



# DMSP observations of High-latitude dayside aurora (HiLDA)

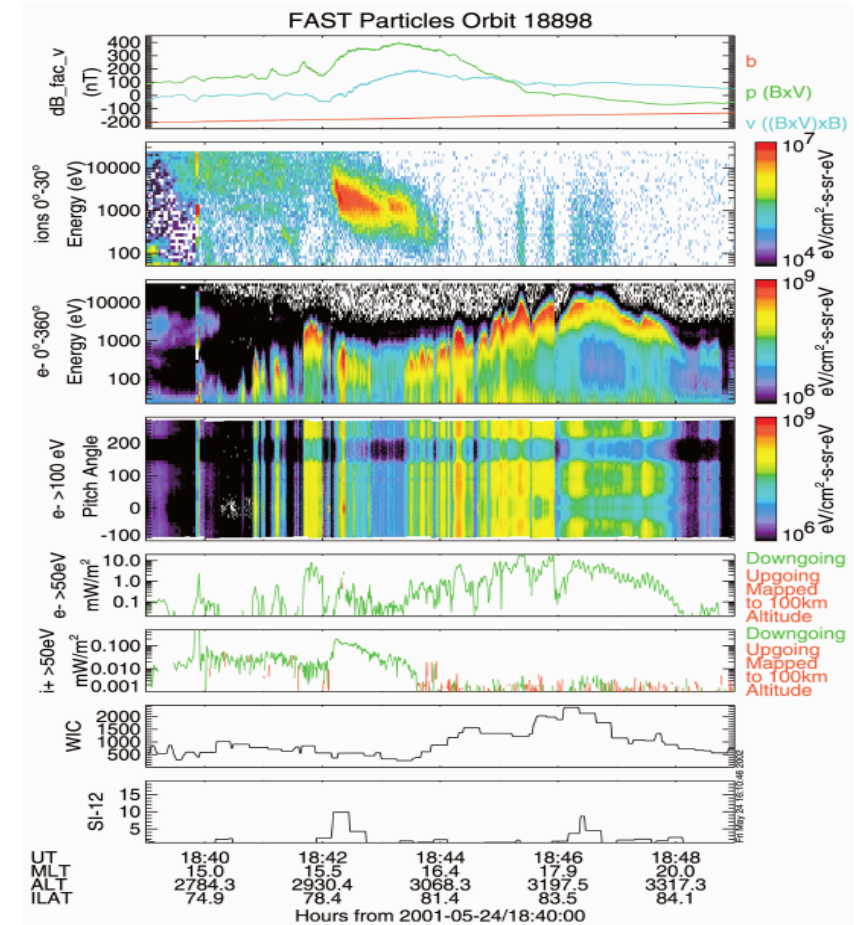
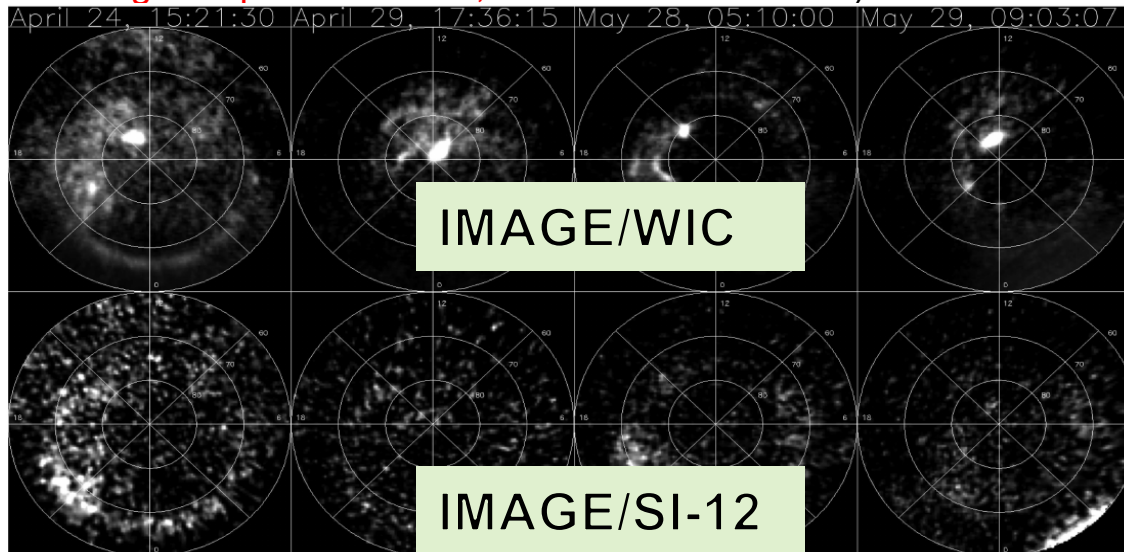
