PVO observations of low frequency, large amplitude magnetosonic waves interacting with the upper Venusian ionosphere: implications for ionospheric structure, heating and escape

C.M. Fowler[1], O.V. Agapitov[1], A. Artemyev[2]

[1]Space Sciences Laboratory, University of California, Berkeley

[2]Institute of Geophysics and Planetary Physics, University of California, Los Angeles

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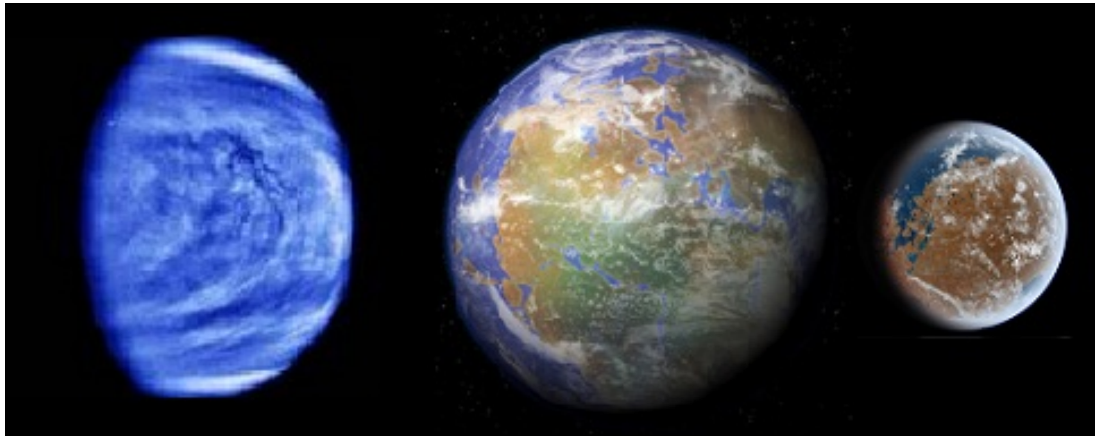
(Image credit: NASA)

The Big Picture



https://praxtime.com/2013/01/27/life-on-wet-planets/

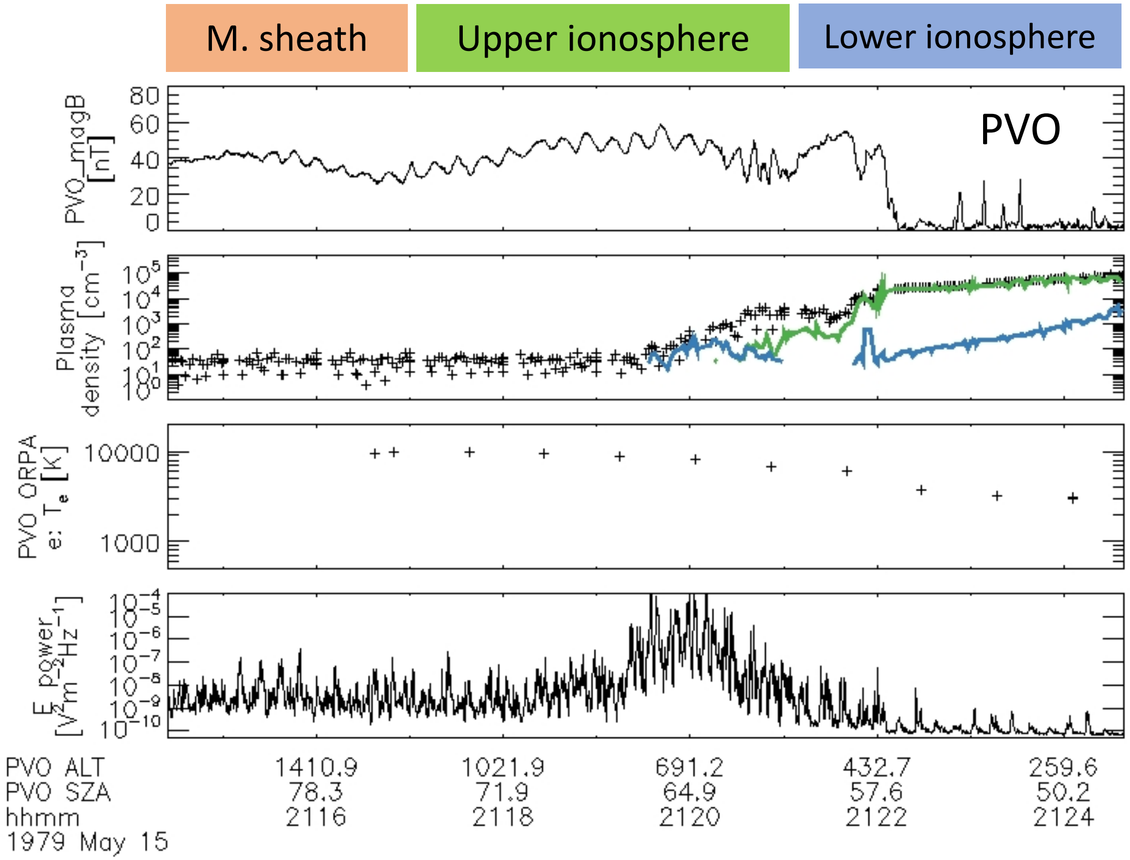
- Understanding atmospheric evolution at Venus and Mars is important.

