

THE MARS EXPRESS/ASPERA-3 AND VENUS EXPRESS/ASPERA-4 SOLAR WIND DATABASES

M. Holmström¹, R. Ramstad¹, S. Barabash¹, Y. Futaana¹, X.-D. Wang¹
¹Swedish Institute of Space Physics, Kiruna, Sweden

Introduction: The upstream solar wind environments at Mars and Venus are often thought to influence, or be the major drivers of many processes in the planets' upper atmospheres and induced magnetospheres. To facilitate studies of such processes and general heliophysics, the PI-institute of the ASPERA-3 and ASPERA-4 plasma particles packages aboard Mars Express and Venus Express has developed a database of official solar wind moments (density, velocity, temperature) to be publicly available and archived. We present the methods used to develop these moments, including the results of intercalibrations with other missions (ACE, WIND, STEREO and MAVEN) and the first solar wind statistics collected at Mars over a full solar cycle.

Method: Moments are generated in five steps:

1. Identify IMA scans outside the bow shock, including an additional safety margin.
2. Exclude all data outside the solar wind direction and when the sun-direction is in a shadowed part of the field-of-view.
3. Subtract background counts (assuming no signal below 100 eV in the solar wind to get noise profile). Negligates contamination noise during SEP events.
4. Fit Gaussian curves to the mass-spectra to separate H⁺, He⁺⁺ and "ghost" H⁺ signals.
5. Integrate distribution to find n_{sw} , v_{sw} . Fit Maxwell to find T_{sw} .

Status and availability: Mars

The Mars Express/ASPERA-3 solar wind database is available in two versions, one (SCAN) based on individual 192 second scans of the instrument and the other (ORB) based on counts integrated over the available inbound/outbound segments before/after crossing bow shock safety margin. Calibration against upstream monitors (ACE/WIND/STEREO) is completed (see Figure 2 for an example comparison) and intercalibration with NASA's more recently arrived MAVEN mission is in progress. A copy of the database can currently be retrieved by request to the ASPERA-3 PI Mats Holmström (matsh@irf.se) and will be publically available from ESA's Planetary Science Archive (PSA) in the near future.

Venus

The Venus Express/ASPERA-4 solar wind database is under development and set to be finalized and published to PSA in the near future. Contact ASPERA-4 PI Yoshifumi Futaana for inquiries (futaana@irf.se).

Several papers have been published that use the data bases [1-6], with more publications under review.

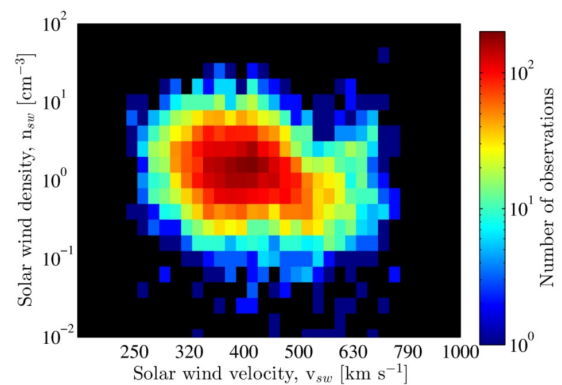


Figure 1: Solar wind density-velocity distribution at Mars based on all included solar wind data collected by ASPERA-3/IMA data and using the ORB version of the database. The mean density and velocity here is 2 cm^{-3} , 400 km/s respectively.

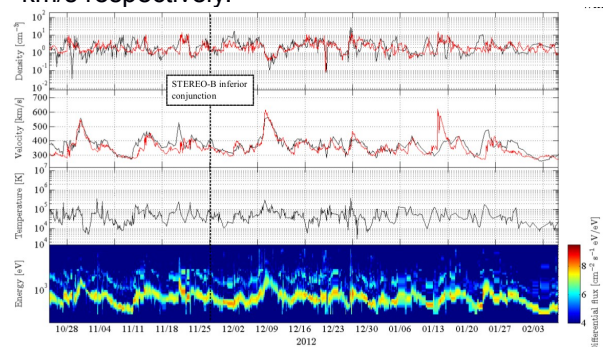


Figure 2: Comparison with 1 AU solar wind monitors. Example ASPERA-3/IMA solar wind moments (black) and spectra, plotted with STEREO-B/PLASTIC moments that are time-shifted and intensity adjusted to Mars angular position and radial distance from the Sun (red).

References:

- [1] Andrews, D.J., et al. (2016), **JGR**.
- [2] Behar, E., et al. (2016), **A&A**.
- [3] Edberg, N.J.T., et al. (2016), **JGR**.
- [4] Ramstad, R., et al. (2015), **JGR**.
- [5] Hall, B.E.S. et al. (2016), **JGR**.
- [6] Ramstad, R., et al. (2016) **JGR**.