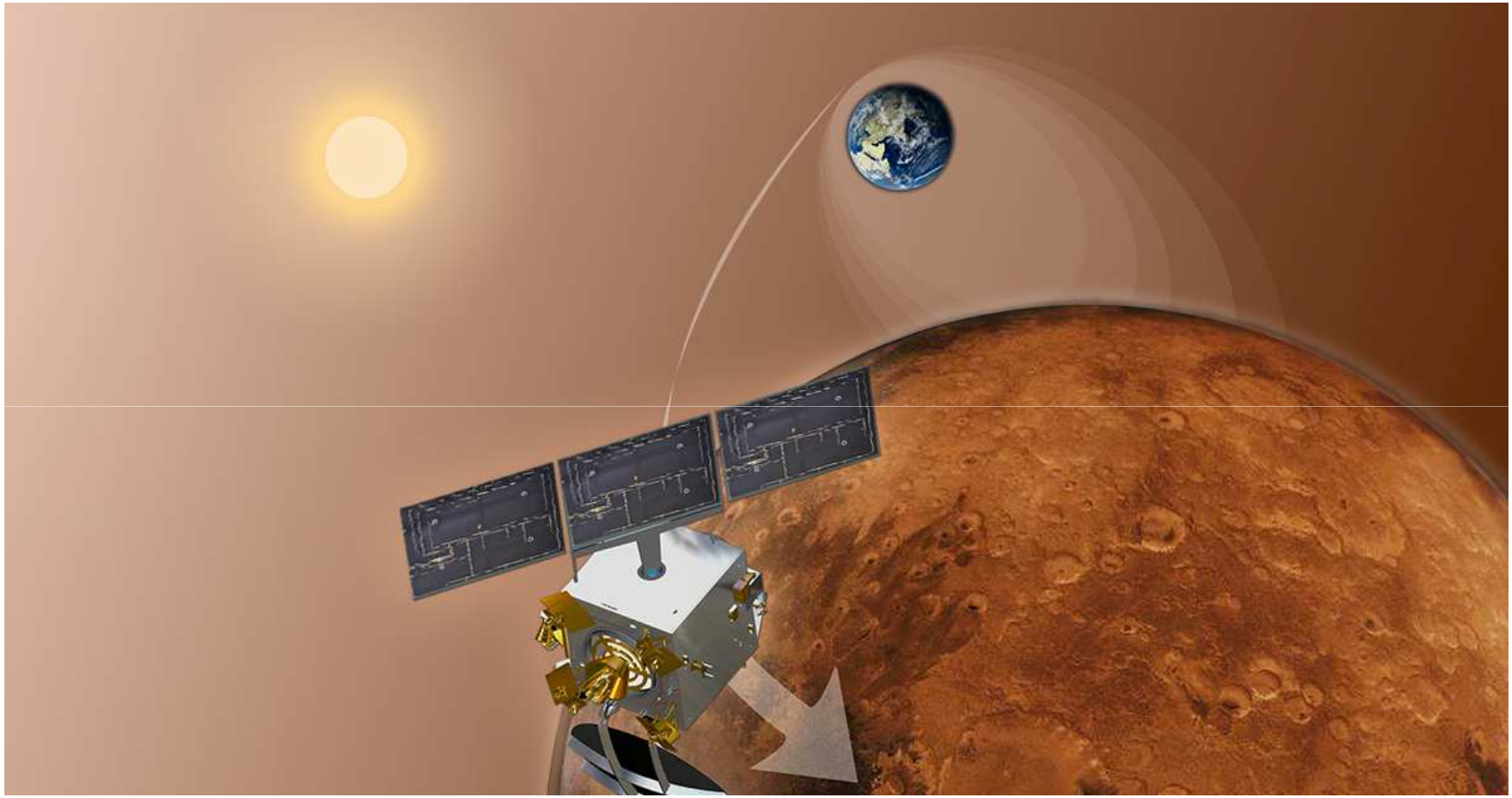
# Mars Orbit Insertion

*Mars Orbiter Mission*



V. Koteswara Rao
Scientific Secretary, ISRO

15-09-2014

