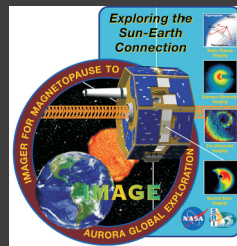
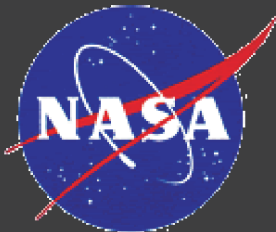


# Determination of Low Latitude Electric Fields from FUV Images

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Abstract. Thousands of images of the nighttime equatorial airglow arcs have been obtained by the far-ultraviolet imager (FUV) on-board the NASA IMAGE satellite. Imaging periods lasting several hours around the time of satellite apogee allow for the determination of the velocity of drifting plasma density depletions occurring within the airglow arcs. These velocities reflect the ExB drift of low-latitude plasma under the influence of a vertical electric field. A survey of several weeks of data produces information regarding the range of electric field magnitudes, and the spatial and temporal frequency of the appearance of plasma depletions. It is found that plasma depletions are observed during >80% of the successive 4-6 hour imaging periods, with significant absences during periods of high magnetic activity. Furthermore, comparisons between  $|E|$  and solar 10.7-cm radio flux shows evidence of the direct effect of solar output on nightside electric fields.

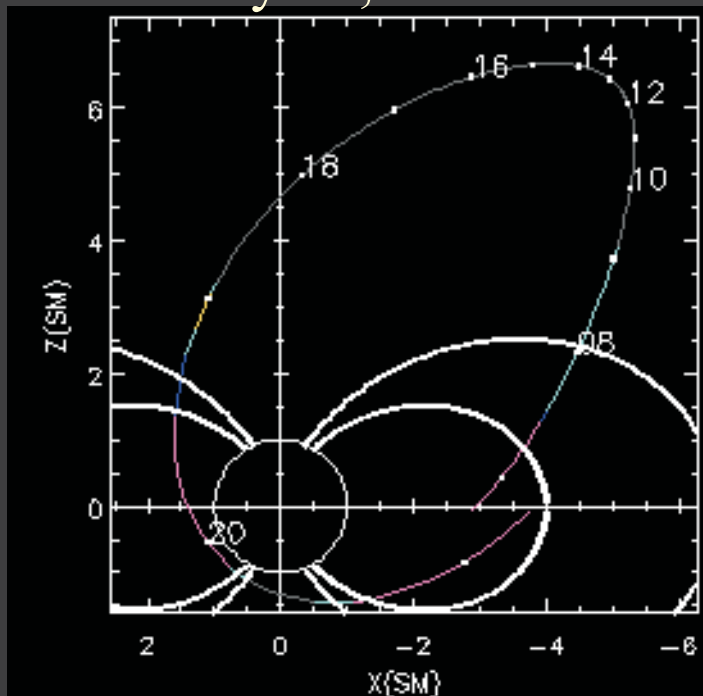


# The SI-13 Imager

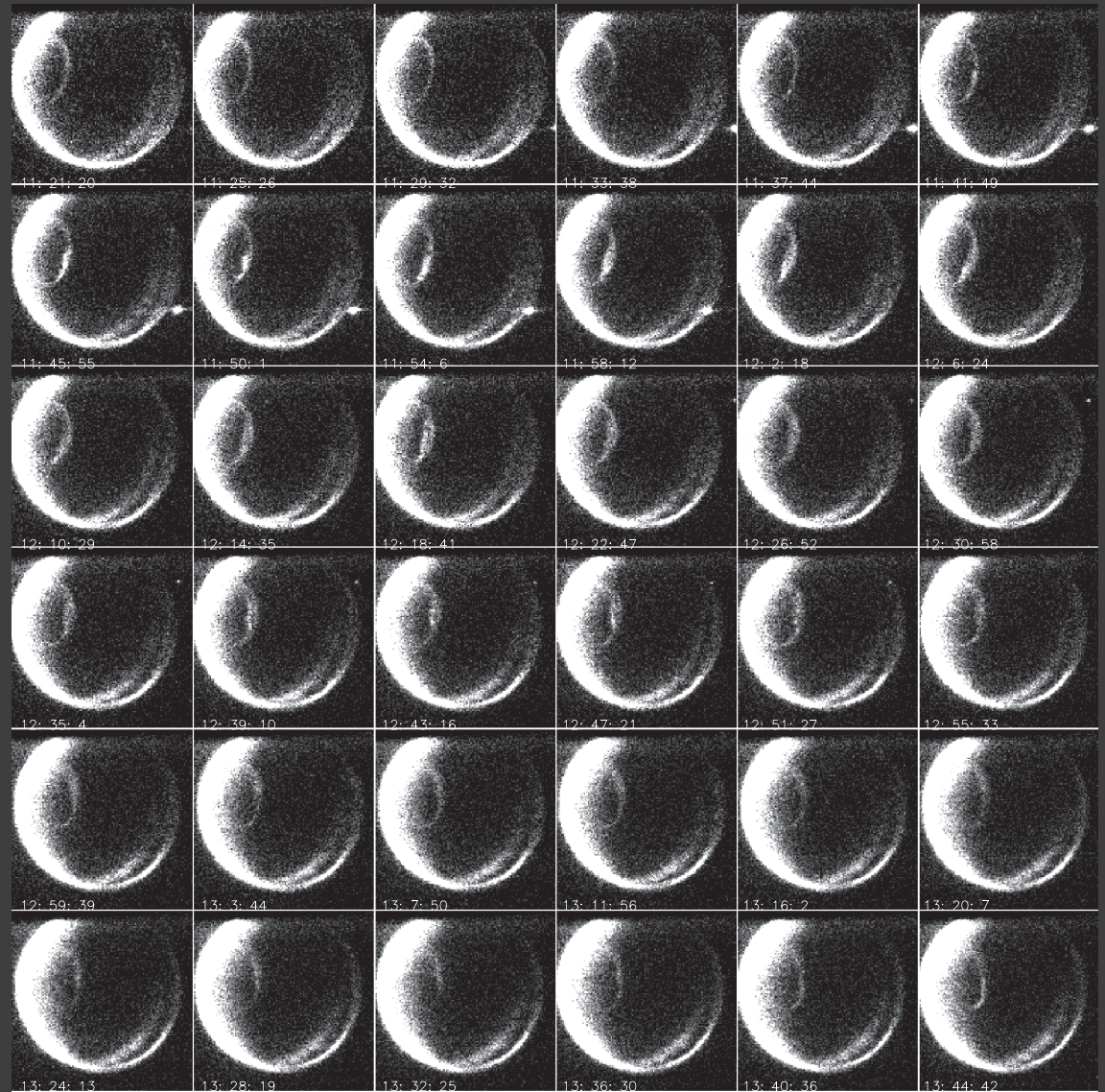
Spectrographic imager  
with 30 nm passband,  
centered at 135.6-nm.

