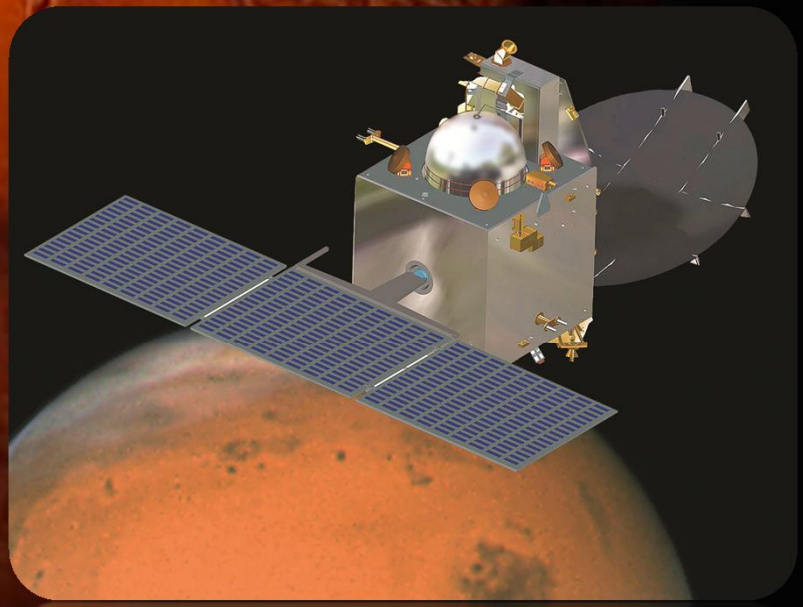
INDIA'S MARTIAN ODYSSEY...

MARS
ORBITER
MISSION



THE MARS ORBITER MISSION

- The Mars Orbiter Mission(MOM) is a spacecraft built by the Indian Space Research Organisation(ISRO) to study Mars.
- ISRO's first interplanetary mission.
- Launched on 5th November 2013 from Sriharikota.
- With its successful insertion into Mars orbit on 24th September, India became the first nation to succeed in its maiden attempt.

MISSION OBJECTIVES

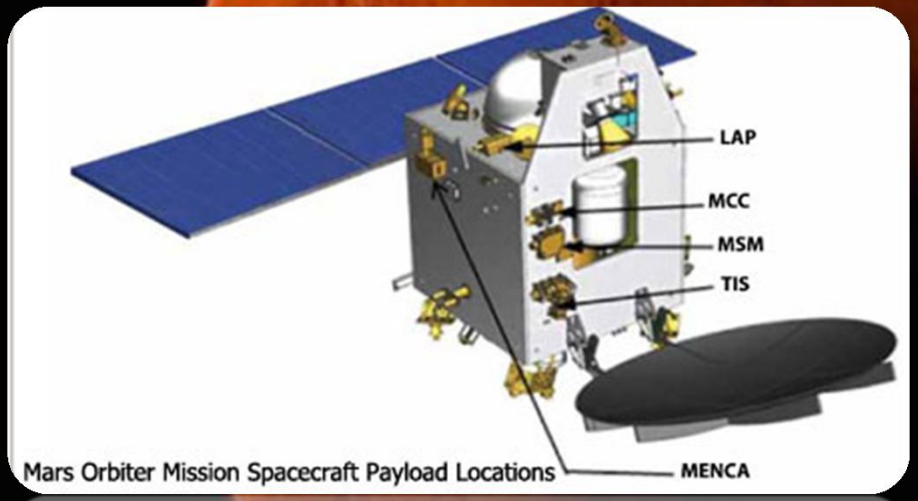
- To design and launch a spacecraft which can reach the Martian orbit
- To conduct deep space mission planning and communication at a distance of 670 million kms
- To develop autonomous features to handle emergency situations
- To explore the atmosphere and surface of Mars by indigenously developed scientific instruments.

ABOUT THE SPACECRAFT

- Mangalyaan weighs 1337 kgs and is roughly the size of a Tata Nano car.
- It has 1 liquid engine and 8 small thrusters for propulsion.
- It also has 3 solar panels, and a high-gain antenna for communication.
- There are 5 indigenously made scientific instruments on MOM.
- Assembled in ISRO Satellite Center, Bengaluru.

MOM'S SCIENTIFIC PAYLOAD

- There are 5 scientific instruments on MOM for the exploration of Mars, which weigh 15kgs in all –
- Mars Colour Camera(MCC)
- Methane Sensor for Mars(MSM)
- Thermal Infrared-imaging Spectrometer(TIS)
- Lyman-Alpha Photometer(LAP)
- Mars Exosphere Neutral Composition Analyser(MENCA).