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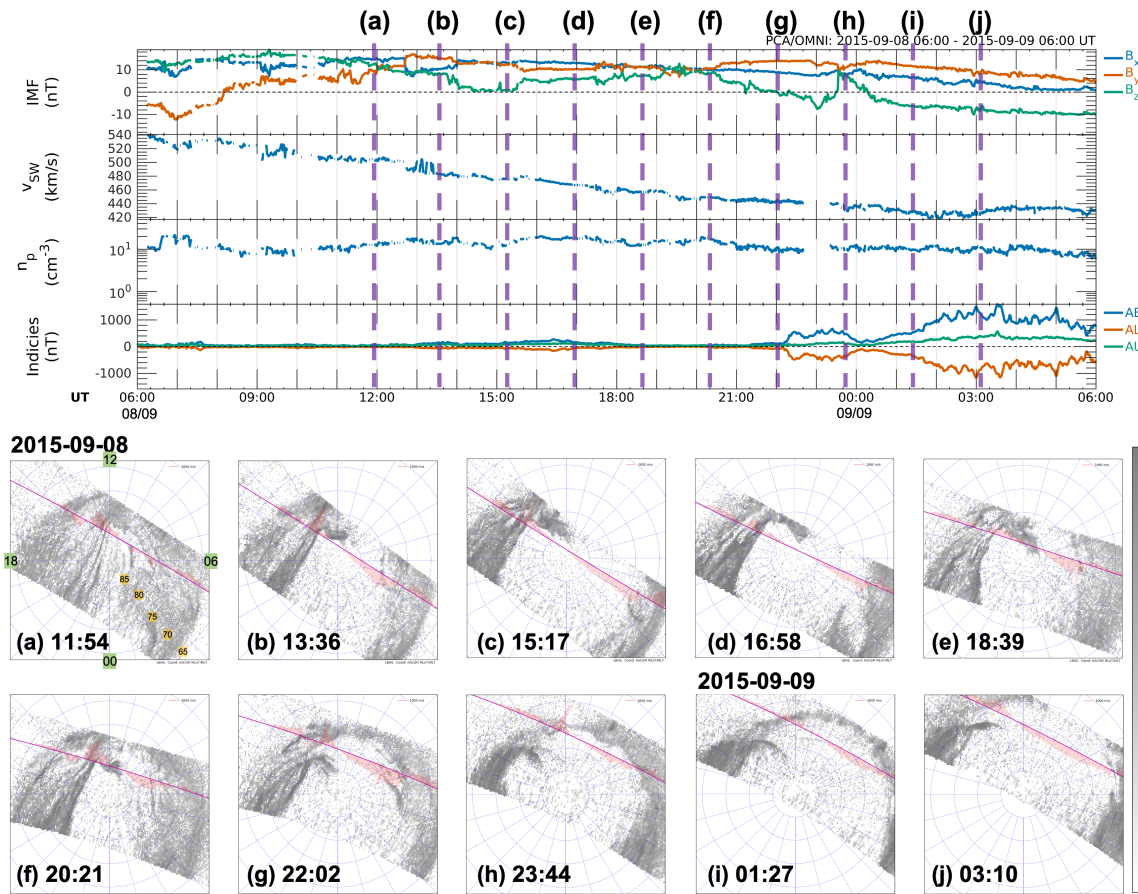
2. The Johns Hopkins University Applied Physics Laboratory, USA