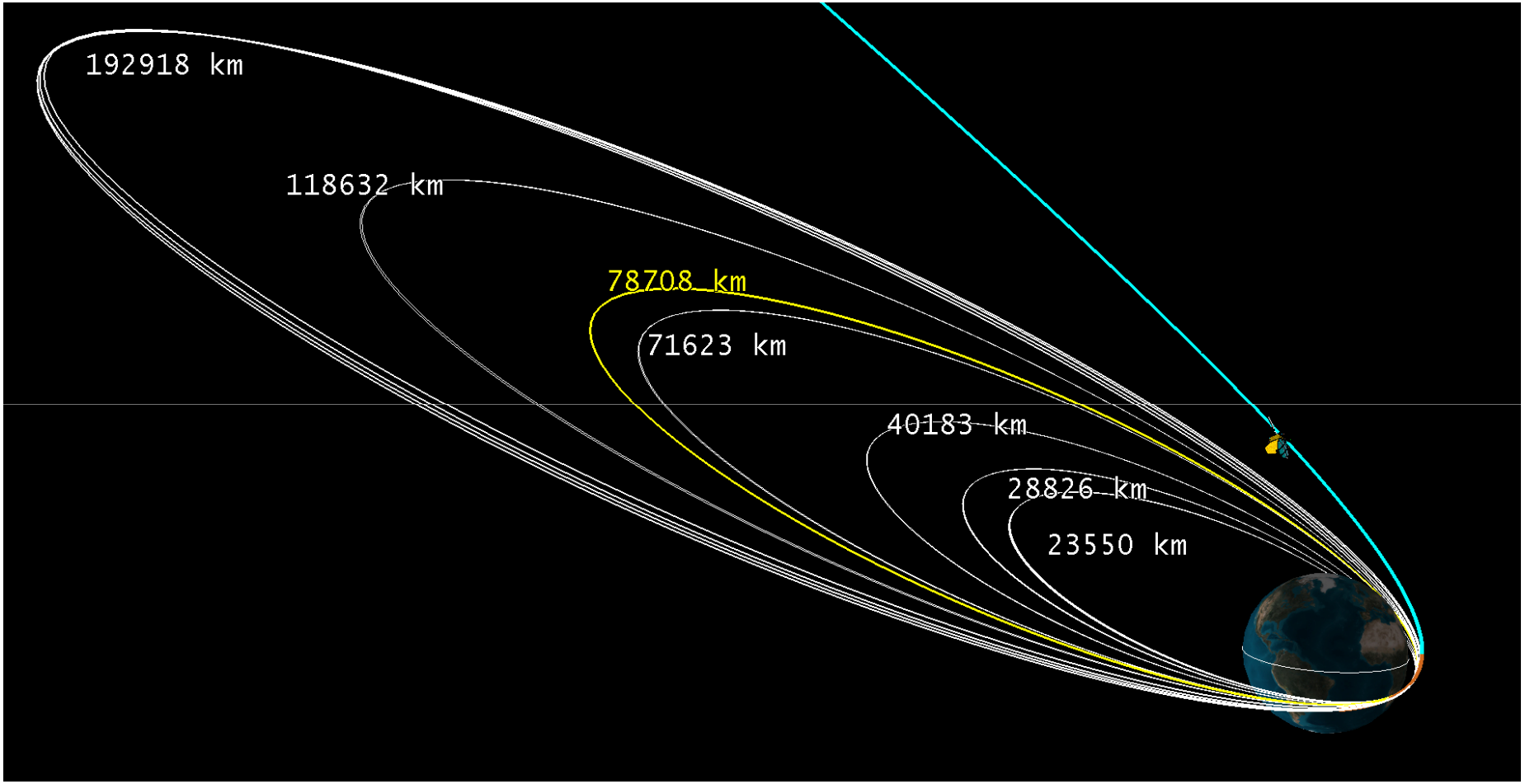
# PSLV C25 launch with Mars Orbiter



PSLV C25 launched the Mars orbiter into an orbit of 250 km X 23,550 km around Earth on 5th November, 2013.

