

**Expected Influence of  
Crustal Magnetic Fields  
on ASPERA-3 ELS Observations:  
Insight from MGS**

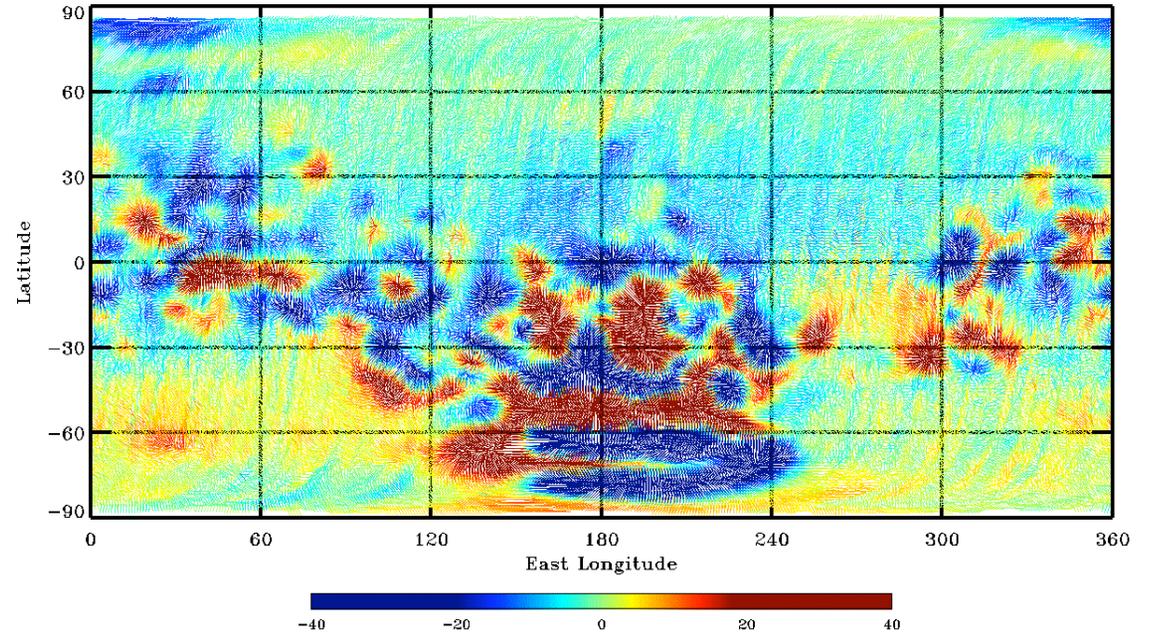
**D.A. Brain, J.G. Luhmann, D.L. Mitchell, R.P. Lin**  
**UC Berkeley Space Sciences Lab**

24 February 2005  
1st Mars Express Science Conference

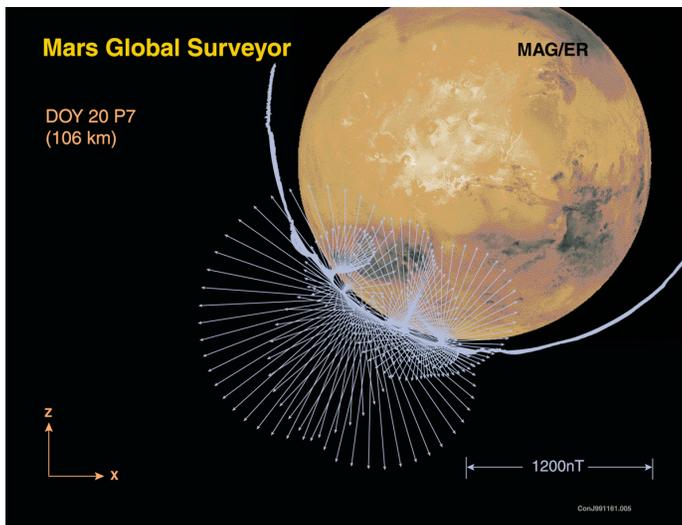
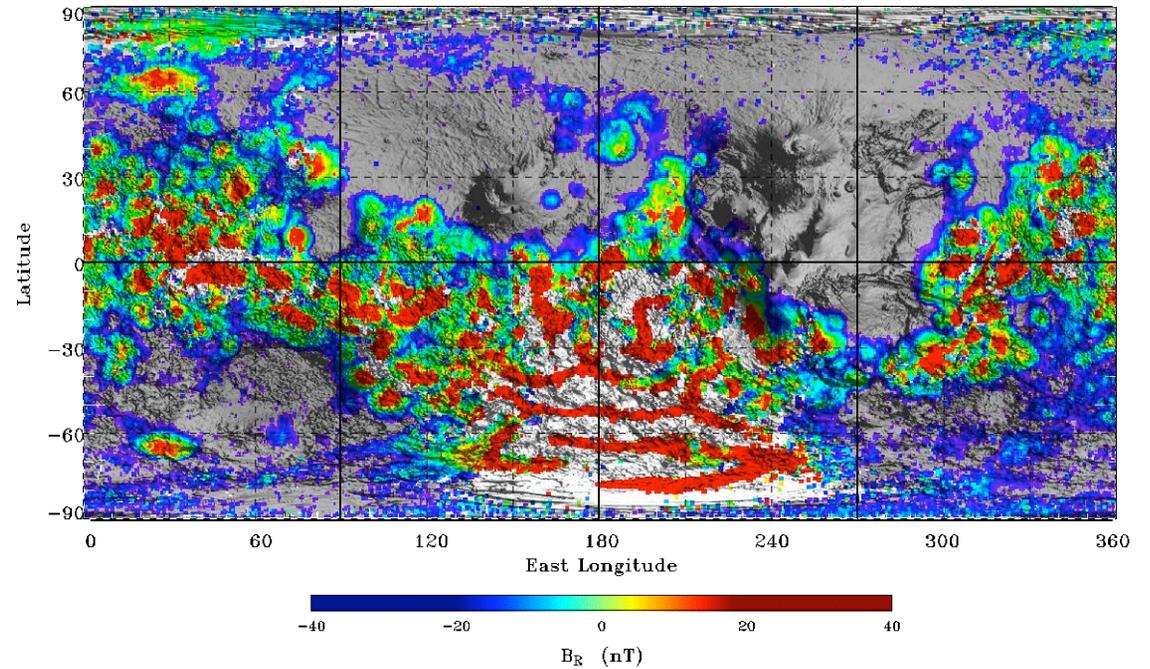