# HiLDA - localized, high-latitude dayside aurora

- Firstly identified by Frey et al., [2003].
- Large-scale spot-like structures. (Unclear about the small-scale structures and surroundings.)
- Observed in Northern hemisphere during strong IMF By+ conditions. (Lack of observations in the southern hemisphere.)
- Inverted-V electron precipitation, and no energetic ions. (Unknown magnetospheric sources, formation mechanism.)

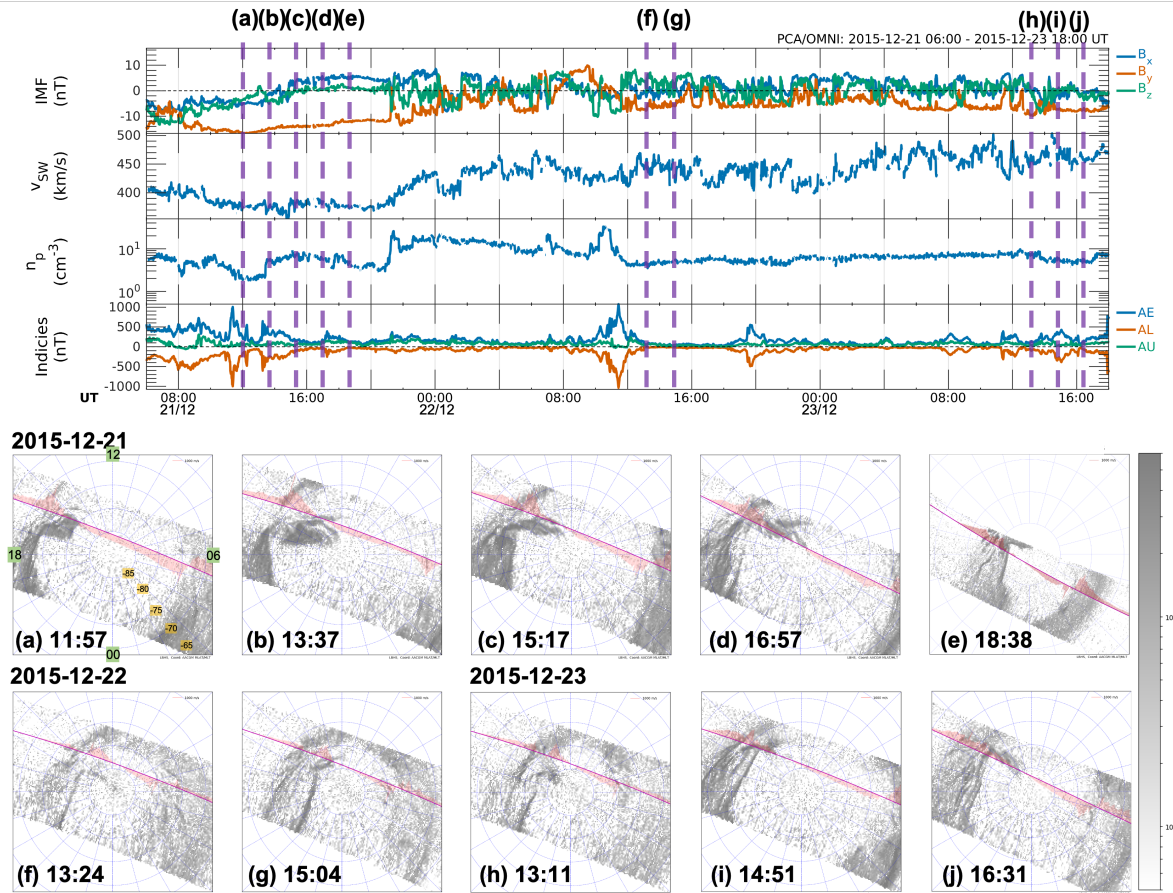


# DMSP/SSUSI Observations: Event 1 in the northern hemisphere



- Strong IMF  $B_y+$ ;  $B_z+$   $\rightarrow$   $B_z-$ ;  $B_x+$ .
