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# India's First Step Towards Unveiling the Mysteries of the Sun with Aditya L-1: India's Own Solar Mission

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## Abstract:

*The essay elucidates on the trajectory and the objectives of India's first solar mission - Aditya L-1 launched by ISRO on 2nd September 2023. It assesses the importance for a nation to embark on a solar journey and how the activities of the sun deeply influence an array of things on earth as well as in outer space. The study throws some light on some fascinating properties of the sun like its coronal mass ejection, solar storms, etc. It emphasizes on how India in her unique way has successfully launched Aditya L-1 and aims at studying some important unexplored mysteries of the sun. The journal informs the reader about what L-1 is, how the satellite was made and what are its scopes. And lastly it touches on the bright future in space exploration for India, followed by the project Aditya L-1 because not only does this solar mission allow us to gather specific salient scientific knowledge but also shows the world the exemplary minds of our country.*

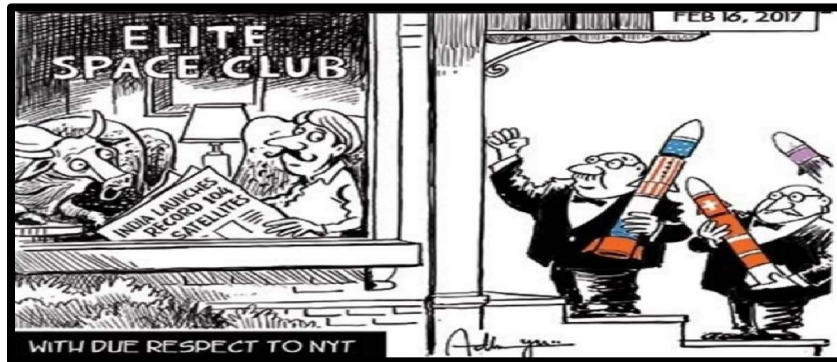
**Keywords:** Lagrange-1, Coronal mass ejection, sun-earth system, geomagnetic sphere, Solar activities.

## 1. Introduction:

I am sure that if we bring out our drawing sheets from our childhood, we would have one thing in common. It would be the sun at the topmost corner of the page, with birds flying across the sky. A must have in our canvases - the Sun! And a must have fascination for most children, adults & scientists is the [mysterious outer space](#).<sup>1</sup>

As a nation pursues progress, politics, the economy, and science stand out as crucial arenas for improvement. India, our homeland, has emerged as a powerhouse in space exploration. This article focuses on the significance, challenges, and breakthroughs of the Solar Mission & Aditya-L-1, exploring India's achievements and aspirations in outer space. Let us dive into a cosmic journey, from launchpad to L1 orbit, as we delve into the indomitable spirit of human exploration and the boundless curiosity propelling us into the cosmos.

<sup>1</sup> <https://www.planetary.org/articles/space-exploration-is-always-worthwhile>



**Fig- 1: After The Safe Landing of one of India's Highly anticipated Satellite, the Country joins the 'Elite Space Club' that was once occupied by other powerful Countries <sup>2</sup>**

## 2. Why do we Need to Study the Sun:

The sun, essential to our existence, is a hot, ionized gas ball influencing our solar system. Studying it reveals insights into fundamental astrophysical processes, including nuclear fusion and solar winds. Aditya L-1 focuses on Helio-physics<sup>3</sup>, studying solar events like flares and storms that impact Earth, disrupting technology. <sup>4</sup>By understanding the sun, we enhance our ability to predict and mitigate space weather effects on communication, power grids, and navigation. The ongoing solar research missions are crucial for addressing scientific, technological, and societal challenges posed by these celestial phenomena. Who would have thought that the little circle at the corner of our drawing sheets in childhood holds such importance?