# Martian Crustal Fields

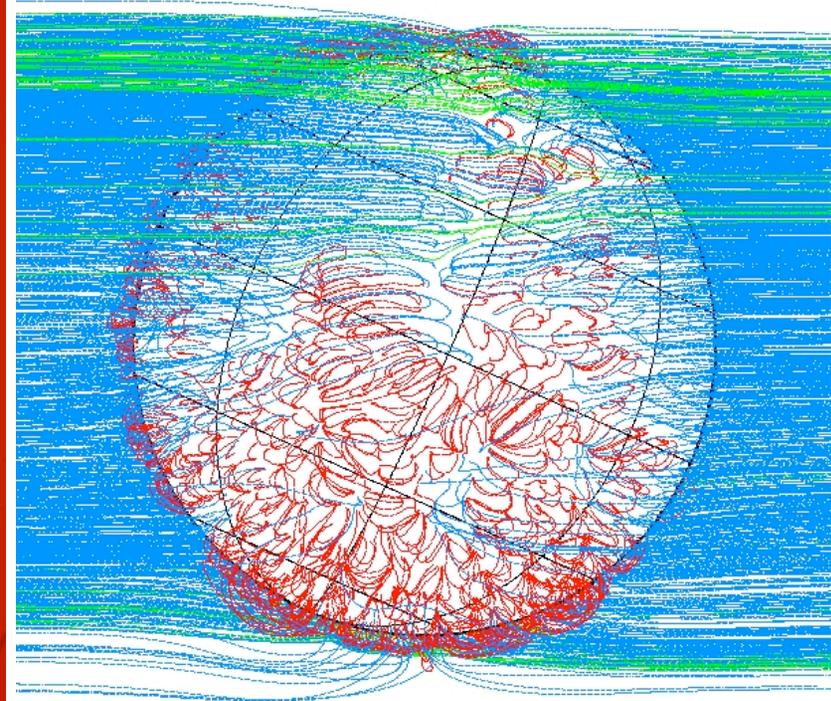
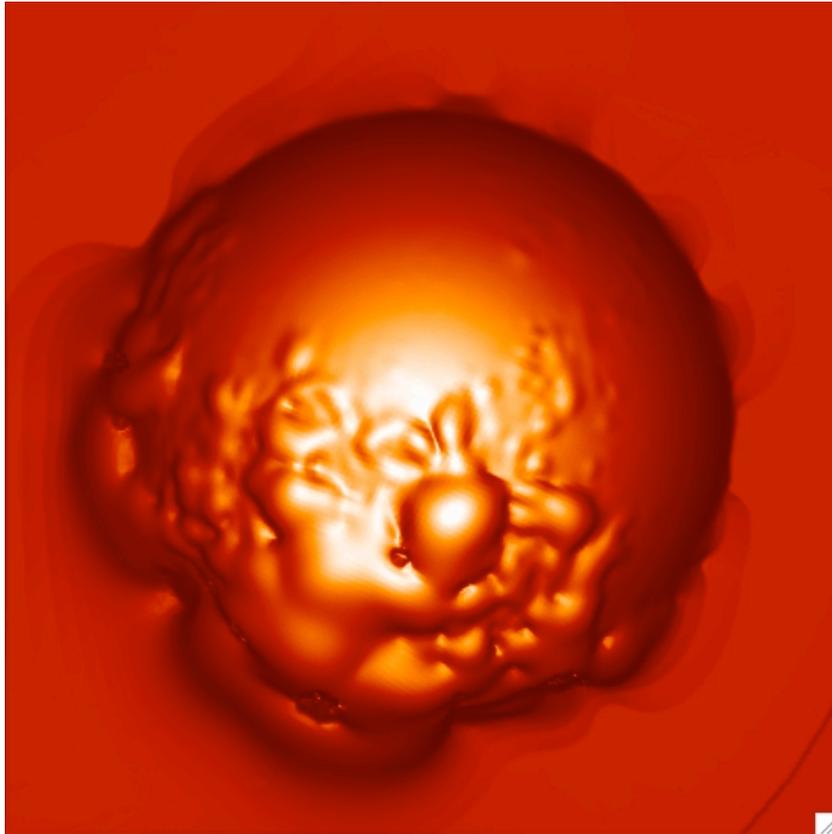
Martian Vector Magnetic Field at 400 km



Martian Vector Magnetic Field at 180 km



# Crustal Fields: Interaction with Solar Wind



closed

open

draped

# Electron Instruments at Mars

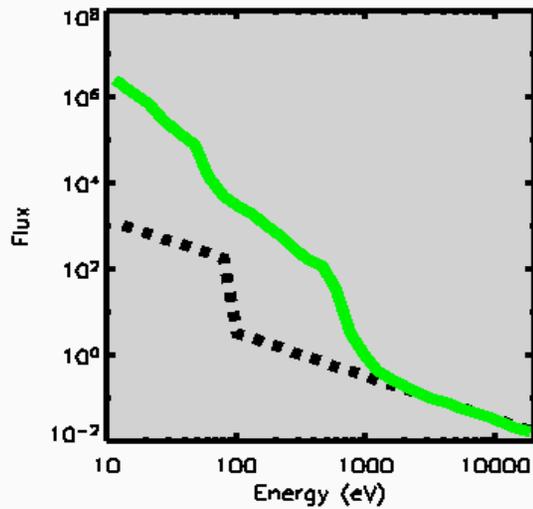
## MGS ER

- 10 eV - 20 keV
- $\Delta E/E = .25$
- FOV =  $14^\circ \square 360^\circ$
- Angular Resolution =  $14^\circ \square 22.5^\circ$
- 2-48 s time resolution
- Circular orbit
- No plasma instruments
- Magnetometer

## ASPERA-3 ELS

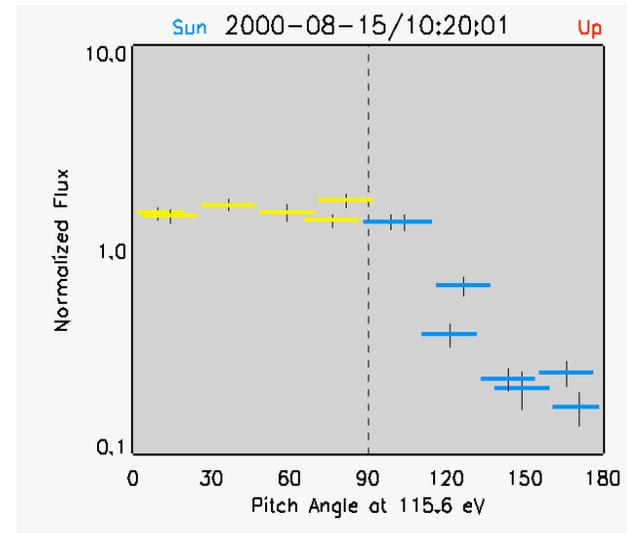
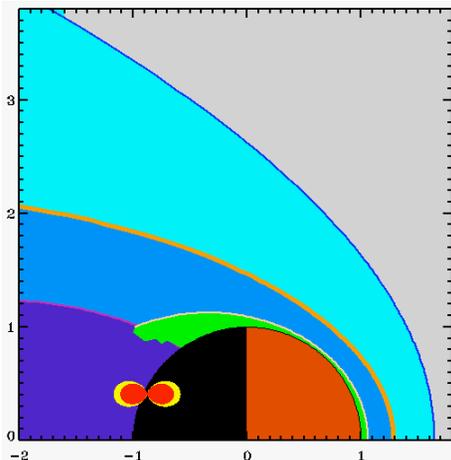
- 10 eV - 20 keV
- $\Delta E/E = .07$
- FOV =  $10^\circ \square 360^\circ$
- Angular Resolution =  $10^\circ \square 22.5^\circ$
- 32 s time resolution (full 3D)
- Elliptical orbit
- Supporting particle instruments
- No magnetometer