- Discrete auroral structures poleward of the oval in the dayside polar cap:
  - Spot-like discrete aurora conjugated with transpolar arcs during  $B_z+$  (b--f).
  - Hook-like aurora arcs during  $B_z-$  (g--j);
- The overlaid cross-track ion flows (red shading) indicate HiLDA located close to the center of the clockwise convection cell.

# DMSP/SSUSI Observations: Event 2 in the southern hemisphere

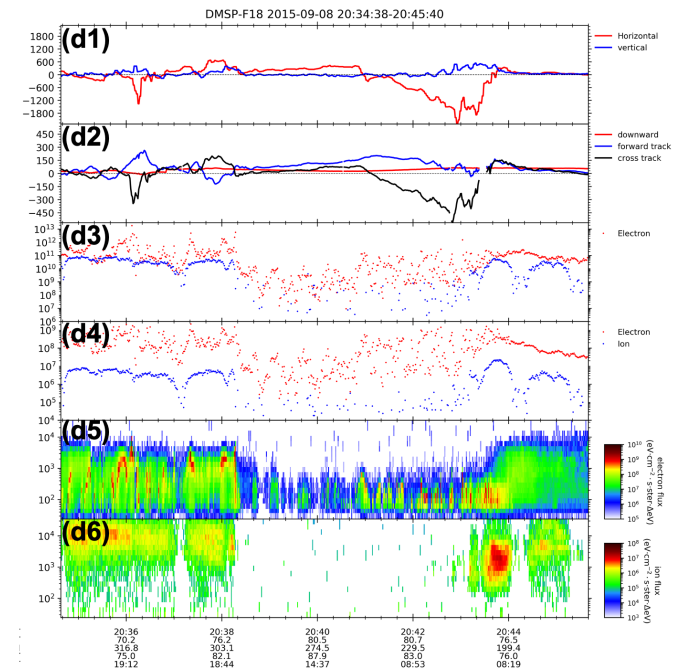
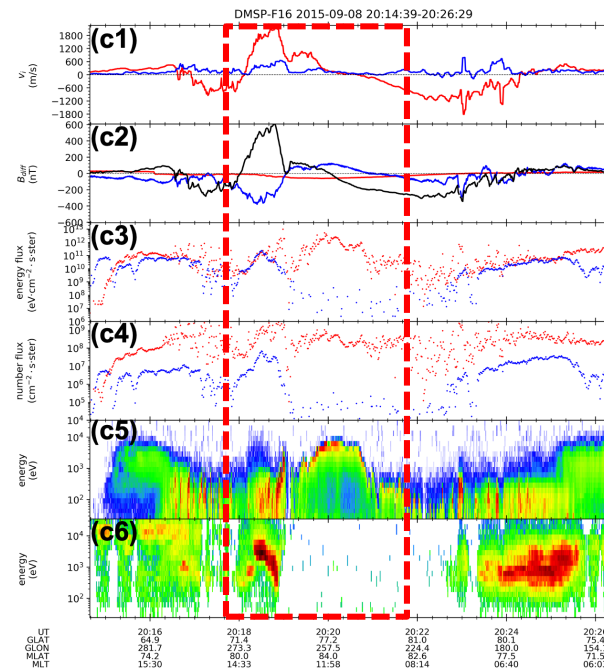
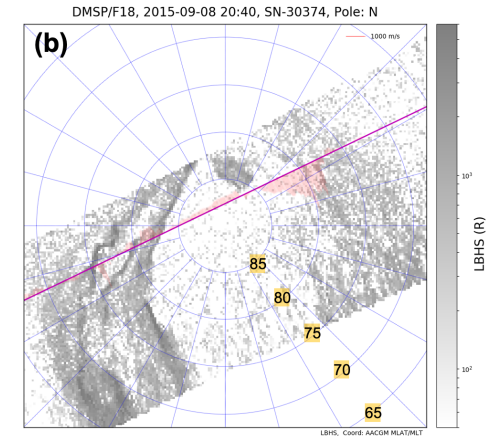
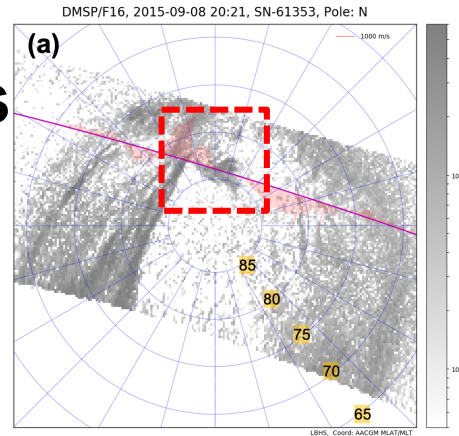