16 $\infty$  FOV, 128x128  
pixels (100 km resolution  
from apogee), 2 minute  
imaging cadence, 5  
second integration time.

Day 87, 2002

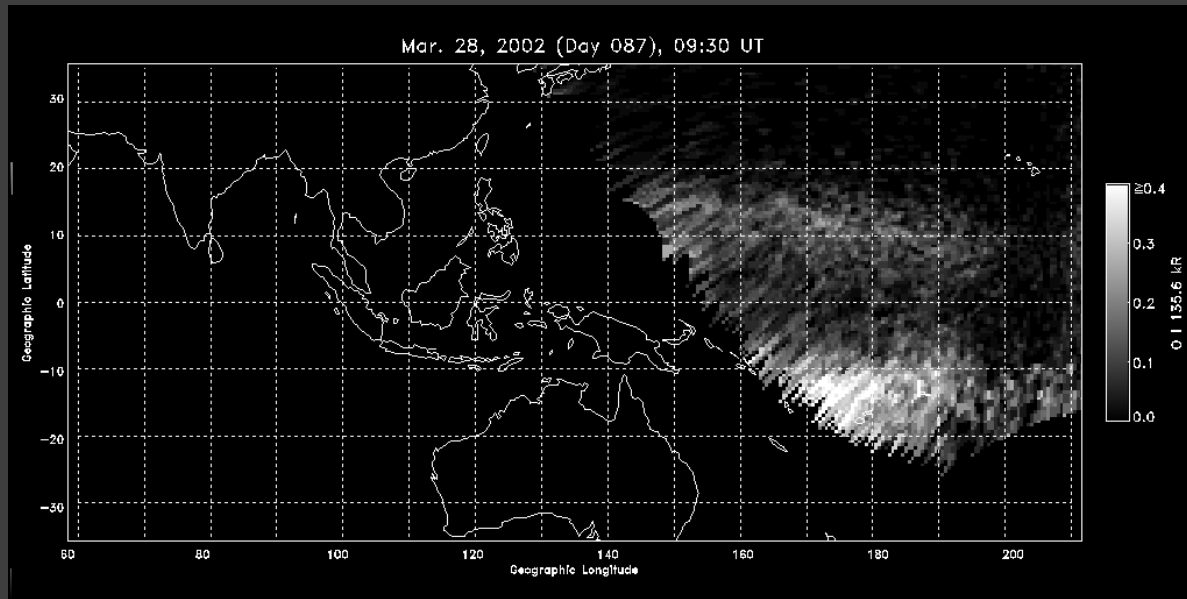


Day 87, 2002

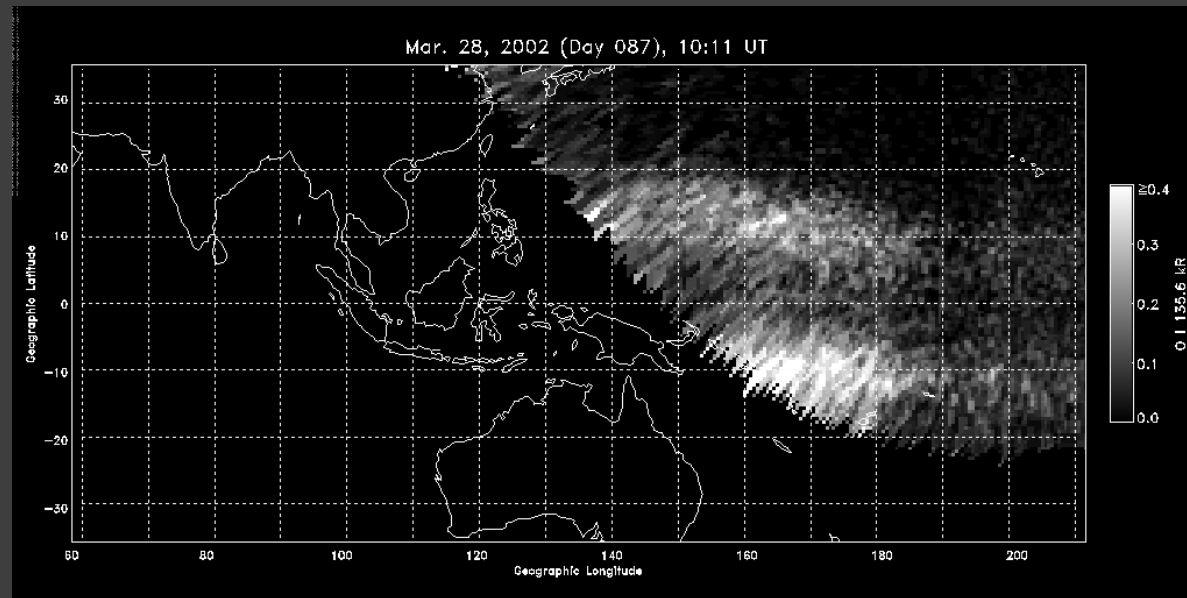


Onboard NASA IMAGE satellite, with  
7 Re Apogee altitude, precessing at  
50 degrees per year.

