

# US and Indian probes successfully reach Mars orbit

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US and Indian spacecraft entered orbit around Mars this week, with the US-launched Mars Atmosphere and Volatile Evolution (MAVEN) making a successful braking maneuver on Sunday night, September 21, and the Indian Mangalyaan (Mars Orbiter Mission in Hindi) duplicating this feat on Wednesday morning.

Both missions took advantage of the favorable conjuncture between Mars and Earth that occurs only once every 780 days, launching last November and making nearly identical ten-month journeys of 711 million kilometers to reach the fourth planet from the Sun.

The orbital insertion maneuver once a mission reaches Mars (or any planet) is one of the most precarious operations in space exploration. Spacecraft must brake sharply, from a speed of 22 kilometers per second, and very precisely, in order to be captured by the planet's relatively weak gravitational field. Moreover, since Mars is currently 216 million kilometers away and signals take 12 minutes to reach Earth, the entire process must be automated.

As a result of these difficulties, more than half of all previous Mars missions have failed to reach their destination safely, either flying past the planet or crashing into it. The Indian mission was the first time that a country's space organization succeeded in reaching Mars orbit on its initial attempt.

Mangalyaan's successful insertion into Mars orbit was the occasion for a full-scale chauvinistic celebration by the right-wing government of the new Prime Minister, Narendra Modi, who was at the ISRO command center in Bangalore during the event. This included telling children across India to be in school before 6:45 a.m. local time to watch the insertion on state television.

Modi boasted that India had succeeded where China had failed in 2012 and Japan in 1999, making it the first

Asian country to reach another planet. The ISRO called it a "national pride event" and suggested that the low cost of the mission, only \$72 million compared to \$672 million for the US MAVEN, showed that India was developing a more cost-efficient approach that would have commercial value.

From a scientific standpoint, the US and Indian missions are at opposite ends of the spectrum. Mangalyaan has comparatively few instruments—only one percent of its total weight. It is designed to showcase the growing technical abilities of the Indian Space Research Organization, especially following the failure of a Chinese mission to Mars in 2012.

The MAVEN spacecraft is a platform for investigating the atmosphere of Mars, particularly the outermost layer, in an effort to determine how the planet lost most of its once abundant envelope of carbon dioxide, nitrogen, oxygen, water vapor and other gases.

Chief mission scientist Bruce Jakosky, speaking at a press briefing last week, said, "One of the really overarching questions about Mars is whether there was ever life." Studying the atmosphere means "We're learning about the history of the habitability of Mars."

Referring to the lost carbon dioxide and surface water, both evidenced in studies of the planet's surface by previous missions, Jakosky posed the question, "Where did the water go? Where did the CO<sub>2</sub> go from that early environment?" He continued, "It can go two places: down in the crust or up to the top of the atmosphere where it can be lost to space."

The purpose of the MAVEN mission is to test the second possibility, particularly the impact of the solar wind on the planet's outer atmosphere. Previous observations from the Mars Express orbiter have shown that the solar wind—the stream of charged particles

emitted by the Sun—penetrates deeply into the Martian atmosphere and could account for much of the water loss during the planet's four-billion-year history.

The MAVEN spacecraft will spend about six weeks circling downwards toward its final orbit around the planet, dropping from an initial 35-hour oblong orbit to a tight circle taking just four and a half hours.

After several weeks of testing its eight instruments to ensure that they are working properly after the ten-month voyage, scientists at the University of Colorado's Laboratory for Atmospheric and Space Physics, who are the primary group managing the mission, will study the impact of comet C/2013 A1, also known as Siding Spring, which passes within 130,000 kilometers of Mars on October 19. Jakosky said, "The odds of having an approach that close to Mars are about one in a million years, so it's really luck that we get the opportunity here."

The arrival of MAVEN and Mangalyaan brings the number of spacecraft orbiting Mars to five, joining the Mars Odyssey and Mars Reconnaissance Orbiter, both operated by NASA, and the Mars Express orbiter of the European Space Agency. Both Mars Express and Mars Reconnaissance Orbiter used ground-penetrating radars to look for water deposits in the planet's crust, but they found nothing.

In addition, NASA operates two rovers on the surface of the planet, Opportunity and Curiosity, making the efforts to study Mars the largest for any of the planets of the solar system.

While the insertion of Mangalyaan into Mars orbit is a scientific achievement, it also demonstrates the pernicious impact of national rivalries on space exploration. The ISRO essentially had to reinvent the wheel, including methods to navigate from Earth to Mars, duplicating efforts already undertaken by the United States, Europe, Russia and China.

The US operations on Mars demonstrate another reactionary consequence of capitalist anarchy. The recent budget submitted by the Obama administration, for the fiscal year beginning October 1, zeroes out Opportunity. A rover that has survived a decade of hostile conditions on the Martian surface may not survive the hostile conditions of Washington politics.

Besides shutting down Opportunity, the Obama budget would also kill the Lunar Reconnaissance Orbiter, now circling the Moon and sending back a

steady stream of data about Earth's nearest neighbor. Last year Opportunity cost \$13.2 million to operate and the LRO only \$8.1 million—rounding errors in a \$3 trillion budget, of which more than \$1 trillion goes to the military, intelligence and nuclear weapons production.

Also currently zeroed out, although money is expected to be restored in a supplemental appropriation, are the Curiosity rover, the two Mars orbiters, the NASA contribution to the ESA's Mars Express orbiter, and the Cassini space probe orbiting Saturn.



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