- Strong IMF By-; Bz- -> Bz+.
- HiLDA displays in various forms, including auroral spots, multiple arcs, hook-like arcs.
- Connection with the duskside oval or TPAs.
- Located at lower latitude when the IMF is southward.



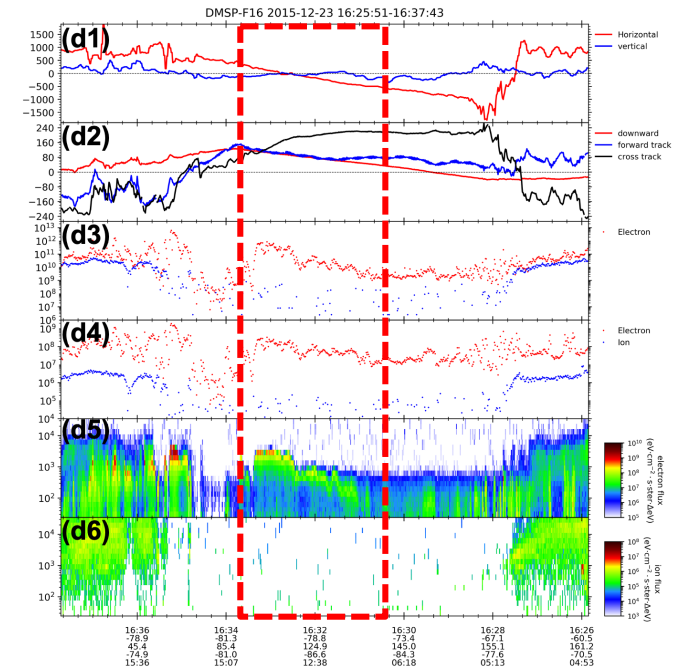
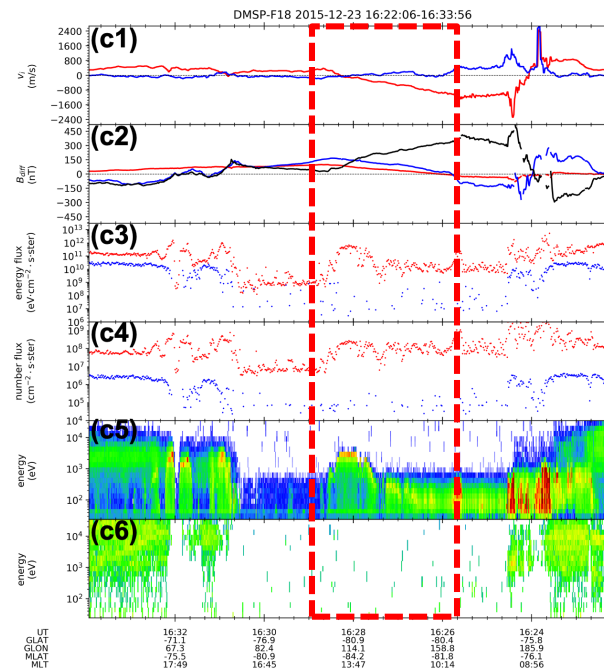
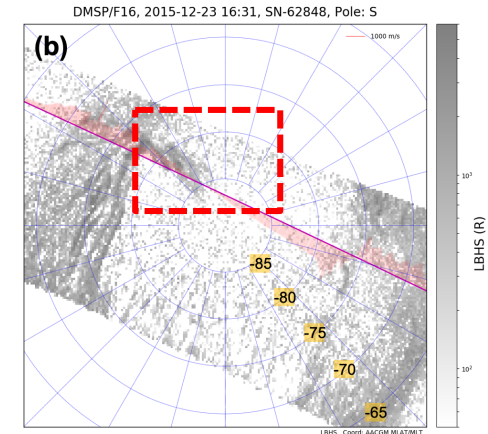
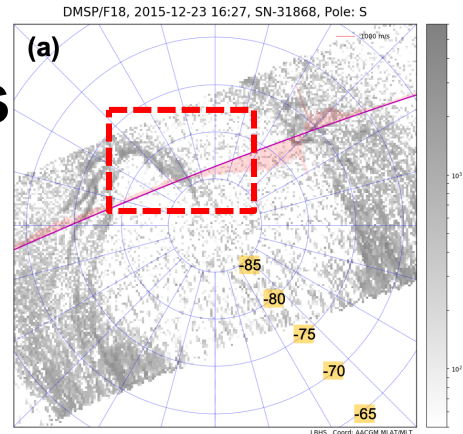
# Inverted V structures