Payloads

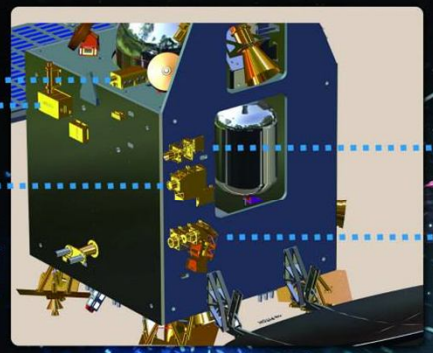
Lyman Alpha Photometer (LAP)

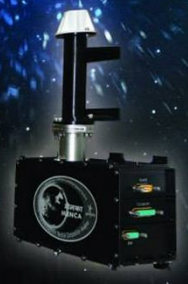
Lyman Alpha Photometer (LAP) is an absorption cell photometer. It measures the relative abundance of deuterium and hydrogen from Lyman-alpha emission in the Martian upper atmosphere (typically Exosphere and exobase). Measurement of D/H (Deuterium to Hydrogen abundance Ratio) allows us to understand especially the loss process of water from the planet.

Methane Sensor for Mars (MSM)

MSM is designed to measure Methane (CH_4) in the Martian atmosphere with ppb accuracy and map its sources. Data is acquired only over illuminated scene as the sensor measures reflected solar radiation. Methane concentration in the Martian atmosphere undergoes spatial and temporal variations.

Atmospheric studies

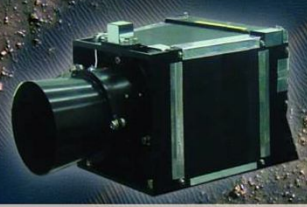




Mars Exospheric Neutral Composition Analyser (MENCA)

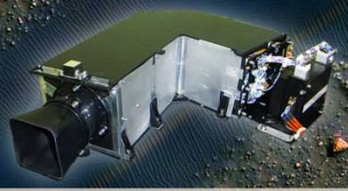
MENCA is a quadruple mass spectrometer capable of analysing the neutral composition in the range of 1 to 300 amu with unit mass resolution. The heritage of this payload is from Chandra's Altitudinal Composition Explorer (CHACE) payload

Particle environment studies



Mars Color Camera (MCC)

This tri-color Mars Color Camera gives images & information about the surface features and composition of Martian surface. They are useful to monitor the dynamic events and weather of Mars. MCC will also be used for probing the two satellites of Mars – Phobos & Deimos. It also provides the context information for other science payloads.

