

A Survey of Ionospheric Parameters Using PFISR

‘A LITTLE BIT OF PEACE AND QUIET’

ISR SUMMER SCHOOL 2012

BANFF, AB

GROUP 7: MEGAN GILLIES, KRISHNA PRASAD GUDIVADA, HICHEM MEZAOUI, MATTHEW PATRICK, ABIYOT WORKAYEHU, JONATHAN YEE



UNIVERSITY OF
CALGARY

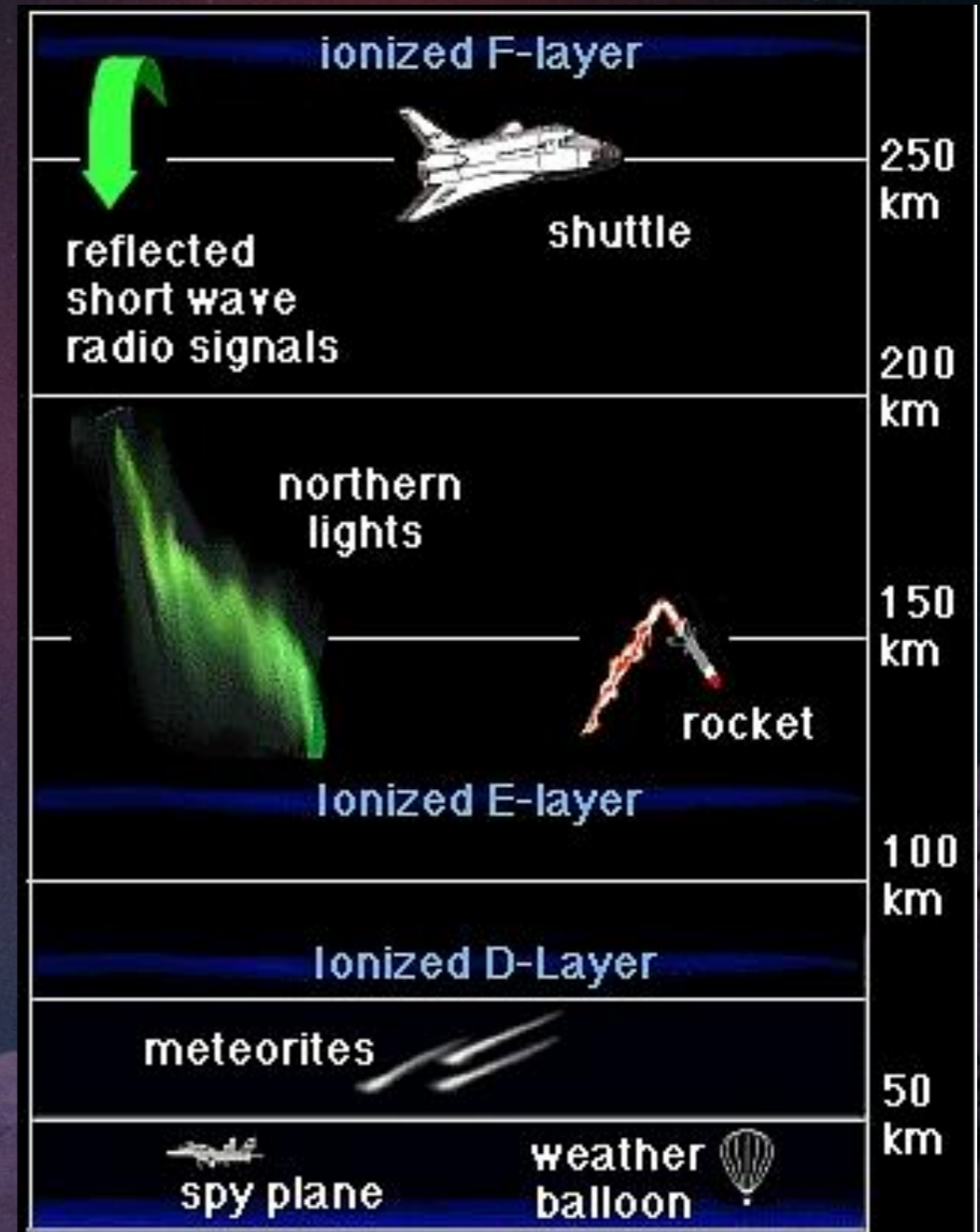


Wisdom at the source of the Blue Nile



Scientific Goals

- Use PFISR to investigate simultaneous plasma motion in the E and F regions
- Look for latitudinal variations in standard parameter profiles such as N_e , T_i , and T_e
- Possibly see other features such as a precipitation event, meteorites, or aurora



Experiment

Instrument: Poker Flat Incoherent Scatter Radar
(PFISR)

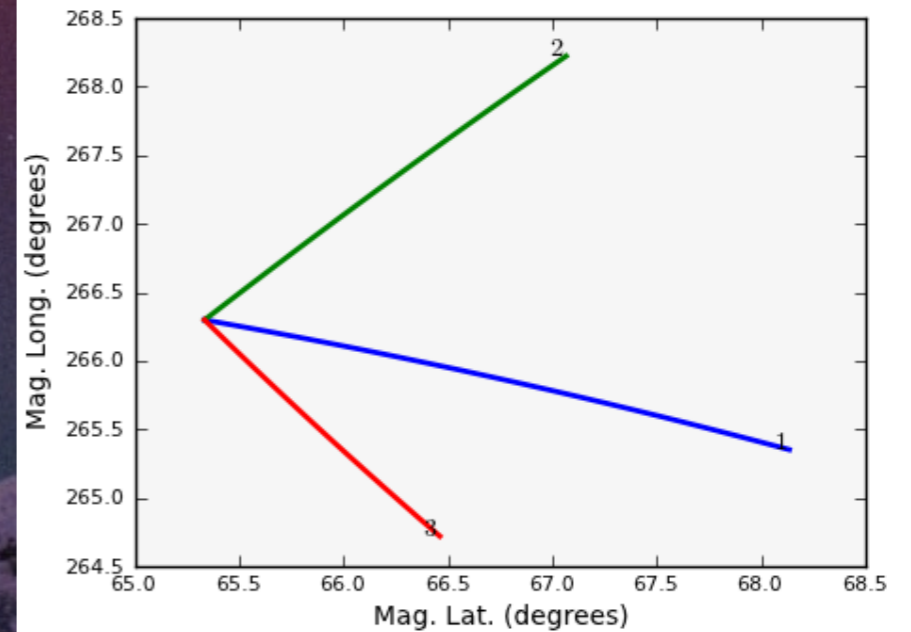
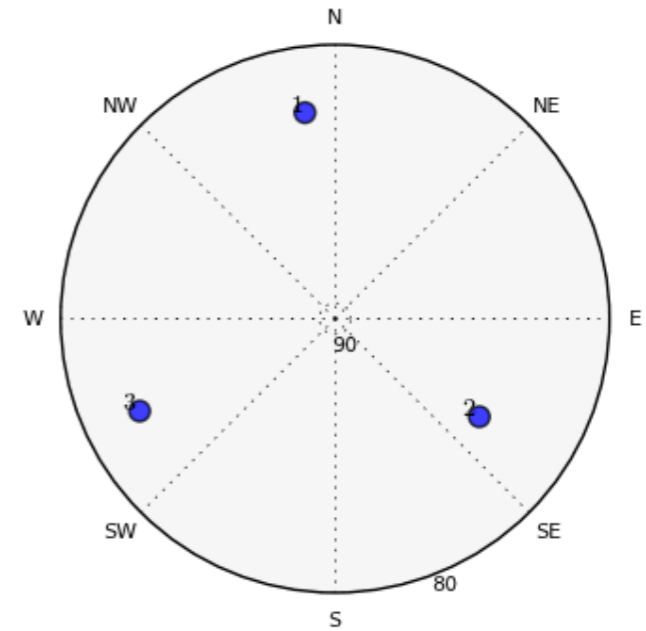