# Geocentric phase and Trans Mars Injection

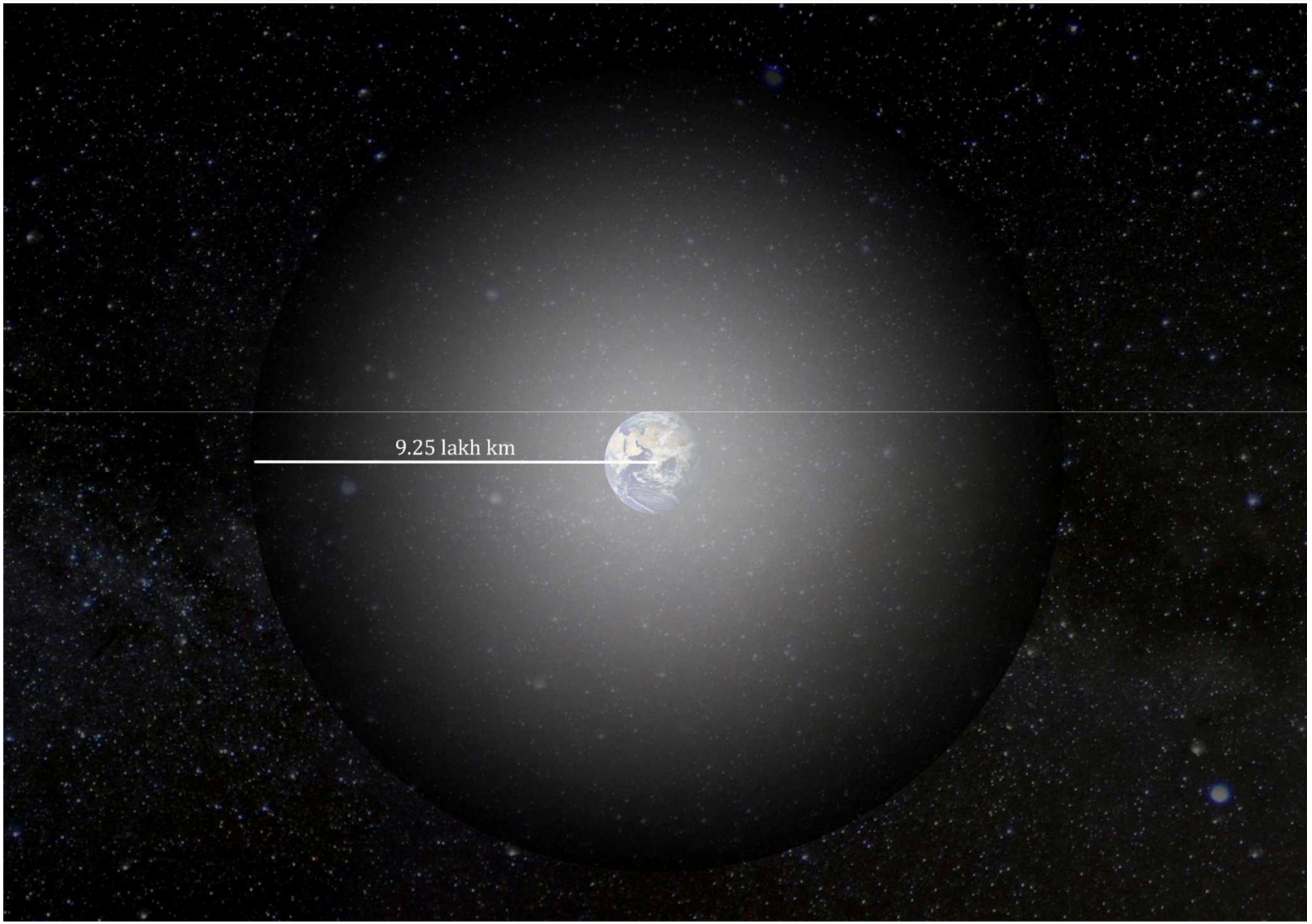
*Mars Orbiter Mission*




- Six Earth Bound manoeuvers were carried out on 7th, 8th, 9th, 11th, 12th and 16th Nov. 2013.
- Trans Mars Injection was carried out on Dec 1, 2013 at 00:49 hrs IST.