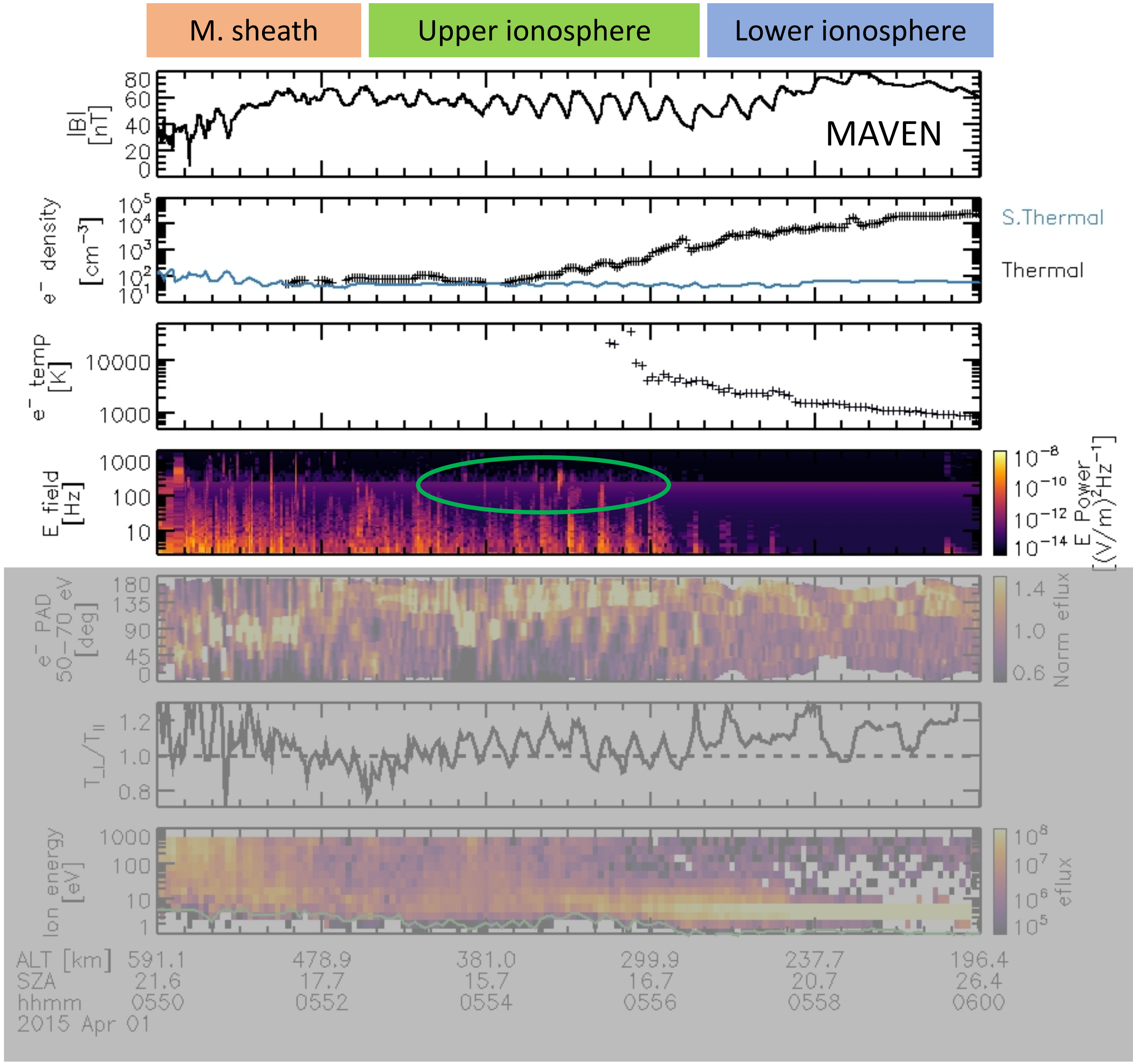
- Ion escape to space is one component of atmospheric evolution.
  - Cold (<1 eV) planetary ions must be accelerated to overcome gravity.
    - Wave-particle interactions are one mechanism.

