Smooth operation of 'LAM' critical to Aditya-L1 success

The ISRO will be using a Liquid Apogee Motor identical to the one used in the Mars and moon missions, says LPSC chief; the motor will be shut down for the best part of the four-month journey

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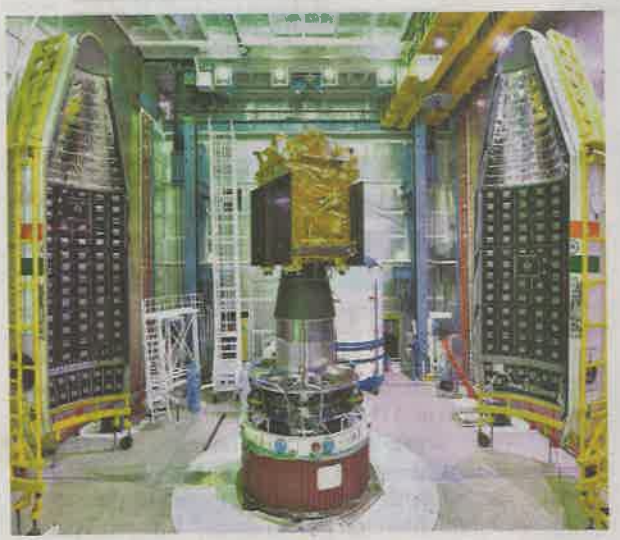
A small but powerful engine going by the acronym 'LAM' will have a critical role to play in the upcoming Aditya-L1 mission of the Indian Space Research Organisation (ISRO) to study the sun.

The successful operation of LAM, short for Liquid Apogee Motor, is vital to the ISRO's plans to place the Aditya spacecraft in a halo orbit at Lagrangian Point L1.



Moving forward: The rehearsal for the launch of the Aditya-L1 Mission was completed in Sriharikota on Wednesday. ISRO TWITTER

Tried and trusted

Developed by the Liquid Propulsion Systems Centre (LPSC), the ISRO centre for liquid and cryogenic propulsion in Thiruvananthapuram, LAM has played an important role in missions, including the 2014 Mars Orbiter Mission (MOM), Mangalyaan, and the more recent Chandrayaan-3.

In simple terms, LAM engines are used for orbital adjustment manoeuvres of satellites and spacecraft in orbit.

For the Aditya-L1 mission, the ISRO will use a LAM identical to the one used in the Mars and moon missions, says LPSC Director V. Narayanan.

Aditya-L1 is the first 'space-based observatory class Indian solar mission to study the sun', the ISRO said.

Newton thrusters

The ISRO is planning to launch the mission using a Polar Satellite Launch Vehicle (PSLV-XL) on September 2.

Once the Aditya spacecraft exits the earth's sphere of influence and heads toward its destination – the Lagrangian Point L1 which is 1.5 million km away – the LAM will shut down for the best part of the four-month journey.

The propulsion system of the spacecraft comprises the 440 Newton LAM engine plus eight 22 Newton thrusters and four 10 Newton thrusters which will be intermittently fired.

The thrusters will be used to correct the orientation of the spacecraft as it traverses the vast emptiness of space.

The big challenge before the ISRO is restarting LAM at the precise moment for 'braking' the spacecraft as it closes in on its destination and nudging it into the desired halo orbit at L1.

During the Mangalyaan mission, this critical manoeuvre, 'waking' the LAM engine after an extended 'hibernation', had given ISRO scientists nail-biting moments.

Identical, yet different

"The propulsion module system on Aditya-L1 is identical to the one used on Chandrayaan-3. The LAM engine is similar. Its propellant combination (mono-methyl hydrazine (MMH) and MON3 (MON, short for mixed oxides of nitrogen) too is the same. Its volume is different, hence propellant tank sizes are also different," says Dr. Narayanan.

About 1.5 million kilometres from the earth between it and the sun is L1, one of the five Lagrangian points or 'equilibrium points' in the sun-earth system.

The Aditya spacecraft is to be placed in a halo orbit at this vantage point in space to carry out studies with its seven scientific payloads.

Coronagraph of Aditya-L1 will send 1,440 images of sun

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The VELC will be able to observe the corona from Lagrange Point 1 of the sun-earth system

The Visible Emission Line Coronagraph (VELC), the primary payload on board India's first dedicated scientific mission, Aditya-L1, to study the sun, will be sending 1,440 images of the sun every day to ground stations. The VELC, developed by the Indian Institute of Astrophysics (IIA), Bengaluru, will be able to observe the corona continuously from the Lagrange Point 1 (L1) of the sun-earth system, which is about 1.5 million km from the earth.

Aditya-L1 is scheduled to be launched by the Indian Space Research Organisation (ISRO) from the Satish Dhawan Space Centre in Sriharikota at 11.50 a.m. on Saturday.

"Though Aditya-L1 mission will be launched on September 2, there will be a cruise phase of 100-plus days before it reaches the L1 point. Once it reaches that point, the doors will be open from most likely from the first week of January 2024 and we will make continuous observations for using the VELC payload," Ramesh R., principal investigator of the VELC payload, told *The Hindu*. Professor Ramesh added that the VELC payload would be sending 1,440 images of the sun in a day.

"With so much data, the ground segment should be ready to process these images in real time and within a turnaround time of 24 hours these should be sent back to ISRO so that the data are disseminated to the scientific community and the public," he said.

"We need tremendous computing power for which the IIA is ready and all the software are being tested so that with the minimum overlap time the data from the spacecraft will be downloaded at the Indian Deep Space Network in Byalalu from where they will process the L0 data [Level 0] data and send them to the payload operations centre in the IIA which will be processed within 24 hours and sent back to the Indian Space Science Data Centre for dissemination," Professor Ramesh said. There will be six other payloads on board the Aditya-L1, whose mission life is five years.