# MOM leaves the SOI of Earth

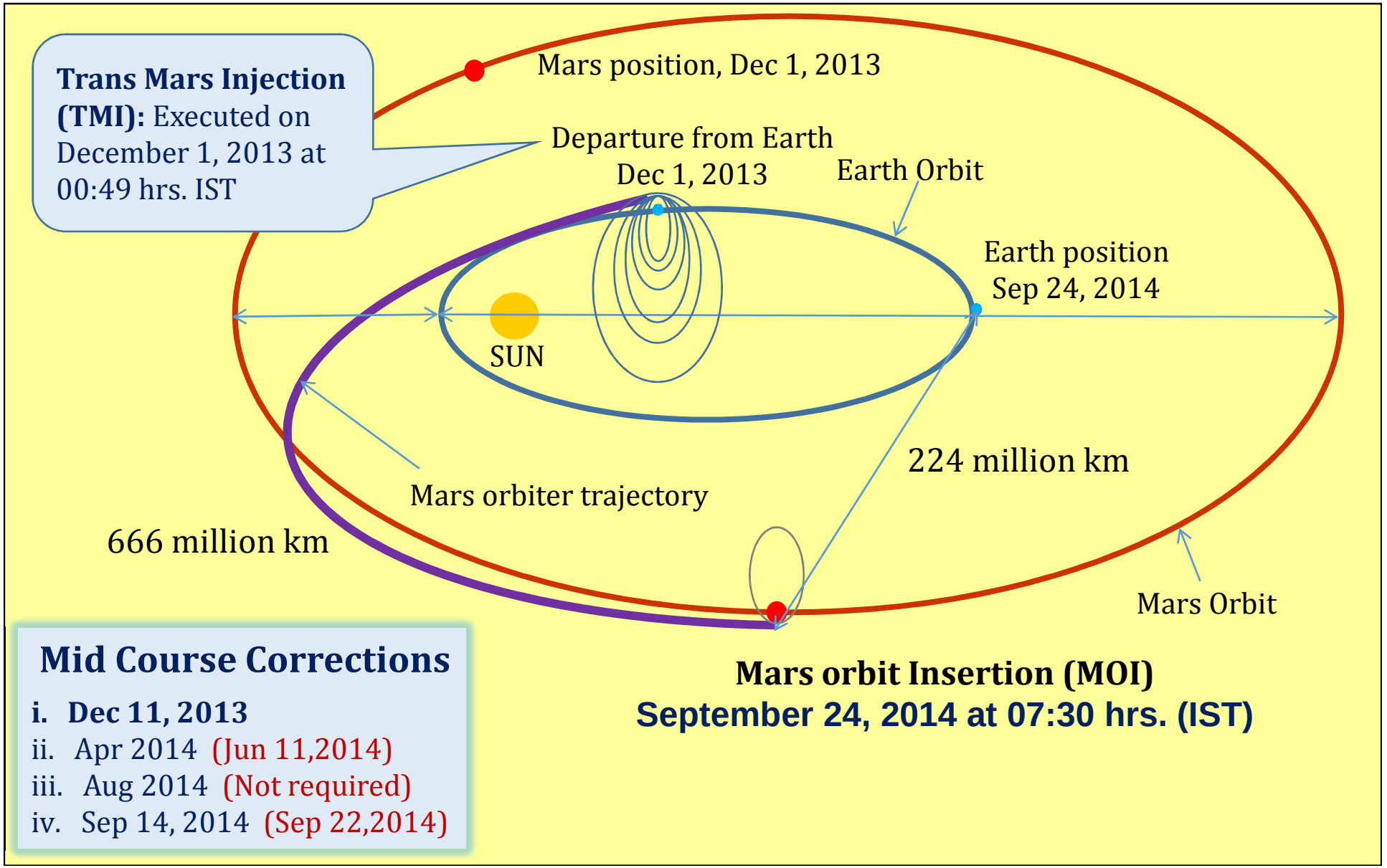





The spacecraft left the Sphere Of Influence of Earth on 4th December, 2013

# Mars Orbiter Mission Trajectory





# The status today

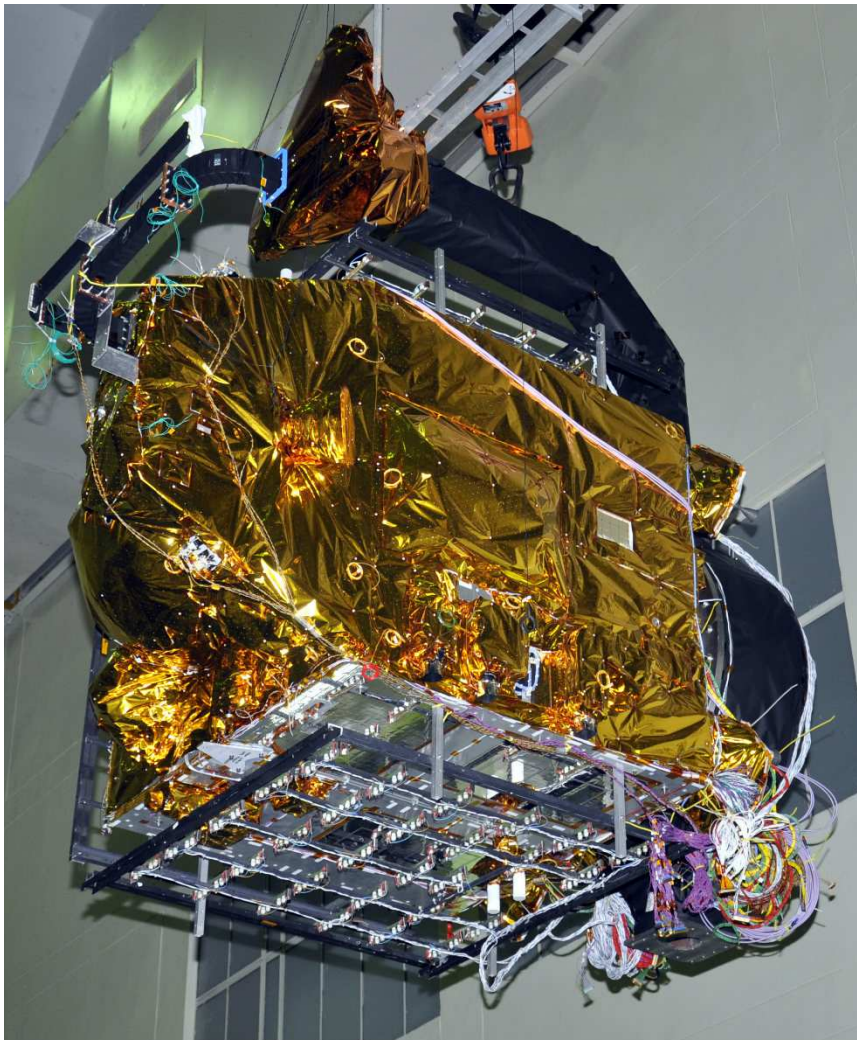
*Mars Orbiter Mission*

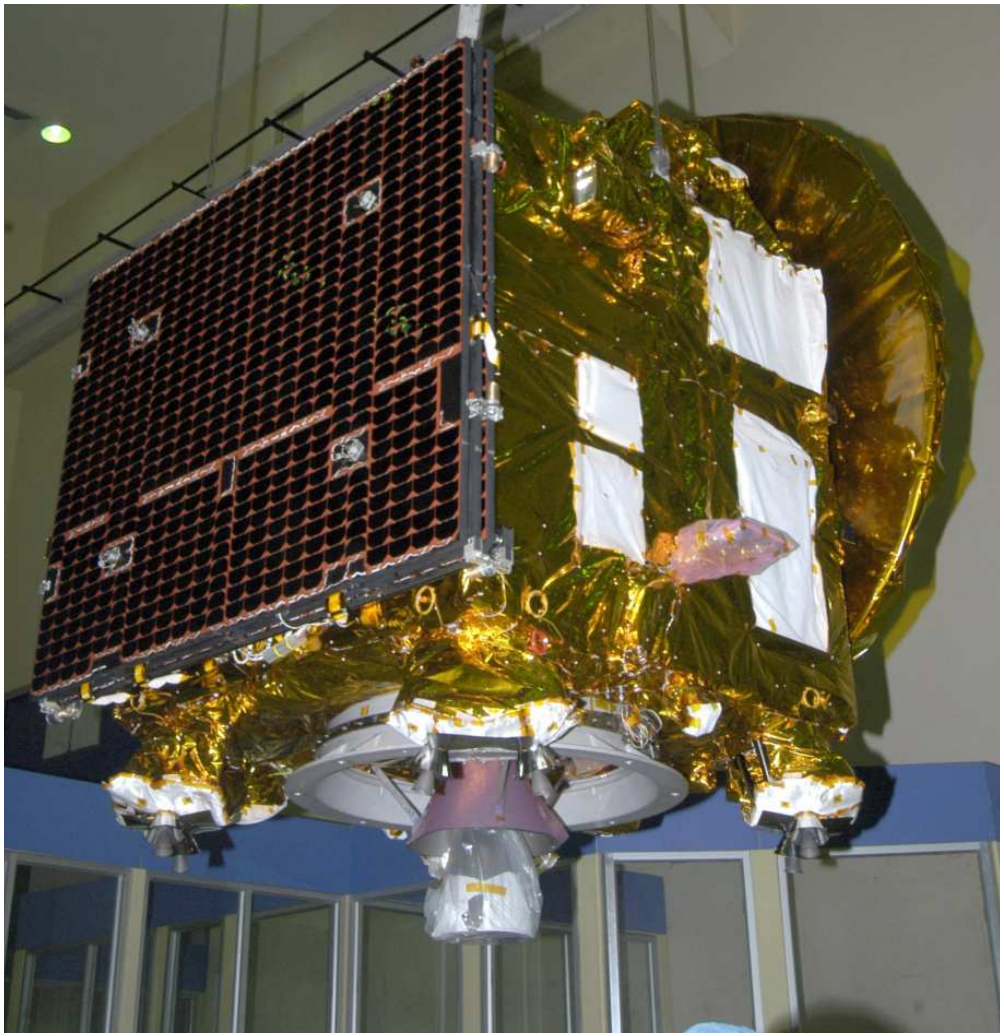
| | | |
|---|---|---|
| 1 | Distance between Earth and MOM | 215 Million kms |
| 2 | One way communication delay | 718 seconds (~ 12 min.) |
| 3 | Distance covered on the Heliocentric path | 653 Million kms |
| 4 | Distance to travel in Heliocentric path to Mars | 13 Million kms |
| 5 | Percentage of the journey covered | 98 % |
| 6 | Distance between Mars and MOM | 2.496 Million km |

