

Zwan-Wolf Effect

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Zwan-Wolf Effect Latest News

NASA's MAVEN spacecraft recently recorded something Mars has never shown before, which is the Zwan-Wolf effect.

About Zwan-Wolf Effect

- It is a process where **charged particles** are **squeezed along magnetic structures**, known as **flux tubes**.
- The Zwan-Wolf effect was **discovered** in **1976** and has **so far only been observed** in **planetary magnetospheres** and **not their atmospheres**.
- **How does it happen?**
 - The **solar wind** is a **stream of charged particles** flowing outwards from the sun.
 - As the **solar wind** **near the magnetic field of a planet**, it becomes **compressed near the magnetic boundaries**.

- This **creates a difference in pressure**, or pressure gradient, that **squeezes the charged particles along the magnetic field**, away from the stream.
- As a result, **closer to the stream** is an **area with a lower density of charged particles**. This is called the **Zwan-Wolf effect**.
- **On Earth**, this mechanism **deflects much of the solar wind and protects us** from the Sun's constant bombardment.

Why are the New Findings Important?

- **Unlike Earth, Mars is not protected by a global magnetic field**, affecting how it interacts with the solar wind and space weather.
- The Zwan-Wolf effect was **observed in the ionosphere — deep within the Martian atmosphere below 200 km** — which **contains** significant numbers of **electrically charged particles**.
- The data showed that **these charged particles** were being **squeezed and distributed around Mars' atmosphere**.
- It suggests that **Mars**, despite lacking a global magnetic field, **experiences similar interactions with the solar wind**, offering valuable insights into the planet's atmospheric dynamics.

Key Facts about MAVEN Spacecraft

- **Mars Atmosphere and Volatile EvolutionN (MAVEN)** is the **first spacecraft mission** dedicated to **surveying the upper atmosphere of Mars**.
- It is part of **NASA's Mars Exploration Program**.
- It aims to understand the role that **loss of atmospheric gas to space played in changing the Martian climate** over time.
- It was **launched** in November **2013** and arrived at Mars in September 2014.
- It carries three packages of **instruments**.
 - One package **studies the solar wind and its impact on Mars's ionosphere**. (Since Mars has no magnetic field, its atmosphere would be slowly removed by interaction with the solar wind.)
 - The second package is an **ultraviolet spectrometer** that studies the upper atmosphere.
 - The third package is a **mass spectrometer** that studies the composition of the upper atmosphere.
- **MAVEN found that Mars lost about 2/3 of its early atmosphere to space.**

Source: **NDTV**

Source: <https://vajiramandravi.com/current-affairs/zwan-wolf-effect/>

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