Time slot: August 1st, 2012

0200 - 0330 UT / ~ 1300 MLT (post noon sector)

Experimental Parameters

- 3 beams
- elm=[82, 84, 82]
- azm=[-8, 124, -115]



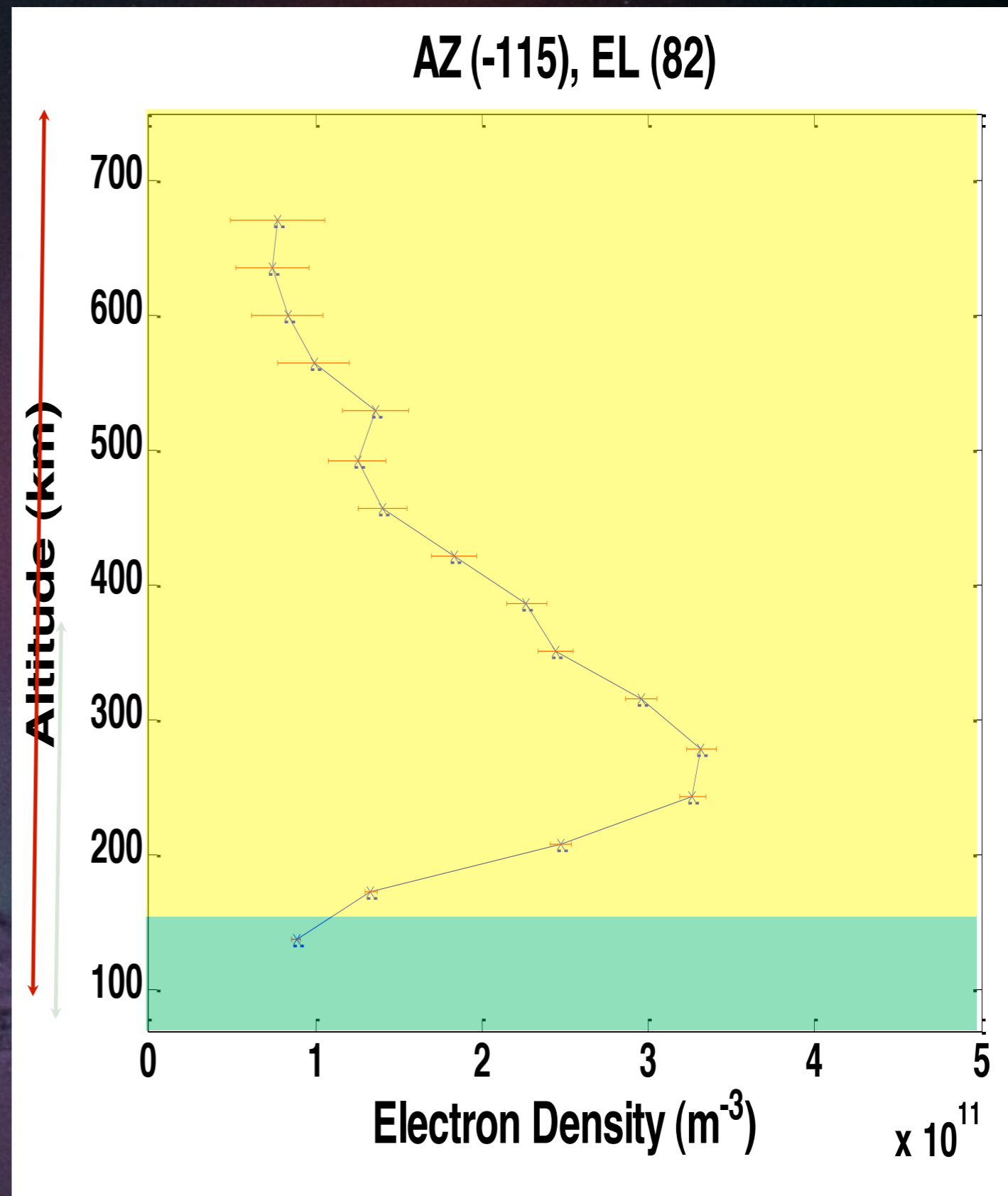
Pulse Sequence

Long Pulse:

