



# 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)**

**Source: PIB**

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