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1. **Aditya-L1 Mission**

Why in News?

The **Indian Space Research Organisation (ISRO)** is preparing for its first scientific expedition to **study the Sun, Aditya-L1.**

- It would be placed into a point in space known as the **L1 Lagrange point.**
- Aditya L1 will be ISRO's **2nd space-based astronomy mission after AstroSat,** which was launched in 2015.
- **Aditya 1** was renamed as Aditya-L1.
    - The Aditya 1 was meant to observe **only the solar corona.**

Key Points

- Aditya-L1 is India's first Solar Mission.
- **Launch Vehicle:** Aditya L1 will be launched using the Polar Satellite Launch Vehicle **(PSLV) XL** with 7 payloads (instruments) on board.
- **Objectives:** Aditya L1 will study
    - The Sun's **corona** (Visible and Near infrared rays)
    - Sun's **photosphere** (soft and hard X-ray)
    - **Chromosphere** (Ultra Violet)
    - Solar emissions,
    - Solar winds and flares,
    - **Coronal Mass Ejections (CMEs)**
- It will carry out **round-the-clock imaging** of the Sun.
- **Challenges:** The distance of the Sun from Earth is approximately 15 crore kms on average.
    - This huge distance poses a scientific challenge.
        - Due to the risks involved, payloads in earlier ISRO missions have largely remained stationary in space
            - However, Aditya L1 will have **some moving components** which increases the risks of collision.
    - 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

- Evolution of every planet, including Earth and the exoplanets beyond the Solar System, is governed by its parent star i.e the Sun in this case.
- The Solar weather and environment affects the weather of the entire system.
    - Therefore, it is important to study the Sun.
- **Effects of Variation in Solar Weather 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.**
- To learn about and **track Earth-directed storms,** and to predict their impact, continuous solar observations are needed.
- Many of the instruments and their components for this mission are being **manufactured for the first time in the country.**

Lagrange Point 1

- Lagrange Points 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.**
- It is named after Italian-French mathematician **Joseph-Louis Lagrange**.
- The L1 point is about 1.5 million km from Earth, or about 1/100th of the way to the Sun.
- L1 refers to Lagrangian/Lagrange Point 1, one of 5 points in the **orbital plane of the Earth-Sun system.**
- These can be used by spacecraft to **reduce fuel consumption** needed to remain in position.
- 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.

AstroSat

- AstroSat was launched in September, 2015, by PSLV-C30 from Sriharikota (Andhra Pradesh).
- It is the **first dedicated Indian astronomy mission** aimed at studying celestial sources in **X-ray, optical and UV spectral bands simultaneously.**

Other Missions to the Sun

- 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.**

2. Habitable-Zone Planet Finder

Why in News?

The Habitable-zone Planet Finder (HPF) has confirmed its first planet **(exoplanet)**.

- It will be called G 9-40b.
- It is orbiting a nearby low mass bright **M-dwarf star** (100 light years from Earth) with an orbital period of 6 Earth-days.

Key Points

- **G 9-40b:** G 9-40b is amongst the top 20 closest transiting planets known.
- **Habitable-zone Planet Finder:** HPF is an **astronomical spectrograph,** built by Penn State University scientists, and recently installed on the 10m **Hobby-Eberly Telescope** at McDonald Observatory (US).
    - The HPF searches for **exoplanets** by using the **Doppler effect.**
    - A spectrograph is an instrument that splits light into its component wavelengths.
        - Scientists measure the properties of light over a specific portion of the spectrum, and draw conclusions on what is responsible for the trends they observe.
    - The HPF provides the **highest precision measurements of infrared signals from nearby low-mass stars,** and astronomers use it to validate the candidate planet by excluding all possibilities of contaminating signals to a very high level of probability.
    - It is designed to detect and characterise planets in the habitable-zone also known as **'Goldilocks zone'**.
    - HPF is currently surveying the nearest low-mass stars, also called **M-dwarfs,** which are the most common stars in the galaxy - with the goal of discovering exoplanets in our neighborhood.

Doppler Effect

- An increase (or decrease) in the frequency of sound, light, or other waves as the source and observer move towards (or away from) each other.
- The effect causes the sudden change in pitch noticeable in a passing siren, as well as the red shift seen by astronomers.

Exoplanet

- An exoplanet or extrasolar planet is a planet outside the Solar System.
- The first confirmation of detection of exoplanets occurred in 1992.
- Exoplanets are very hard to see directly with telescopes.
- They are hidden by the bright glare of the stars they orbit.

M-dwarfs

- These have masses from about 0.08 to 0.6 times that of the Sun.
- In the Milky Way Galaxy, about **70% of the stars are red dwarfs.**
    - These are the smallest type of hydrogen burning star.

Goldilocks Zone

- A habitable zone, also called the "Goldilocks Zone", is the area around a star where it is not too hot and not too cold for liquid water to exist on the surface of surrounding planets.
- Earth is in the Sun's Goldilocks zone.
- If Earth were where the dwarf planet Pluto is, all its water would freeze; on the other hand, if Earth were where Mercury is, all its water would evaporate.

3. 5-G Hackathon

Why in News?

To identify and promote applications in the 5G realm, the Department of Telecommunications (DoT) has launched 5G Hackathon in association with a number of government, academia & industry stakeholders.

Key Points:

- It is aimed at shortlisting India focussed cutting edge ideas that can be converted into workable 5G products and solutions.
- The 5G Hackathon is open to developers, students, start-ups, SMEs, academic institutions & registered companies in India & NRIs.
- Winners of the various phases will share a total prize pool of INR 2.5 Crores

5G Technology

- 5G is the fifth generation wireless technology for digital cellular networks that began wide deployment in 2019
- 5G technology provides quantum leap over 4G in terms of:
    - Speed
    - Peak data rate
    - Latency
    - Spectrum efficiency
    - Connection density