- HiLDA is embended within the polar rain.
- Duskside end of the HiLDA is connected with the TPA.
- Overhead of HiLDA: Monoenergetic electron precipitation up to 8 keV.
- Cusp signature on the dayside end of the TPA with enhanced sunward flows.
- The closed field lines mapped to the TPA may be opened due to the reconnection at high latitudes, which produces strong downward flows on the dayside of HiLDA. As a result, the flow shear generate upward FAC.



# Inverted V structures

- Two distinct region within the upward R0 current.
- One is associated with HiLDA and keV electron precipitation.
- The other on the dawnside of the HiLDA with less energy.
- Polar rain on the dawnside has higher energy flux than on the duskside.
- Indication: HiLDA located close to the boundary between the newly opened field lines on the dawnside (solar wind upstream) and old opened field lines on the duskside (lobe and solar wind downstream) .

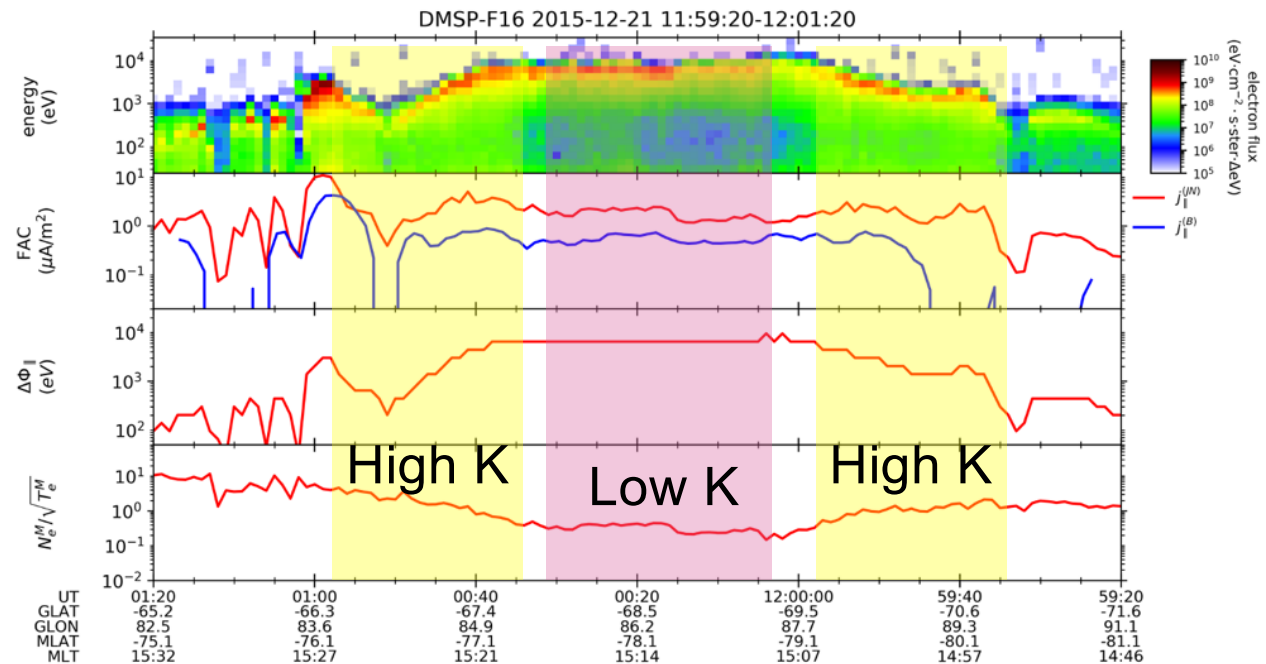
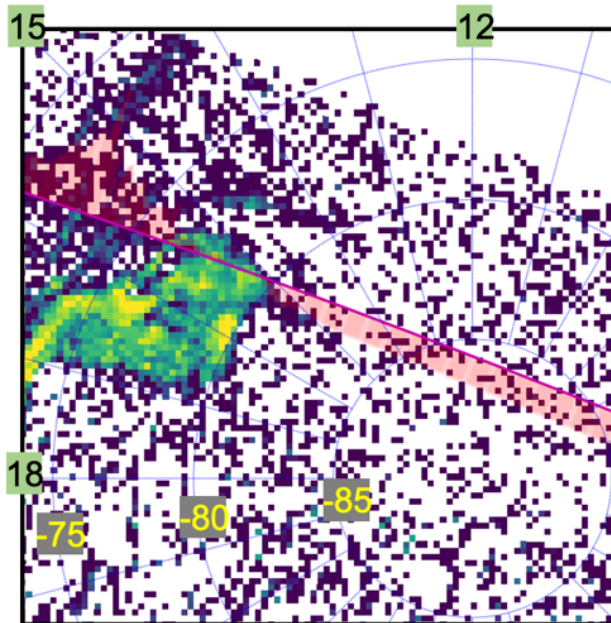


# Current-Voltage relationship

Linear Knight relation:

