

SOLAR WIND INTERACTION AND ATMOSPHERIC LOSS AT VENUS

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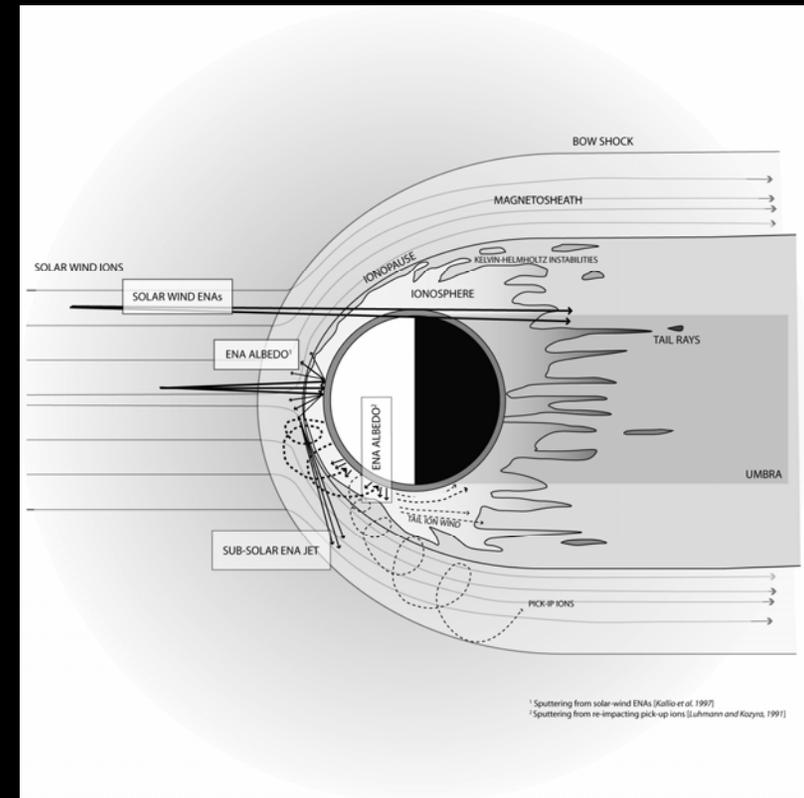
THE APL-TEAM

- ***Pontus Brandt, Ed Roelof, Tom Sotirelis*** at The Johns Hopkins University Applied Physics Laboratory, Laurel, MD
 - The neutral and plasma experiments **ASPERA-3/4** on board MEX and VEX
 - **McNutt, Paxton, Cheng, ...**
- **Terrestrial and planetary magnetospheres and ionospheres**
 - IMAGE, Cluster, DMSP, Cassini, MEX, VEX, MESSENGER, Bepi-Colombo
- **Heliosphere**
 - Voyager, ACE, Ulysses
- **Charged and neutral particles**
- **Energetic Neutral Atom (ENA) imaging**
 - Remote imaging of space plasma and its interaction with neutral gas

THE SCIENCE

- **How does the solar-wind interact with Venus and how does that affect atmospheric evolution?**
 - What are the present **global atmospheric loss rates** of H, H⁺, O, O⁺, molecular ions?
 - Was there an ocean? How quickly was it lost?
 - What are the **loss acceleration mechanisms**?
 - What is the **energy deposition** by charged and neutral particle precipitation?

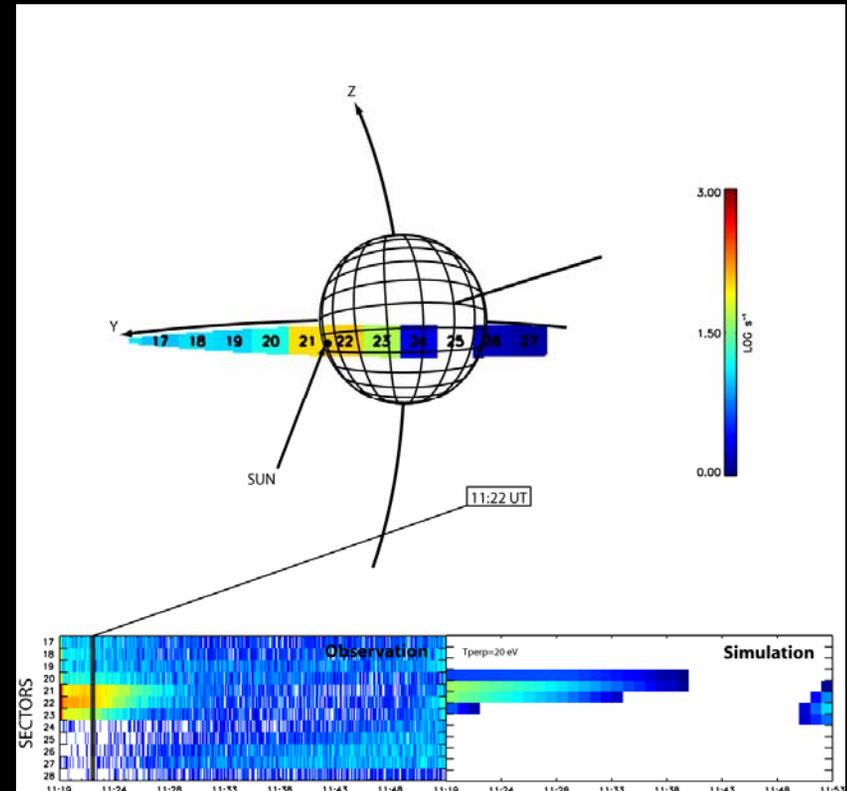
- **Solar min and max measurements essential to understand how the young Sun affect the evolution of Venus**



MEX/ASPERA-3 STUDIES

In anticipation of VEX/ASPERA data

- ENA imagers
 - Constrain global escape rates of energetic neutrals (~100 eV and up) [*Galli et al, 2006; Futaana et al., 2006*]
 - Constrain neutral particle precipitation rates
- Ion-mass spectrometer
 - H^+ , He^+ , O^+ , O_2^+ , CO_2^+ , ~50 eV – 30 keV
 - Acceleration loss mechanisms
 - Heavy ion outflow observed >1 keV [*Lundin et al., 2005*]



NPI Mars observation and simulation from eclipse viewing sunward. Emissions from limb region may be neutrals produced by charge exchange in the Martian exosphere, or, heavy ion outflow from the ionosphere.

SUMMARY

- The atmosphere ultimately escapes into space
- VEX provides unprecedented plasma and neutral measurements
- Solar wind variability/dependence?
- ~1-100 eV escape?
- Comparative studies
 - Mars has lower gravity and is farther from the Sun. *How does this affect ion and neutral escape?*
 - Titan sits in the energetic plasma flow of Saturn's corotating magnetosphere. *How does this affect the energy input to Titan's upper atmosphere?*



Titan ENA image of the interaction between the flow of Saturn's corotating magnetospheric, hot plasma and Titan's upper atmosphere [Mitchell et al., 2005].