### 2.1: The Solar Missions from all Over the World Over the Years:

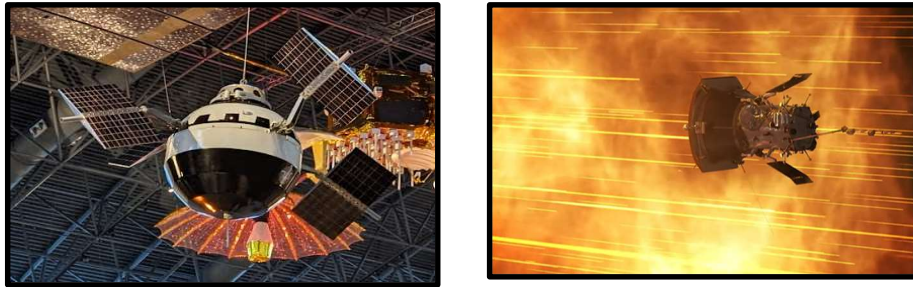
Space agencies and organizations worldwide have invested in numerous solar missions to enhance our understanding of the Sun's impact on space weather, astrophysics, and solar-terrestrial relations. NASA initiated this exploration with PIONEER 5 in 1960, marking a success in studying the interplanetary magnetic field. Joint efforts by JAXA, NASA, and ESA resulted in **Hinode (Solar-B) in 2006** <sup>5</sup>, focusing on the Sun's magnetic fields.

<sup>2</sup> <https://www.buzzfeed.com/andreborges/3-years-after-the-new-york-times-insulted-india-toi-just-cla>

<sup>3</sup> <https://science.nasa.gov/heliophysics/focus-areas/solar-science/>

<sup>4</sup> <https://science.howstuffworks.com/sun.htm>

<sup>5</sup> [https://en.wikipedia.org/wiki/List\\_of\\_Solar\\_System\\_probes](https://en.wikipedia.org/wiki/List_of_Solar_System_probes)



**Fig-2: Pioneer 5<sup>6</sup> on the Left and Parker<sup>7</sup> on the Right**

In 2018, NASA's Parker Solar Probe began probing the Sun's upper atmosphere, the corona, providing vital data on particles and magnetic fields<sup>8</sup>, contributing to our evolving comprehension of the solar system's central star.

**2.2. India’s Space Expeditions Focusing on the Sun:**

India for many years has been a pioneer in the scene of outer space exploration due to the efforts of the brilliant minds of the scientists of Indian Space Research Organization (ISRO<sup>9</sup>) and many other space research organizations. Its exceptional performance is proved by missions like:

<p><b>Fig-3: Chandrayaan-3<sup>10</sup></b></p>	<p><b>Fig-4: Mangalyaan 1<sup>11</sup></b></p>	<p><b>Fig-5: Aryabhata 75<sup>12</sup></b></p>

But until 2nd September 2023 no Indian satellite was out there solely dedicated to the research of the sun and its secrets. Aditya L1, launched by ISRO, becomes the first ever Indian solar mission. As is India’s specialty, the mission had a successful launch and is on its right path heading

<sup>6</sup> <https://www.buzzfeed.com/andreborges/3-years-after-the-new-york-times-insulted-india-toi-just-cla>

<sup>7</sup> <https://images.app.goo.gl/y9hMTtupDfa3q29AA>

<sup>8</sup> <https://scitechdaily.com/5-years-430000-mph-and-counting-how-nasas-parker-solar-probe-is-making-history/>

<sup>9</sup> <https://www.isro.gov.in/Mission.html>

<sup>10</sup> <https://images.app.goo.gl/uNKJnxTC55jHHfdB7>

<sup>11</sup> <https://images.app.goo.gl/bBX41kBS8BWrSVP9>

<sup>12</sup> <https://images.app.goo.gl/WQegAs1umEFN5pTq5>



toward Lagrange Point 1 orbit. Now we dive into the paramount possibilities that arise from Aditya L1.

