

Solar orbiter probe by NASA and ESA

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Manifest pedagogy: The Sun is a little known mystery. To explore the Sun, many efforts have been made in the past. Such one effort is the Solar orbiter probe. As this is the first of its kind mission, aspirants need to know well about it along with other solar missions till date.

In news: NASA, ESA have sent Solar Orbiter probes to map Sun's poles.

Placing it in syllabus: Solar expeditions

Dimensions:

- Solar orbiter probe
- Different solar probes
- India's Aditya-L1 mission

Content:

Solar orbiter probe:

- NASA and the European Space Agency (ESA) have sent a new probe towards the Sun, called the **Solar Orbiter**, built by Airbus Defense and Space.
- It helps researchers to know how the star's vast bubble of energy affects earth and humans in space.
- It was launched from Cape Canaveral, Florida on February 9, 2020.
- The European Space Operations Center in Germany will operate Solar Orbiter.
- The spacecraft **contains 10 instruments.**
- **Nine were provided by ESA** member states and ESA.

- **NASA provided one instrument**, the Solar Orbiter Heliospheric Imager (**SoloHI**), and **an additional sensor, the Heavy Ion Sensor**, which is part of the Solar Wind Analyzer instrument suite.
- Using the **gravitational influence from Earth and Venus**, the probe will map the star's poles, which could allow scientists for the first time **to observe the concentrated source of solar wind that permeates our solar system.**
- Solar wind **is a soup of charged particles that are highly concentrated at the poles**, which affect satellites and electronic devices on Earth.
- Solar Orbiter is on a unique trajectory which includes **22 close approaches to the Sun, bringing the spacecraft within the orbit of Mercury** to study the Sun and its influence on space.
- This vital information will help scientists fill in the gaps in models of the Sun's magnetic field, which drives the Sun's activity.
- While it will spend about three months in its commissioning phase, it will **take about two years to reach its primary science orbit.**
- Solar Orbiter combines **two main modes of study –**
- **In-situ instruments** will measure the environment around the spacecraft, detecting things such as electric and magnetic fields and passing particles and waves.
- The **remote-sensing instruments** will image the Sun from afar, along with its atmosphere and its outflow of material, collecting data that will help scientists understand the Sun's inner workings.
- The mission's **cruise phase lasts till November 2021** which includes **three gravity assists** that Solar Orbiter will use to draw its orbit closer to the Sun: two past Venus in December 2020 and August 2021, and one past Earth in November 2021.

Different solar probes:

Ulysses: It is a **decommissioned** robotic space probe whose **primary mission was to orbit the Sun and study it at all latitudes**. In addition, the probe studied several comets. It was launched in 1990. It was a **joint venture of NASA and the ESA with participation from Canada's National Research Council**. The last day for mission operations on Ulysses was June 30, 2009.

Deep Space Climate Observatory (DSCOVR) (formerly known as Triana):

This is the National Oceanic and Atmospheric Administration (NOAA)'s **first operational deep space satellite** launched in 2015. Its **mission was solar observation and early warning of coronal mass ejections** while providing Earth observation and climate monitoring.

It has been in a directed safe hold since June 2019 due to an anomaly in the laser gyroscope of the Miniature Inertial Measurement Unit (MIMU) and is expected to come out of safe hold and back into operation by early March 2020.

Parker Solar Probe (PSP):

Also called **Solar Probe Plus** is a NASA robotic spacecraft launched in 2018, with the **mission of repeatedly probing and making observations of the outer corona of the Sun**.

It became the **first NASA spacecraft named after a living person**, honoring physicist Eugene Newman Parker, professor emeritus at the University of Chicago.

The Parker Solar Probe is the **first spacecraft to fly into the low solar corona**. It will assess the structure and dynamics of the Sun's coronal plasma and magnetic field, the energy flow that heats the solar corona and impels the solar wind, and the mechanisms that accelerate energetic particles.

On 29 October 2018, the spacecraft became the closest ever

artificial object to the Sun. As of its January 2020 perihelion, the Parker Solar Probe's closest approach is 11.6 million miles.

India's Aditya-L1 mission:

- The Aditya-1 mission was conceived as a 400kg class satellite carrying one payload and was planned to launch in a 800 km low earth orbit.
- The **Aditya-1 mission has now been revised to "Aditya-L1 mission"** and will be **inserted in a halo orbit around the Lagrangian point -1 (L1)**, which is 1.5 million km from the Earth.

((Note: A Lagrangian point is a region of space that lies part way between the Earth and the Sun where gravitational forces of both bodies are balanced. A spacecraft in orbit around these points will simply hover without the influence of any gravitational force. This makes it possible to place objects in a **3D orbit** around these points which is **known as a halo orbit**)).

- A Satellite placed in the halo orbit around the (L1) of the Sun-Earth system has the **major advantage of** continuously viewing the Sun without any occultation/eclipses.
- Aditya-1 was meant to observe only the solar corona.
- But Aditya-L1 with additional experiments can now **provide observations of Sun's Corona , Chromosphere and photosphere.**
- The Aditya L1 will be launched aboard a PSLV-XL from Sriharikota.
- With the inclusion of multiple payloads, the enhanced Aditya-L1 project will enable a **comprehensive understanding of the dynamical processes of the sun** and address some of the outstanding problems in solar physics.

The payloads used are:

1. **Visible Emission Line Coronagraph (VELC)**: To study the diagnostic parameters of solar corona and dynamics and origin of Coronal Mass Ejections
2. **Solar Ultraviolet Imaging Telescope (SUIT)**: To image the spatially resolved Solar Photosphere and Chromosphere in near Ultraviolet (200-400 nm) and measure solar irradiance variations.
3. **Aditya Solar wind Particle Experiment (ASPEX)** : To study the variation of solar wind properties as well as its distribution and spectral characteristics.
4. **Plasma Analyser Package for Aditya (PAPA)** : To understand the composition of solar wind and its energy distribution.
5. **Solar Low Energy X-ray Spectrometer (SoLEXS)** : To monitor the X-ray flares for studying the heating mechanism of the solar corona.
6. **High Energy L1 Orbiting X-ray Spectrometer (HEL1OS)**: To observe the dynamic events in the solar corona and provide an estimate of the energy used to accelerate the particles during the eruptive events.
7. **Magnetometer**: To measure the magnitude and nature of the Interplanetary Magnetic Field.