- The Venusian and Martian ionospheres may be particularly susceptible to wave-particle interactions.
  - Lack of global dipole magnetic field.

- Comparative planetology between Venus, Mars and Earth can further inform us of these processes.
  - Venus = strong gravity, no dipole magnetic field.
  - Mars = weak gravity, "weak" crustal magnetic fields.
  - Earth = strong gravity, strong dipole magnetic field.

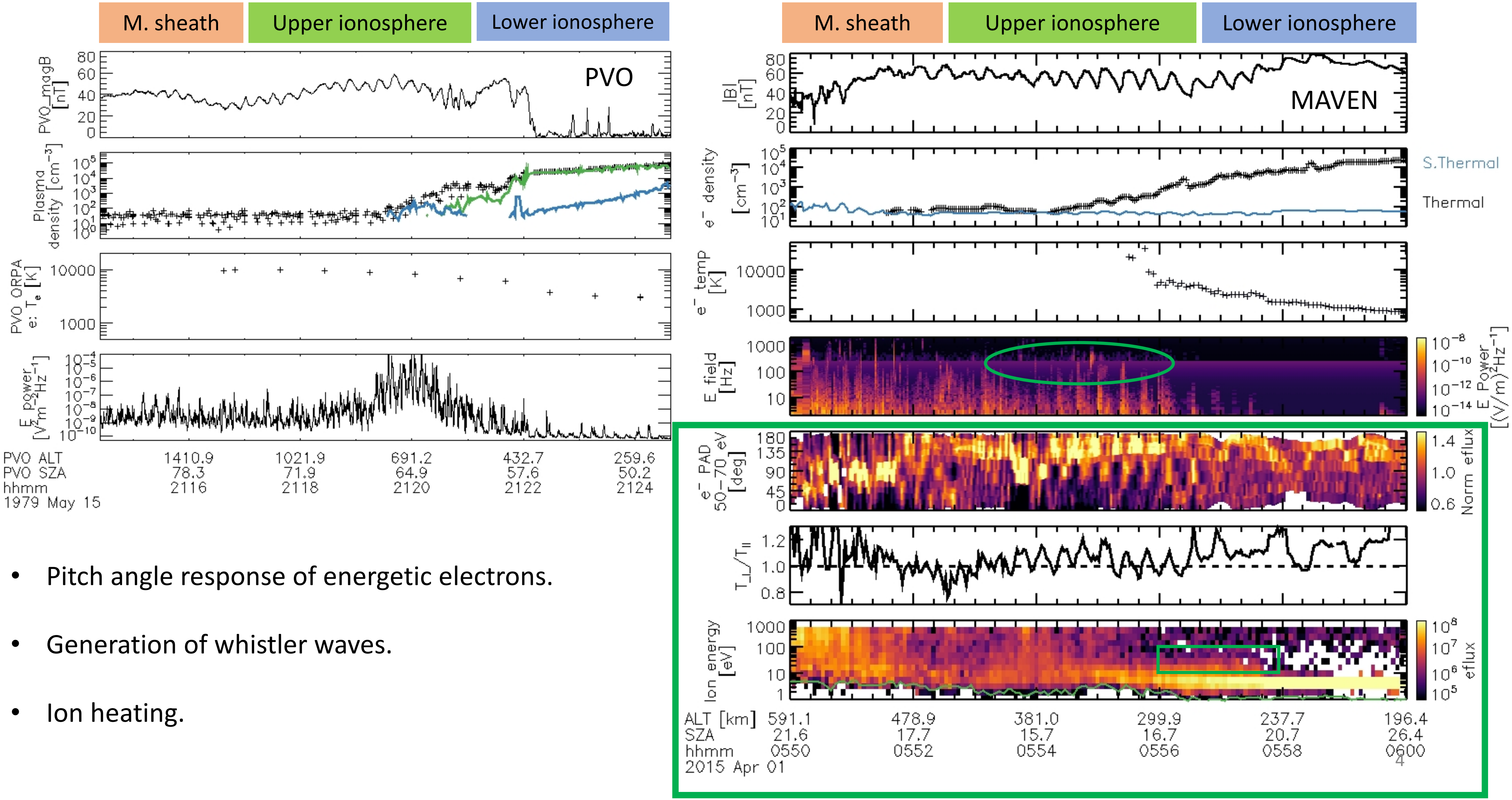
Plasma measurements at Venus and Mars





- Compressive waves propagate into upper ionospheres.
- Electric field waves observed.
- Disturbed ion densities.
- Enhanced thermal electron temperature.

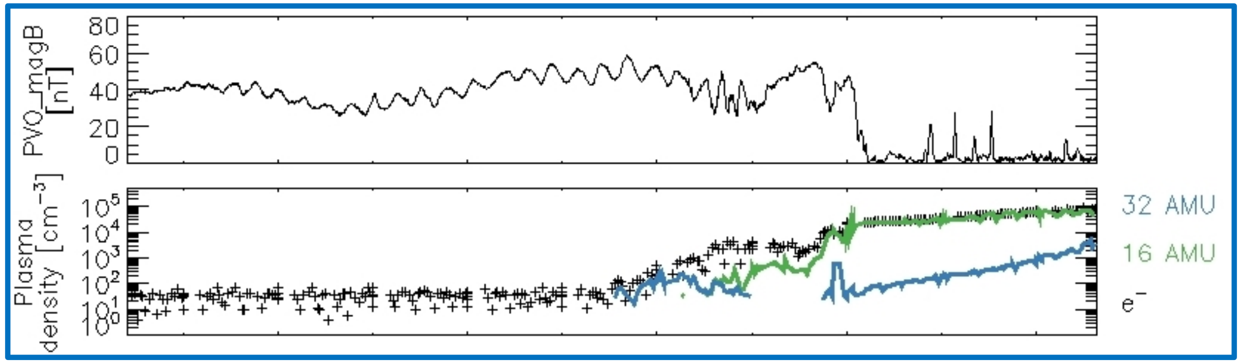
Plasma measurements at Venus and Mars