- 480 μs
- 72 km resolution
- 100-700 km

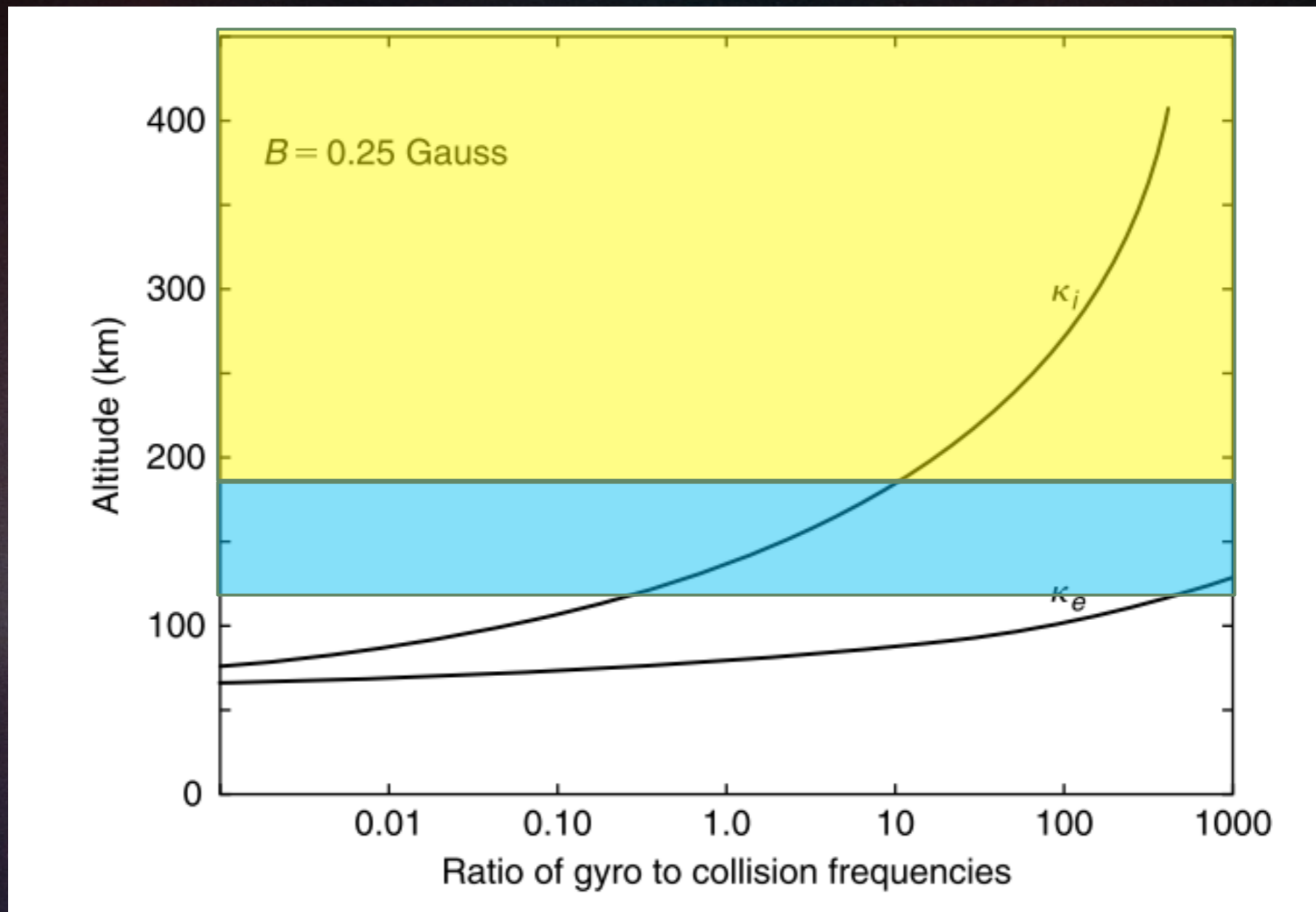
Alternating Code (AC)

- 32 pulses of 30 μs
- 4.5 km
- 80-350 km

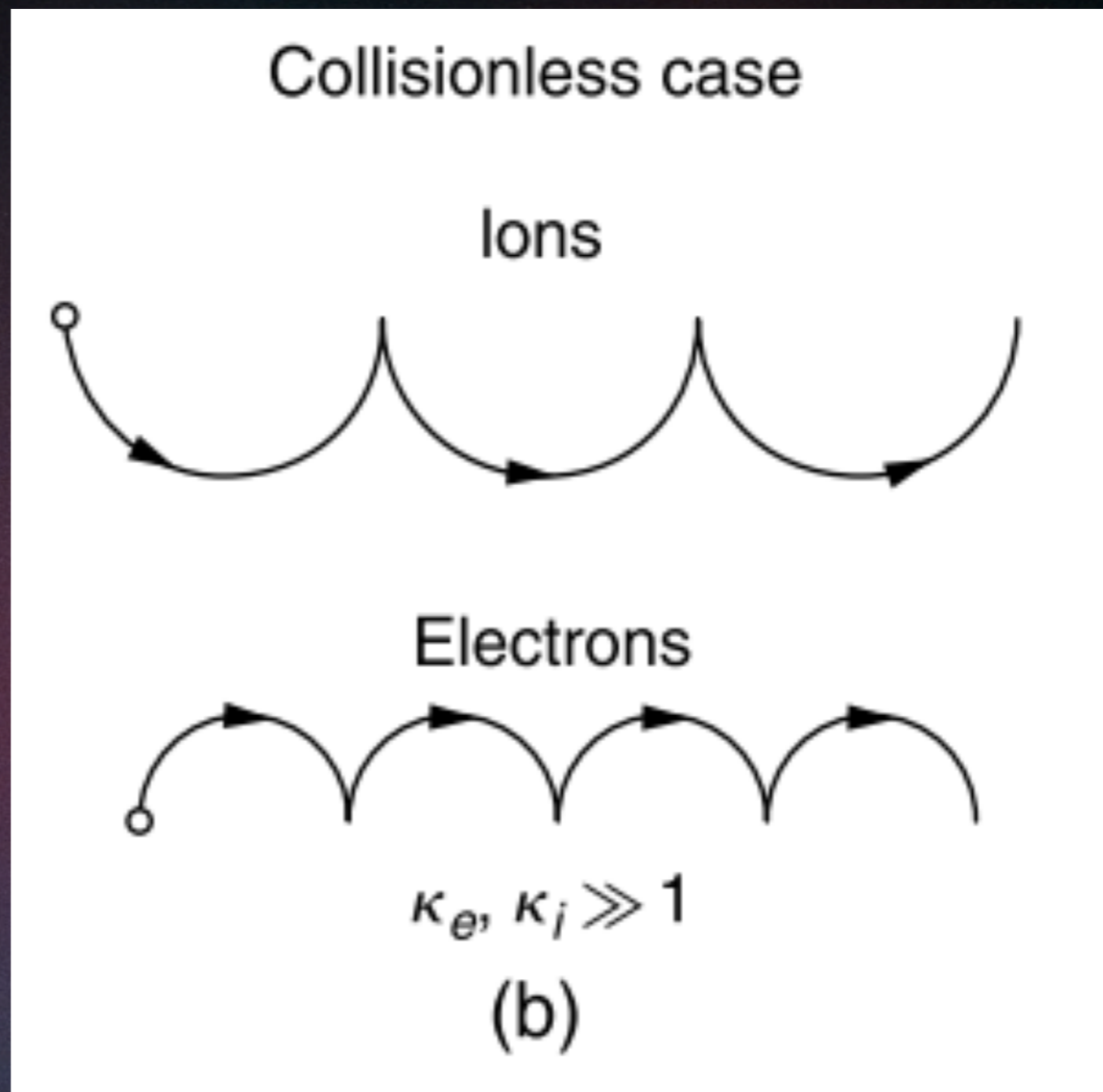
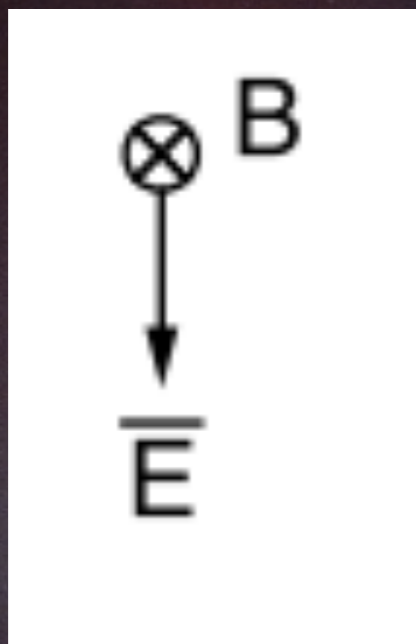


