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Energetic Neutral Atom (ENA) Imaging of the Heliosheath: Spectral Characteristics and Implications for Shock Acceleration from Observations by the Neutral Particle Detector (NPD) on board Venus Express (VEX)

P. C. Brandt (1), E. C. Roelof (1), P. Wurz (2), S. Barabash (3), D. Bazell (1), R. DeMajistre (1), T. Sotirelis (1), and R. Decker (1)

(1) The Johns Hopkins University Applied Physics Laboratory, SRP, Laurel, United States (pontus.brandt@jhuapl.edu), (2) University of Bern, Bern, Switzerland, (3) The Swedish Institute of Space Physics, Kiruna, Sweden

Here we report on the spectral characteristics across the sky of ENAs in the ∼0.1-3 keV range generated in the heliosheath observed by NPD on board Venus Express. Plasma and energetic particle measurements during the termination shock crossings by the Voyagers reveal that most of the particle energization occurs in the pick-up ion energy range (∼0.1-10 keV) [*Richardson, Nature, July, 2008*] - a range that was not covered by the Voyager instrumentation, but is covered by the ASPERA-4/NPD measurements. We seek to determine if the ENA spectra observed by NPD are consistent with the expected energization at these energies.

The Interstellar Boundary Explorer (IBEX) is the only mission so far dedicated to imaging the heliosheath and was launched October 2008. While the IBEX data is currently being analyzed, several other, non-dedicated instruments on board various missions (Venus Express, Cassini, IMAGE, Mars Express, SOHO, STEREO) are seeking to provide meaningful measurements of the structure and spectral characteristics of the heliosheath. One of those instruments is the NPD belonging to the ASPERA-4 experiment suite on board VEX. NPD is a time-of-flight (TOF) instrument using a coincidence technique to identify ENAs (and is therefore not sensitive to, for example X-rays) and has an instantaneous field-of-view (FOV) of $5^\circ \times 180^\circ$ with six sectors of each $5^\circ \times 30^\circ$ FOV. A scanning platform allows the FOV to scan across half of the entire sky in one scan.

By restricting about three years of measurements to Venus eclipse and to directions that look more than 90° away from the Sun and Venus direction, we minimize unwanted ENAs from Venus and solar background. The resulting spectra from the sky show an influx of ENAs. The obtained spectra vary slightly across the sky and are in good agreement with the expected ENA spectrum and intensity derived from in-situ ion measurements by Voyager-1 and 2, and hydrogen gas density estimates from pick-up ion measurements.