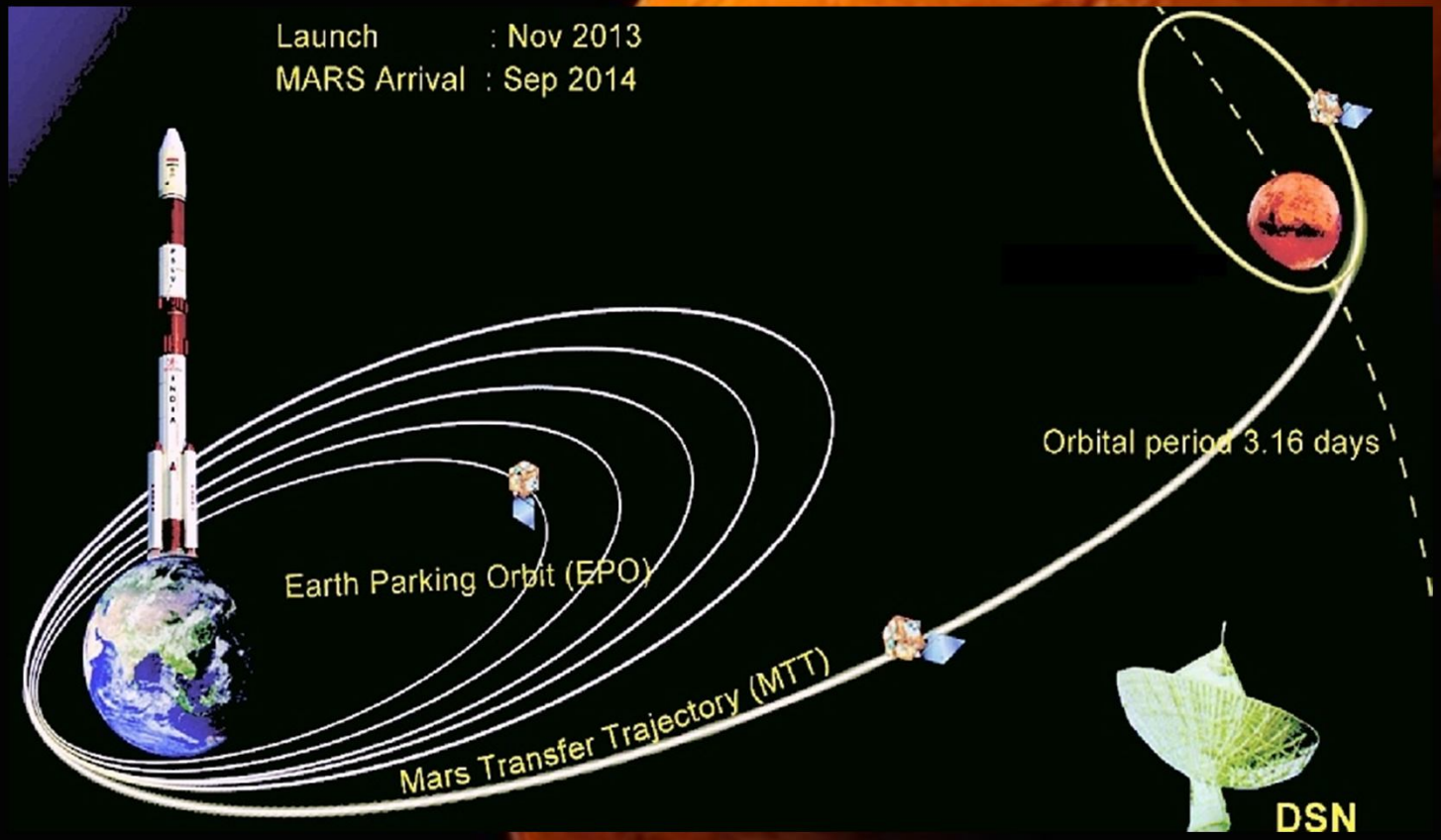


Thermal Infrared Imaging Spectrometer (TIS)

TIS measure the thermal emission and can be operated during both day and night. Temperature and emissivity are the two basic physical parameters estimated from thermal emission measurement. Many minerals and soil types have characteristic spectra in TIR region. TIS can map surface composition and mineralogy of Mars.

Surface Imaging Studies

THE JOURNEY TO MARS..



LAUNCH

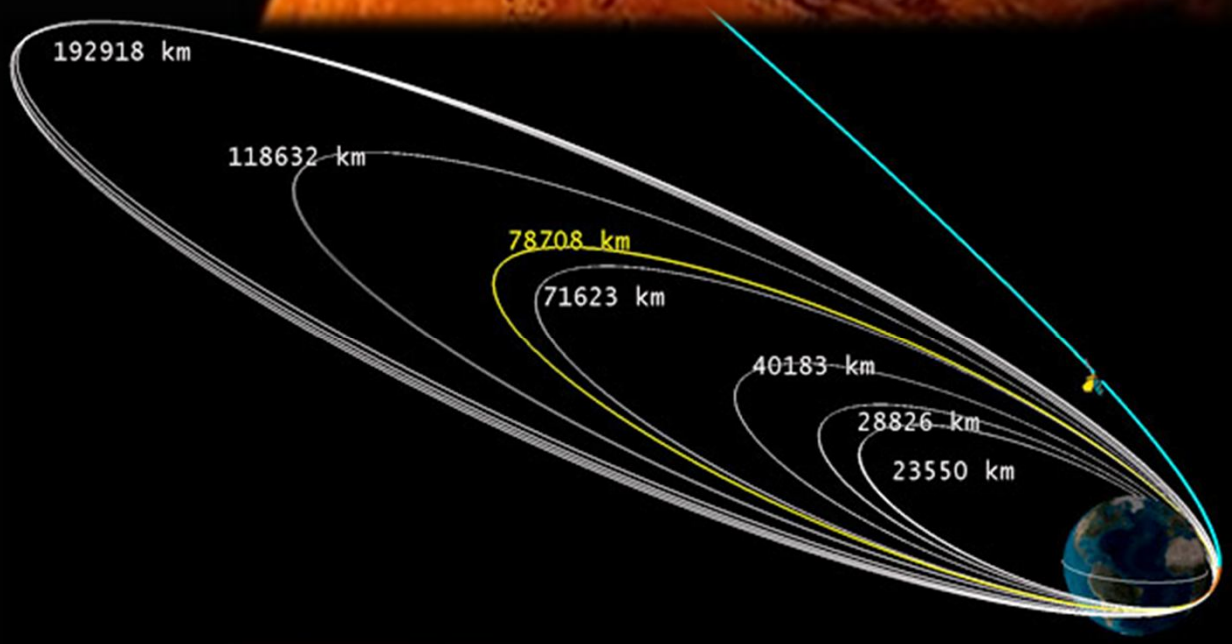
- The Mars Orbiter Mission was launched on 5th November 2013.
- It was launched from the Satish Dhawan Space Center in Sriharikota.
- Launched atop the Polar Satellite Launch Vehicle(PSLV).