# MGS Electron Data



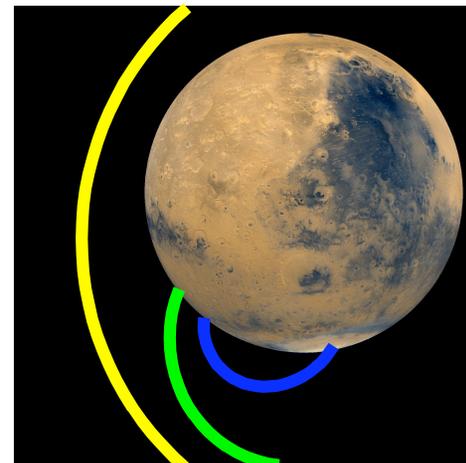
Energy Distribution

Identifies plasma regime



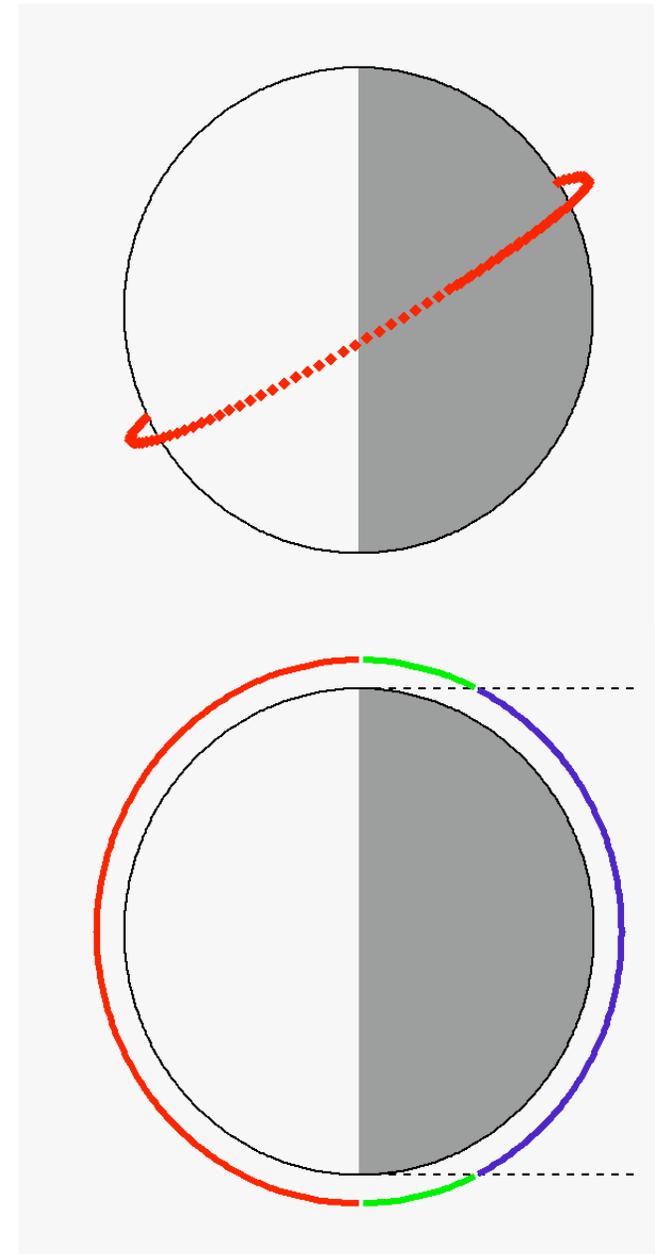
Angular Distribution

Identifies field topology

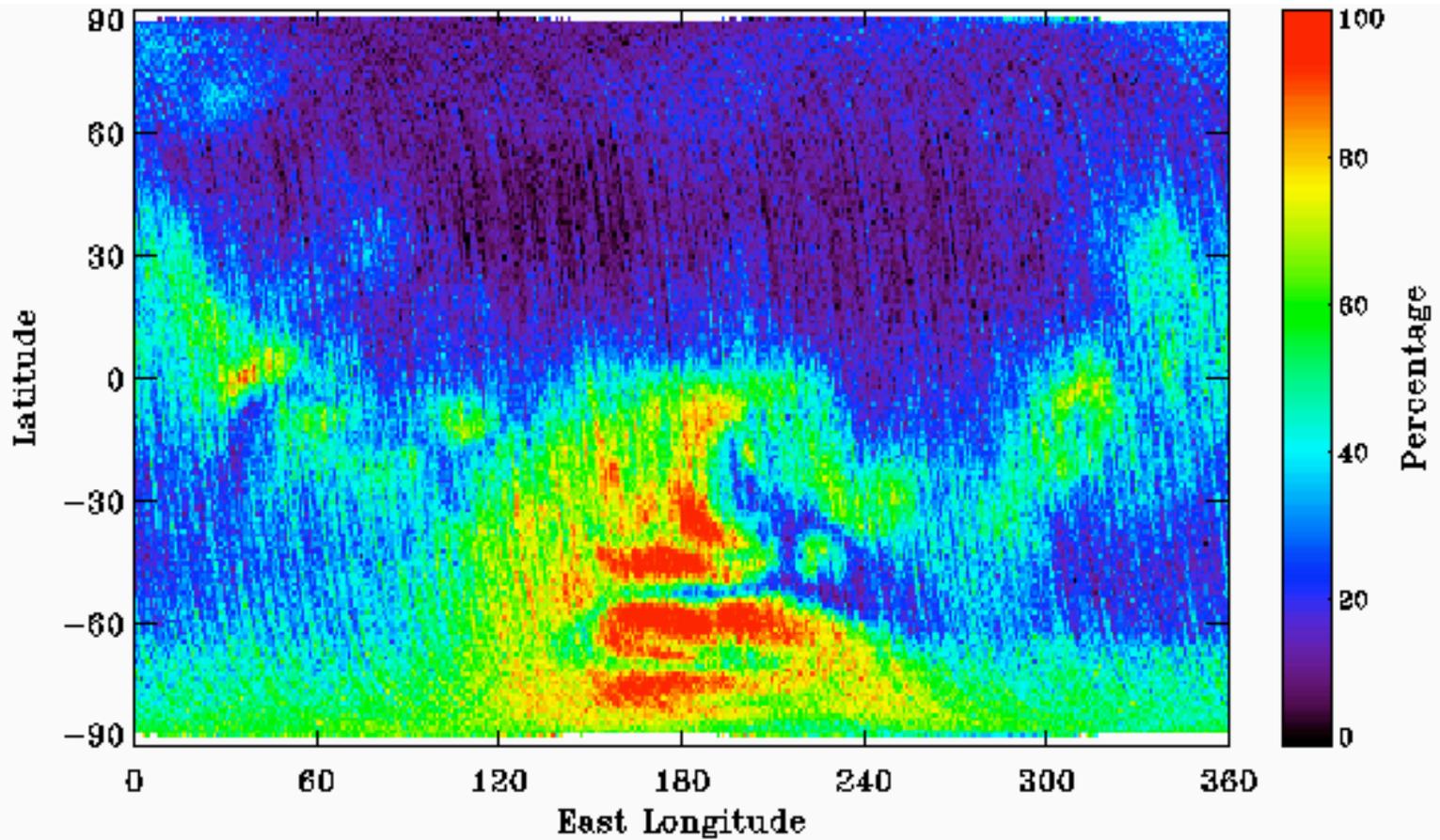
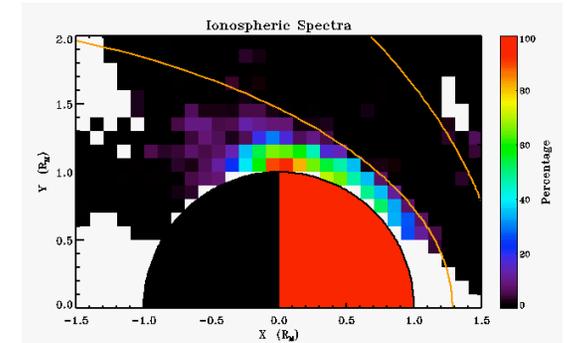


