

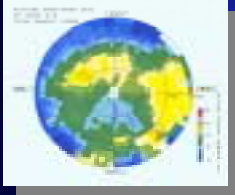
# Center for Theoretical Geo/Cosmo Plasma Physics

## Photoelectron-Driven Dayside Polar Wind

### ONLY THEORY CAPABLE OF EXPLAINING:

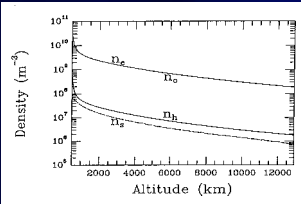
- Large Ambipolar Electric Fields
- Oxygen Outflow and Its Dominance
- Continuous Outflow from subsonic collisional to supersonic collisionless regimes
- Large outward nonclassical heat flux

KNOWLEDGE OF ELECTRON AND ION DENSITIES AND OUTFLOW IS IMPORTANT TO SPACE LAUNCH, ORBIT OPERATIONS, AND SPACE WEATHER FORECASTING.



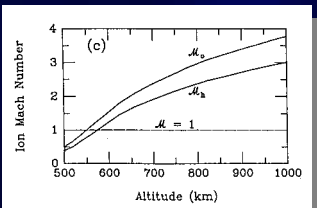
### NUMBER DENSITIES

[Subscripts o,h,e and s refer to oxygen ions, protons, thermal electrons and photoelectrons, respectively.]  
 • Note the dominance of oxygen ions over protons.

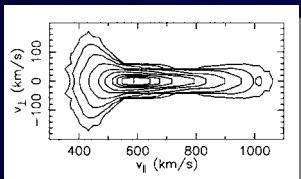


### ION MACH NUMBERS

\* Note that both flow velocities become supersonic at ionospheric altitudes.



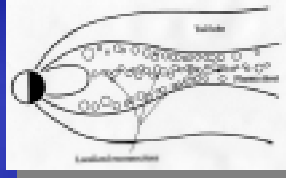
### DOUBLE PEAK ION DISTRIBUTION IN FAST STREAM SOLAR WIND



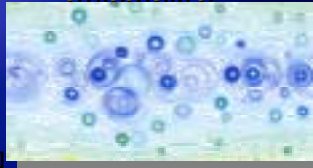
## Complexity in Space Plasmas - Resonances, Coherent Structures, And Self-Organized Criticality RELEVANCE TO SPACE WEATHER

- SUBSTORMS
- AURORAL PHENOMENA
- MAGNETOSPHERE/IONOSPHERE COUPLING

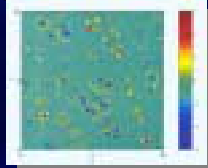
### SPORADIC, LOCALIZED RECONNECTIONS IN THE EARTH'S MAGNETOTAIL



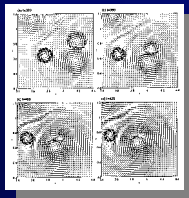
### SIMULATIONS: COHERENT MAGNETIC STRUCTURES



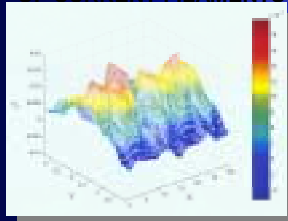
### SPORADICALLY GENERATED CURRENT FILAMENTS



### LOCALIZED MERGING



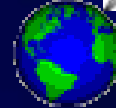
### PREFERENTIAL ACCELERATION OF CURRENT FILAMENTS



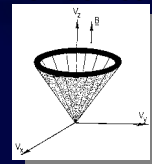
X: SUN-Earth direction  
 Y: Cross-tail direction  
 Alfvén speed: 0.025  
 Arbitrary units

## Electromagnetic Tornadoes In Space

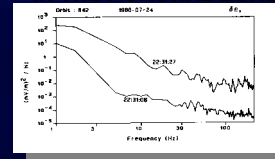
### ION ACCELERATION IN THE AURORAL ZONE



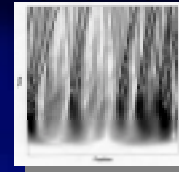
### ION CONICS



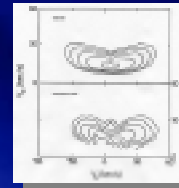
### BROADBAND LOW FREQUENCY INTERMITTENT TURBULENCE IN THE AURORAL ZONE



### SPIKY LOWER HYBRID TURBULENCE



### THEORY/DATA CLOSURE



### FREJA STATISTICS:

- 85% events associated with Broadband Turbulence (types 1 & 2)
- 14% events associated with Spiky Lower Hybrid Turbulence (types 3 & 4)