A photograph of a snowy mountain range under a dark night sky. The sky is filled with a vibrant aurora borealis, showing streaks of green and purple light. The mountains are covered in snow and are silhouetted against the glowing sky. The overall scene is serene and majestic.

Ionospheric Particle Motion Simplified



A parameter k defined as the ratio of the gyro to collision frequency is introduced to characterize the response of the partially ionized plasma to applied steady forces



$k \gg 1$ (collisionless case): after about one gyro-period the particles are moving at right angle to the electric field

Collisional case



Ions

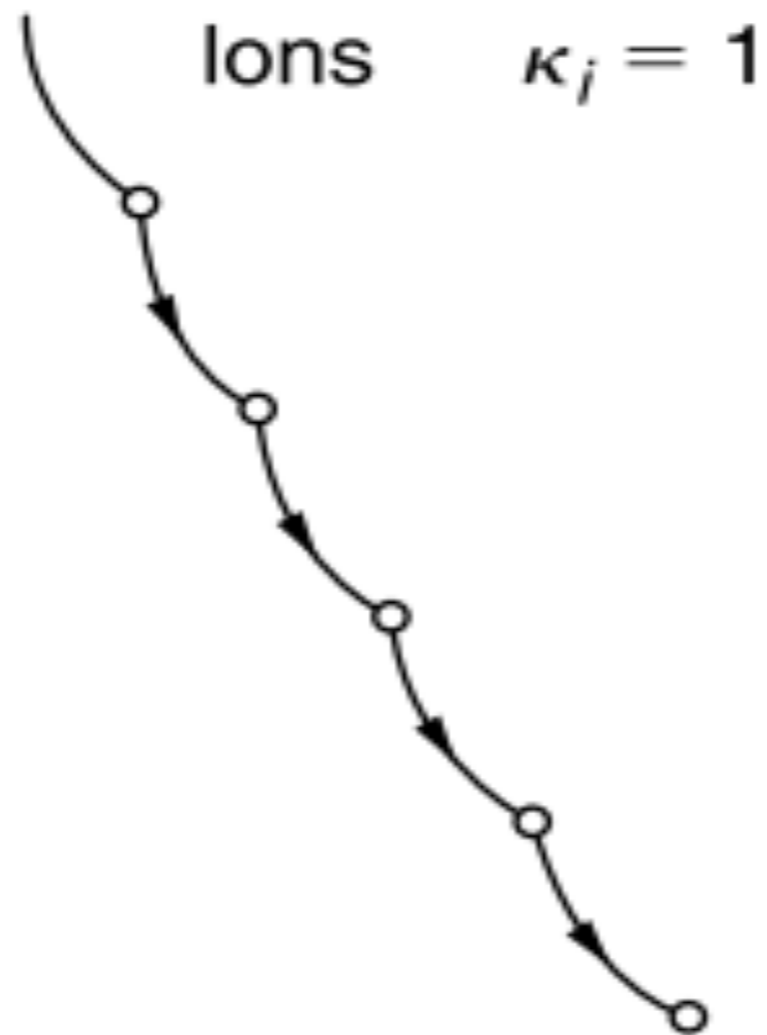


Electrons

$$k_e, k_i \ll 1$$

Case $k \ll 1$: many collisions occur and the particle moves parallel to the applied field

