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INDIA'S STAR RISES

Another giant leap in space programme as Isro's Aditya-L1 is successfully placed in halo orbit near sun

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NEW DELHI: At 4pm on Saturday, India made history by parking its observatory — Aditya-L1 — in an orbit around Lagrange Point 1, about 1.5 million kilometres from us, setting the stage for at least five years of observations.

Scientists at the Indian Space Research Organisation (Isro) performed a series of manoeuvres to place the craft in its intended halo orbit on Saturday, 12½ days after the mission was launched on September 2 last year.

"Halo-Orbit Insertion (HOI) of its solar observatory spacecraft, Aditya-L1 was accomplished at 4pm on January 6," the space agency said after the insertion.

Prime Minister Narendra Modi hailed the achievement as "landmark" as he congratulated

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Aditya-L1 reaches parking spot

The spacecraft was placed in a halo orbit around the Lagrange Point 1 (L1) of the Sun-Earth system on Saturday, in a new milestone for India's space programme

127 DAYS-LONG JOURNEY

Earth SOI exit
Cruise phase
Halo orbit insertion in L1
Aditya L1
Earth centered orbit transfer
1.5 million km

STEPS SO FAR

Once it left Earth's gravitational Sphere of Influence (SOI), the cruise phase started. On Saturday, the spacecraft was injected into a large halo orbit around L1 by firing short burns of the engines

1.5 MILLION KM from the Earth distance of L1 from Earth

Lagrangian Points are positions in space where the gravitational forces of a system like the Sun and Earth create pockets of equilibrium. These can be used by spacecraft to stay docked in a single position without requiring to burn fuel

Each planet, with respect to the Sun, has five such points — L1 to L5. Of these, L1 and L2 are closest to the planet, and thus serve as good spots for observational missions

PM MODI LEADS IN CONGRATULATING TEAM ON SUCCESS OF SOLAR MISSION

NEW DELHI: The successful docking Aditya-L1 in a halo orbit around Lagrange Point 1 drew congratulatory messages from across the political spectrum, with Prime Minister Narendra Modi leading the wishes.

"India creates yet another landmark, India's first solar observatory Aditya-L1 reaches its destination," Modi said and lauded the "relentless dedication" of scientists.

President Droupadi Murmu lauded the scientific community, and said, "This mission will enhance our knowledge of the sun-earth system and benefit the entire humanity."

"From moon walk to sun-stance," remarked Union minister Jitendra Singh, recalling the Isro successes including the soft landing of Chandrayaan-3 and the launch of the XPoSat.



spacecraft was placed in a low-Earth orbit. Subsequently, the orbit was made more elliptical, and the craft was catapulted towards its final destination using onboard propulsion. Once it left Earth's gravitational Sphere of Influence (SOI), the cruise phase started.

On Saturday, the final manoeuvres were performed, which involved "firing of control engines for a short duration" to control the speed of the craft, and orient it towards the orbit by maintaining a minimum fuel consumption condition, Isro said.

Explaining the process, an official said that the craft was moving from the Earth towards L1 in the direction of the Sun.

"A final firing was done at this point, making the spacecraft align with the Halo Orbit. If the HOI (Halo Orbit Insertion) manoeuvre was not conducted as done today, the spacecraft would have moved in the direction marked (towards the Sun)," the Isro statement added.

"A successful insertion further involved constant monitoring along with the adjustment of the spacecraft's speed and position by using onboard thrusters. The success of this insertion not only signifies Isro's capabilities in such complex orbital manoeuvres, but it gives confidence to handle future interplanetary missions," the statement read.

The orbit of Aditya-L1 is periodic, located roughly 1.5 million km from Earth on the continuously moving Sun-Earth line with an orbital period of about 177.86 Earth days.

"This specific Halo orbit is selected to ensure a mission lifetime of 5 years, minimising station-keeping manoeuvres and thus, fuel consumption and ensuring a continuous, unobstructed view of sun," Isro said.

Highlighting the scientific importance of the mission, Isro chief S. Somanath said, "The solar mission, Aditya-L1 is for the whole of the world, not for India alone, for all of us to understand and make use of its scientific importance."

While the space agency had the option of performing multiple attempts at adjusting the orbit of the spacecraft, it was preferred that the manoeuvre be completed in a single attempt to avoid utilisation of excess fuel.

An excess fuel bank ensures

the space agency has the window to perform additional experiments with the same craft. This was also the case with the propulsion module of Chandrayaan-3 when it was brought back to the Earth's orbit to test for future return missions. This was possible only because the propulsion module of Chandrayaan-3 had excess fuel.

The spacecraft is equipped with seven payloads to study the Sun's corona, chromosphere, photosphere and solar wind. From L1, the spacecraft will be able to see how particles and radiation from heightened solar activity has an effect, while also studying the outer surface of the star in close detail — something that is normally not possible from the Earth, or even its orbit.

ADITYA-L1
the scientists for their "relentless dedication".

"India creates yet another landmark. India's first solar observatory Aditya-L1 reaches its destination. It is a testament to the relentless dedication of our scientists in realising among the most complex and intricate space missions. I join the nation in applauding this extraordinary feat. We will continue to pursue new frontiers of science for the benefit of humanity," PM Modi said on X, formerly Twitter.

The insertion of Aditya-L1 into the Halo Orbit presents a critical phase for the mission, which demanded precise navigation and control, the space agency said in a statement.

The L1 point mentioned in the statement refers to Lagrange Point 1, a region where gravitational forces of celestial objects work in such a way that the spacecraft can be parked in what is known as a halo orbit — an oval that shifts on three axes.

Following its launch, the

127-day journey paves way for crucial data on space weather

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NEW DELHI: The Aditya-L1 spacecraft on Saturday completed a 127-day journey to reach its final parking spot, reading itself for five years of crucial observations about various aspects of the Sun.