**The health of the spacecraft and the payloads is normal**

# The Propulsion challenge

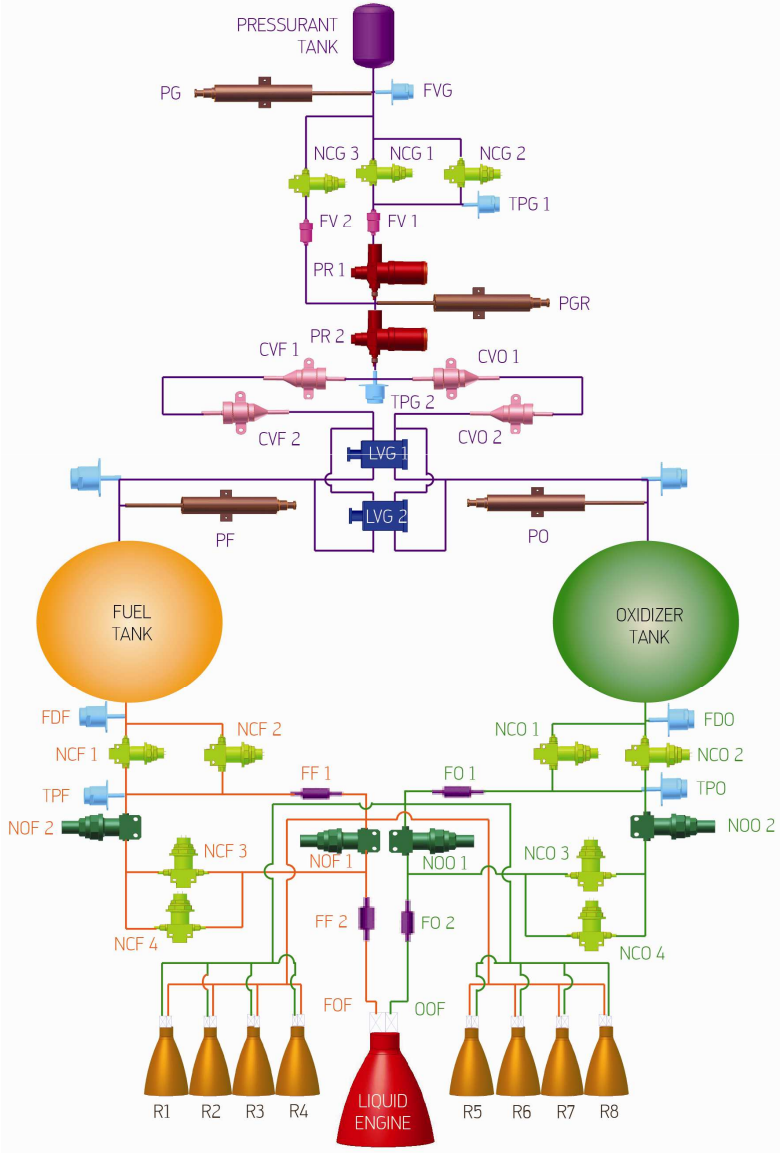
*Mars Orbiter Mission*





# The Propulsion system

*Mars Orbiter Mission*



# Major events before MOI



| Sl. No. | Activity | Date |
|---|---|---|
| 1 | Uploading of commands | 14-09-14<br>15-09-14 |
| 2 | Verification of uploaded commands | 14-09-14<br>15-09-14 |
| 3 | Entry into Sphere of Influence of Mars | 22-09-14 |
| 4 | Fourth Trajectory correction manoeuver and test-firing of Main Liquid Engine<br>• Duration : 3.968 seconds<br>• Fuel consumption: 0.567 kg<br>• ΔV : 2.142 m/s | 22-09-14<br>@1430 Hrs (IST) |
| 5 | Health Monitoring & checks | Ongoing |