# MGS ER Data Set

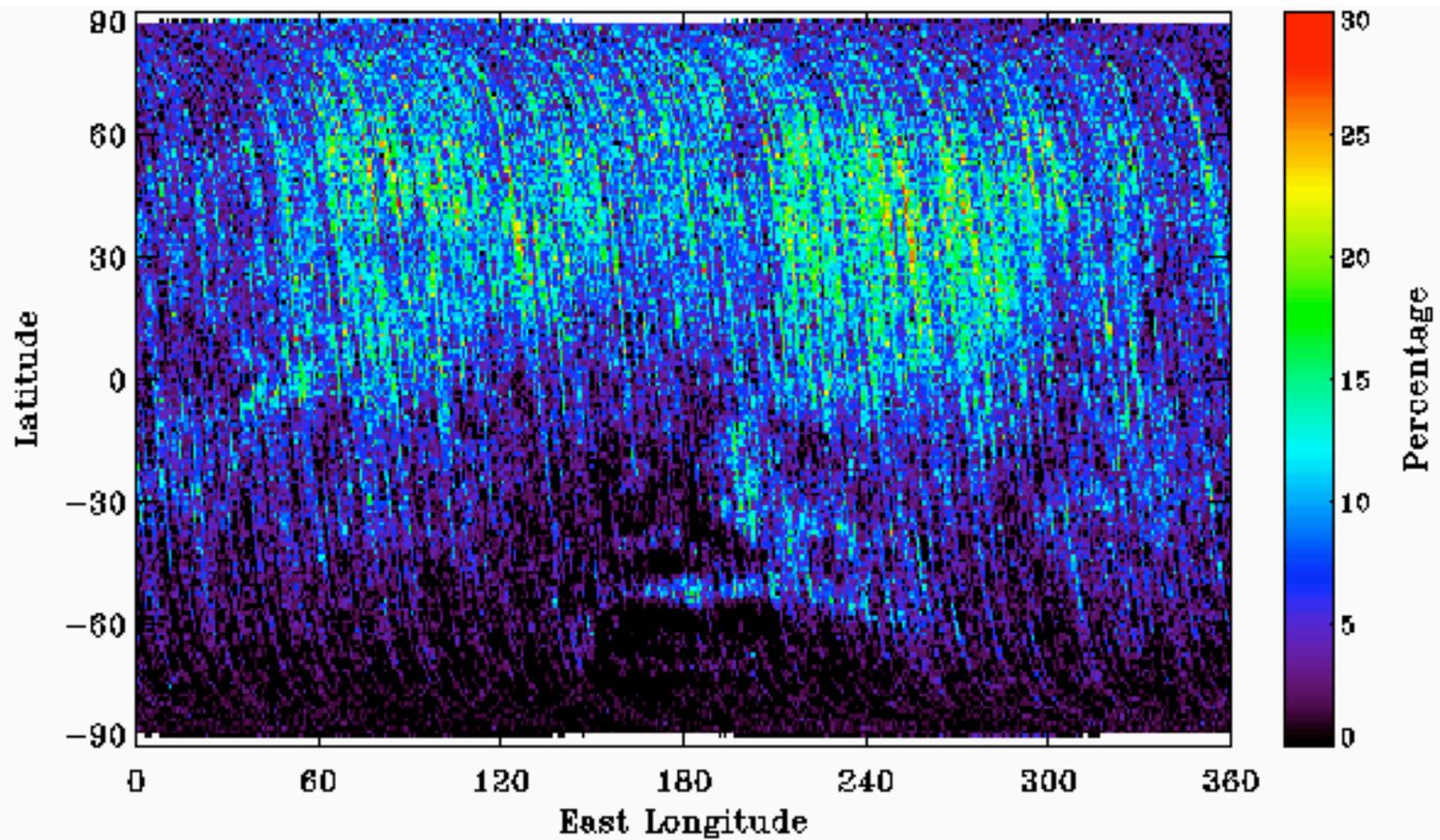
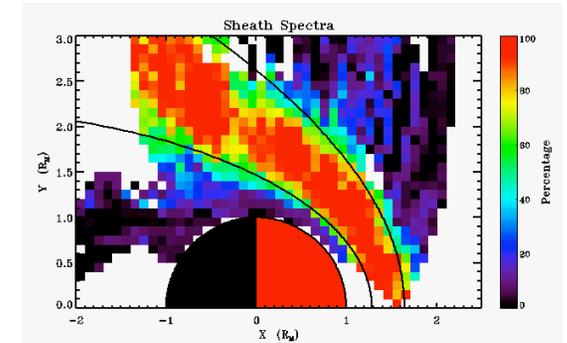
- **Mapping orbit data**  
( ~ 400 km altitude, 2am/2pm orbit )
- **Over 5+ years of data**  
01 July 1999 - 14 September 2004  
(10's of millions of observations)
- **Grid data**  
by longitude / latitude ( $1^\circ \square 1^\circ$ )  
and by **dayside** / **terminator** / **shadow**
- **Calculate % in each bin**  
having given topology, plasma regime
- **Note SW conditions orbit by orbit**  
 $P_{SW}$ , IMF clock angle (proxies)