LAUNCH VIDEO

India Launch Mangalyaan!
Rocket: PSLV-XL
Payload: MOM (Mars Orbiter Mission)
Launch: 5th November 2013 @ 9:09 UTC/GMT
Footage Length: T-1 Minute to T+3 Minutes

ORBIT RAISING MANOEUVRES

- In order to achieve the velocity required to escape the earth's gravity(escape velocity), 6 orbit raising manoeuvres were performed on 6th, 7th, 8th, 10th, 11th and 15th November.
- These manoeuvres raised the orbit of MOM and also increased its speed, which made it easier to achieve the Earth's escape velocity.



TRANS MARS INJECTION

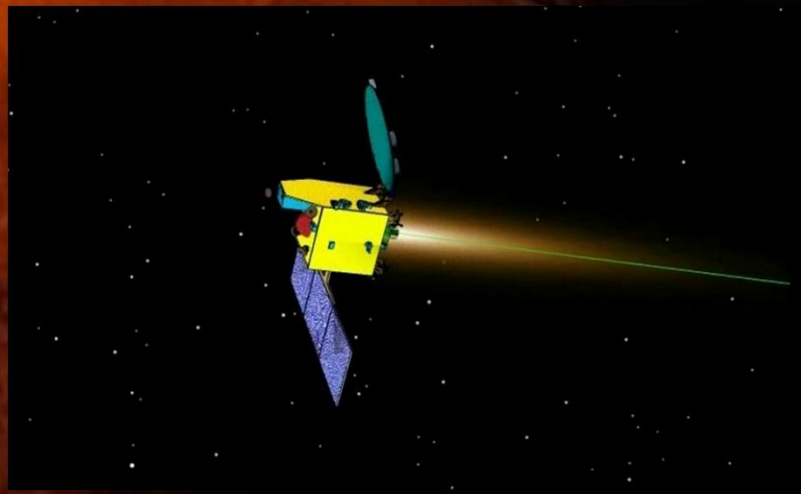
- On 30th November 2013, the engines of MOM were fired for 23 minutes.
- The earth's escape velocity was achieved by MOM and the spacecraft left the earth's orbit.
- The spacecraft then embarked on its 10-month, 670 million kms long journey towards Mars.

