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 <u>ISRO's(Indian</u> <u>Space Research Organisation)</u> second space-based astronomy mission after <u>AstroSat</u>, 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.
 - $\circ~$ 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 <u>magnetosphere</u>.
- **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.

101

• 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/<u>eclipses</u>.
- 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).

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