### 3. Aditya L1 or Suryayaan:

#### 3.1 Aim of the Solar Mission:

- i) Understanding the dynamics of solar atmosphere;
- ii) Studying the distribution of solar winds and temperature anisotropy;
- iii) Better knowledge about the sun's Corona;
- iv) To learn what is CME (coronal mass ejection) and its influence on earth's weather.

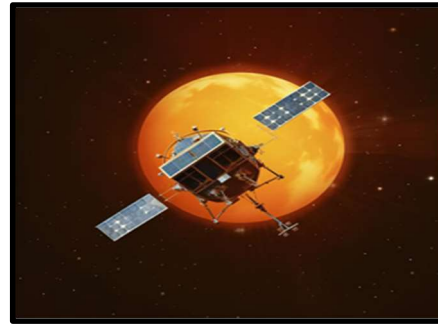


Fig-6: Aditya on L-1 Orbit Getting clear view of the Sun<sup>13</sup>

#### 3.2 What does the L-1 in the Aditya L-1 stand for?

Lagrange points are positions in space where the gravitational forces between the Earth and the Moon or the Earth and the Sun offer enhanced regions of attraction and repulsion. Aditya L1, targets Lagrange 1 out of 5 such points in the Earth-Sun system. Utilizing gravitational influences strategically, Aditya L1, like the James Webb Space Telescope<sup>14</sup> at Lagrange 2, ensures continuous observation of the Sun. This orbital placement capitalizes on celestial dynamics, providing a stable vantage point for in-depth solar exploration.

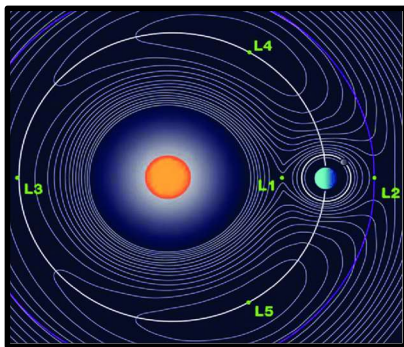


Fig-7: Lagrange Points<sup>15</sup>

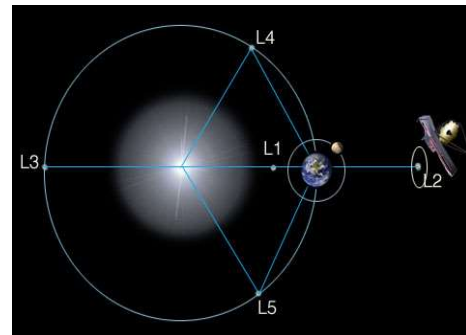


Fig: James Webb Telescope at L-2<sup>16</sup>

<sup>13</sup> <https://images.app.goo.gl/cpGdJk7mnpCyDPst8>

<sup>14</sup> <https://webb.nasa.gov/content/about/orbit.html>

<sup>15</sup> [https://www.google.com/imgres?imgurl=https%3A%2F%2Fphysics.aps.org%2Fassets%2F3946a65a-ffec-4a77-8394-b60ebf458bf3%2F19\\_1.png&tbnid=nPADfv-c8feR5M&vet=1&imgrefurl=https%3A%2F%2Fphysics.aps.org%2Farticles%2Fv2%2F19&docid=YzvXyrH6\\_Q34BM&w=600&h=525&source=sh%2Fx%2Fim%2Fm1%2F0](https://www.google.com/imgres?imgurl=https%3A%2F%2Fphysics.aps.org%2Fassets%2F3946a65a-ffec-4a77-8394-b60ebf458bf3%2F19_1.png&tbnid=nPADfv-c8feR5M&vet=1&imgrefurl=https%3A%2F%2Fphysics.aps.org%2Farticles%2Fv2%2F19&docid=YzvXyrH6_Q34BM&w=600&h=525&source=sh%2Fx%2Fim%2Fm1%2F0)

<sup>16</sup> <https://images.app.goo.gl/HM7iZ5a4gmLvawaZ7>

### 3.3 Coronal Mass Ejection:

Storms are not at all a surprising occurrence on earth. But it is truly fascinating to know that even on the sun we have solar storms which are much more violent as well as intriguing than we could imagine. Coronas, the sun's crown-like layer, release magnetic fields in events known as **coronal mass ejections (CMEs)**<sup>17</sup>.