# Measurements of Equatorial Airglow



Maps of 135.6-nm emissions are generated from original images and shown in a geographic projection.



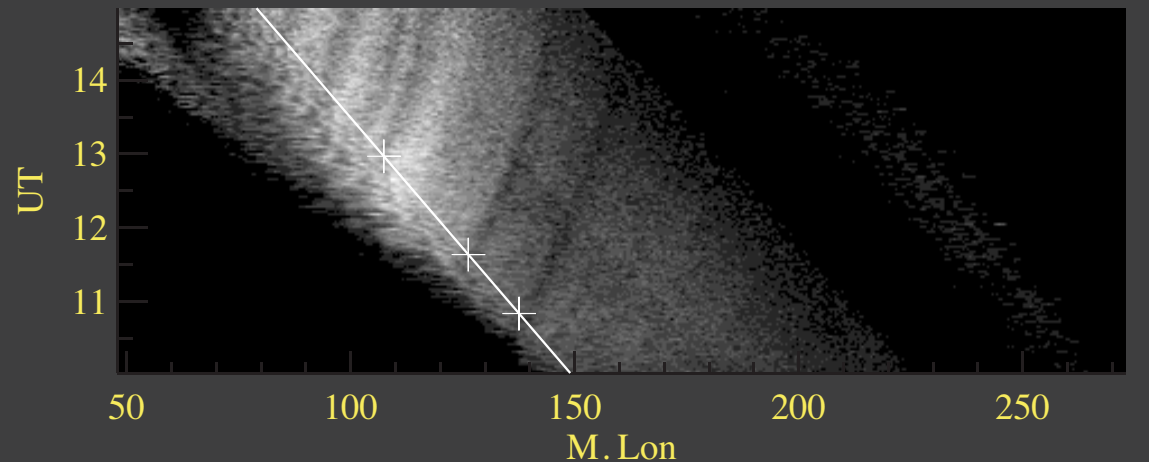
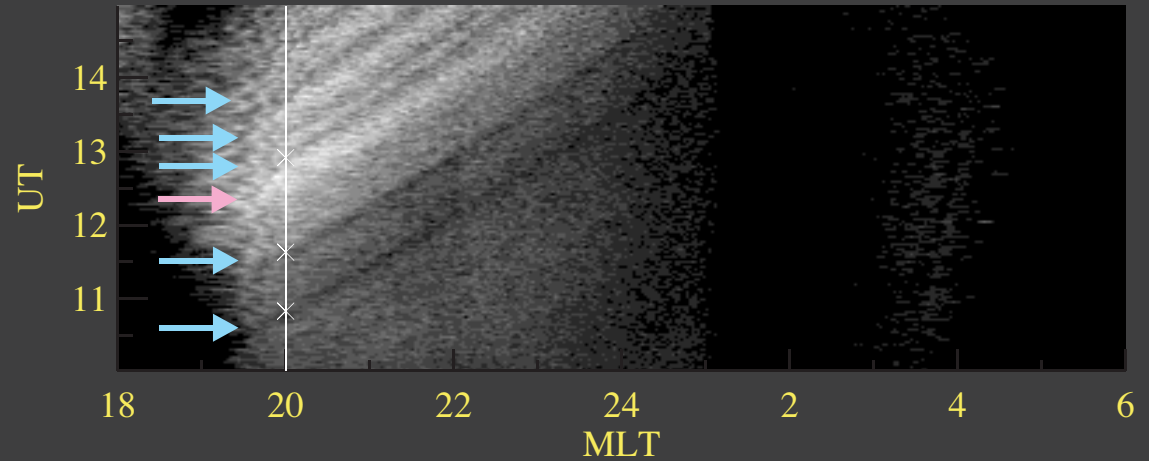
In the time series, points on Earth proceed to the nightside, and the bands appear to move westward. The western cutoff is 19 MLT or the end of viewable points on Earth.