Intermediate case



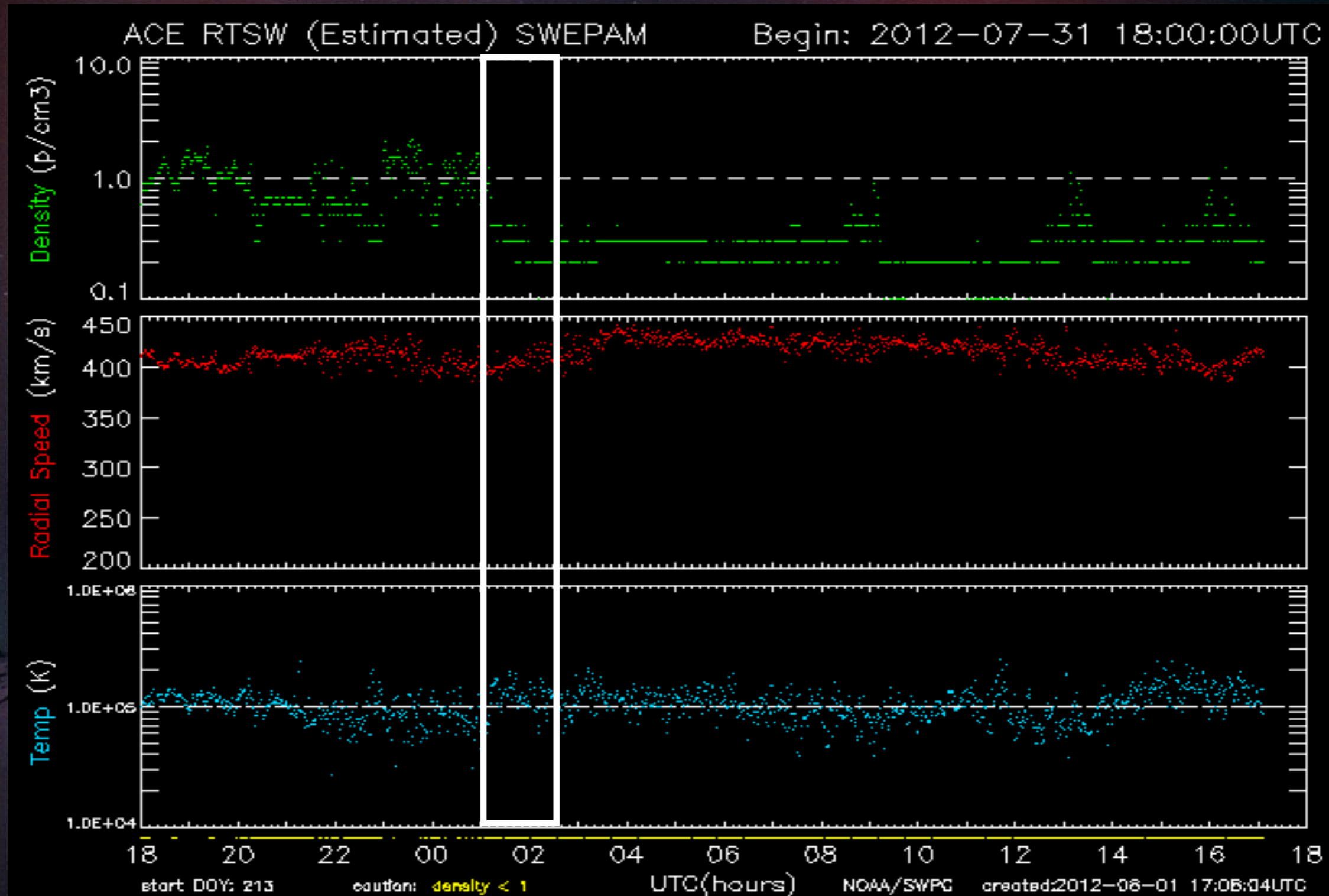
(c)

$\kappa = 1$: the net motion is at 45° angle to the electric field

A photograph of a snowy mountain range under a night sky. The mountains are covered in snow and are illuminated by a soft, purple light. The sky is dark with a prominent aurora borealis (Northern Lights) display, showing vertical streaks of green and purple light. The overall scene is serene and cold.

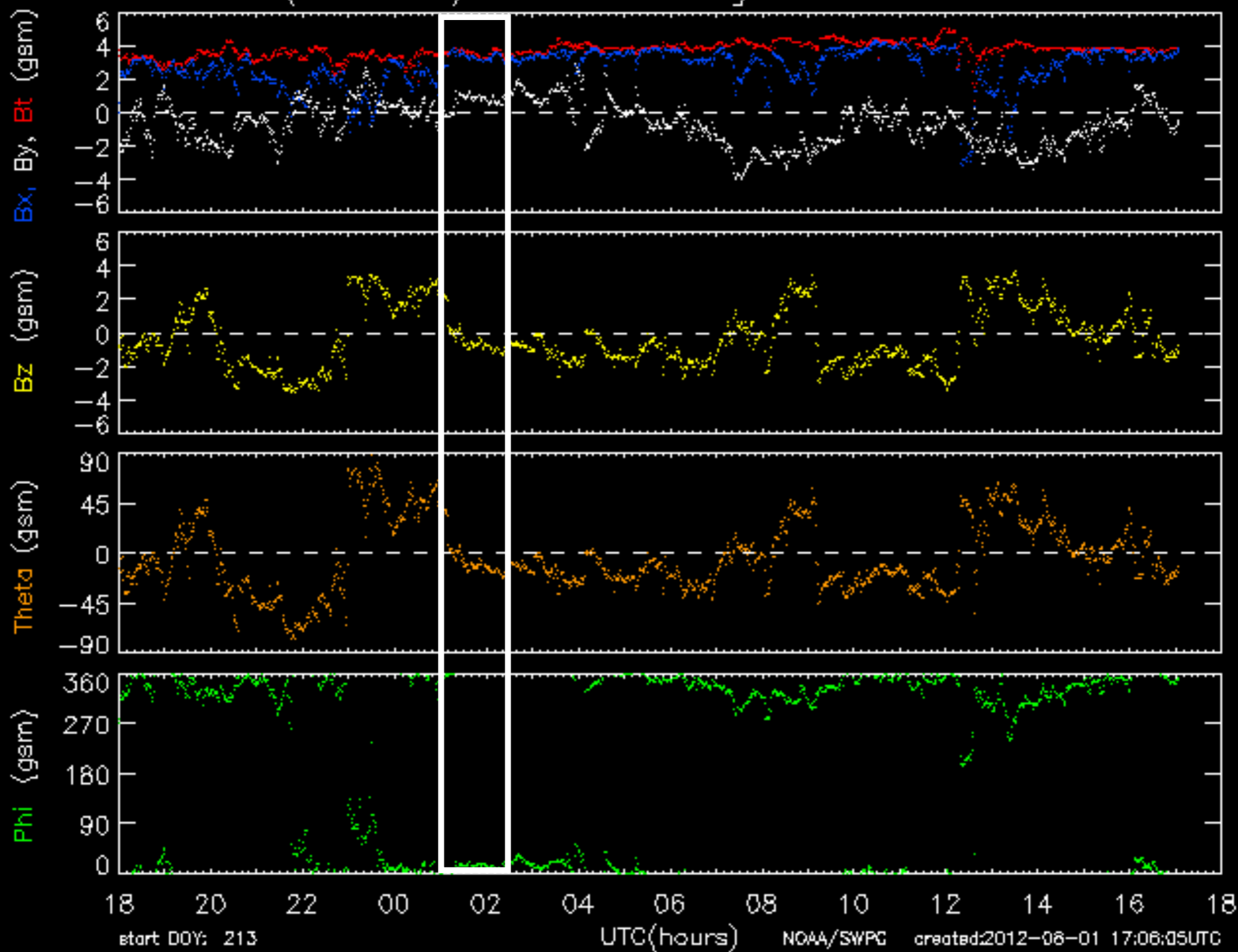
What's the weather like?

Solar wind and Interplanetary magnetic field conditions?