These eruptions expel charged particles, plasma, and solar material into space, essential for research. CMEs impact solar and geomagnetic events, contributing to phenomena like the Northern and Southern lights. Projects like ADITYA L1 and The Solar Dynamics Observatory are dedicated to studying these solar activities, unraveling the mysteries of these captivating celestial events.

### 3.4 Constructing and Launching the **Suryayaan**<sup>18</sup>:

This unique satellite, led by ISRO Principal Scientist Dr. Sankarasubramanian K<sup>19</sup>, marks India's first step in understanding solar properties and observing the local environment at L-1. With seven payloads, including VELC, PAPA, and HELIOS, the satellite focuses on remote sensing of the Sun. Four payloads capture high-definition images and analyze data for efficient results, ensuring the satellite keeps the Sun in sight while three others conduct investigations.

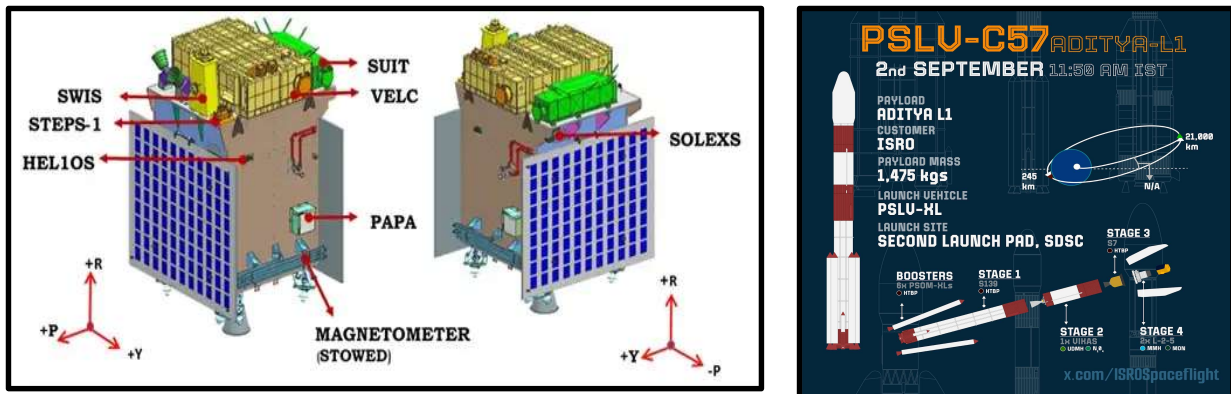


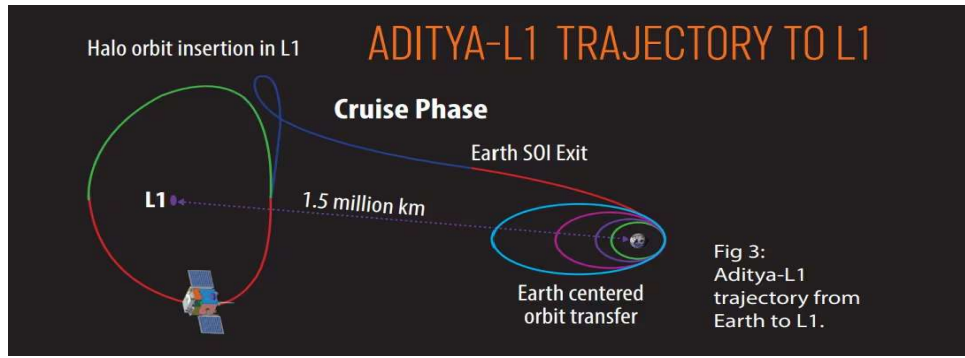
Fig-8: Making Aditya L-1 and Pslv-C57 that Launched the Satellite<sup>20</sup>

