ISRO's Stride To The Sun

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Abstract:

The sun is the nearest star to the earth, it helps the earth to sustain life on it. The sun provides the right amount of light and heat for the sustainability of any living creature.The Aditya L1 mission aims to provide further insight about the sun and promises to give much more valuable information to the scientists of not only ISRO but all throughout the world.The Aditya L1 mission will help in studying about solar storms and many other such phenomena , these kinds of natural disasters caused by the sun destroy many satellites sent from earth which not only causes a lot of economical losses but also leads to incomplete missions and causes space pollution.This research paper dives into the details and the importance of this mission.

Introduction:

Aditya L1 shall be the first space based Indian mission to study the Sun. The spacecraft shall be placed in a halo orbit around the Lagrange point 1 (L1) of the Sun-Earth system, which is about 1.5 million km from the Earth.It carries Seven specially designed distinct scientific payloads, five of which have been developed by the ISRO. A satellite placed in the halo orbit around the L1 point has the major advantage of continuously viewing the Sun without any eclipses. This will provide a greater advantage of observing the solar activities and its effect on space weather in real time. The Aditya L1 took off on september 2 2023 from the Satish Dhawan Space Centre its projected to reach the L1 orbit on January 12 2024

Importance of the MIssion:

Aditya-L1 will help scientists better understand various solar phenomena, including solar flares, coronal mass ejections (CMEs), and their influence on space weather, which can impact satellite communications, power grids, and navigation systems on Earth Solar observation, studying the Sun's corona, monitoring space weather, and providing critical data for understanding the Sun's influence on Earth's climate and space environment.

Objective:

The major science objectives of Aditya-L1 mission are:

- Study of Solar upper atmospheric (chromosphere and corona) dynamics.
- Study of chromospheric and coronal heating, physics of the partially ionised plasma, initiation of the coronal mass ejections, and flares
- Observe the in-situ particle and plasma environment providing data for the study of particle dynamics from the Sun.
- Physics of solar corona and its heating mechanism.
- Diagnostics of the coronal and coronal loops plasma: Temperature, velocity and density.
- Development, dynamics and origin of CMEs.
- Identify the sequence of processes that occur at multiple layers (chromosphere, base and extended corona) which eventually leads to solar eruptive events.
- Magnetic field topology and magnetic field measurements in the solar corona .
- Drivers for space weather (origin, composition and dynamics of solar wind).

Name:

Aditya in Sanskrit means the Sun. L1 here refers to Lagrange Point 1 of the Sun-Earth system. For common understanding, L1 is a location in space where the gravitational forces of two celestial bodies, such as the Sun and Earth, are in equilibrium. This allows an object placed there to remain relatively stable with respect to both celestial bodies.

Dimensions:

The Aditya-L1 spacecraft had a launch mass of 3,252 pounds (1,475 kilograms). It is a cube-shaped satellite with a honeycomb sandwich structure.Its main body has dimensions of 2.9 feet x 2.9 feet x 2 feet (89 cm x 89 cm x 61.5 cm),

Working:

The spacecraft carries seven payloads to observe the photosphere, chromosphere and the outermost layers of the Sun (the corona) using electromagnetic and particle and magnetic field detectors. Using the special vantage point L1, four payloads directly view the Sun and the remaining three payloads carry out in-situ studies of particles and fields at the Lagrange point L1, thus providing important scientific studies of the propagatory effect of solar dynamics in the interplanetary medium.

Materials used & payload details

Built by the Indian Space Research Organization (ISRO) in collaboration with Indian academic institutions, Aditya L1's primary material is High Strength Alloy Steel.The spacecraft is also equipped with Radiation Shielding, Radiation-hardened materials would be used to protect sensitive instruments from the Sun's radiation. Aditya L1, primarily constructed of High Strength Alloy Steel, isn't just durable but also resistant to space's extreme temperatures. Along with its robust exterior

Type	Payload	Capability
Remote Sensing Payloads	1) Visible Emission Line Coronagraph(VELC)	Corona/Imaging & Spectroscopy
	2)Solar Ultraviolet Imaging Telescope (SUIT)	Photosphere and Chromosphere Imaging-Narrow & Broadband
	3) Solar Low Energy X-ray Spectrometer(SoLEXS)	Soft X-ray spectrometer: Sun-as-a-star observation
	4)High Energy L1 Orbiting X-ray Spectrometer(HEL1OS)	Hard X-ray spectrometer: Sun-as-a-star observation
In-situ Payloads	5)Aditya Solar wind Particle Experiment(ASPEX)	Solar wind/Particle Analyzer Protons & Heavier Ions with directions
	6)Plasma Analyser Package For Aditya (PAPA)	Solar wind/Particle Analyzer Protons & Heavier Ions with directions
	7)Advanced Tri-axial High Resolution Digital Magnetometers	In-situ magnetic field (Bx, By and Bz).

Budget:

The ISRO Aditya L1 costs around 400 crores which is roughly around 50 million USD
Compared to chandrayaan 2 and chandrayaan 3 this mission was much cheaper
The chandrayaan 2 costed 978 crores
The chandrayaan 3 costed 600 crores
Which makes the Aditya L1 the cheapest out of the three recent missions of ISRO

Difference between the objectives of the Chandrayaan 3 and Aditya L1:

Aditya-L1 mission of ISRO helps to understand the structure and the internal mechanism of the Sun and its impact on Earth's atmosphere
Chandrayaan 3 on the other hand helps in Engineering and implementing a lander to land safely and softly on the surface of the Moon. Observing and demonstrating the rover's driving capabilities on the Moon.

International collaborations

The Aditya-L1 mission is expected to collaborate with other international solar missions, such as NASA's Parker Solar Probe and the European Space Agency's Solar Orbiter, to enhance our understanding of the Sun.

Conclusion:

In conclusion, the Aditya-L1 mission represents a significant stride in our quest to unlock the mysteries of our nearest star, the Sun. This research paper has aimed to shed light on the objectives, instruments, and scientific goals of this ambitious Indian Space Research Organisation (ISRO) initiative. By delving into the mission's planned orbit, instrumentation, and international collaborations, we have gained a deeper appreciation for the potential contributions of Aditya-L1 to our understanding of the Sun and space weather.