



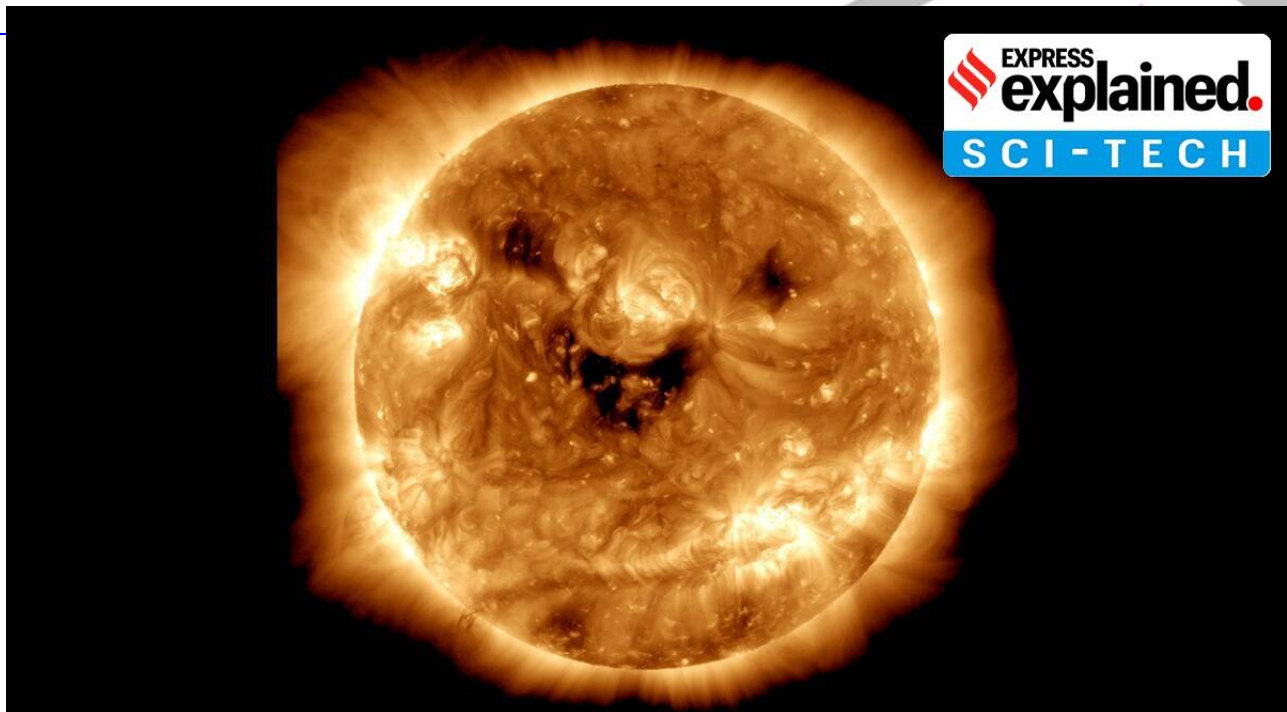
Coronal Holes

Why in News?

Recently, NASA captured an image having [dark patches on the sun's surface](#) resembling eyes and a smile.

- These patches are called '**Coronal holes**', which can be seen in ultraviolet light but are typically invisible to our eyes.

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What are Coronal Holes?

- **About:**
 - These are **regions on the sun's surface from where fast solar wind gushes out into space.**
 - In these regions, the **magnetic field is open to interplanetary space**, sending solar material out in a **high-speed stream of solar wind** i.e. [geomagnetic storm](#).
 - They have **lower temperatures and appear much darker than their surroundings** as they contain little solar material.
 - Coronal holes can **last between a few weeks to months.**
 - The holes are not a unique phenomenon, **appearing throughout the sun's approximately 11-year solar cycle.**
 - They can last much **longer during solar minimum**, a period of time when activity on the Sun is substantially diminished.
- **Significance:**

- Coronal Holes are **important in understanding the space environment** around the earth through which our technology and astronauts' travel.

What is a Geomagnetic Storm?

- Geomagnetic storm is a solar storm that occurs during the **release of magnetic energy** associated with sunspots (**'dark' regions on the Sun that are cooler than the surrounding photosphere - the lowest layer of the solar atmosphere**), and can last for a few minutes or hours.
- It is a **major disturbance of Earth's magnetosphere** that occurs when there is a very **efficient exchange of energy from the solar wind into the space environment** surrounding Earth.
 - The magnetosphere **shields our home planet from harmful solar and cosmic particle radiation**, as well as erosion of the atmosphere by the solar wind - the constant flow of charged particles streaming off the Sun.
- These storms **result from variations in the solar wind** that produce major changes in the currents, plasmas, and fields in Earth's magnetosphere.
 - The solar wind conditions that are effective for creating geomagnetic storms are sustained (for several to many hours) periods of high-speed solar wind, and most importantly, a southward directed solar wind magnetic field (opposite the direction of Earth's field) at the dayside of the magnetosphere.
 - This **condition is effective for transferring energy** from the solar wind into Earth's magnetosphere.
- The largest storms that result from these conditions are associated with solar **Coronal Mass Ejections (CMEs)** where a billion tons or so of plasma from the sun, with its embedded magnetic field, arrives at Earth.
 - CMEs are large ejections of plasma and magnetic fields that **originate from the Sun's corona** (outermost layer).

UPSC Civil Services Examination Previous Year Question:

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)

Exp:

- Solar flares are powerful bursts of energy.
- The storms can often be observed as **beautiful aurorae in our night sky**, but they can also cause major disturbances in Earth's power grids and navigation systems.

- A massive solar flare erupted from the Sun's surface, disrupting radio **waves, telecommunication networks, and power systems by triggering an intense magnetic storm.**
- Scientists have found evidence of an extreme solar 'tsunami' deep within the Earth's ice through analyses of ice cores from Greenland and Antarctica.
- A magnetic dam is formed which is storing a big mass of plasma. At the end of a solar cycle, this magnetic dam can break, releasing huge amounts of plasma cascading like a tsunami towards the poles.
- Therefore, **statements 1, 3, 4, 6 & 7 are correct. Hence option (c) is correct.**

Source: IE

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