# Identification of drifting forms

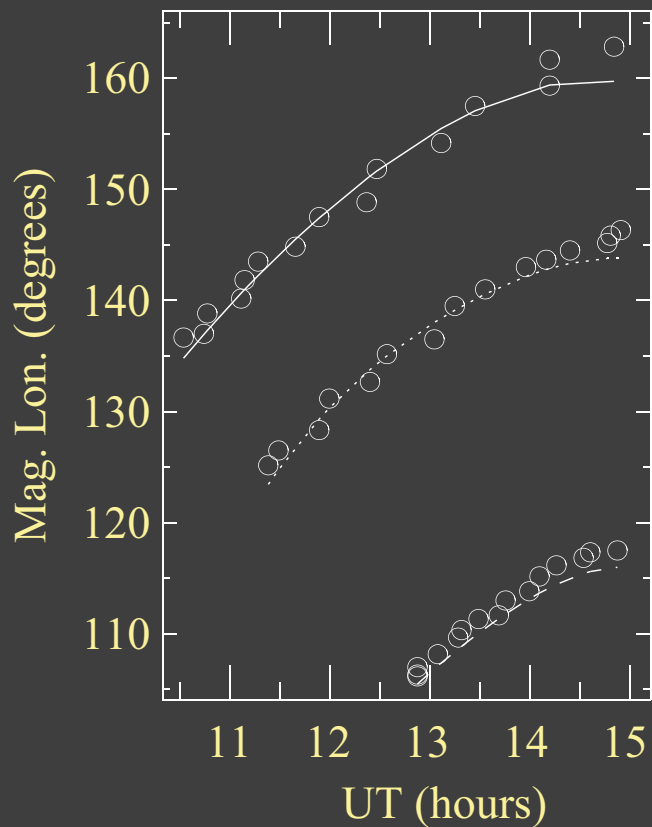
After integrating all the counts in the 0-30° magnetic latitude region of each image obtained over 5 hours, travelling decreases in brightness become apparent.

Presented in 'inertial' and co-rotating coordinate systems (top and bottom respectively), both show the drifting brightness depletions. The bottom plot shows that they are superrotating. The 20 MLT sector is indicated with a white diagonal line.



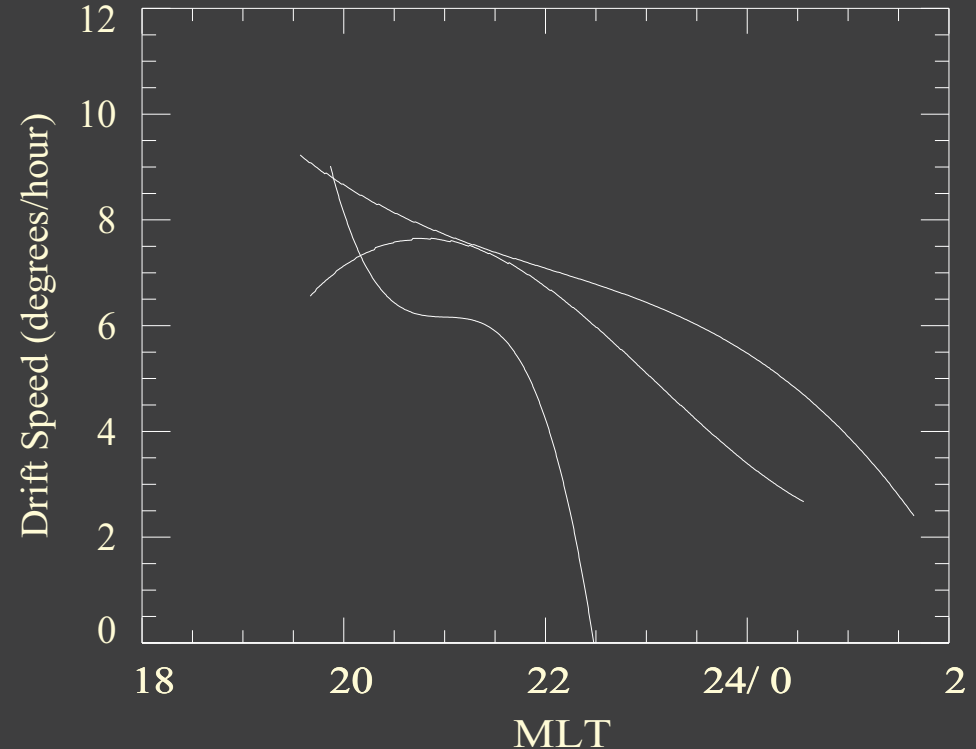
5 drifting decreases, , are obvious, and are signatures of plasma 'bubbles', or well developed spread-F instabilities. There is also a drifting brightness enhancement, , occurring after 1200 UT.

# Determination of Drift Speeds



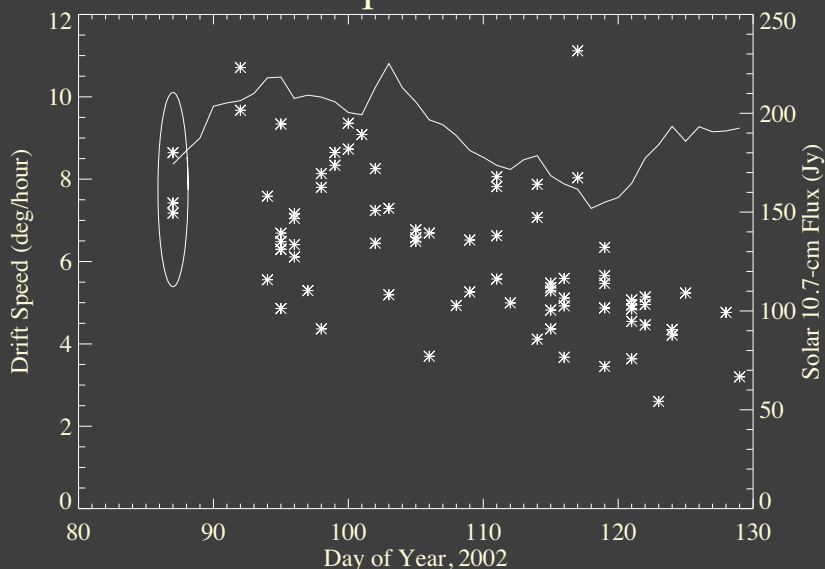
Three of the Day 87 drifting brightness depletions are tracked and fitted as a function of UT and Magnetic Longitude (top plot). The velocity is determined in degrees per hour and shown as a function of Magnetic Local Time. (bottom plot)

These drift determinations can be made only in the March-May period, as the polar orbit plane is fixed in inertial space. The initial analysis shown here is done for all days between March 28 and May 9, 2002.



