

STARWARD LAUNCH: ADITYA-L1 TO CARRY PAYLOAD TO STUDY SUN'S CORONA

BALA CHAUHAN @ bengaluru

ADITYA-L1, India's first dedicated scientific mission to study the Sun, scheduled for launch at 11.50am Saturday from Satish Dhawan Space Centre at Sriharikota (SHAR), will carry the Visible Emission Line Coronagraph (VELC), a "unique" payload to study the Sun's corona. Developed by the Indian Institute of Astrophysics (IIA), Bengaluru, VELC will "capture the Sun as though it is in total solar eclipse", IIA Director Annapurni Subramaniam told *TNIE* in an exclusive chat, while on her way to SHAR on Friday evening.

Besides VELC, Aditya-L1 will carry six other payloads (SUIT - Solar Ultraviolet Imaging Telescope, ASPEX-Aditya Solar Wind Particle Experiment, PAPA - Plasma Analyser Package for Aditya, SoLEXS - Solar Low Energy X-Ray Spectrometer, HELIOS-High Energy L1 Orbiting X-ray Spectrometer, Magnetometer) with enhanced science scope and objectives possible by extensive remote and in-situ observation of the Sun.

"VELC required very careful designing because the aim is to capture the Sun as though it is in total eclipse. It has to capture the entire light from the Sun. In the middle of the instrument it has to throw out most of the light from the Sun's disk and focus only on the corona to create an image. This is very challenging to throw out light without scattering it, else it will spoil the image of the corona. No one has seen the corona because the Sun's disk is very bright," added Subramaniam.

The IIA took eight years to deliver VELC to the Indian Space Research Organisation (ISRO). "The instrument was developed in a laboratory which had to be very clean. The IIA had to create a Class 10 Cleanroom (Class 10 cleanrooms are ultra-clean stringently controlled cleanrooms utilized primarily for nanotechnology, semiconductor, and control zones) to develop the VELC. It was a complex process. The number of people working at a certain time was less to avoid contamination. They wore personal protection equipment. Any particles settling on the needles and lens of the instrument would cause scattering of sunlight and blur the images,"

A rewarding mission

Aditya-L1 will be a technically challenging, scientifically rewarding and operationally meaningful mission. It will be technically challenging to acquire an orbit around L1 Lagrangian point, scientifically rewarding; to understand solar activities and model them and operationally meaningful mission to forewarn disturbance in space weather due to solar activities, to take safety measures on the operational satellites.

— M Annadural, former scientist, ISRO



the director added.

Explaining in detail, Principal Investigator, VELC, Ramesh R of IIA said "there are three main concentric regions in the Sun's atmosphere -- the photosphere or visible orange ball, the chromosphere and the corona. One can't visually observe the latter on a normal day because the light coming from the photosphere is a million times brighter than the light coming from the corona. One has to wait for a total solar eclipse to watch the corona. Moon will completely eclipse the bright light from the photosphere during a total solar eclipse, making it possible to observe the faint emission from the corona. Solar eclipses happen twice or thrice a year, and last four to five minutes. There are transient, fast-changing activities in the corona during which coronal material is ejected into the interplanetary space. The Coronal Mass Ejection (CME) carries huge mass of coronal material (~10¹² kg, i.e. one trillion kg), which could travel at the speed of 3,000km per second. Some of these CMEs could propagate towards the Earth also. They can stream along the Earth's magnetic field lines, leading to changes in the geomagnetic field, which can affect underground pipelines and high voltage transformers, they can also disturb the communication satellites. The latter are vital because Internet, mobile communications, TV programmes etc.

need these satellites. The typical example is the loss of SpaceX satellites recently".

The scientist added that to "study these transient CMEs one has to study the Sun on a continuous basis that is, 24x7x365 basis. A ground based observatory will not be able to do it because of the limited duration for observations of the Sun - from morning till evening only. Moreover, the dust particles in the Earth's atmosphere will also scatter sunlight, distorting and blurring the images. One needs to go to a vantage point in space to study the Sun, he added.

VELC 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, in the direction of the Sun. The satellite will be placed in a halo orbit around the Lagrangian Point 1 (L1). It will revolve around the Sun with the same relative position, and hence the Sun can be observed continuously from there. "VELC would also be able to observe the solar corona from very close to the location from where it starts above the photosphere/chromosphere and generate images of the corona every minute, unlike the previous space solar missions. It is to be noted that the start place of the corona in the solar atmosphere is where the coronal mass ejections occur and propagate outwards," said Ramesh.

He added that the "VELC can obtain images of the corona every minute. The data will be downloaded by ISRO's Indian Deep Space Network (ISDN) antenna in the Indian Space Science Data Centre (ISSDC), Byalalu, Bengaluru. After the initial quality check the VELC data will be transferred to the Payload Operation Centre (POC) at IIA. The first level of processed data will be sent back to ISSDC from IIA within 24 hours for dissemination".

ISRO chairman offers prayers for solar mission

EXPRESS NEWS SERVICE @Nellore

THE Chairman of the Indian Space Research Organisation (ISRO), S Somanath, offered special prayers at Chengalamma Parameshwari temple in Sullurpeta town of Tirupati district on Friday, ahead of the Aditya L-1 launch scheduled on Saturday at 11.50 am. The temple priests, led by executive officer A Srinivasulu Reddy, accorded a ceremonial welcome to the ISRO delegation.

Speaking to the media, the ISRO chairman stated that the primary objective of the Aditya-L1 mission is to meticulously study the Sun's atmosphere

during its 125-day journey.

"The Aditya-L1 mission would commence at 11.50 am on Saturday, utilising the dependable Polar Satellite Launch Vehicle (PSLV) C57," he added.

Director of the Satish Dhawan Space Centre (SDSC-SHAR) A Rajarajan and group director at ISRO P Gopi Krishna were also present. Meanwhile, a group of ISRO scientists embarked on a pilgrimage to the Tirumala temple on Friday morning. The ISRO delegation carried a replica of the Aditya-L1 spacecraft inside the hill temple and conducted special prayers seeking divine intervention for the mission's success.



ISRO Chairman S Somanath prays at Sri Chengalamma Parameshwari temple in Sullurpeta, ahead of the ambitious Aditya L-1 mission, on Friday | EXPRESS

'Will have life of five years, but can go beyond that'

CONTINUED FROM PAGE 1

LAGRANGE Point, and the gravitational forces of the Earth and Sun acting on it, enables the satellite to reduce fuel consumption needed to remain in that position. A satellite placed in this position has a major advantage of constantly facing the Sun without hindrance from occultation or eclipses.

The mission aims at observing the solar atmosphere, mainly the chromosphere and corona — the outermost layers of the Sun — and conducting studies to record the local environment from L1. There are seven payloads onboard Aditya-L1, with four of them carrying out remote sensing of the Sun and three conducting solar observations. The mission has been in the works for about three years and in discussion since 2008. Developed indigenously by ISRO, Aditya L1 will have a life of five years, but ISRO scientists said it could go beyond that.

Halo orbit

The satellite will be placed in a halo orbit around Lagrange Point 1 (L1) of the Sun-Earth system, which is about 1.5 million km from the Earth. Live telecast of the mission can be watched on the Doordarshan channel or ISRO's YouTube and Facebook.