ISRO successfully places Aditya L1 in orbit

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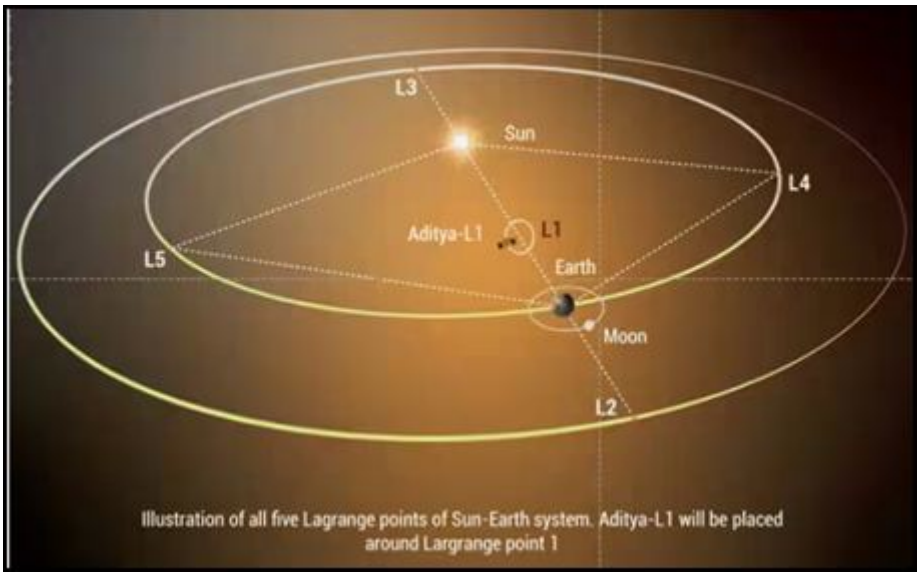
What's in today's article?

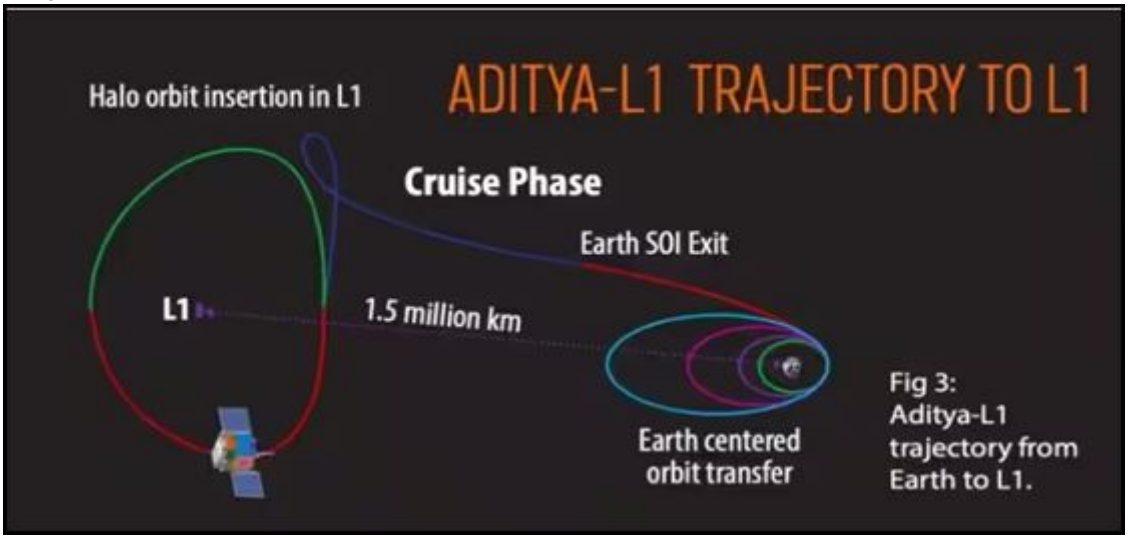
- **Why in news?**
- **What is Aditya L1 Mission?**
- **Why is Aditya-L1 important?**

Why in news?

- The Indian Space Research Organisation (ISRO) successfully launched the observatory that will study the Sun from 1.5 million kilometres away.
    - It is the space organisation's **maiden expedition to study the Sun**.
    - It is also ISRO's **second astronomy observatory-class mission** after AstroSat (2015).
- It took nearly 63 minutes for one of the heaviest configurations of the PSLV to place the spacecraft in a precise elliptical orbit of nearly 235 km x 19,500 km.