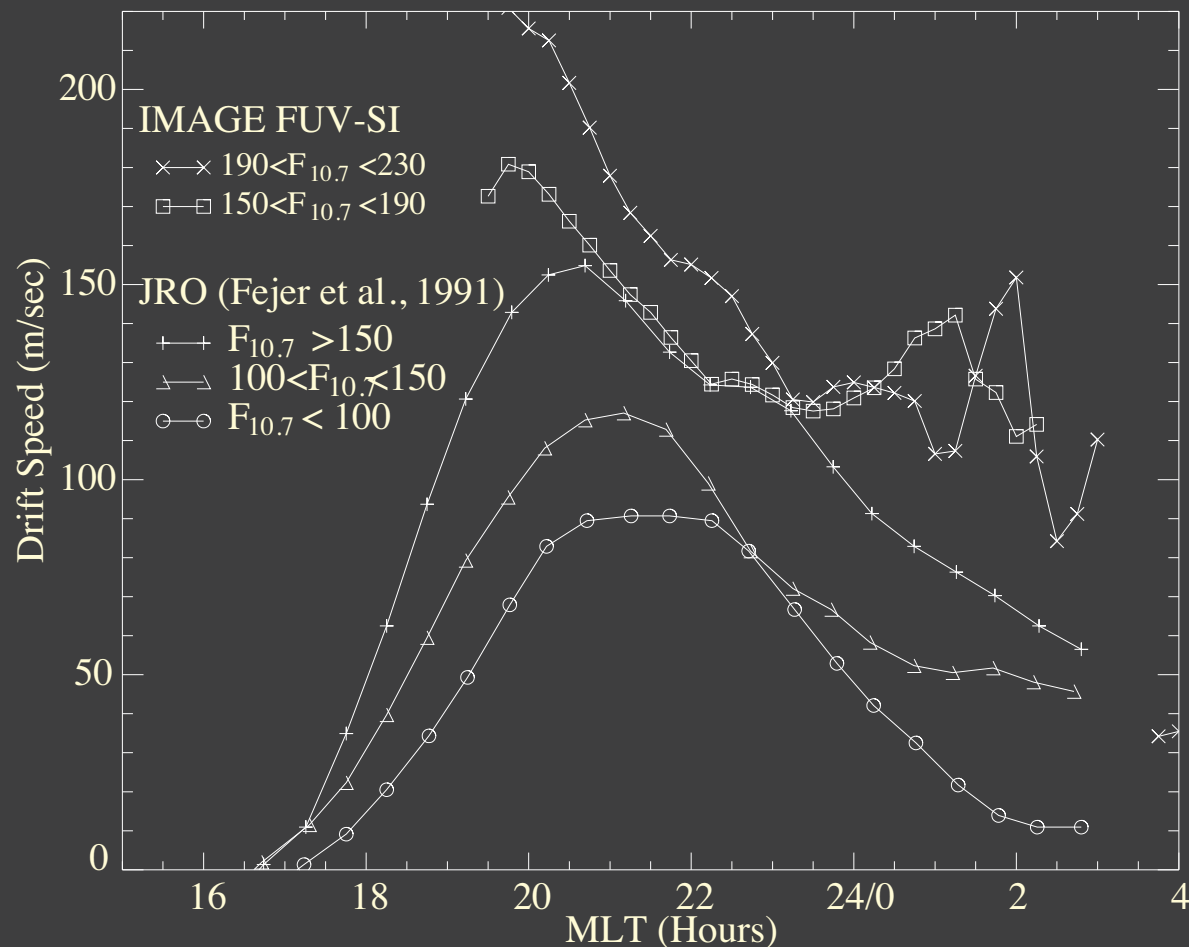
# Equinox Equatorial Plasma Drift Speed

Observed Speeds at 20 MLT



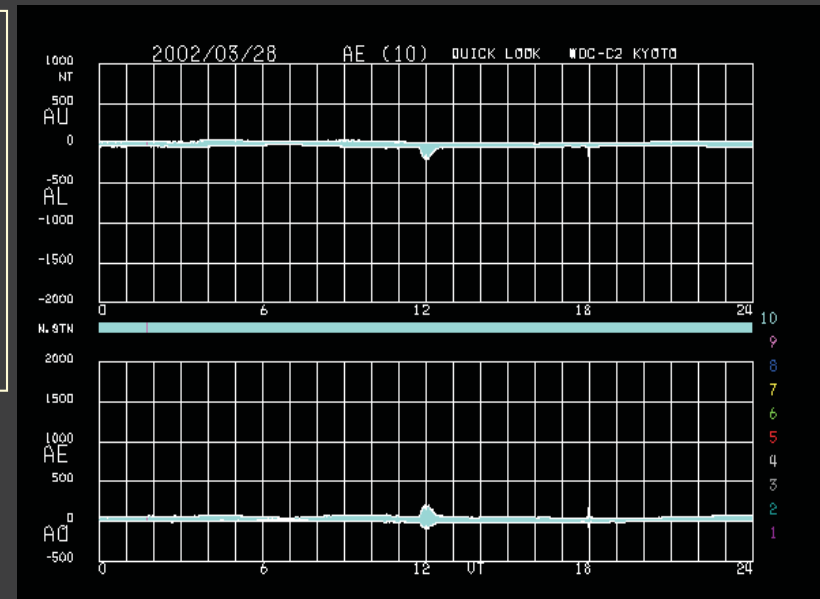
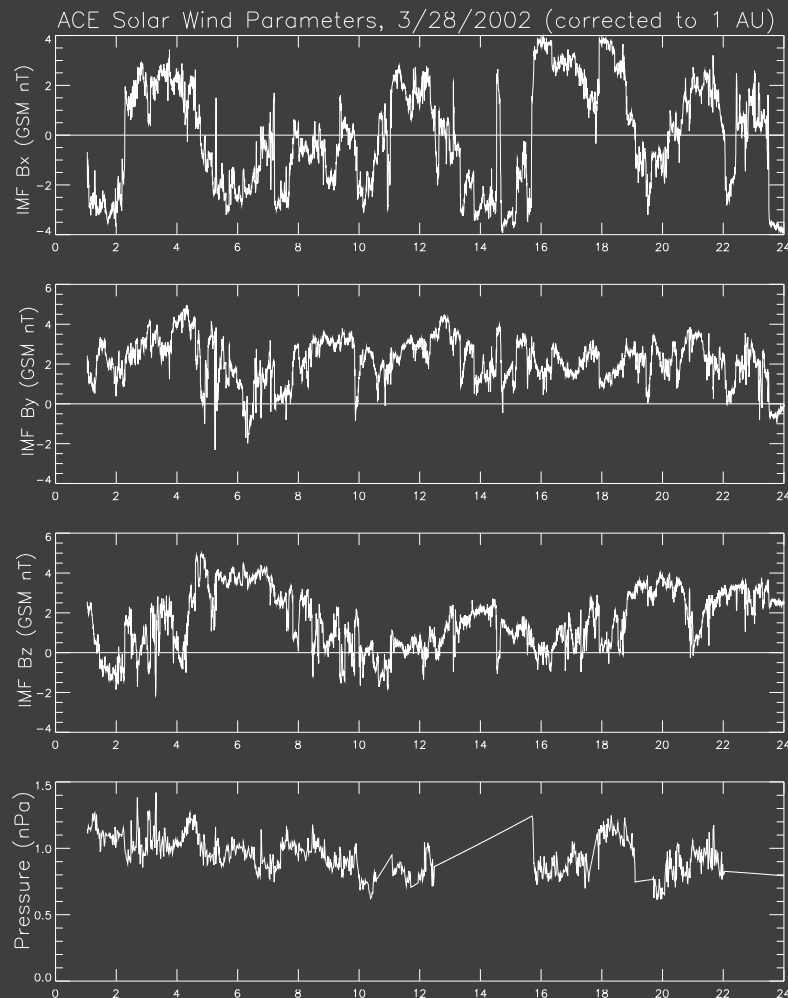
The drift speed of the brightness depletions is interpreted as the plasma drift speed. The average speed is then determined at every MLT, as done to the left for 20 MLT. The trend indicates lower drift speeds with lower solar flux.