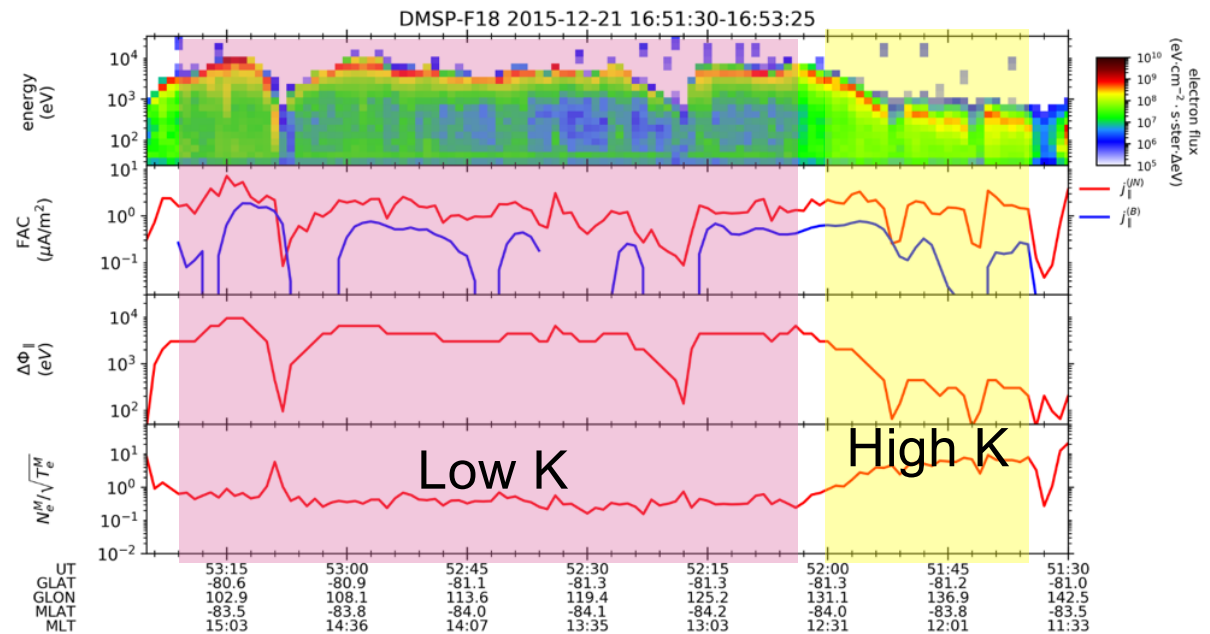
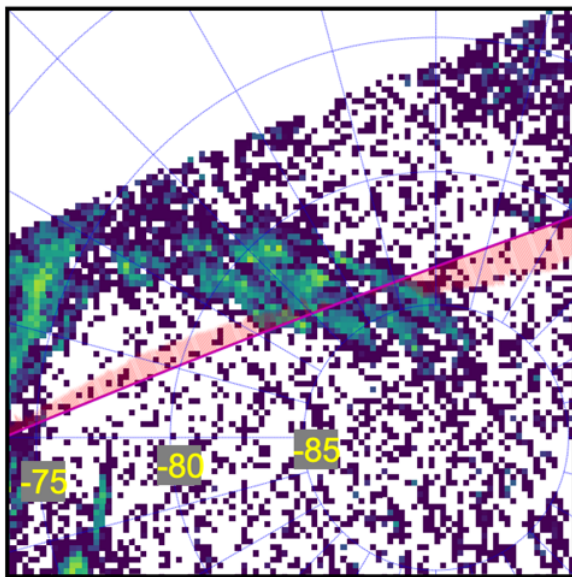
$$j_{//} = K \Delta \Phi_{//}, \text{ where } K = \frac{n_e e^2}{\sqrt{2\pi m_e T_e}}$$

- High K region: close to the solar wind or magnetosheath electron density.
- Low K region: Lobe density
- Not controlled by the solar wind directly.



# Another case...

- Multiple arcs.
- K is almost a constant for the duskside arcs.
- K increased on the dawnside edge, indicating increased source density.







# Summary

- Morphology: tongue-like or spot-like forms, fine structures, and temporal variation. Connection with the duskside oval or oval-aligned arcs.
- Particle precipitation: electron inverted-V, no ion precipitation. Polar rain outside: dawnside and equatorward higher energy flux, duskside smaller.
- Current-voltage relation (Knight relation): relatively lower density in the source region inside HiLDA, and the density increases toward to the boundary. HiLDA is located at a boundary layer between newly reconnected field lines and old field lines.
- Ionospheric convection: centered at the clockwise convection cell for IMF  $B_y+$  ( $B_y-$ ) in the northern (southern) hemisphere.
- Produced by the dayside reconnection on the duskside flank and possible lobe reconnection that often conjugates with TPAs.