The Draping Magnetic Field Around Mars

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Based in: LASP
With global magnetic field

Without global magnetic field
Solar wind

- It is released from the upper atmosphere of the sun, called the corona.
- The practices found in the solar wind are mostly electrons and protons.
- IMF interplanetary magnetic field frozen in the solar wind
- The speed of the solar wind when it hits Mars is 400 km/s
MAVEN

- Stands for:
  - Mars Atmosphere and Volatile Evolution

- Developed by:
  - NASA

- Launch date:
  - November 18, 2013

- Orbital intersection:
  - September 22, 2014
The Magnetometer (MAG) measures the interplanar solar wind.

**Observations:**

- Vector magnetic field in the **unperturbed solar wind** \((B \sim 3 \, \text{nT})\), **magnetosheath** \((B \sim 10-50 \, \text{nT})\), and **crustal magnetospheres** \((B < 3000 \, \text{nT})\), with the ability to spatially resolve crustal magnetic cusps (horizontal length scales of \(\sim 100 \, \text{km}\))

**Data was used from:**

- November 2014 till October 2017

Background about Mars

- 141.6 million mi far from the Sun
- Orbital period: 687 days
- Second smallest planet in the solar system
- Its radius is half of Earth’s
Fun Fact

When the solar wind hits Mars, auroras happen mostly likely all over the planet at night.

Mars boundaries

X: Points from Mars to the sun
Y: Completes the right hand rule
Z: Pointing in the electric field direction
Methodology:

- Time series plots
- 3D plots
- Maps
Time series plot:

• Two time series plots:
  • Spacecraft position
  • Magnetic field data
Spacecraft Position time series plot

Existing bow shock  Entering the bow shock
Magnetic field time series plot

Existing bow shock

Entering the bow shock
3D plot of one orbital period around Mars

Arrow length: 10 nT
• Of all the data combined
  
  • With **weak** solar wind dynamic pressure and IMF
  
  • With **strong** solar wind dynamic pressure and IMF
Map of the magnetic field around Mars
Weak solar wind

Strong solar wind
Dynamic pressure:

- Dynamic pressure formula:
  \[ \vec{E} = -\vec{V}_{sw} \times \vec{B}_{imf} \]

- Solar wind Velocity
- Interplanetary Magnetic field
Weak Solar wind dynamic pressure
Weak IMF

Strong Solar wind dynamic pressure
Strong IMF
Summary

- Mars doesn’t have a global magnetic field of its own
- The IMF drapes around Mars and results in a magnetic field
- Three methods show the behavior of the magnetic field around Mars based on the solar wind pressure and the IMF
Thank You!

Any Questions? 😊