

# **Support Centre for Aditya-L1**

# Why in News

ARIES facility (Aryabhata Research Institute for Observational Sciences) will host the support centre for Aditya-L1 mission, which is due to be launched next year (2022).

 ARIES is an autonomous institute under the Department of Science & Technology and is located in Nainital (Uttarakhand).

# **Key Points**

- About Aditya-L1 Mission:
  - It is India's first scientific expedition to study the Sun. It will be ISRO's(Indian Space Research Organisation) second space-based astronomy mission after AstroSat, which was launched in 2015.
  - ISRO categorises Aditya L1 as a 400 kg-class satellite that will be launched using the <u>Polar Satellite Launch Vehicle (PSLV)</u> in XL configuration.
    - It will be inserted in a halo orbit around the L1 ( Lagrangian point 1), which is 1.5 million km from the Earth.
  - The space-based observatory will have seven payloads (instruments) on board to study the Sun's corona, solar emissions, solar winds and flares, and Coronal Mass Ejections (CMEs), and will carry out round-the-clock imaging of the Sun.
- Aditya-L1 Support Centre (ASC):
  - The main aim of this centre is to let every researcher in India perform analysis over scientific data obtained from Aditya-L1. It will expand the visibility of Aditya-L1 beyond India at the international level.
  - It will **host a compendium of the location** and duration of different features on the solar surface such as **coronal holes, prominences, flares, CMEs and <u>sunspots</u>.** 
    - Continuous monitoring of the location and duration of these features will help in monitoring the Earth directed CMEs and thereby, the space weather.
- Challenges in Launching the Mission:
  - The distance of the Sun from Earth (approximately 15 crore kms on average, compared to the only 3.84 lakh kms to the Moon). This huge distance poses a scientific challenge.
  - Aditya L1 will have some moving components which increases the risks of collision.
    - Due to the risks involved, **payloads in earlier <u>ISRO</u> missions** have largely remained stationary in space.
  - Other issues are the super hot temperatures and radiation in the solar atmosphere.
    - However, **Aditya L1 will stay much farther away**, and the heat is not expected to be a major concern for the instruments on board.
- Importance of Studying the Sun:

- Every planet, including Earth and the **exoplanets** beyond the Solar System, evolves and this evolution is governed by its parent star.
- **Sun affects the weather** of the entire system.
  - Variations in this weather can change the orbits of satellites or shorten their lives, interfere with or damage onboard electronics, and cause power blackouts and other disturbances on Earth.
- To learn about and track **Earth-directed storms**, and to predict their impact, continuous solar observations are needed.

## Other Missions to Sun:

- Japan's Solar-C EUVST: The EUVST (Extreme Ultraviolet High-Throughput Spectroscopic Telescope Epsilon) would be studying the solar wind released by the solar atmosphere, as well as studying how this atmosphere drives solar material eruption.
- NASA's EZEI Mission: The EZEI (Electrojet Zeeman Imaging Explorer) Mission would study the atmosphere of the earth and electric currents in it, which link the <u>aurora</u> to the magnetosphere.
- NASA's Parker Solar Probe's aim is to trace how energy and heat move through the Sun's corona and to study the source of the solar wind's acceleration.
  - It is part of NASA's 'Living With a Star' programme that explores different aspects of the Sun-Earth system.
- The earlier **Helios 2 solar probe, a joint venture** between NASA and space agency of erstwhile **West Germany**, went within **43 million** km of the **Sun's surface in 1976.**

#### Sun's Corona

- Corona is a luminous envelope of plasma that surrounds the Sun and other celestial bodies.
- It is extended to millions of kilometres into space and is commonly seen during a total solar eclipse.
- The corona of the Sun is much hotter than its visible surface.
  - The intense temperature of the Sun's corona is due to the presence of highly ionized ions which give it a spectral feature.

## **Solar Winds and Flares**

- The solar wind is a continuous stream of charged particles that flows out of the Sun in all directions.
- The strength of the solar wind varies depending on the activity on the surface of the Sun.
- The Earth is mostly protected from the solar wind by its strong magnetic field.
  - However, some types of activity, like solar flares, can cause high energy particles to emit from the Sun which can be dangerous to astronauts and can cause damage to satellites orbiting Earth.

## **Coronal Mass Ejection**

- A **Coronal Mass Ejection (CME)** is a significant release of plasma and accompanying magnetic field from the solar corona.
- They often follow solar flares and are normally present during a solar prominence eruption.
  - **Prominences** are clouds of incandescent, ionized gas ejected from the Sun's surface.
- The plasma is released into the solar wind, and can be observed in coronagraph imagery.
- An ARIES team has recently developed an algorithm to study the accelerating solar eruptions in the lower corona called **CMEs Identification in Inner Solar Corona (CIISCO).**

# **Lagrangian Point 1**

- Lagrange Points, named after Italian-French mathematician Josephy-Louis Lagrange, are positions in space where the gravitational forces of a two-body system (like the Sun and the Earth) produce enhanced regions of attraction and repulsion.
- These can be used by spacecraft to reduce fuel consumption needed to remain in position.
- L1 refers to Lagrangian/Lagrange Point 1, one of 5 points in the orbital plane of the Earth-Sun system.
- The L1 point is about 1.5 million km from Earth, or about 1/100th of the way to the Sun.
- A Satellite placed in the halo orbit around the Lagrangian point 1 (L1) has the major advantage of continuously viewing the Sun without any occultation/eclipses.
- The L1 point is home to the Solar and Heliospheric Observatory Satellite (SOHO), an international collaboration project of <u>National Aeronautics and Space Administration (NASA)</u> and the European Space Agency (ESA).