<sup>17</sup> <https://www.space.com/coronal-mass-ejections-cme>

<sup>18</sup> [https://www.isro.gov.in/Aditya\\_L1.html](https://www.isro.gov.in/Aditya_L1.html)

<sup>19</sup> [https://www.isro.gov.in/PrincipalScientist\\_of\\_theAditya.html](https://www.isro.gov.in/PrincipalScientist_of_theAditya.html)

<sup>20</sup> [https://www.google.com/imgres?imgurl=https%3A%2F%2Fakm-img-a-in.tosshub.com%2Fsites%2Fvisualstory%2Fstories%2F2023\\_08%2Fstory\\_59078%2Fassets%2F8.jpeg%3Ftime%3D1693289741%26size%3D%3A900&tbnid=e8PNkZavXIB-rM&vet=1&imgrefurl=https%3A%2F%2Fwww.businesstoday.in%2Fvisualstories%2Ftrending%2Fmeet-isros-aditya-l1-after-moon-its-time-for-sun-59078-29-08-2023&docid=sJWLjbMFm2YTeM&w=540&h=900&source=sh%2F%2Fim%2Fm1%2F0](https://www.google.com/imgres?imgurl=https%3A%2F%2Fakm-img-a-in.tosshub.com%2Fsites%2Fvisualstory%2Fstories%2F2023_08%2Fstory_59078%2Fassets%2F8.jpeg%3Ftime%3D1693289741%26size%3D%3A900&tbnid=e8PNkZavXIB-rM&vet=1&imgrefurl=https%3A%2F%2Fwww.businesstoday.in%2Fvisualstories%2Ftrending%2Fmeet-isros-aditya-l1-after-moon-its-time-for-sun-59078-29-08-2023&docid=sJWLjbMFm2YTeM&w=540&h=900&source=sh%2F%2Fim%2Fm1%2F0)



**Fig-9: Aditya-L1 Trajectory to L1<sup>21</sup>**

As the figure shows the trajectory of the satellite<sup>22</sup> Following its successful launch on September 2, 2023 is set to undergo 5 triggers, the last one being on 19th September, to achieve its required velocity to spring out the gravitational force of earth. Marking the beginning of its 110-day trajectory to the destination around the L1, it undergoes a Trans-Lagrangian1 insertion maneuver. On reaching its destination after 4 months from then, another movement sets it on the orbit and now it is strategically placed at a position that covers 1% distance between sun and earth. It now gazes upon the sun and completes its mission life there doing a detailed study of the sun and collecting the data as discussed in its objectives.

#### 4. Output Revealed from Adityal-1:

The satellite marked its first milestone by giving the world the full-disk images of the Sun in near ultraviolet wavelengths. Revealing noteworthy characteristics such as sunspots, plage, and quiet Sun regions, the satellite offers scientists pioneering insights into the intricate details of the sun.

#### 5. The Future of the Space Expeditions on Sun and upcoming Missions of the ISRO:

Current focus in space organizations is not just on launching more sun satellites but deeply analyzing data from previous missions. Aditya L-1's data is eagerly awaited, a triumph for ISRO and science. As for upcoming projects it includes **GAGANYAAN<sup>23</sup>**, India's first crewed space mission, set to launch a three-member crew for a three-day orbit.