# The D Day - 24th September,2014

*Mars Orbiter Mission*

| | When? | IST | What? |
|---|---|---|---|
| 1 | T-3 hours | 04:17:32 | Change over to Medium Gain Antenna |
| 2 | T-21 minutes | 06:56:32 | Forward rotation starts |
| 3 | T-5 minutes 13 seconds | 07:12:19 | Eclipse starts |
| 4 | T-3 minutes | 07:14:32 | Attitude control with thrusters |
| 5 | T | 07:17:32 | Liquid Engine Burn starts |
| 6 | T+4.3 minutes | 07:21:50 | Mars occult starts |
| 7 | T+5 minutes | 07:22:32 | Telemetry OFF |
| 8 | T+ 12.5 minutes | 07:30:02 | Confirmation of Burn start |
| 9 | T+19.48 minutes | 07:37:01 | Eclipse ends |

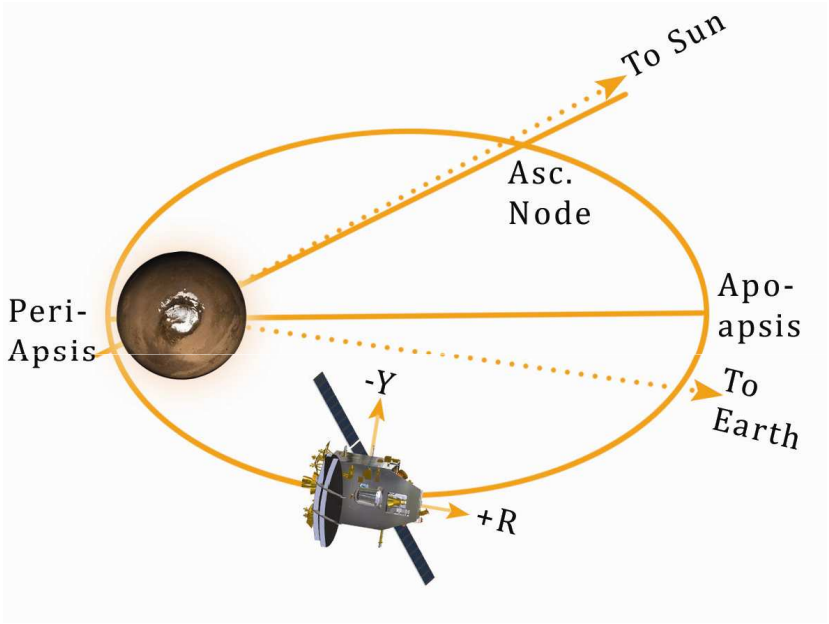
# The D Day-24th September, 2014

*Mars Orbiter Mission*

| | When? | IST | What? |
|---|---|---|---|
| 10 | T+ 24.23 minutes | 07:41:46 | Liquid engine Burn Ends |
| 11 | T+ 25.73 to<br>T+ 47 minutes | 07:42:46 to<br>08:04:32 | Reverse Manoeuver starts |
| 12 | T+ 27.78 minutes | 07:45:10 | Occult ends |
| 13 | T+ 30.43 minutes | 07:47:46 | Telemetry resumes and Doppler measurement to provide first information about total burn performance |
| 14 | T+ 35.23 minutes | 07:52:46 | Reverse Manoeuver ends |