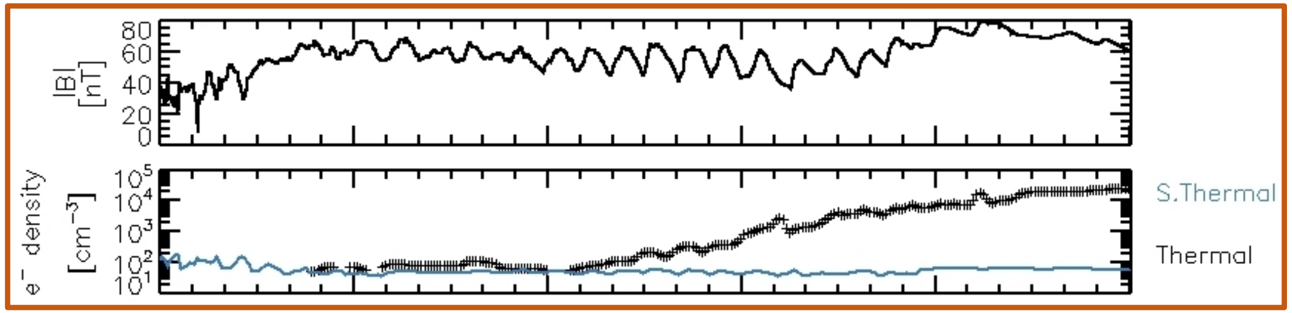
- Pitch angle response of energetic electrons.
- Generation of whistler waves.
- Ion heating.

Summary

- Wave-particle interactions can energize ionospheric particles, driving atmospheric loss to space.



- Similar types of waves are observed at Venus and Mars.



- Comparative studies can enhance our understanding at both bodies.

- Comprehensive plasma measurements at Venus would provide novel observations of processes important for atmospheric evolution, structure, energetics, etc.

(Fowler+ 2020, Localized heating of the Martian topside ionosphere through the combined effects of magnetic pumping by large-scale magnetosonic waves and pitch angle diffusion by whistler waves, GRL)