The average speeds are shown at every MLT observed by SI-13 to the right. The data are divided into low and high solar flux sets. Results from a study using Jicamarca Radar data are also shown. The FUV-determined drift speeds are 20-30% higher.



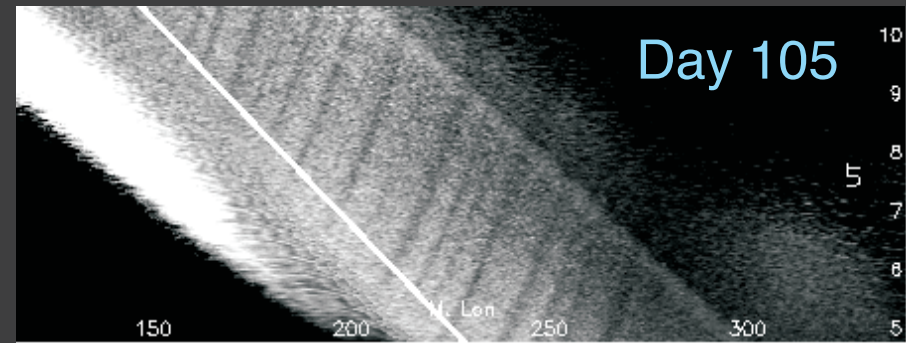
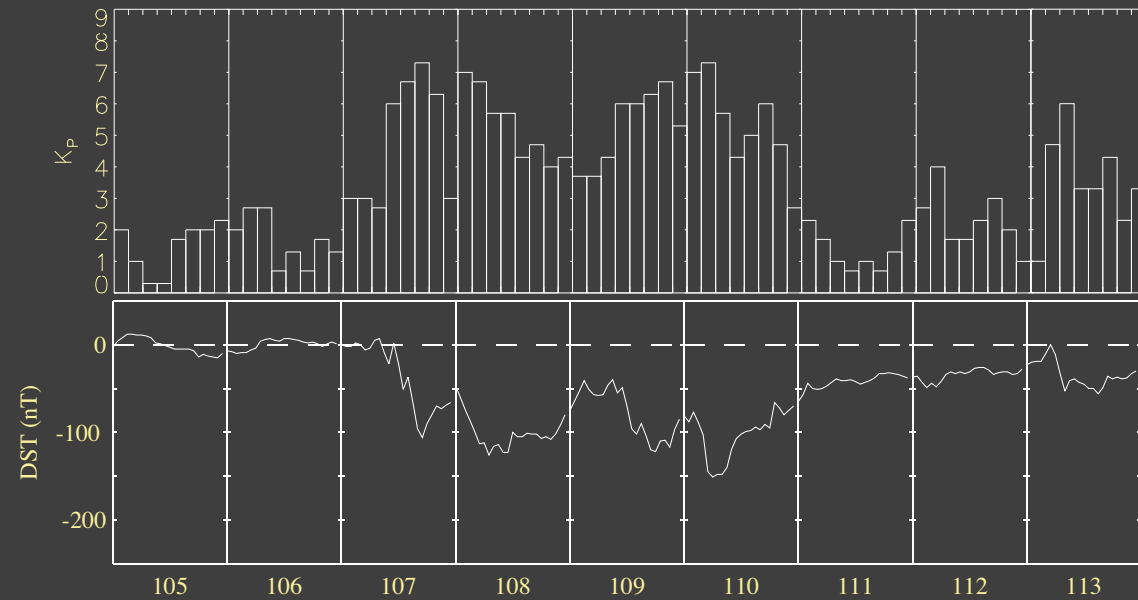
# Equatorial Plasma Enhancement: Day 87, 2002

