



# Solar Coronal Holes

[Source: PIB](#)

The study has revealed that Indian astronomers have **accurately estimated** the **thermal and magnetic field structures** of **solar coronal holes (SCH)**.

## What are Solar Coronal Holes?

- **About: Coronal Holes** are large, [dark regions on the Sun](#) that are **cooler and less dense than the surrounding plasma**. It was first discovered in the **1970s** by **X-ray satellites**.
- **Occurrence:**
  - They occur in areas where the **Sun's magnetic field is open to interplanetary space**, allowing **high-speed solar wind (geomagnetic storm)** to escape.
    - Open magnetic field lines are **magnetic field lines that do not form closed loops** but extend outward into space without returning to their source.
  - Coronal holes are **most prevalent during the declining phase of a solar cycle** and are typically found near the **Sun's poles**.
- **Properties of Coronal Holes:**
  - **Uniform Temperature:** Coronal holes maintain a consistent temperature across latitudes, indicating a deep origin within the Sun.
  - **Magnetic Field Variation:** Magnetic field strength increases from the solar equator to the poles, likely influenced by **Alfvén wave disturbances**.
    - **Alfvén wave disturbances** are **low-frequency oscillations in the magnetic field and ions of a plasma** that can cause fluctuations in the solar wind and geospace.
- **Impacts of SCH:**
  - **Impact on Space Weather:** The high-speed solar wind from coronal holes interacts with Earth's magnetic field, causing **geomagnetic storms** that can disrupt satellites, GPS, and communication networks.
  - **Effect on Indian Monsoon:** The study suggests that, along with sunspots, the radiative effects of coronal holes **influence Indian monsoon rainfall variability**.
  - **Ionospheric Disturbances:** Coronal hole activity affects Earth's ionosphere, impacting **radio wave propagation** and **telecommunication systems**.

## Sunspots

- [Sunspots](#) are **dark areas on the sun's surface** that are **caused by strong magnetic fields**. They are **cooler than the surrounding areas of the sun**, making them appear darker on the surface of the Sun (photosphere).
- **Coronal holes and sunspots differ in location, magnetic field, and visibility.**

	Coronal hole	Sunspot
Location	In the sun's upper atmosphere, the corona	In the sun's lower atmosphere, the photosphere
Magnetic field	Open magnetic lines that allow solar wind to flow freely	Extremely strong magnetic fields with twisted magnetic lines
Visibility	Only visible in UV or X-ray light	Visible in visible light





A dive  
into



# Space Weather

We are here!



8.3 minutes  
Time of  
sunlight to  
reach Earth

1 AU

## Space weather

refers to conditions within the solar system due to the Sun's radiation

**Geomagnetic storms** are the temporary disturbance of Earth's magnetosphere caused by a solar wind shock.



The disturbance, which drives the magnetic storm, typically is a solar coronal mass ejection.

**Coronal mass ejections (CMEs)** are eruptions of solar plasma and magnetic fields from the Sun. CMEs involve the emission of electrically charged matter and magnetic field into space.

CMEs are surprisingly thin and scattered along a wide area of 0.25 astronomical unit

400 km / s  
Solar wind speed

The **Solar wind** is a stream of charged particles emitted from the upper atmosphere of the Sun. It is made of electrons and protons. The thermal energy of the plasma of the crown is so high that exceeds the gravitational field of the star and expands in the interplanetary space like the wind.

The **Aurora** is an impressive and bright celestial phenomenon that is observed in the upper layers of the atmosphere and can be seen in the northern parts of the earth. The phenomenon presents a variety of colours and patterns, with sudden appearances and relatively rapid transformations.



150 million km  
Astronomical Unit (AU)

Read More: [What is a Geomagnetic Storm?](#)

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)**

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