



Electromagnetic Ion Cyclotron Waves

Why in News?

Scientists have identified **Electromagnetic Ion Cyclotron (EMIC) waves**, a form of [plasma waves](#) in the [Indian Antarctic station, Maitri](#).

- These waves play an important role in **precipitation of killer electrons** (electrons having speed close to **speed of light, which form the radiation belt of planet Earth**), which are hazardous to [space-borne technology/instruments](#).
- The study can help understand the **impact of energetic particles** in the radiation belts on the [low orbiting satellites](#).

What are Electromagnetic Ion Cyclotron Waves?

- The **EMIC waves** are the **discreet [electromagnetic emissions](#)** observed in the Earth's magnetosphere.
- These waves are **generated in the equatorial latitudes** and propagate along magnetic field lines to its footprint in the high latitude ionosphere.
- Their signatures can be **recorded in both space as well as ground-based magnetometers**.

Magnetosphere

- [Magnetosphere](#) is the cavity in which the Earth lies and stays **protected from the wrath of the Sun**.
- It is formed by the **interaction between Earth's magnetic field and the solar wind**, which is a **continuous stream of charged particles**, mainly electrons and protons, flowing from the Sun.
 - **Earth's magnetic field** is generated by the motion of **molten iron in its [outer core](#)**.

Magnetometer

- A magnetometer is a **scientific instrument used to measure the strength and direction of magnetic fields**.
- It can be used to study the **Earth's magnetic field**, as well as magnetic fields of other celestial bodies, such as planets, moons, stars, and galaxies.
 - **Magnetometers work based on the principles of [electromagnetic induction](#) or magnetoresistance**.

What are Plasma Waves?

- **About:**
 - Plasma waves are a type of **electromagnetic wave** that propagates through **plasma**, which is a **state of matter**.
 - Plasma is formed when a **gas is heated to high temperatures or subjected to strong electric fields**, causing its atoms to become ionised, **meaning they lose**

or gain electrons and become charged particles.

- More than **99% of the matter in the visible universe consists of plasma.**
 - **Our Sun, solar wind, the interplanetary medium, near-Earth region, magnetosphere,** and the upper part of our atmosphere all consist of plasma.

▪ **Application:**

- **Plasma waves** have significant applications in various fields, including [astrophysics](#), **space science, plasma physics, and communication technology.**
 - For example: they are involved in the **generation of auroras**
- The study of plasma waves also provides us with information on **regions inaccessible to us, transport mass and energy across different regions, how they interact with charged particles** and control the overall dynamics of the **Earth's magnetosphere.**

What are the Other States of Matter?

▪ **About:**

- States of matter are the different physical forms that matter can exist in, based on their unique properties such as **shape, volume, and particle arrangement.**
- The three most commonly known states of matter are solid, liquid, and gas.
 - Additionally, there are two less common states of matter known as **plasma and Bose-Einstein condensate.**

- **Bose-Einstein Condensate:** It is a state of matter that **occurs at very low temperatures,** close to absolute zero. It was first predicted by [Albert Einstein](#) and **Indian physicist Satyendra Nath Bose in the 1920s.**

UPSC Civil Services Examination Previous Year Question (PYQ)

Q. Discuss the work of 'Bose-Einstein Statistics' done by Prof. Satyendra Nath Bose and show how it revolutionised the field of Physics. **(2018)**

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