# Nominal orbit around Mars



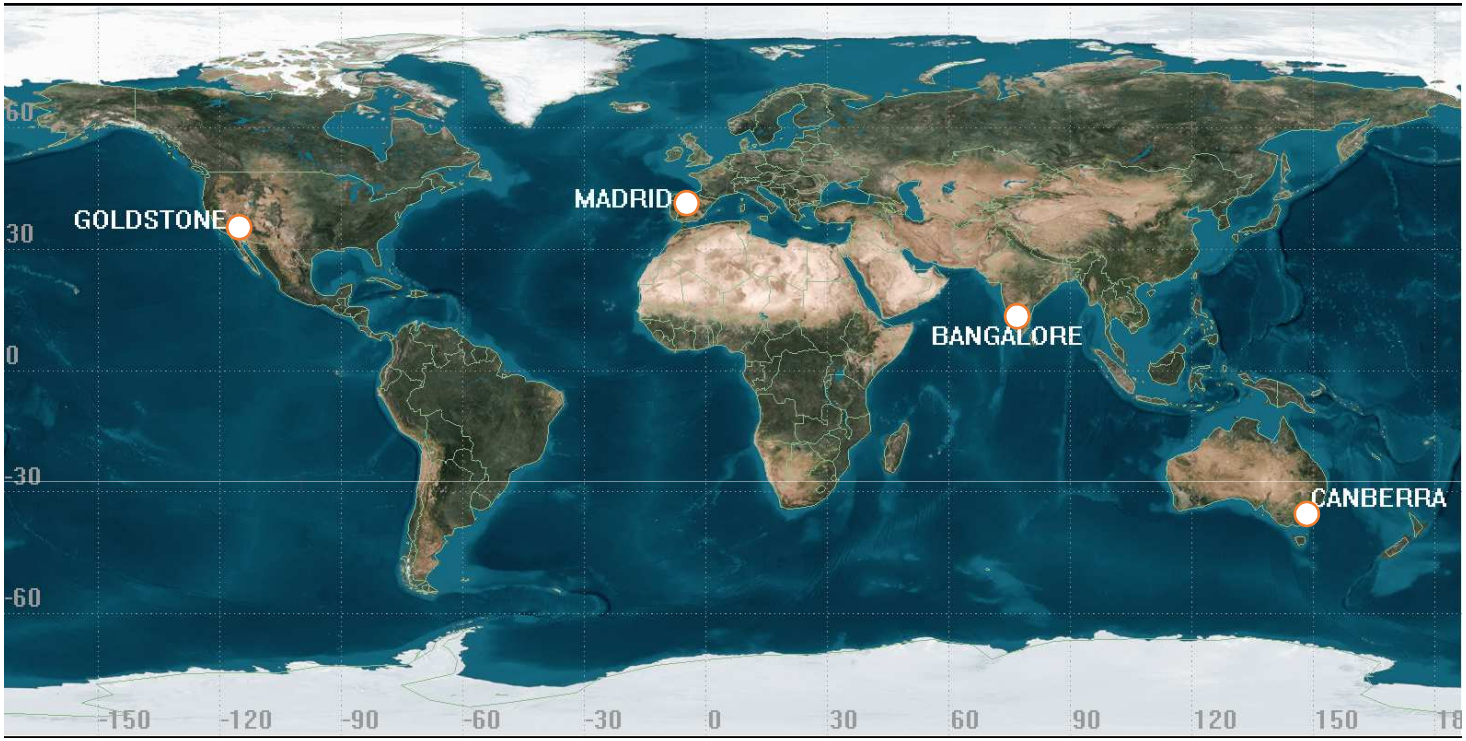



| Mars Orbit Insertion<br>with Main Liquid Engine + 8 AOCE thrusters | |
|---|---|
| Burn duration | 1454 seconds (24 minutes & 14 seconds) |
| Propellant consumption | 249.5 kg |
| ΔV imparted | 1098.7 m/s |
| Nominal Orbit around Mars | 423 X 80,000 Km |
| Orbital period | 3.2 Earth days |

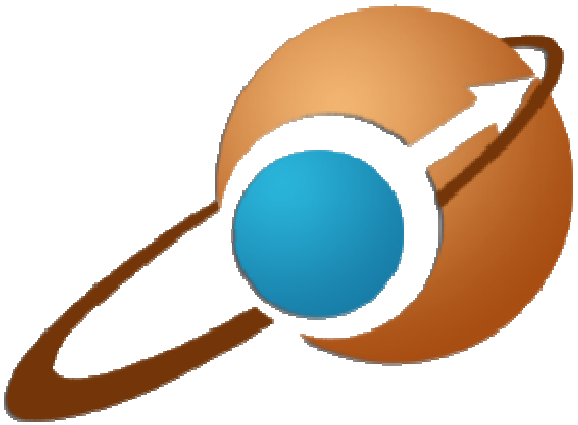
| | |
|---|---|
| Estimated arrival altitude as of now | 723 km |
| Estimated arrival altitude post TCM4/Test firing | 515 km |

# Ground Station Support During MOI

*Mars Orbiter Mission*




| Indian Deep Space Network | India |
|---|---|
| Goldstone | USA |
| Madrid | Spain |
| Canberra | Australia |



# ***Thank You***

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