Aditya L1 Mission

- **About**
  - 

  - Launched by the PSLV-C57, Aditya-L1 mission aims to study prospects of Sun.
    - The solar probe was carried into space by the Polar Satellite Launch **Vehicle (PSLV) in 'XL' configuration**.
  - This mission is India's solar mission where the spacecraft will be placed in a halo orbit around the Lagrange point 1 (L1) of the Sun-Earth system.
    - The Lagrange point as defined by NASA refers to positions in space where the gravitational forces of a two-body system like the Sun and Earth produce enhanced regions of attraction and repulsion.
    - There are five Lagrange points –**L1, L2, L3, L4, and L5.**
    - Placing the satellite in a **halo orbit around L1** of the Sun-Earth system enables continuous viewing of the Sun without any eclipses or obstructions.
  - The mission will span five years and carry seven specialised payloads designed to observe various aspects of solar activity.
- **Trajectory followed**
  - 

  - The PSLV initially placed the Aditya L-1 in a lower Earth orbit.

- Subsequently, the spacecraft's orbit around the Earth will be raised multiple times before it is put on a path to a **halo orbit around the L1 Lagrange point**.
    - A spacecraft can orbit about an unstable Lagrange point with a minimum use of thrusters for stationkeeping.
    - Such an orbit is known as a halo orbit as it appears as an ellipse floating over the plane
    - **A halo orbit, however, isnot the usual orbit** because the unstable Lagrange point doesn't exert any attractive force on its own.
  - The spacecraft will finally be stationed 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.
  - The Aditya L-1 will cover its journey to the L1 point in about four months.
- **Objectives of the Aditya L-1**
  - To expand our knowledge of the Sun, and how its radiation, heat, flow of particles, and magnetic fields affect us;
  - To study the upper atmospheric layers of the Sun called chromosphere and corona;
    - While the corona is the outermost layer, the chromosphere is just below it.
  - To examine coronal mass ejections (CMEs), which are large expulsions of plasma and magnetic fields from the Sun's corona;
  - To analyse the corona's magnetic field and the driver of the space weather;
  - To understand why the Sun's not-so-bright corona is a million degree Celsius hot when the temperature on the surface of the Sun is just about 5,500 degree Celsius;
  - To help scientists know the reasons behind the acceleration of particles on the Sun, which leads to the solar wind — the constant flow of particles from the Sun;
- **Payloads**
  - The spacecraft carries seven payloads. Out of these, 4 will be the remote sensing payloads which will study the sun and remaining 3 will be the payloads to study the L1 in situ.
- **Remote sensing payloads which will study the sun:**
  - **Visible Emission Line Coronagraph** (VELC) for corona/imaging and spectroscopy;
  - **Solar Ultraviolet Imaging Telescope** (SUIT) for photosphere and chromosphere imaging;
  - **Solar Low Energy X-ray Spectrometer** (SoLEXS), which is a soft X-ray spectrometer for Sun-as-a-star observation; and
  - **High Energy L1 Orbiting X-ray Spectrometer** (HEL1OS), which is a Hard X-ray spectrometer for Sun-as-a-star observation
- **The payloads to study the L1 in situ**
  - **Aditya Solar wind Particle Experiment** (ASPEX), for solar wind/particle analyzer protons and heavier ions with directions;
  - **Plasma Analyser Package For Aditya** (PAPA), for solar wind/particle analyzer electrons and heavier ions with directions; and
  - **Advanced Tri-axial High Resolution Digital Magnetometers** for in situ magnetic field study.

Why is Aditya-L1 important?

- **India in the big league**
  - It is the first space-based Indian mission to study the Sun.
  - So far, **only two other space agencies** have had their spacecraft reach L1 or the Lagrange point: USA's National Aeronautics and Space Administration (NASA) and the European Space Agency (ESA).
- **Need to study sun from space**
  - Studying the Sun from space is essential because the Sun emits various forms of radiation, energetic particles, and magnetic fields in all wavelengths.
  - Earth's atmosphere and magnetic field act as protective shields against harmful solar radiation, making space-based observations crucial for comprehensive understanding.
- **Understanding space weather**
  - Every planet, including Earth and the exoplanets beyond the Solar System, evolves — and this evolution is governed by its parent star.
  - The solar weather and environment affect 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.
  - Knowledge of solar events is key to understanding space weather.

Q1) What are Lagrange points?

Lagrange points, also known as Lagrangian points or libration points, are specific positions in space where the gravitational forces of two large bodies, such as the Earth and the Moon or the Earth and the Sun, produce enhanced regions of attraction and repulsion. These points were first described by the French mathematician Joseph-Louis Lagrange in 1772. There are five Lagrange points in the Earth-Sun system, labeled L1 through L5.

Q2) What is photosphere?

The photosphere is the outermost layer of the Sun's surface and the layer that emits visible light. It is the region of the Sun that we typically think of as the "surface" when we observe the Sun from Earth. The term "photosphere" is derived from the Greek words "photo," which means light, and "sphaira," which means sphere, so it essentially translates to "sphere of light."

Source: ISRO successfully places Aditya L1 in orbit an hour after challenging launch | ISRO | The Hindu | The Economic Times | Times of India | Indian Express