NASA's STEREO-’s Earth Flyby

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Why in News?

In a significant development, **NASA's (National Aeronautics and Space Administration) Solar Terrestrial Relations Observatory (STEREO-A)** spacecraft has made its first Earth Flyby, nearly 17 years after its initial launch.

- During the Earth flyby, **STEREO-A will collaborate with Nasa's Solar and Heliospheric Observatory (SOHO)** and Nasa's Solar Dynamics Observatory (SDO), enhancing its observations.
- This collaboration aims to optimize the spacecraft's stereo vision to capture varying-sized solar features at different distances.

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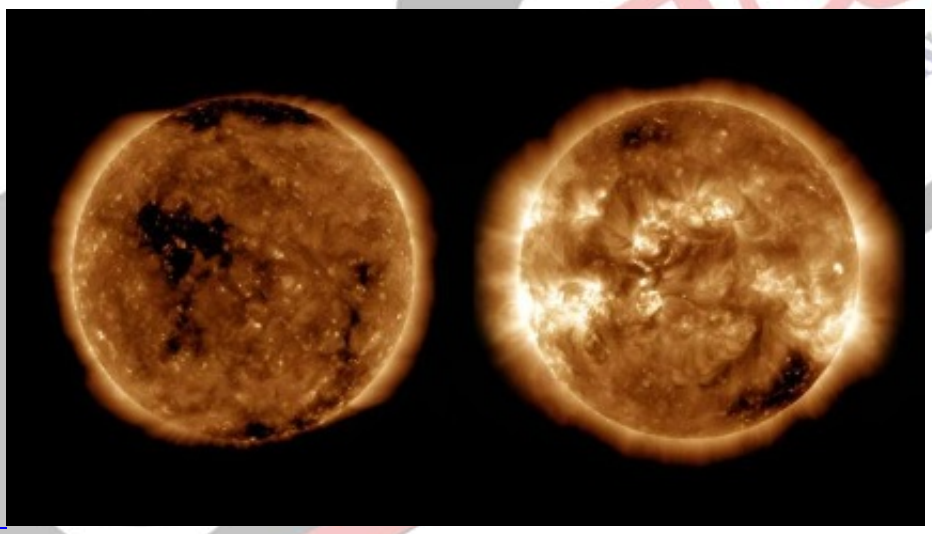

What are STEREO-A and STEREO-B?

- **STEREO-A (A stands for Ahead), along with its twin STEREO-B (B stands for Behind)**, was launched in 2006 to study the **Sun's Behavior** by charting Earth-like orbits around it.
    - Their primary goal was to provide a stereoscopic view of the Sun, **enabling researchers to study it from multiple perspectives.**
- In 2011, STEREO-A achieved **a pivotal milestone by reaching a 180-degree separation** in its orbit from STEREO-B. This spatial arrangement allowed humanity to **observe the Sun as a complete sphere** for the first time, offering **crucial insights into its complex structure** and activity.
    - STEREO-B broke contact with **mission control in 2014 after a planned reset (B's mission officially ended in 2018).**

What is the Purpose of STEREO-A's Earth Flyby?

- **Stereoscopic Vision of the Sun:**
  - STEREO-A's Earth flyby will enable it to once again employ stereoscopic vision, a technique mirroring human depth perception.
  - This method involves combining views from different locations to extract 3D information from 2D images of the Sun.
- **Scientific Objectives:**
  - Scientists plan to utilize this opportunity to identify active regions beneath sunspots and uncover 3D information about their structure.
  - Additionally, a new theory suggesting that coronal loops may be optical illusions will be tested.
  - The flyby also offers insights into the evolution of the magnetic field of Coronal Mass Ejections (CMEs) as they travel towards Earth.
    - CMEs, which are bursts of solar material, have the potential to disrupt satellite communications, radio signals, and even impact power grids on Earth.
    - By obtaining multipoint measurements from inside a CME, researchers aim to enhance their computer models and predictions about these solar eruptions.
- **Solar Activity Dynamics:**
  - This upcoming flyby will be starkly different from STEREO-A's early days in 2006, because at that time the Sun was in its Solar Minimum phase.
  - As the Sun approaches the predicted Solar Maximum for 2025, its heightened activity presents a distinct perspective for STEREO-A's observations.

Note: Solar Maxima and Minima refer to the two phases of the **Solar Cycle** that occur over an approximately **11-year period**. These cycles are characterized by changes in the number **of sunspots, solar flares, and other solar phenomena.**

- The solar maximum is the phase **when the Sun is most active,** with many sunspots and intense eruptions.
- The solar minimum is the phase **when the Sun is least active,** with few or no sunspots and calm surface.

UPSC Civil Services Examination, Previous Year Question (PYQ)

Q. If a major solar storm (solar flare) reaches the Earth, which of the following are the possible effects on the Earth?(2022)

1. GPS and navigation systems could fail.
2. Tsunamis could occur at equatorial regions.
3. Power grids could be damaged.
4. Intense auroras could occur over much of the Earth.
5. Forest fires could take place over much of the planet.
6. Orbits of the satellites could be disturbed.
7. Shortwave radio communication of the aircraft flying over polar regions could be interrupted.

Select the correct answer using the code given below:

(a) 1, 2, 4 and 5 only
(b) 2, 3, 5, 6 and 7 only
(c) 1, 3, 4, 6 and 7 only
(d) 1, 2, 3, 4, 5, 6 and 7

Ans: (c)