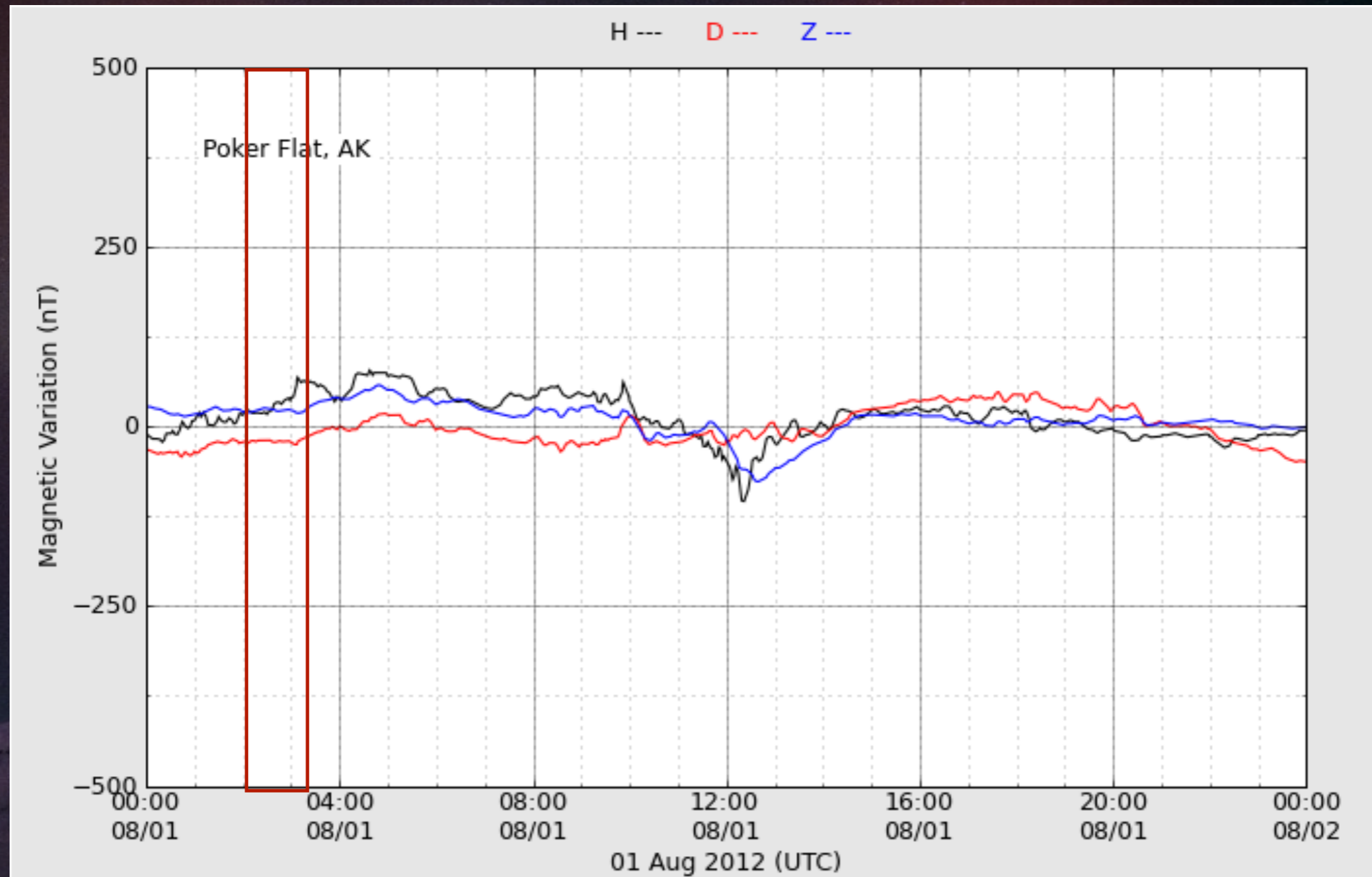


ACE RTSW (Estimated) MAG

Begin: 2012-07-31 18:00:00UTC

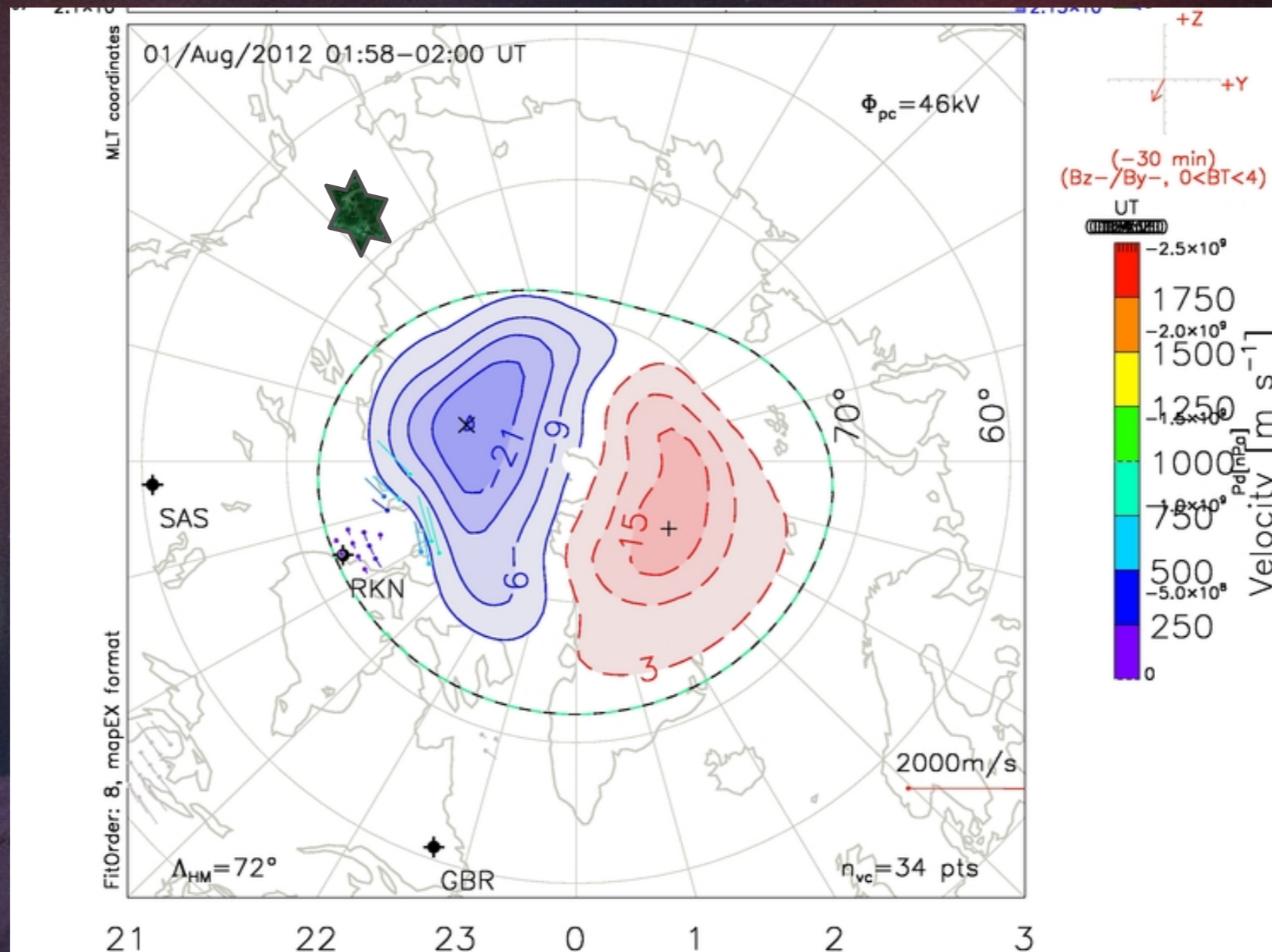