Depletions in FUV brightness are believed to be strong depletions in F layer densities produced by spread-F instabilities. What are the sudden equatorial enhancements? (see [Identification of Drifting Forms](#), this poster)



There is no evidence for a strong inter-planetary electric field effect at low latitudes, as the solar wind pressure and IMF variations are small (left). The occurrence that stands out is the small (200 nT) substorm (above) that occurs at basically the same time as the first appearance of the brightness enhancement. The impulsive substorm electric fields could be larger than any other source, and therefore merit future investigation.

# Suppression of Spread-F, April 7-11, 2002



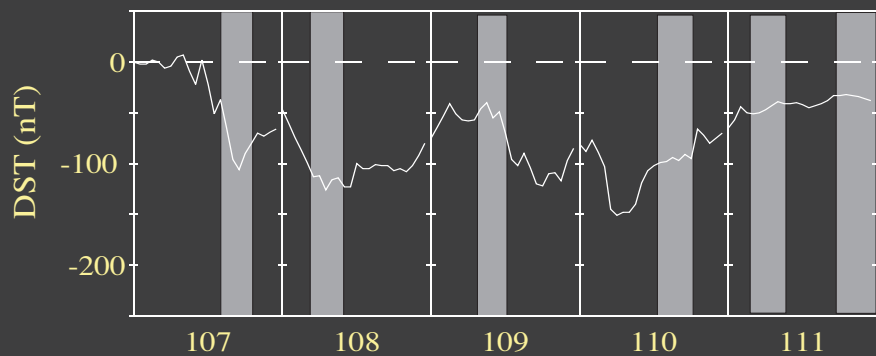
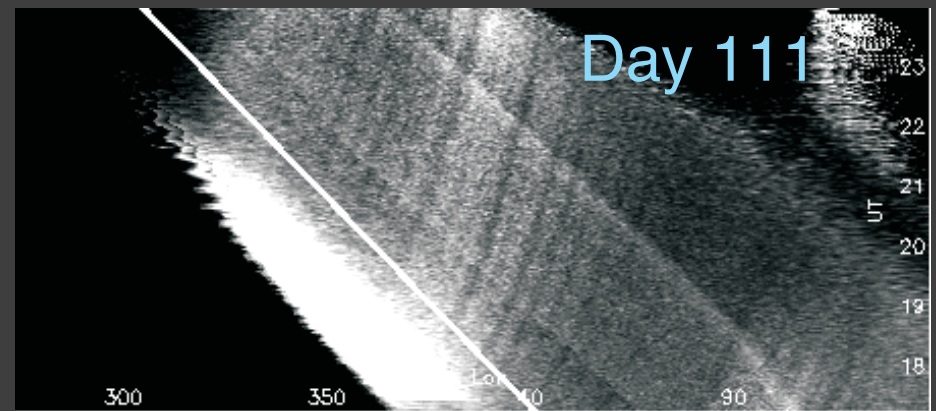
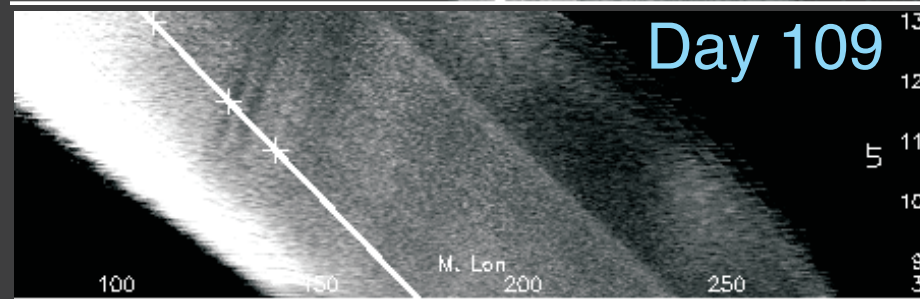
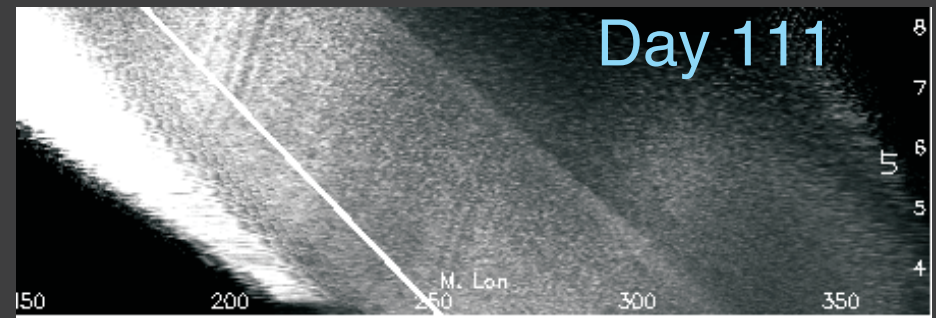
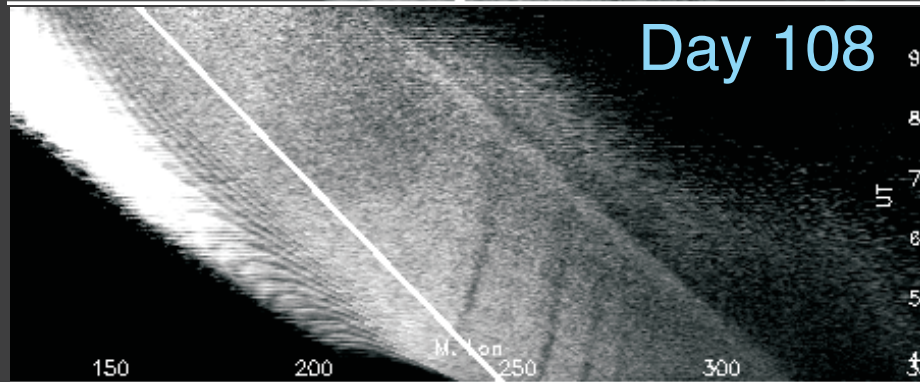
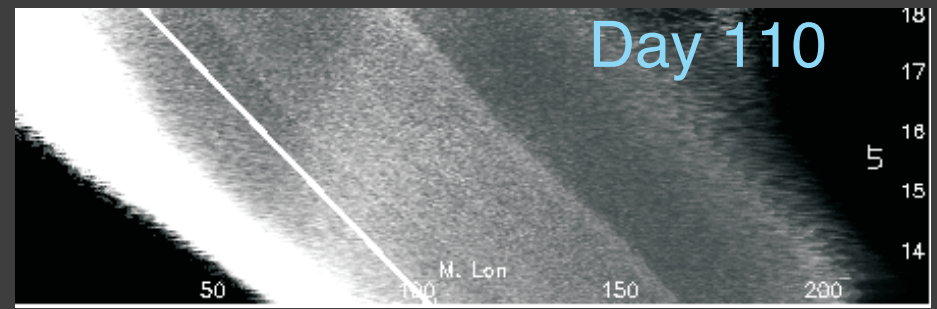
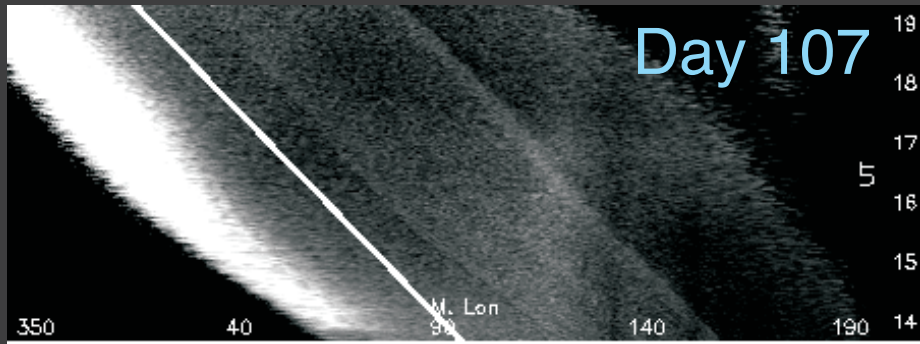
Nightside observations of the 135.6-nm line were made during the intense geomagnetic storm of April, 2002. It is known that strong electric fields associated with storms can suppress the mechanism for development of spread-F bubbles.

