The Martian Atmosphere: A Pebble in a Stream of Solar Wind

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MAVEN
Mars Atmosphere and Volatile Evolution Mission
CU/LASP • NASA GSFC • UCB/SSL • LMCO • NASA/JPL

Mars – A Desert World

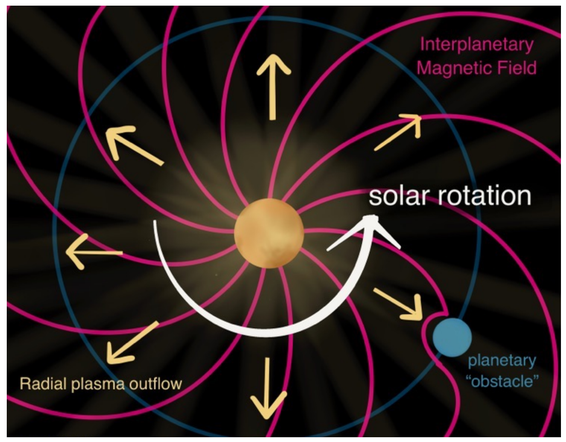
3.7 Billion Years Ago:
- Liquid Water Ocean
- Thick Atmosphere
- Warm

Today:
- Dry, dusty, desert
- Thin Atmosphere - <1% of Earth's
- Cold! average -81°F

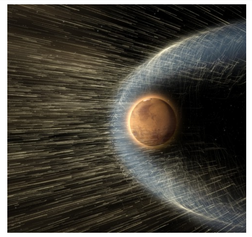
Where did the Martian atmosphere go?

Mars Atmosphere and Volatile EvolutioN (MAVEN) mission
- Orbiting Mars since 2014
- Principal Investigator mission managed by LASP
- ***Objective:*** Find out how particles in the Martian atmosphere are lost to space, and how thick Mars' atmosphere was in the past

How does Mars Interact with the Solar Wind?



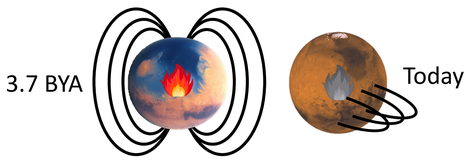
Solar Wind Plasma: a stream of ions and electrons (plasma) from the Sun's atmosphere travelling at 1 million mph throughout the solar system

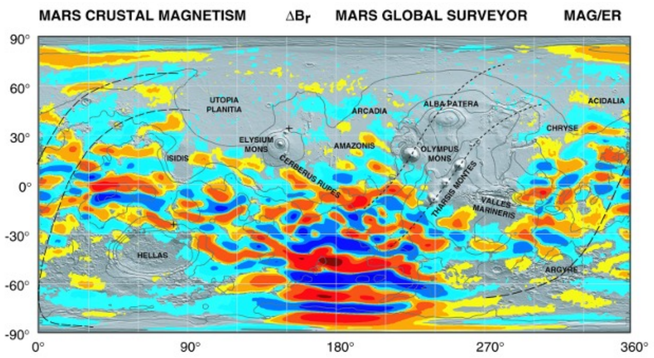


Interplanetary Magnetic Field (IMF): Magnetic field originating from the Sun that is carried by the solar wind through the solar system

What shields an atmosphere from the solar wind and IMF?

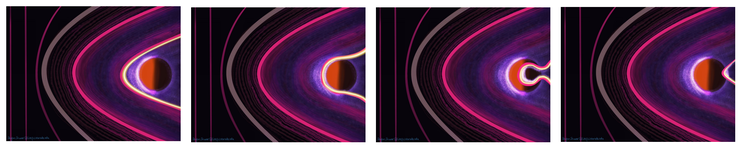
Planetary Magnetic Fields:
When Mars cooled ~3.7 Billion years ago, it's global magnetic field was "frozen into" parts of the surface, creating **crustal magnetic fields**





Planetary Ionosphere:
Solar radiation hits a planet's atmosphere, breaking particles into ions and elections, and creating an ***ionosphere*** that can push back against the solar wind and IMF

