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INDIA'S MAIDEN MARS MISSION PUTS ISRO ON A NEW HIGH

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The much awaited tryst of the Indian first Interplanetary spaceflight carrying the spacecraft christened 'Mangalayan' succeeded in its very first attempt creating history on September 24, 2014.[1] The 440N Liquid Apogee Motor (LAM) along with the onboard thrusters was initiated at 0730 hours to place the spacecraft in the desired elliptical orbit with a periapsis of 423 Km and an apoapsis of 80,000 km. With this, Indian Space Research Organisation (ISRO) has achieved a new milestone by becoming the first Asian country to insert a satellite in the Martian orbit, that too at the very first attempt and is now the fourth space agency in the world after NASA, Russian Federal Space Agency and European Space agency to accomplish a Mars mission. The project was approved by the government on August 03, 2012 and thus is one of the accomplishments of ISRO in a record time.[2] Also, the project has been completed at a meagre spending of Rs. 450 Crore[3] and is the cheapest interplanetary mission in world at almost the tenth of cost of similar missions.

The Mars Orbiter Mission (MoM), christened Mangalayan was successfully launched from SHAR, Sriharikota on November 05, 2013 aboard PSLV C-25 and has entered the Mars orbit after a journey of nearly 700 million kilometres over 324 days. After being inserted smoothly into an elliptical orbit, the spacecraft underwent through a series of orbit raising manoeuvres from November 07, 2013 to November 16, 2013. The spacecraft after a "Trans Mars Injection (TMI)" manoeuvre involving firing of its main LAM engine on December 01, 2013 was put in the Mars Transfer Trajectory (MTT). During the course of its journey, only

a few trajectory correction manoeuvres were attempted successfully by firing of thrusters. As the LAM engine had remained idle for a prolonged duration after its last use on December 01, 2013, the insertion of spacecraft in its slated orbit on September 24, 2013 was completely dependent on the revival of this engine. The most dreaded and the only major glitch expected was the restart of LAM engine after a prolonged idle period of more than 300 days. The ISRO scientists were aware of the possibility of malfunctioning of this engine, and thus had already incorporated redundant valves and fuel pipelines. In wake of this, the team of scientist planned out a test firing of LAM for a duration of four seconds on September 22, 2014. The successful conduct of this test not only resulted in trajectory correction[4] but imparted the required confidence to the scientist community to proceed amicably towards the final manoeuvre slated for morning of September 24, 2014. The spacecraft weighing at 1340 kg had carried a propellant fuel of 852 kg and now would be left with estimated 60 kg of fuel as the final manoeuvre towards orbit insertion is completed.[5] Thus, with this the possibility of life expectancy of MoM has gone way beyond the expected time of six months.

Mars has always been the prime focus of interest to our scientific community owing to proximity and resembling earth in many ways. Just like earth, Mars rotates on its axis in 24 hours and 37 minutes. In comparing the time of 365 days required by the earth orbit the sun; Mars completes its orbit in 687 days.[6] The gravity of Mars is one third of the Earth's gravity and has a thin atmosphere with atmospheric pressure of one percent as compared to earth.[7] Thus, human interest in Mars has continued from ages and possibility of sustaining life on this planet has intrigued man over a considerable time. Quoting Dr K Radhakrishnan, Chaiman ISRO, the need to invest in space programme is "for finding solutions to the problems of man and society."[8] Exploration of Mars will enable better understanding of our planet. The mission will help study of Martian surface as well as the atmospheric and mineral composition. Any telltale signs of life or evidence that life in primitive form existed may assist us to understand the origin of life and in latter case will help in understanding as to why life got eradicated. The Mangalayan spacecraft has carried 5 payloads weighing a total of around 15 kg. These payloads comprise of a Lyman Alpha Photometer (LAP) to study the loss of water from the planet, a methane sensor, a

spectrometer to help in particle environment studies, a coloured camera to transmit Martian images and information to earth and Thermal imaging spectrometer to carry out surface studies.[9]

ISRO's main objective of Mars mission is to mature the required designs of satellites and launch system as vehicles for technology development and demonstration. With the success of the mission, ISRO has gained experience in propulsion and power systems, automation, robotics and sensors and this would go a long way in planning for its future space assignments. The mission also demonstrates the trade-offs between existing and newer technologies like cryogenic fluid management, Solar power, Nuclear propulsion, Nuclear power, communication system and spacecraft autonomy. In addition to the research and development that went into this project, ISRO will benefit immensely in the planning, management and operations fields for progressive space missions. It will help India in enhancing the capability in space from scientific, commercial and military viewpoint. Long-term objectives of mission Mars will be to study the planetary evolution and origin of life, composition of planet, its geological evolution, dynamics of Martian atmosphere, origin and history of water and life and its extant and extinct. The study will also help ascertain possibility of futuristic human settlement.

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End Notes

[1] "Mars Orbiter Mission", at http://www.isro.org/mars/updates.aspx accessed on September 24, 2014

[2] "Mars Orbiter Mission: 10 facts you should know", at http://zeenews.india.com/news/sci-tech/mars-orbiter-mission-10-facts-you-should-know_1474425.html accessed on September 23, 2014

[3] ibid

[4]"Mars Orbiter Mission", at " http://www.isro.org/pressrelease/scripts/pressreleasein.aspx?Sep22_2014 accessed on September 23, 2014

[5] "Can MoM have a longer life?", at http://timesofindia.indiatimes.com/home/science/Can-MOM-have-a-longer-life/articleshow/43263162.cms accessed on September 23, 2014

[6] Mars Orbiter Mission", at http://www.isro.org/pslv-c25/pdf/pslv-c25-brochure.pdf accessed on November 12, 2013

[7] ibid

[8]"India's first space rocket blasts off to Mars", at http://www.bbc.co.uk/newsround/24815541 accessed on November 12, 2013

[9] "Mars Orbiter Mission", at http://www.isro.org/pslv-c25/pdf/pslv-c25-brochure.pdf accessed on November 12, 2013