Day 105 is the last time, prior to storm onset, during which numerous depletions are observed. More than 15 depletions are seen on the nightside in 6 hours.

On day 107 (next panel), no depletions are seen in the 14-19 UT period, during the first major drop in Dst. Minor depletions are seen on day 108 after 4 UT (next panel), but they fade before reaching 24 LT. More very faint signatures are seen on day 109 after 11 UT. Day 110 shows no evidence of plasma depletions. A signature of repeating depletions is seen late on day 111.



# Suppression of Spread-F, April 7-11, 2002:2



# Summary

The SI-13 channel on the NASA-IMAGE satellite obtained images of the low latitude ionosphere in March-May, 2002. These images have been analyzed to reveal drifting brightness depletions, corresponding to spread-F plasma 'bubbles'

The drift speeds are determined for 94 separate bubbles, and the local time variation the average speed compares well to earlier observations from ground based radars (Fejer et al., 1991). The ~20% larger speeds may have to do with the latitude of the observations, with the peak in FUV emissions occurring @  $\pm 10^\circ$  away from the dip equator (Jicamarca is at  $+2^\circ$ ). Eastward plasma drifts are known to be faster away from the equator (e.g., Aggson et al., 1987).

Sudden enhancements in FUV intensities indicate increases in plasma densities. These increases drift eastward like the more common bubbles, but how they are related, if at all, to spread F is not known. The decrease in spread-F activity during the magnetic storm is well documented behavior of plasma bubbles, and therefore reinforces the interpretation of these brightness decreases as plasma bubbles.

## References

Aggson, T. L., N. C. Maynard, F. A. Herrero, H. G. Mayr, L. H. Brace, and M. C. Liebrecht, Geomagnetic equatorial anomaly in zonal plasma flow, JGR, 92, 311-315, 1987.

Fejer, B. G., E. R. de Paula, S. A. Gonzales, and R. F. Woodman, Average vertical and zonal F region plasma drifts over Jicamarca, JGR, 96, 13901-13906, 1991.