<sup>21</sup> [https://www.google.com/imgres?imgurl=https%3A%2F%2Fakm-img-a-in.tosshub.com%2Fsites%2Fvisualstory%2Fstories%2F2023\\_08%2Fstory\\_59078%2Fassets%2F8.jpeg%3Ftime%3D1693289741%26size%3D\\*%3A900&tbnid=e8PNkZavXIB-rM&vet=1&imgrefurl=https%3A%2F%2Fwww.businessstoday.in%2Fvisualstories%2Ftrending%2Fmeet-isros-aditya-l1-after-moon-its-time-for-sun-59078-29-08-2023&docid=sJWLjbMFm2YTeM&w=540&h=900&source=sh%2Fx%2Fim%2Fm1%2F0](https://www.google.com/imgres?imgurl=https%3A%2F%2Fakm-img-a-in.tosshub.com%2Fsites%2Fvisualstory%2Fstories%2F2023_08%2Fstory_59078%2Fassets%2F8.jpeg%3Ftime%3D1693289741%26size%3D*%3A900&tbnid=e8PNkZavXIB-rM&vet=1&imgrefurl=https%3A%2F%2Fwww.businessstoday.in%2Fvisualstories%2Ftrending%2Fmeet-isros-aditya-l1-after-moon-its-time-for-sun-59078-29-08-2023&docid=sJWLjbMFm2YTeM&w=540&h=900&source=sh%2Fx%2Fim%2Fm1%2F0)

<sup>22</sup> <https://indianexpress.com/article/explained/explained-sci-tech/aditya-l1-corrects-trajectory-why-how-was-this-done-8973882/>

<sup>23</sup> <https://www.hindustantimes.com/india-news/after-aditya-l1-isro-chief-s-somanath-on-indias-upcoming-missions-101693557264259.html>

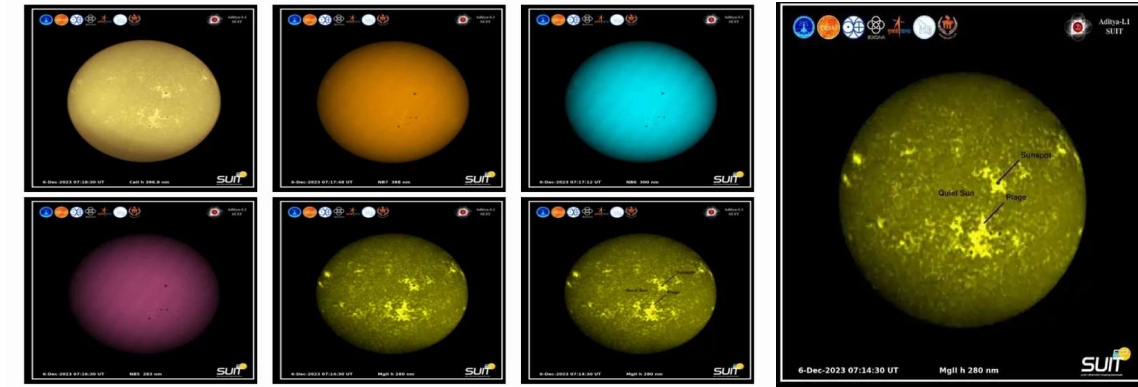


Fig-10: Output From Aditya L1<sup>24</sup>

Followed by NISAR, a joint NASA-ISRO venture, aims to map the planet every 12 days, providing crucial data on ecosystem changes, ice mass, and natural hazards. What we are hoping to accomplish for now is the successful completion of the Aditya L-1 because not only is this a win for ISRO but the scientific arena as whole.

## 6. Conclusion:

Valmiki's Ramayana once gave us an insight on how the mischievous Hanuman tried to devour the sun thinking it was a ripe fruit. But now as the world is developing and leaning towards science as one of its pillars, it is safe to say that the sun is, more or less, the same source of fascination and curiosity to us. Entering the world of mysterious solar activities and possibilities through India's first solar mission Aditya L-1, we have reinforced our position as one of the pioneers in space research. Thus, the empty void of outer space is anything but empty to us. With each mission, we bring back knowledge, innovation, and inspiration, solidifying our place as explorers of the cosmos and stewards of our home planet. The study of our sun is hence a plethora of hopes and scopes and a testament to humanity's insatiable curiosity, boundless ingenuity, and unwavering dedication to unravel the secrets of the star and the space.

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<sup>24</sup> <https://images.app.goo.gl/sry1Mr3TV94pJ8CJ8>



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