Space Plasmas in the Solar System, including Planetary Magnetospheres (D)
Pickup Ions in the Heliosphere and Beyond (D1.3)
Consider as poster only.

IMPROVED CALCULATION OF INTERSTELLAR PICKUP ION PROPERTIES FROM ULYSSES/SWICS DATA

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Integrating the particle spectra of ions in the solar wind allows for the determination of the bulk plasma properties such as the density and temperature of interstellar pickup ions. These results are important for validating simulations of the interaction between the solar wind and the local interstellar medium. Including the effects of interstellar pickup ions in these simulations can significantly modify the outer heliospheric boundaries. We build on the particle spectra from [1], which are generated from measurements made by the Solar Wind Ion Composition Spectrometer (SWICS) instrument on the Ulysses spacecraft with a new method of converting the particle distribution functions from the spacecraft frame to the solar wind frame. This approach offers an improvement upon the standard narrow-beam approximation. We calculate the moments of these particle spectra to determine the bulk plasma properties of interstellar pickup ions. We focus on pickup protons (H+) and pickup helium (He+) for this study. We compare our density and temperature results for pickup protons to those in [2], where the particle spectra are converted to the solar wind frame using the narrow-beam approximation. We have previously shown results for pickup protons for twelve-hour intervals and pickup helium for twenty-day intervals over two months during the "Halloween 2003" solar storms, and we are currently working on extending these analyses to a wider range of dates. During this two-month period, the pickup proton density calculated using this new method is higher than that calculated in [2], and the calculated pickup proton temperature is significantly smoother. The pickup helium density during the first twenty-day interval agrees with previous calculations, but the results for the next two twenty-day intervals are made inaccurate by the large CMEs during this time period, which cause issues in the He+ distribution functions due to rapid changes in solar wind speed. Efforts are being made to address this issue, though the negative effects are reduced outside of this period of extreme solar activity. Our results are promising for the purpose of

studying interstellar pickup ions during quiet times as well as during solar events. The results of this analysis will be used to validate simulations of the interaction between the solar wind and the local interstellar medium. This will make it possible to reveal the contribution of pickup ions in greater detail.

[1] Zhang, M. et al. 2019, Determination of Plasma, Pickup Ion, and Suprathermal Particle Spectrum in the Solar Wind Frame of Reference. The Astrophysical Journal, 871:60 (9pp). https://doi.org/10.3847/1538-4357/aaf509

[2] Intriligator, D. S. et al. 2012, Pickup Protons: Comparisons using the three-dimensional MHD HHMS PI model and Ulysses SWICS measurements. Journal of Geophysical Research, 117, A06104. https://doi.org/10.1029/2011JA017424