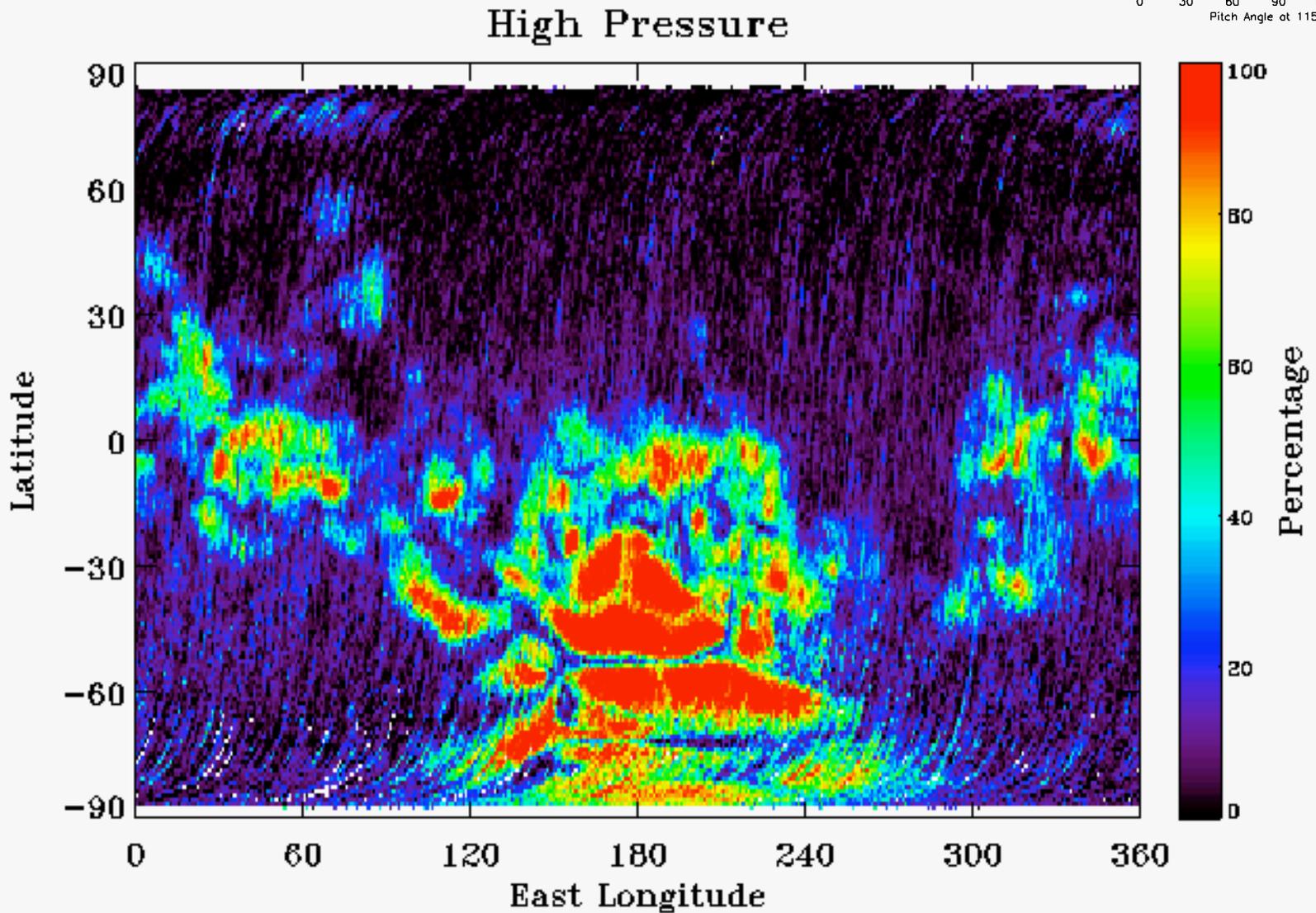
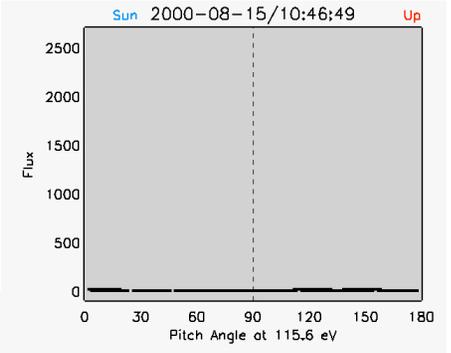
# Plasma Regime: **Dayside** Ionosphere



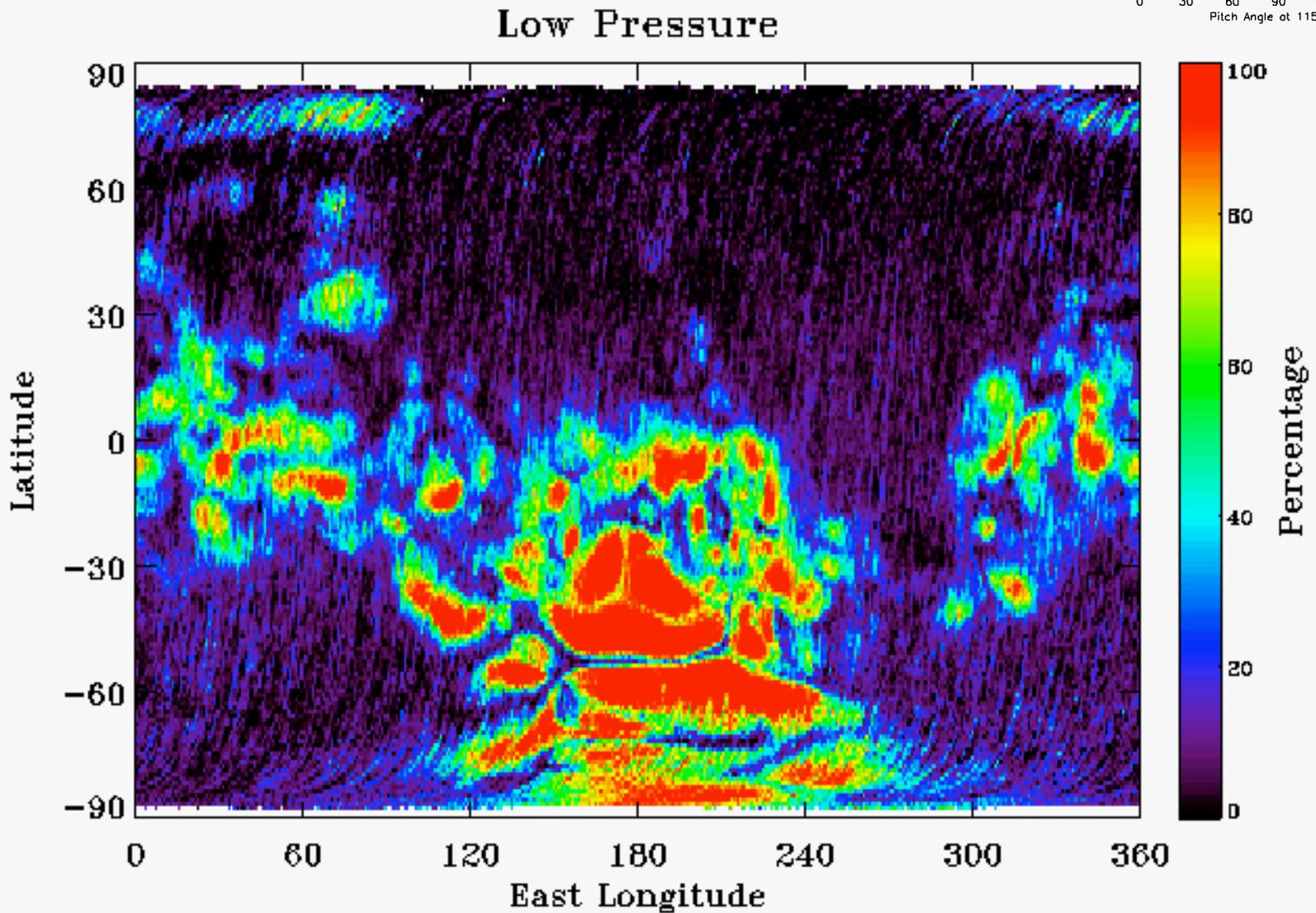
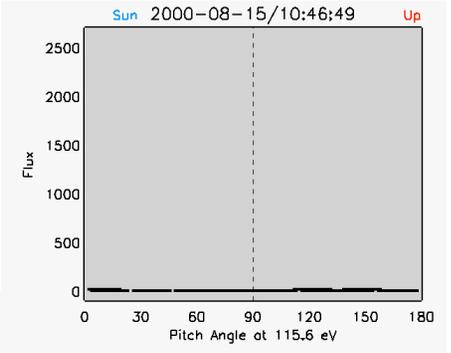
# Plasma Regime: **Dayside Sheath**