TRAJECTORY CORRECTION MANOEUVRES

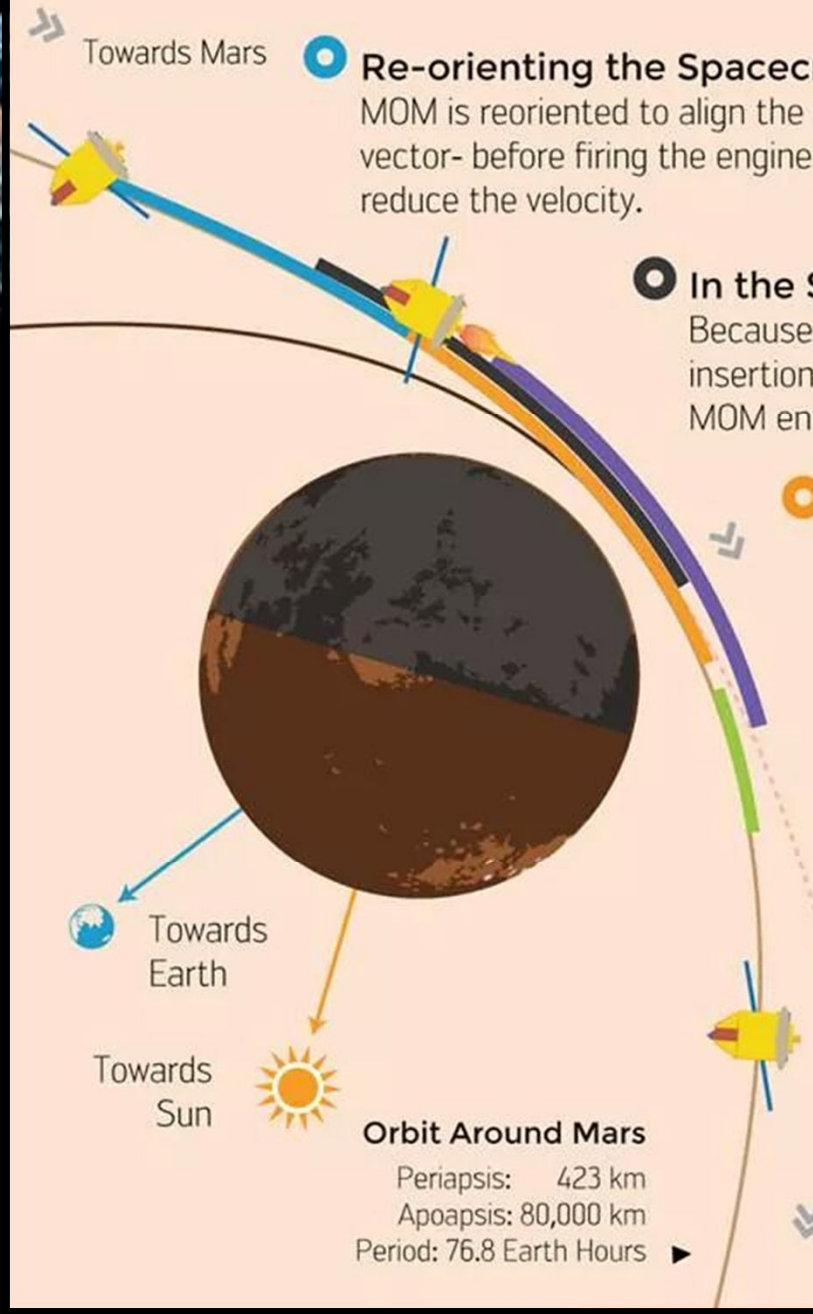
- While the MOM was on way to Mars, 3 trajectory correction manoeuvres were carried out.
- These manoeuvres corrected the path being followed by the MOM on way to Mars.
- Initially, 4 of them were planned but since the spacecraft was moving with great precision, it was postponed.
- A 4-second long manoeuvre was done on 22nd September 2014 , which also tested the main engine(which had been idle since December'13) for the Mars orbit insertion.

MARS ORBIT INSERTION

- On 24th September 2014, the engines were fired for 24 minutes and the MOM was successfully placed in Martian Orbit.
- Initially, the spacecraft was rotated so that it faces opposite to Mars.
- The firing of engines lowered the speed of the spacecraft from 22 km/s to 4 km/s in order to place it in Martian orbit.
- During this, the communication of MOM with the scientists was blacked out due to an eclipse.



Getting Into Martian Orbit



Re-orienting the Spacecraft

MOM is reoriented to align the thrust vector- before firing the engines to reduce the velocity.

In the Shadow of Mars

Because of the Mars-Sun-Earth geometry, the orbit insertion is destined to happen while MOM is in eclipse. MOM enters eclipse 5 minutes before Burn Start.

Engine Firing

The Main liquid Engine and eight smaller thrusters fire, imparting braking velocity of 1098.7 m/s.

The communication blackout

The radio link between MOM and Ground station gets blocked by Mars and MOM executes all operations autonomously.

Resuming Communication

The burn is terminated when the required braking velocity is achieved and MOM is in Martian Orbit. The spacecraft is reoriented to point its Antenna towards Earth to resume communication.

SCIENTISTS AND PM REJOICE AT ISRO

FIRST PICTURE OF MARS

HOW INDIA WILL BENEFIT FROM MOM?

- With the success of MOM, that too on India's maiden attempt, India enters the elite club of countries that have sent successful Mars missions(USA, Russia and Europe).
- With yet another successful launch of the PSLV, ISRO is expected to attract more commercial customers.
- The success of this mission opens gates for more such interplanetary missions by ISRO.
- If MOM is able to sense methane gas on Mars(which no other mission has done till date), then scientists all over the world will benefit from ISRO's achievement.

MOM IN A NUTSHELL

THANK YOU!

BY
TUSHAAR NEB
X-DD