After the successful insertion of Aditya-L1 into a Halo Orbit around Lagrange Point L1, a region about 1.5 million kms from the Earth, ISRO chief S Somanath said that the satellite will have a mission life of at least five years and findings calculated in this period will be significant not just for Indian scientific community but for the world.

Understanding the Sun is not important for India alone, everyone around the world is looking forward to the findings," Somanath said in his address to media after the space agency's scientists performed the final set of manoeuvres to place the craft in a halo orbit around L1.

From L1, the spacecraft will be able to see how particles and radiation from brightened solar activity has an effect, while also studying the outer surface of the star in close detail — something that is normally not possible from the Earth, or even its orbit.

Giving details about the 1.5 million km journey of the craft, Annapurni Subramaniam, director of Indian Institute of Astrophysics, said it was completed in three phases — the earth-bound orbit, the cruise phase and finally the insertion of the craft into the halo orbit. Now the orbit phase of the mission will start where the experiments will be turned on.

"This is a big milestone for us. Now that the craft has been inserted into a halo orbit around L1, we will start the process of operating all the science instruments on-board. The next phase will be a performance evaluation phase and we will start receiving data," Subramaniam said. IIA designed the primary payload, the Visible Emission Line Coronagraph (VELC).

Experts associated with the mission said that in the coming days, shutters of all instruments on board will be opened, operationalising them. After a few rounds of tests, the first set of data will also start coming in.

"By mid-January, we should start receiving the first set of data from L1," said Jagdev Singh, the first principal investigator of India's solar mission.

The country's first solar observatory is carrying seven payloads to study the Sun's corona, chromosphere, photosphere and solar wind.

The seven payloads include — VELC, which is the primary pay-

Its destination Sun for Aditya

India's first solar observatory Aditya-L1 on Saturday reached its destination, an orbit around the L1 point. A look at the key aspects of the mission

ON SEPT 2

ISRO launched Aditya-L1 on board its PSLV-XL, which placed it in the Low-Earth Orbit. Later, four Earth-bound manoeuvres were performed

ON SEPT 30

The spacecraft escaped the sphere of Earth's influence (SOI), beginning its journey to the Sun-Earth Lagrange Point (L1)

ON JAN 6

ISRO performed the Halo-Orbit Insertion (HOI) maneuver, parking the craft in the halo orbit at 4pm

Science objectives

The primary objective is to observe the solar atmosphere — the chromosphere and the corona, the two outermost layers of the star. The major scientific objectives include

"The success of this insertion not only signifies ISRO's capabilities in such complex orbital manoeuvres, but it gives confidence to handle future interplanetary missions," the space agency said

MISSION DURATION: 5 YEARS

The orbit for Aditya-L1 was selected to ensure a mission lifetime of five years, minimising station-keeping manoeuvres, fuel consumption and ensuring a continuous, unobstructed view of Sun, ISRO said

loads; Solar Ultraviolet Imaging Telescope (SUIT); Solar Low Energy X-ray Spectrometer (SoLEXS); High Energy LI Orbiting X-ray Spectrometer (HELIOS), which are remote sensing payloads; Aditya Solar wind Particle Experiment (ASPEX); Plasma Analyser Package for Aditya (PAPA), Advanced Tri-axial High Resolution Digital Magnetometers, which are in-situ payloads.

Using the special vantage point L1, four payloads (VELC, SUIT, SoLEXS, HELIOS) will directly view the sun, and the remaining three payloads (ASPEX, PAPA and Advanced Tri-axial High Resolution Digital Magnetometers) will carry out

in-situ studies of particles and fields at L1, providing scientific studies of the propagatory effect of solar dynamics in the interplanetary medium, the space agency said.

Somanath said that Aditya-L1 mission will unravel many aspects of the space weather, which will prove to be crucial for the scientific community world over.

The National Aeronautics and Space Administration (NASA) in its documents have highlighted that activity on the Sun's surface creates a type of weather called space weather. While the Sun is around 150 million kms from the Earth, space weather can affect

Understanding the coronal heating and solar wind acceleration

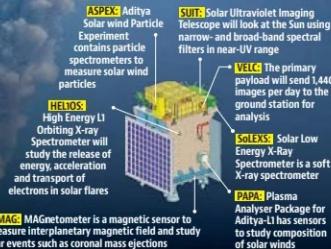
To understand coupling and dynamics of solar atmosphere

Understanding initiation of coronal mass ejection, flares and near-Earth space weather

To understand solar wind distribution and temp anisotropy

Payloads on board

Aditya-L1 is carrying seven scientific payloads developed indigenously in collaboration with ISRO



Earth and the rest of the solar system, in worst cases damaging satellites and causing electrical blackouts on Earth.

"Strong solar flares generate intense radiation, hurling extreme ultraviolet and X-ray photons our way. CMEs (coronal mass ejections) are massive eruptions that eject vast amounts of magnetized plasma, reaching speeds up to millions of km per hour. These are sources of severe space weather," said Dibyendu Nandi, professor of physics and head, Center of Excellence in Space Sciences India, Indian Institute of Science Education and Research in Kolkata.

CONGRATULATORY MESSAGES POUR IN

India creates yet another landmark. India's first solar observatory



Aditya-L1 reaches its destination
NARENDRA MODI, PM

Another grand feat accomplished by ISRO. This mission will enhance our knowledge of the sun-earth system and benefit the entire humanity



DROUPADI MURMU, President

India is no longer to be led by other countries, we are ready to lead others to give them cues. Space economy is also going to be an important part of India's growth story



JITENDRA SINGH, Union MoS

Aditya-L1 is for the whole of the world, not for India alone, for all of us to understand and make use of its scientific importance



SOMANATH, ISRO chief