Ion Signatures of Pseudobreakups and Expansive Aurora in the Magnetotail

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Abstract

We present plasma distributions measured by the WIND spacecraft during two perigee passes through the near-Earth plasma sheet (PS) region. During the first interval (26 July, 1997), Polar UVI observed a series of pseudobreakups, characterized by localized, short-lived auroral brightenings. Two large auroral expansions were observed by UVI during the second interval (27 March, 1996). WIND plasma measurements revealed large ion velocity moments associated with large fluctuations in the magnetic field. Large <**V**> were observed during all types of auroral activity. The plasma distributions indicate that the large ion velocity moments are not due to flows in the fluid sense, but are the result of complex ion dynamics.

Pseudobreakup (26 July, 1997)

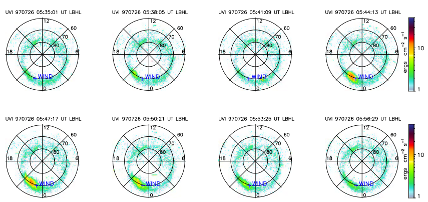

Figure 1: A sequence of Polar UVI images of a pseudobreakup. The footprint of the WIND spacecraft in the ionosphere is shown by the blue plus (+) signs.

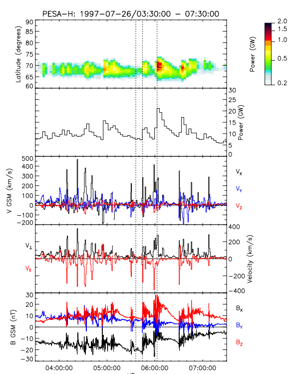

Figure2: From top to bottom, keogram (auroral emissions as a function of latitude and Universal Time at a fixed local time) constructed from UVI images; total power deposited into the nightside ionosphere by precipitating electrons; three components (GSM) of the velocity moment obtained from ion distributions measured by WIND; ion velocity moment components perpendicular and parallel to the magnetic field; and three components (GSM) of the magnetic field measured at WIND. Vertical lines mark data shown in Figure 3.

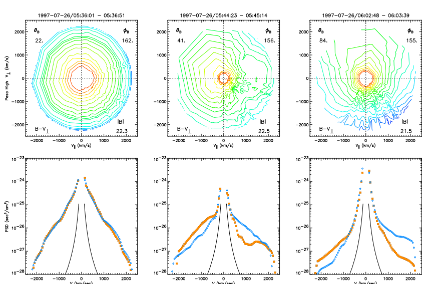

Figure 3: Examples of phase space distributions for ions (first row) and cuts of the distributions parallel (orange stars) and perpendicular (blue diamonds) to the direction of the magnetic field (second row).

Comparison

- Large <**V**> in PS observed during all phases of activity, not only at onset also observed with little to no ionospheric signature
- Large <**V**> associated with large amplitude, high frequency **B** fluctuations
- Ion distribution functions similar for pseudobreakups and major auroral expansions
- Ion distribution functions:
    - large anisotropy
    - beam-like features
    - rapid time variations
    - non-gyrotropic

Caveat: possible time-aliasing, only average picture of ion dynamics

Conclusions

- Continuum of electron precipitation scale sizes: pseudobreakup to major expansion
- Large <**V**> in PS occur at all phases of activity
- Complex ion distribution functions
- Cause of large <**V**> not "flow" in fluid sense
    - non-Maxwellian
    - both perpendicular and parallel velocity components
    - cannot transform to frame of symmetry

Open Questions

- What initiates large <**V**> in PS?
- What initiates electron precipitation into ionosphere?

Acknowledgments

WIND MFI Magnetometer data provided by Ronald R. Lepping (PI)

Expansive Phase (27 March, 1996)

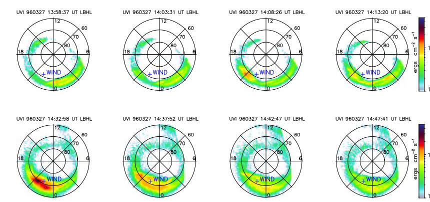

Figure 4: A sequence of Polar UVI images of major expansion-type aurora. The footprint of the WIND spacecraft in the ionosphere is shown by the blue plus (+) signs.

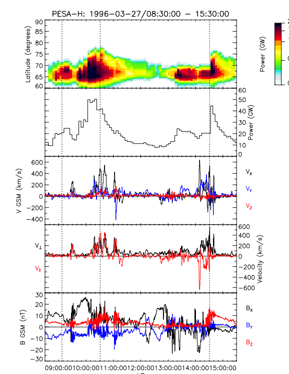

Figure 5: Same format as Figure 2.

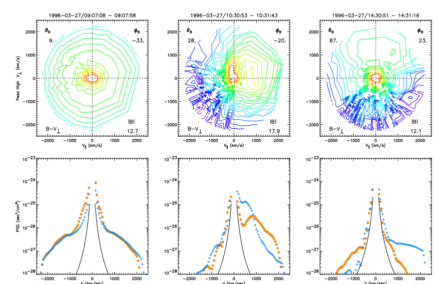

Figure 6: Same format as Figure 3.