



Solitary Wave in Martian Magnetosphere

Why in News?

Recently, [Indian Institute of Geomagnetism \(IIG\)](#), an autonomous institute of the Department of Science and Technology (DST) has found evidence of "solitary waves" in the **weak magnetic field** around Mars for the first time.

- Scientists used **high-resolution electric field data** from [NASA's MAVEN spacecraft](#) to make the discovery of solitary waves.

What are the Key Highlights of the Discovery?

- Unlike **Earth**, the planet **Mars** does not have any **intrinsic magnetic field**. This allows the **high-speed solar wind** to interact directly with the Mars atmosphere, like an obstacle in flow.
 - It has been suggested that even in a **weak and thin magnetosphere** as that of Mars, **frequent occurrences of solitary waves can be observed**.
- However, **despite several missions to Mars**, the presence of solitary waves in the Martian magnetosphere **has never been reported earlier**.
- The waves were found **mostly in the morning and evening on Mars**, at altitudes of **1000-3500 km**, and their **exact cause is still unknown**.

What are Solitary Waves?

- **About:**
 - Solitary waves are the **distinct electric field fluctuations** (bipolar or monopolar) that follow constant amplitude-phase relations.
 - Their **shape and size are less affected** during their propagation.
- **Significance:**
 - Solitary waves have been found to play a significant role in the dynamics of various **physical systems**, such as in the [Earth's magnetosphere](#) and in the **Martian magnetosphere**.
 - In the **Earth's magnetosphere**, they are known to be responsible for the **energization and transport of plasma particles**, which can affect the behaviour of satellites and other space-borne equipment.
 - In the **Martian magnetosphere**, their significance is not fully understood yet, but it has been suggested that **they may play a role in the loss of atmospheric ions on Mars**.

What are the Key Points Related to Mars?

- **Size and Distance:**
 - It is the **fourth planet from the Sun** and the second-smallest planet in the Solar System.
 - Mars is about half the size of Earth.
- **Similarity to the Earth (Orbit and Rotation):**
 - As Mars orbits the Sun, it completes one rotation every **24.6 hours**, which is very similar to one day on Earth (23.9 hours).
 - Mars' axis of rotation is tilted **25 degrees** with respect to the plane of its orbit around the

Sun.

- This is similar to Earth, which has an axial tilt of **23.4 degrees**.

◦ Mars has **distinct seasons like Earth**, but they last longer than seasons on Earth.

▪ **Various Mars Missions:**

- [ExoMars rover \(2021\) \(European Space Agency\)](#)
- [Tianwen-1: China's Mars Mission \(2021\)](#)
- [UAE's Hope Mars Mission \(UAE's first-ever interplanetary mission\) \(2021\)](#)
- [India's Mars Orbiter Mission \(MOM\) or Mangalyaan \(2013\)](#)

UPSC Civil Services Examination Previous Year Question (PYQ)

Q. Consider the following statements: (2016)

The Mangalyaan launched by ISRO

1. is also called the Mars Orbiter Mission
2. made India the second country to have a spacecraft orbit the Mars after USA
3. made India the only country to be successful in making its spacecraft orbit the Mars in its very first attempt

Which of the statements given above is/are correct?

- (a) 1 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans: (c)

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