



Distant Gamma-Ray Burst Disturbed Earth's Upper Atmosphere

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Why in News?

According to recent researchers, [gamma-ray burst \(GRB\)](#) triggered by a [supernova](#) explosion in a galaxy situated **nearly two billion light-years from earth**, induced a notable disruption in the [ionosphere](#) of Earth.

What are the Major Takeaways from the Research?

- **Background:**
 - Approximately **two billion years ago**, in a distant galaxy outside our Milky Way, a large star met its end in a colossal explosion known as a supernova. This event released an **immense surge of gamma rays**.
 - The journey of these waves spanned across the cosmos, reaching Earth in **2022**.
- **Takeaways from the Research:**
 - The effects of the gamma-ray burst were studied with the help of the **China Seismo-Electromagnetic Satellite (CSES)**, also called **Zhangheng**, a **Chinese-Italian mission launched in 2018**.
 - It housed the **Electric Field Detector (EFD) instrument**, providing unprecedented resolution for analysis.
 - The GRB induced a remarkable disturbance in Earth's ionosphere, a zone extending 30-600 miles above the planet's surface, **detected in October, 2022**.
 - The European Space Agency's Integral (**International Gamma-Ray Astrophysics Laboratory**) and several satellites near Earth registered the impact, revealing a **strong variation in the ionosphere's electric field**.
 - The gamma rays lingered for about 13 minutes, affecting the ionosphere for several hours, even **triggering lightning detectors in India**.
 - Scientists **identified this GRB as the most potent ever recorded**.

What is a Gamma Ray Burst?

- **About:**
 - **Gamma-ray bursts are short-lived explosions of [gamma rays](#)**, the most energetic form of light.
 - Lasting from a **few milliseconds to several hours**, they shine hundreds of times brighter than a typical supernova and about a million trillion times as bright as the Sun.
 - Observed in distant galaxies, they are the **brightest electromagnetic events known to exist in the universe**.
- **Types:**
 - Astronomers classify gamma-ray bursts into **long- and short-duration events**. While the two types of events are likely created by different processes, both result in the **creation of a new [black hole](#)**.
 - **Long-duration bursts** last anywhere from **2 seconds to several hours**.

Although they are associated with the deaths of massive stars in supernovas, **not every supernova results in a gamma-ray burst.**

- **Short-duration bursts last less than 2 seconds.** They appear to result from the **merger of two neutron stars into a new black hole**, or the merger of a neutron star and a black hole to form a larger black hole.

What is the Ionosphere?

▪ About:

- The ionosphere is a region of **Earth's upper atmosphere**, spanning an altitude of approximately **30 to 600 miles (50 to 950 kilometers)** above the Earth's surface.
- The ionosphere is **ionized by solar radiation** that creates a layer of charged particles.
 - It is highly sensitive to changing magnetic and electrical conditions in space, usually connected to solar activity. It also **expands and contracts in response to solar radiation.**

▪ Significance:

- **Radio Propagation:** The ionosphere affects the **propagation of radio waves by reflecting and refracting them back to Earth.**
 - This phenomenon enables long-distance communication via radio transmissions.
- **Protection from Solar Radiation:** It shields the Earth's surface from harmful solar radiation, particularly from the sun's extreme ultraviolet rays.
- **Auroras Formation:** Interactions between charged particles from the sun and the Earth's magnetic field in the ionosphere **create phenomena such as** auroras, which are luminous displays predominantly seen at high latitudes.

UPSC Civil Services Examination, Previous Year Question (PYQ)

Q. Recently, scientists observed the merger of giant 'blackholes' billions of light-years away from the Earth. What is the significance of this observation? (2019)

- (a) 'Higgs boson particles' were detected.
- (b) 'Gravitational waves' were detected.
- (c) Possibility of inter-galactic space travel through 'wormhole' was confirmed.
- (d) It enabled the scientists to understand 'singularity'.

Ans: (b)