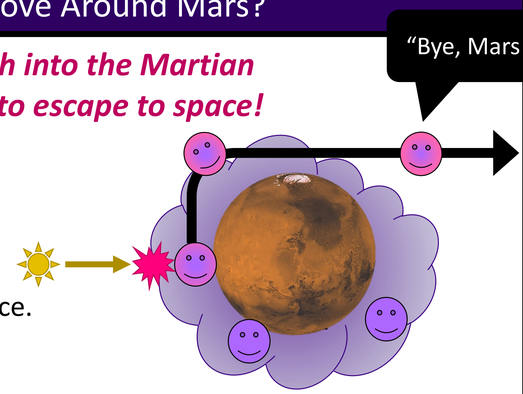
Mars' crustal magnetic fields and ionosphere cause the IMF to slide over the planet – but we don't know where that happens!

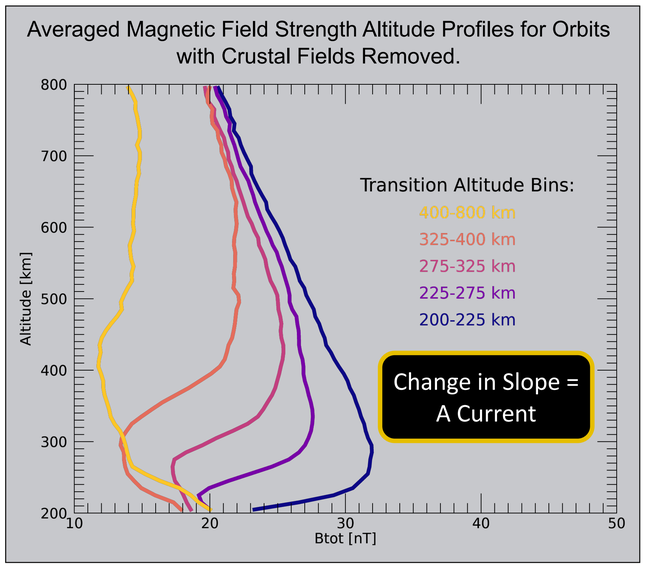


Where does the Solar Wind Move Around Mars?

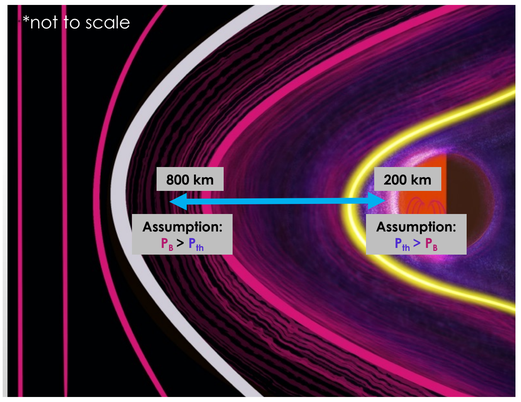
If the solar wind and IMF penetrate deep enough into the Martian atmosphere, it can cause atmospheric particles to escape to space!

- A **current** tells us that the atmosphere is working to protect itself from the solar wind
- We search for currents by looking at transitions between the solar wind and Martian ionosphere at certain heights, or altitudes, above the Martian surface.



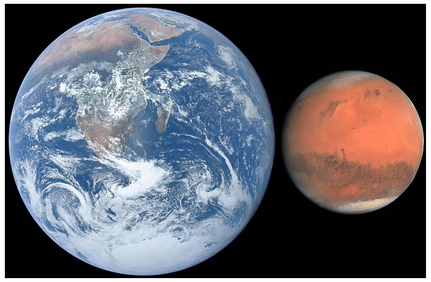


A change in magnetic field strength and direction indicates a current.



Broader Impacts and the Colorado Space Industry

Broader Impacts of Research:
- Analog for hard-to-study region in the Earth's atmosphere.
- Important for communication between the Earth and Mars for current and future exploration of the Red Planet.



Colorado Space Economy:
- 2nd Largest in USA.
- Companies enticed by access to highly trained/educated individuals

LASP 75

LASP:
- Largest research institute at CU Boulder
- Internationally recognized for planetary and space research
- >175 undergraduate/ graduate students employed alongside scientists and engineers
- Has sent instrument to every planet in solar system (+ Pluto!)