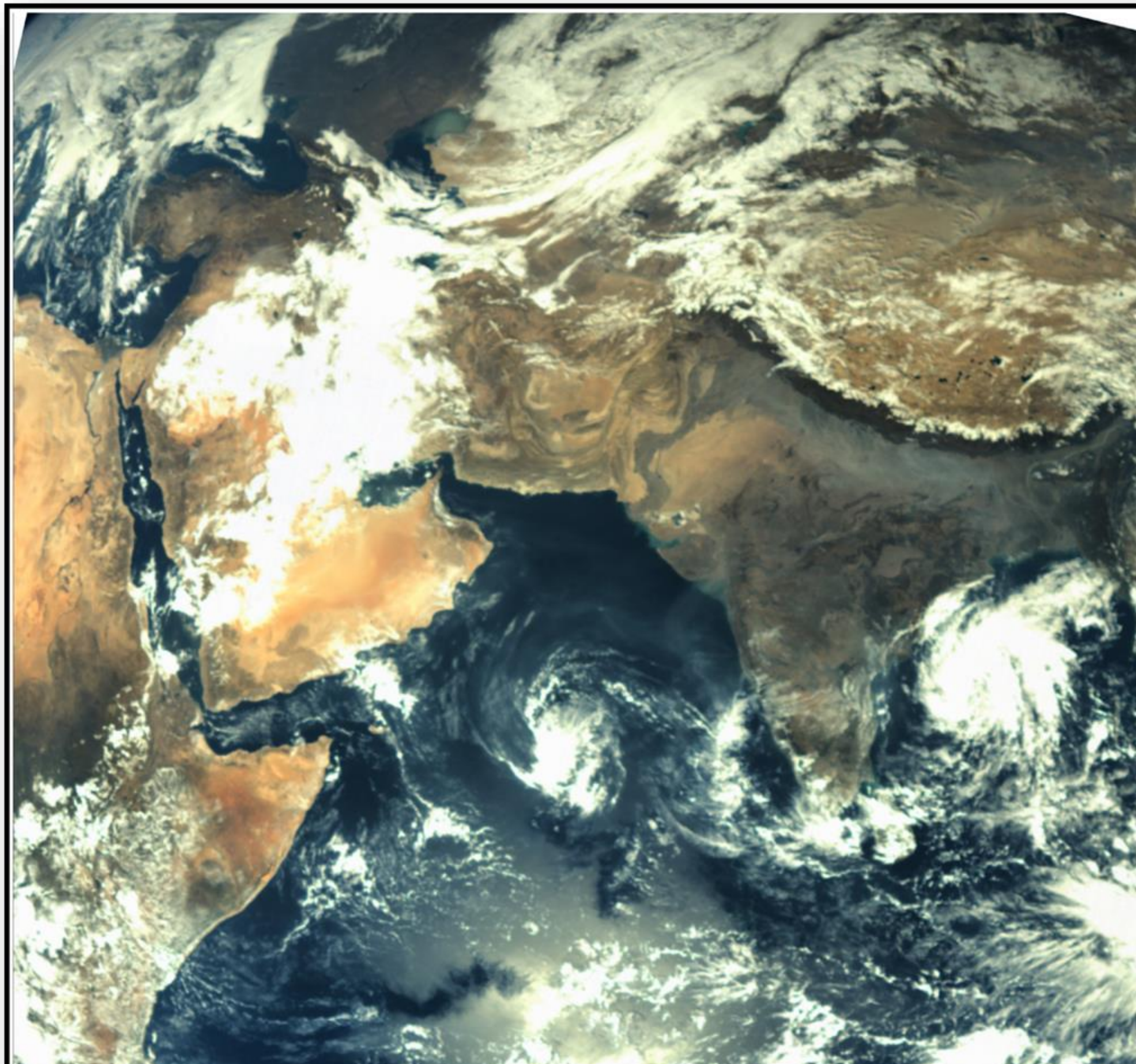
Ground Segment

Mars Orbiter Mission

- 32 m antenna of Indian Deep Space Network (IDSN), Bangalore
- ISRO Telemetry, Tracking and Commanding Network (ISTRAC) Stations
- International ground stations of JPL/NASA

A Portrait of India by MOM

Mars Orbiter Mission



First image captured by Mars Color Camera during calibration in Earth bound phase

The Firsts to MOM's credit!

- Unique launch vehicle trajectory and mission concept
- First interplanetary mission by India
- First Indian spacecraft to escape the Sphere Of Influence of Earth and orbit Sun
- First mars mission in the world to succeed in TMI in first attempt
- First time two spacecraft from different agencies reaching Mars almost simultaneously
- Most economical interplanetary mission in the world-Realized with a budget of ` 450 Cr, including launch Vehicle, Spacecraft and Ground Segment in comparison with NASA's MAVEN with a budget of 6000 Cr. Excluding launch cost
- Shortest Project Schedule-Realized in a schedule of 15 Months- from conceptualization to launch (space, launch & ground segments); MAVEN took ~6 years
- Youngest team accomplished the project in shortest time.
- First Indian spacecraft to successfully survive Van Allen belt crossing 39 times
- First Indian spacecraft to incorporate full scale on-board autonomy
- First to use Ship Borne Terminals to track the launch vehicle by ISRO
- First ISRO project to go online (face book/twitter) enhancing outreach!

Outreach

MOM Team is posting deep insights into the mission, near real-time updates and interacting with about 3 lakh facebook followers on the official page:

Facebook.com/isromom

Dare Mighty Things!

"Far better it is to dare mighty things, to win glorious triumphs even though checkered by failure, than to rank with those timid spirits who neither enjoy nor suffer much because they live in the grey twilight that knows neither victory nor defeat"

-Theodore Roosevelt

Go MOM!