All about Auroras

Why in news?

A crimson glow lit up the dark sky in parts of Ladakh in a rare stable auroral red arc event at the Hanle Dark Sky Reserve in the high Himalayas due to the strong solar magnetic storms launched towards Earth.

What is Auroras?

- **Polar lights**- An aurora is a natural light display that is predominantly seen in high-latitude regions around the Arctic and Antarctic.
- **Formation-**These lights occur due to interactions between solar winds—streams of charged particles ejected from the Sun—and the Earth's magnetosphere, a region dominated by Earth's magnetic field.
- When these charged particles collide with atoms and molecules in the Earth's upper atmosphere, they produce light.
- **Solar storms**- They are caused by *Coronal Mass Ejections* (CMEs), which are significant releases of magnetic particles and plasma from the Sun's corona.
- **Visibility-**Auroras are only visible at night, and usually only appear in lower polar regions.

Auroras visibility is seen in regions about 66.5° north and south of the Equator.

Region	Known as
In north (Arctic circle) it is called as northern lights	Aurora borealis
In south (Antarctic Circle) it is called as southern lights	Aurora australis

- **Vibrant colour**-
  - **Oxygen-** It gives off green and red light.
  - **Nitrogen**- It gives blue and purple.
- **Strongest auroras**- It occur during periods of *high solar activity*, such as solar storms or solar flares.

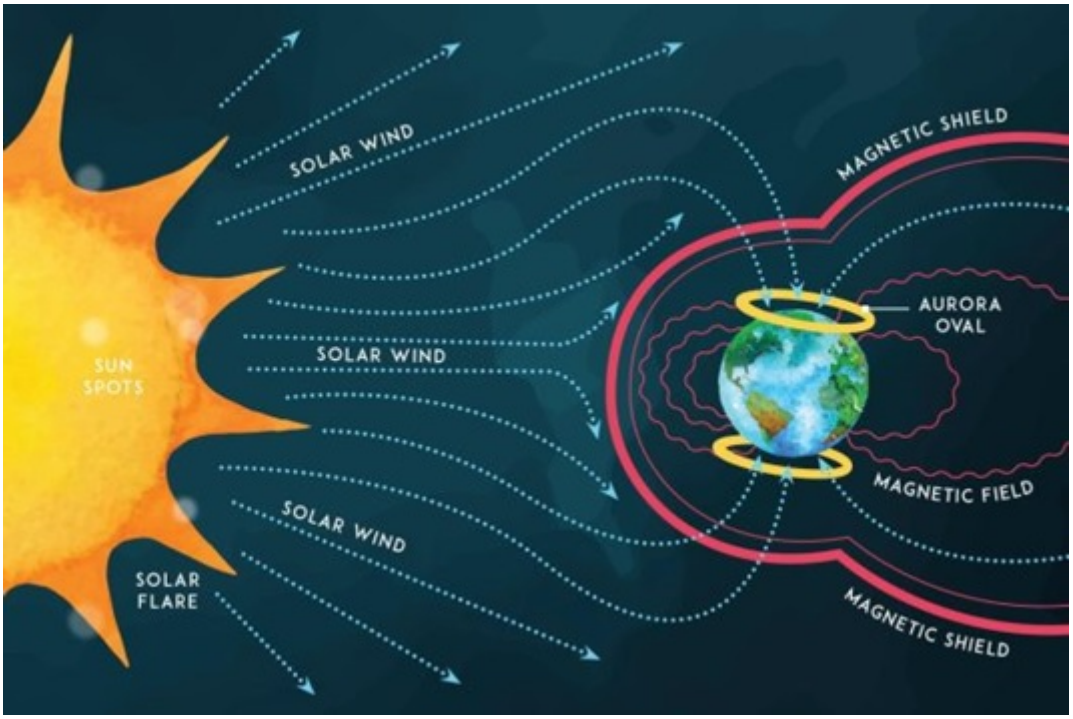
How are auroras formed?

- **Solar winds**- The Sun emits a continuous stream of charged particles, primarily electrons and protons, known as the solar wind. These particles travel through space and can sometimes interact with Earth's magnetic field.
- **Interaction with Earth's Magnetosphere**- When these charged particles from the

solar wind reach Earth, they encounter the Earth's magnetosphere.

The magnetosphere is a protective magnetic field that surrounds our planet and deflects most of the solar wind particles.

- **Magnetosphere disturbances-** Some solar wind particles, particularly during periods of heightened solar activity (such as solar flares and coronal mass ejections), can disturb the magnetosphere. These disturbances can cause particles to become trapped in the Earth's magnetic field lines.



- **Movement toward the poles-** The Earth's magnetic field lines guide these trapped particles toward the polar regions. This is because the magnetic field is weaker and more concentrated at the poles, providing a path of least resistance for the particles.
- **Collisions in the atmosphere-** As the charged particles spiral along the magnetic field lines and enter the Earth's upper atmosphere (the thermosphere and ionosphere), they collide with atoms and molecules of gases, primarily oxygen and nitrogen.
- **Excitation-** These collisions transfer energy from the charged particles to the gas atoms and molecules, exciting them to higher energy states.
- When these excited atoms return to their normal state, they release energy in the form of light. This light is what we see as auroras.

Why auroras are seen in Ladakh?

- **Heightened solar activity**: The solar storms were unusually intense and multiple CMEs struck Earth in quick succession, greatly disturbing the usual space weather.
- **High intensity of CMEs**- The CMEs that reached Earth were particularly intense, traveling at speeds up to *815 km/second*. This high intensity meant that a large number of charged particles were directed towards Earth, significantly disturbing the magnetosphere.

- **Magnetic latitude-** Although auroras are typically confined to high-latitude regions near the poles, the intensity of these solar storms allowed auroras to be visible at lower latitudes, such as Ladakh.
- **Enhanced Auroral oval**-During intense solar storms, the auroral oval (the ring-shaped region around the poles where auroras are typically visible) can expand towards lower latitudes. This expansion brought the auroral activity into regions like Ladakh.
- **Clear sky**- Ladakh's high altitude and clear skies provided optimal conditions for observing the auroras. The region's lack of light pollution also made it easier to see the faint auroral displays.

Quick facts

Hanle Dark Sky Reserve (HDSR)
• **Organised by**- Indian Institute of Astrophysics (IIT) in collaboration with Department of Wildlife Protection, UT Ladakh to observe the optical phenomenon in the sky. • **1st dark sky region-** It is India's 1st dark sky region notified by UT of Ladakh comprising an area of radius roughly 22 km around Hanle. • **Objectives**- - It preserves the dark skies by *reducing light pollution* in the surrounding areas. - It uses these dark skies to *promote astrotourism* as a means to further enhance socio-economic development in the area. • **Significance of Dark Sky** – To observe stars, star clusters, nebulae, and galaxies (such as Milky Way, Andromeda and the Triangulum) with the naked eye. • **Bortle scale**- HDSR comes under Bortle Class 1 skies, it helps to measure the night sky's brightness at a given location. • **Range**-The Bortle scale ranges from Class 1 (darkest skies available over the earth) to Class 9 (pale, light-marred skies over the insides of cities).

References

1. Indian Express- Aurora lights in India
2. The Hindu- Auroral arc in Ladakh sky

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