Geomagnetic Activity?

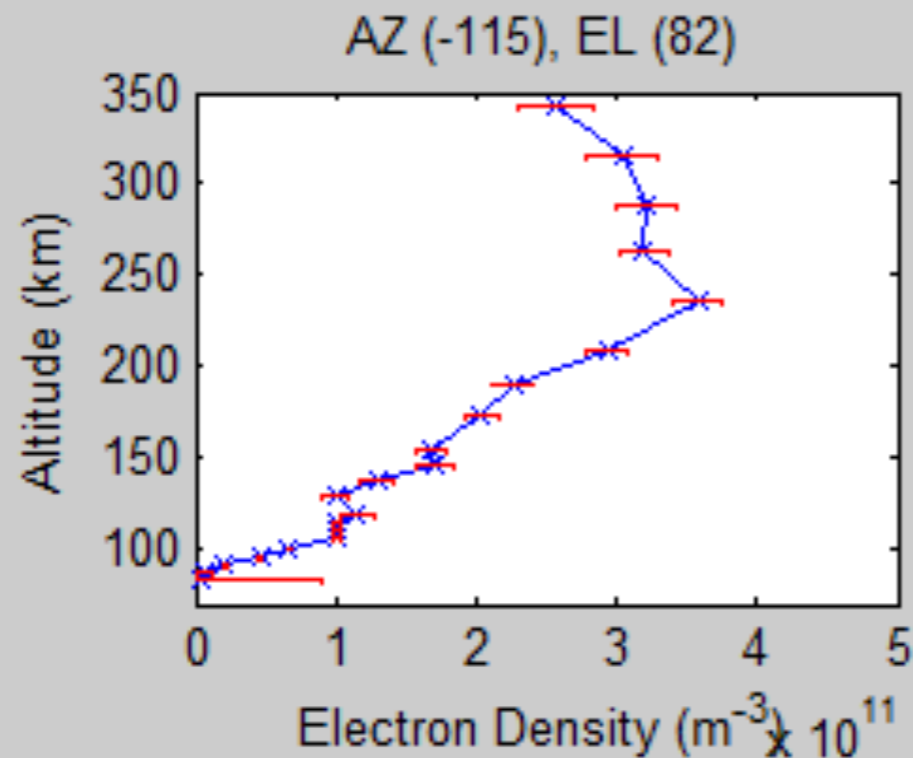
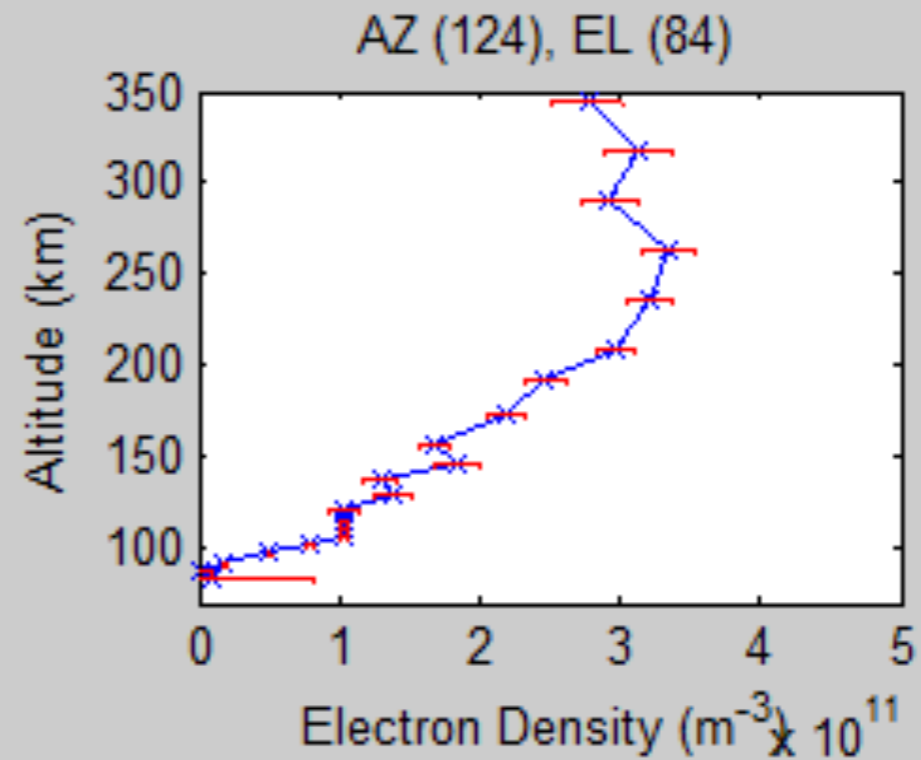
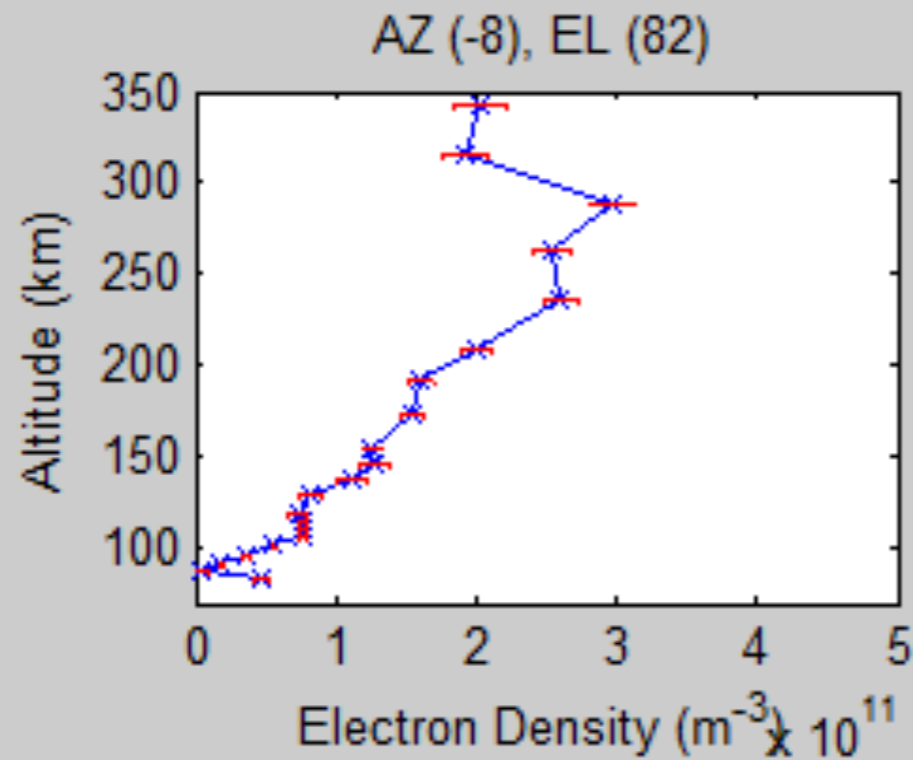