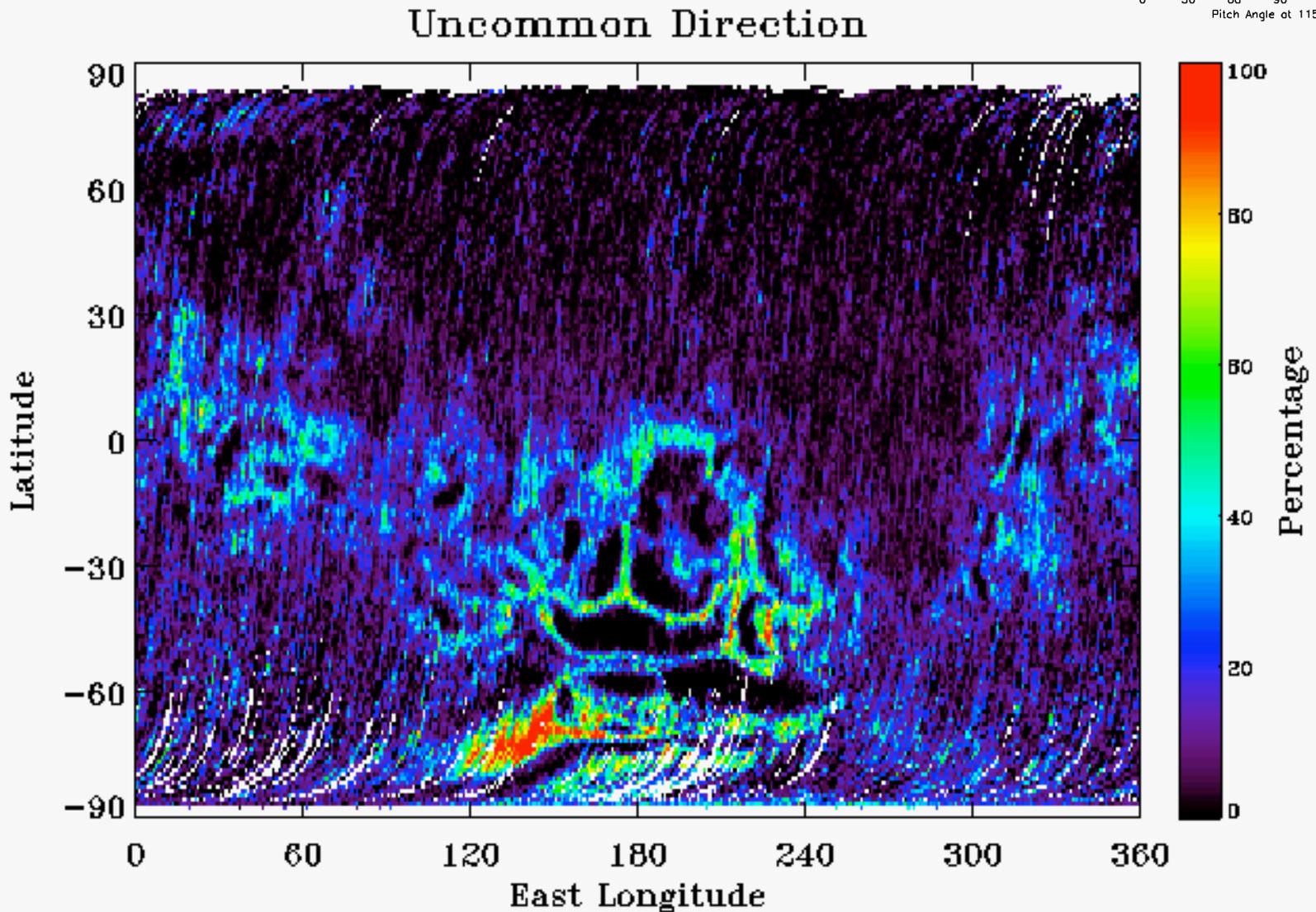
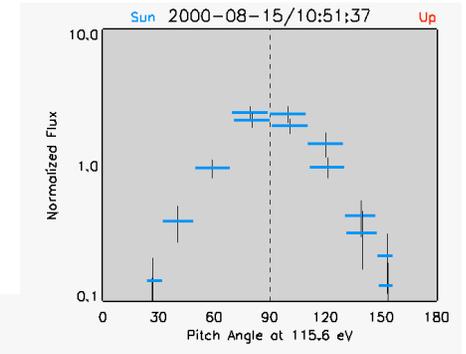
# Field Topology (Shadow): Closed Field



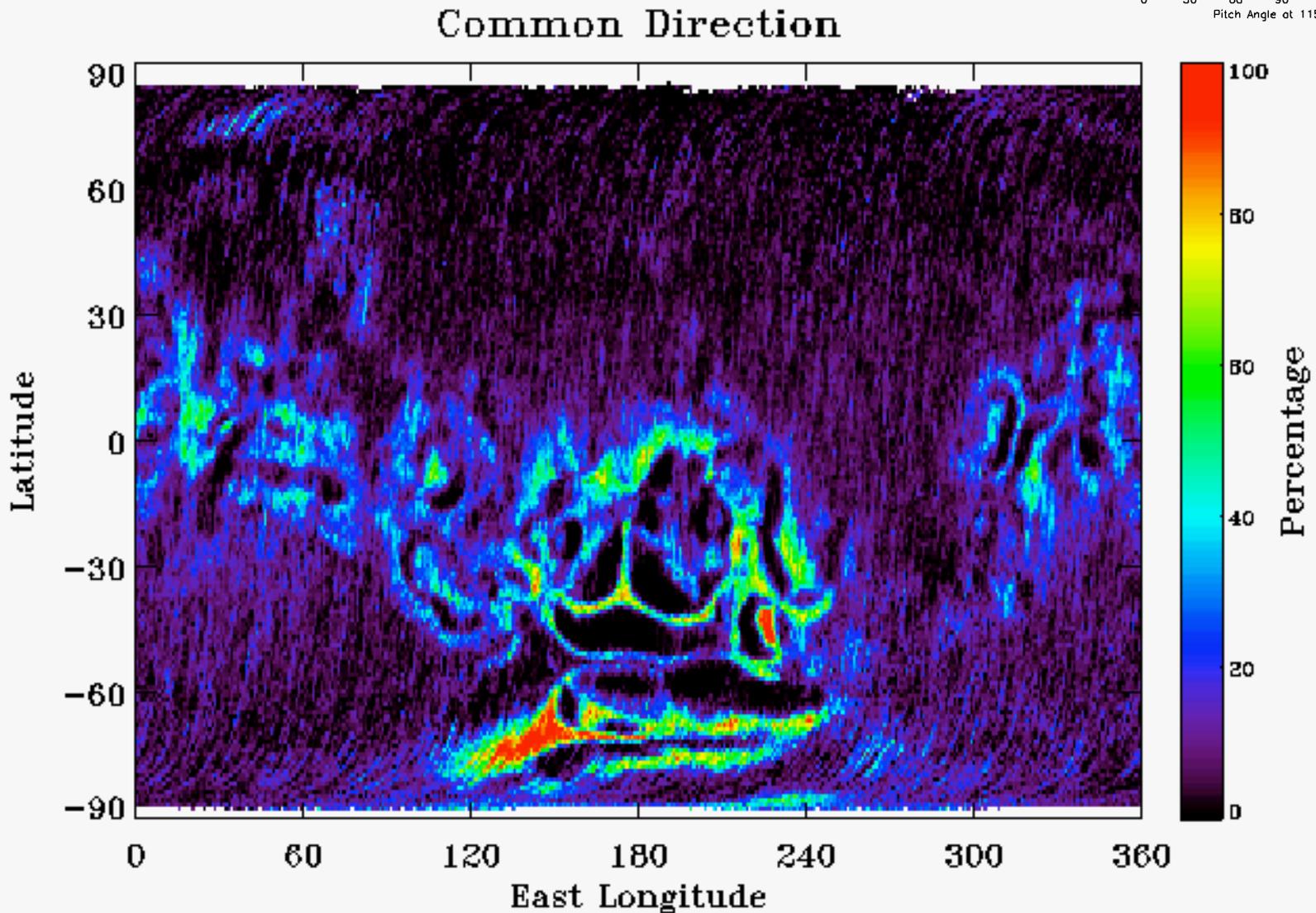
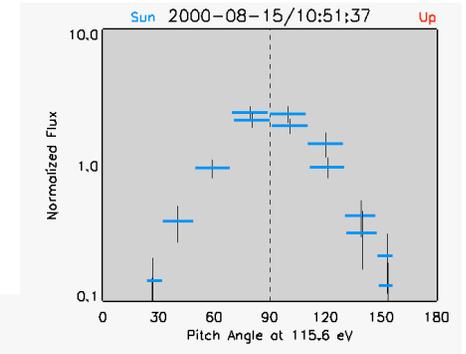
# Field Topology (Shadow): Closed Field



