



Contribution ID: 377

Type: **Oral contribution**

Pick-up Ion Scattering in the Outer Heliosheath - implications for IBEX and Voyager 1 observations.

Friday, 31 July 2015 11:15 (15 minutes)

The nearly circular band of energetic neutral atom (ENA) emission dominating the field of view of the Interplanetary Boundary EXplorer satellite (IBEX), is most commonly attributed to the effect of charge exchange of secondary pickup ions (PUIs) gyrating about the magnetic field in the outer heliosheath and the interstellar space beyond.

The main difficulty with this model is the problem with stability of ring distributions that tend to generate waves and scatter onto a shell on time scales too short for charge exchange to occur. We performed a careful study of the ring instability using theoretical dispersion relations, hybrid plasma simulations, and fully kinetic PIC

simulations that included electron dynamics.

In addition to several prescribed distributions, we used primary ENA fluxes from the global kinetic-neutral model of the heliosphere to obtain a smooth empirical representation of the PUI ring produced from solar-wind and heliosheath ENAs. Simulations reveal that the ring distribution generates both left- and right-hand polarized waves traveling parallel to the background magnetic field. Narrow rings generate abundant magnetic fluctuations at the resonant frequencies, whereas simulations with broadened rings show very low levels of turbulence. Nonetheless, particle scattering occurs for every type of rings we studied. Results are discussed in the context of IBEX observations of the ribbon and the recent Voyager 1 in situ measurements of magnetic field fluctuations in the outer heliosheath.

Collaboration

– not specified –

Registration number following "ICRC2015-I/"

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Session Classification: Parallel SH 02 Outer Helio

Track Classification: SH-TH