# Field Topology (Shadow): Recently Closed Field?

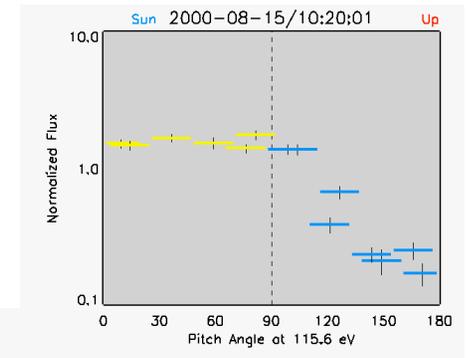


# Field Topology (Shadow): Recently Closed Field?

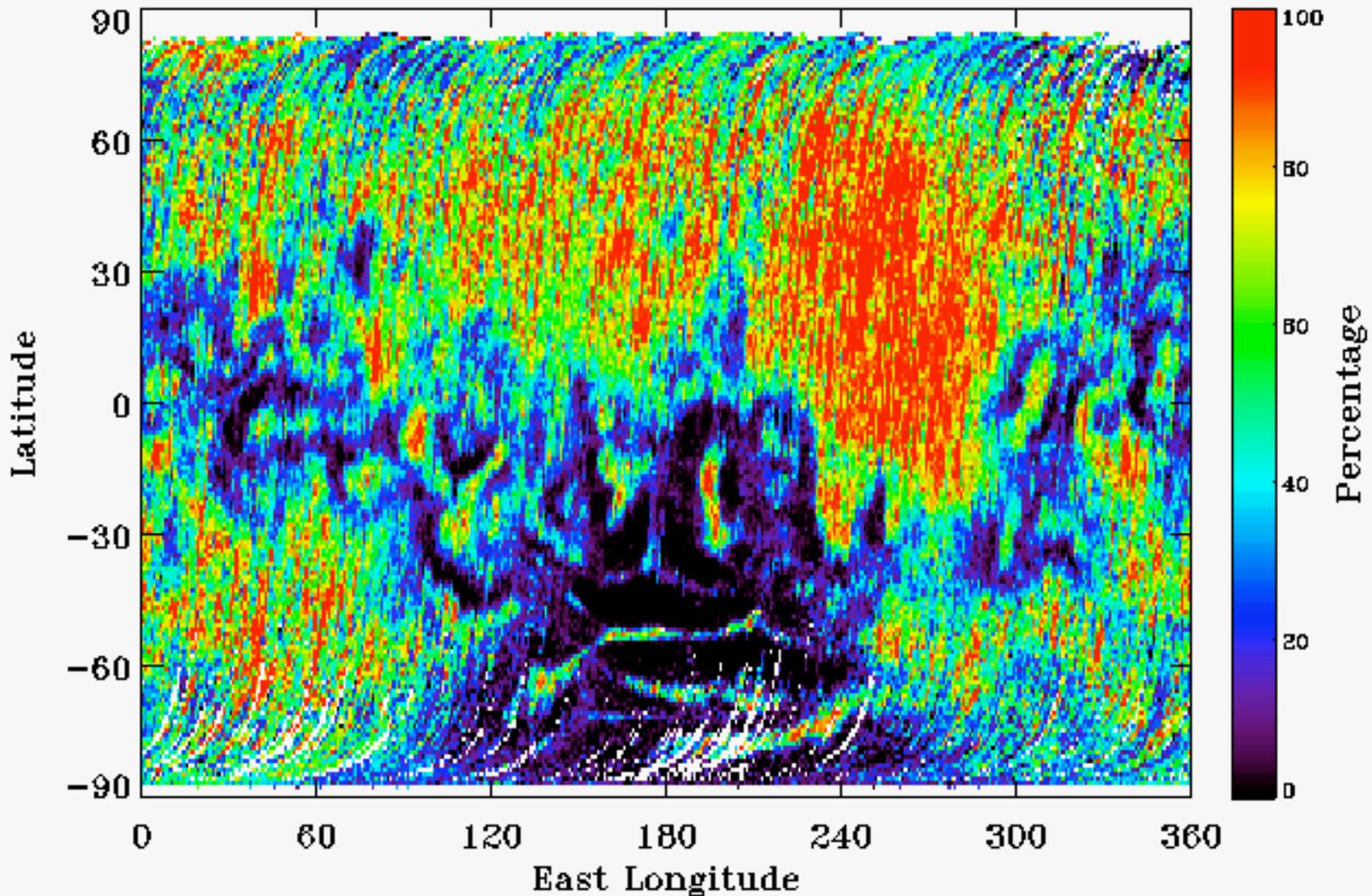




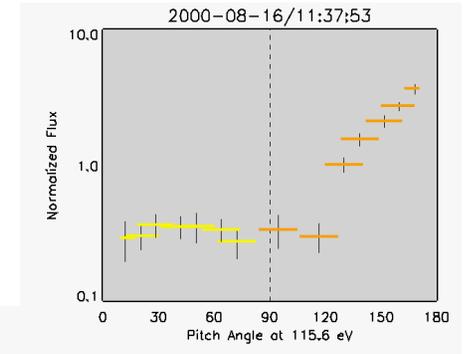
# Field Topology (Shadow): “Open” Field



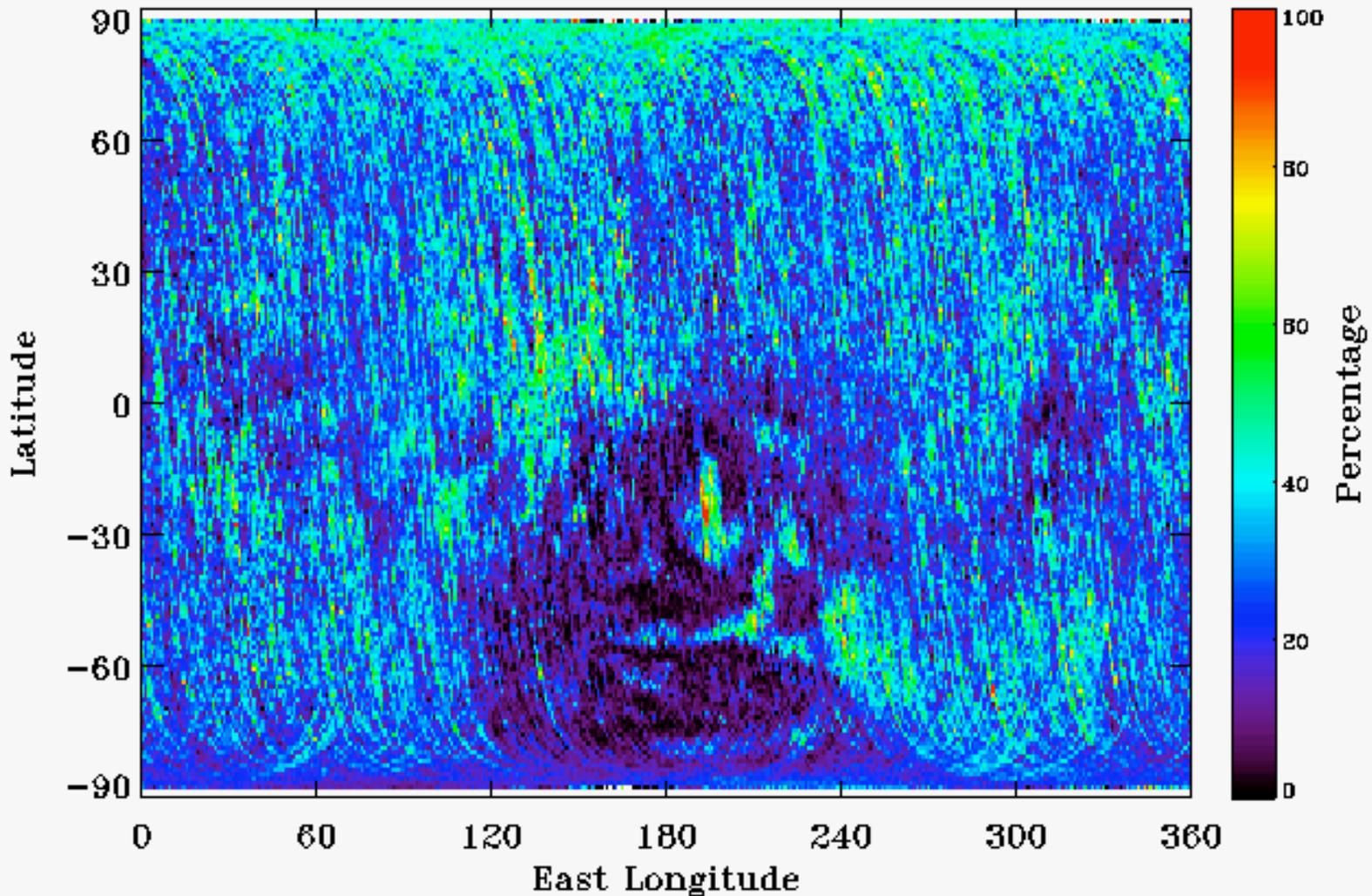
Uncommon Direction



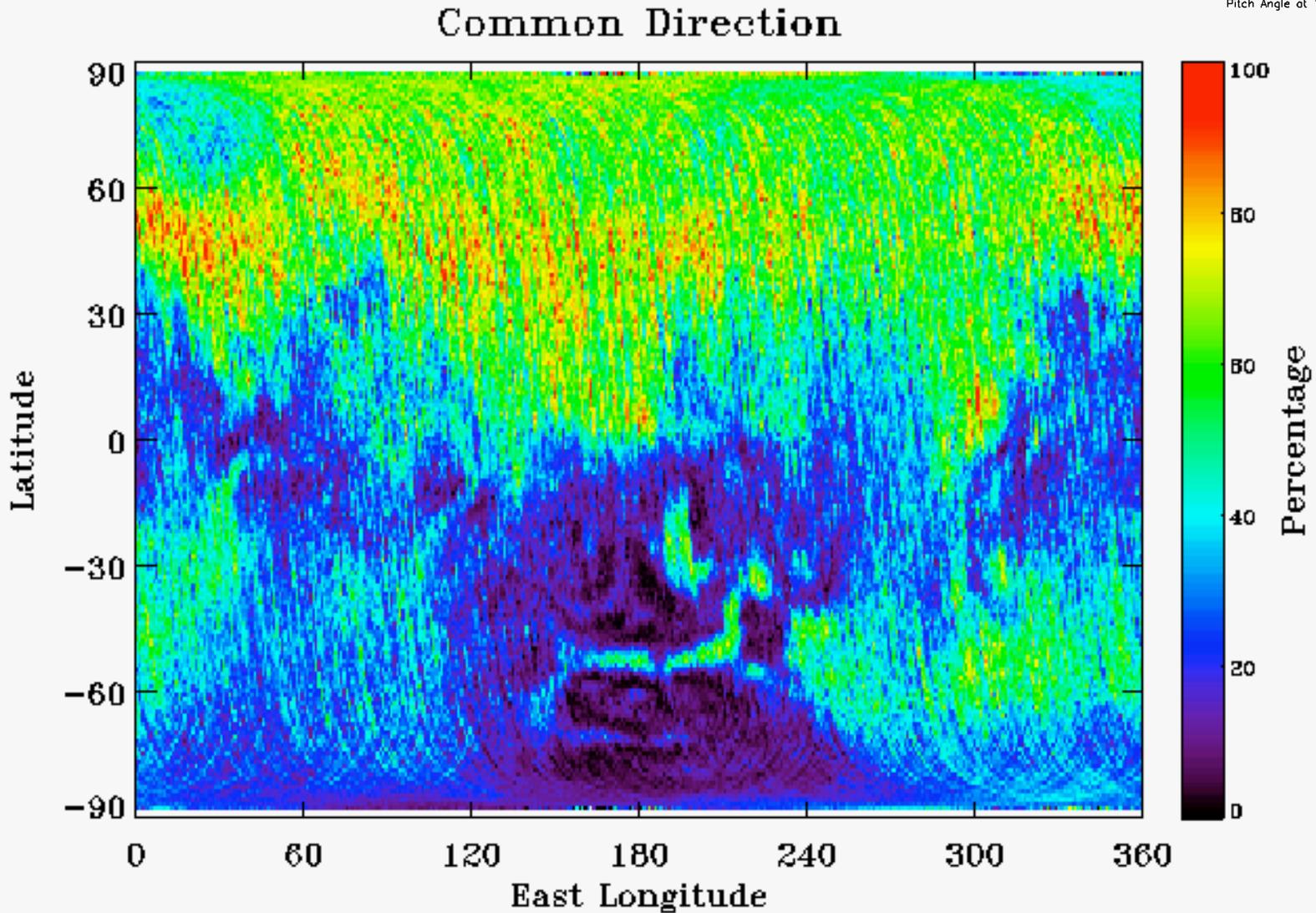
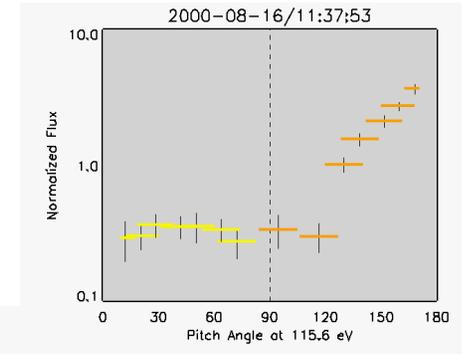
# Field Topology (Dayside): “Open” Field



Uncommon Direction



# Field Topology (Dayside): “Open” Field



# Summary

- Electrons tell us about **plasma regime** and **field topology**
- Crustal fields locally **protect atmosphere** from the solar wind **and** allow **access of solar wind plasma** to lower ionosphere
- Crustal fields respond to changes in  $P_{sw}$  and **IMF** clock angle
- Same techniques outlined here can be used with **ELS data**
- Magnetic field from **MGS** provide **context for ELS** observations
- The elliptical orbit of **Mars Express** and supporting particle data provide valuable **context for MGS** measurements