Geomagnetic Activity: Poker Flat Magnetometer

Ionospheric Convection?

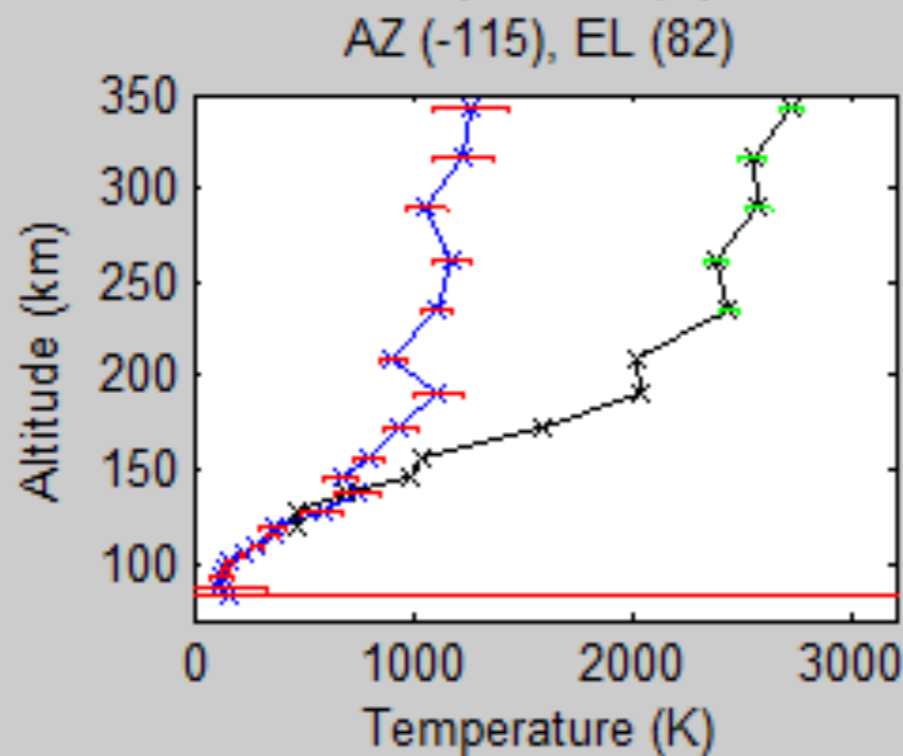
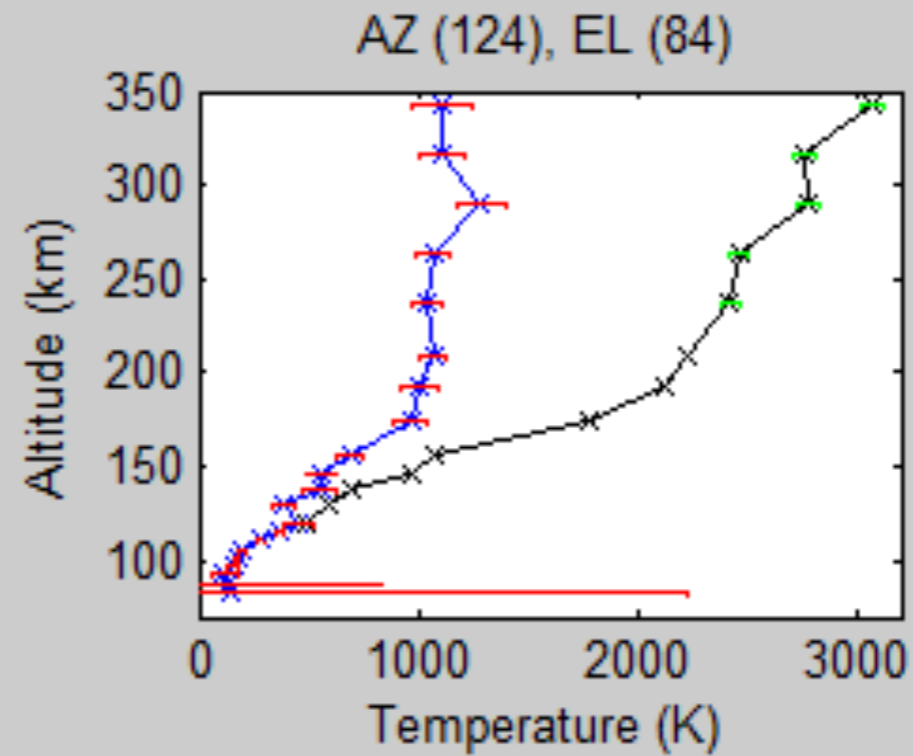
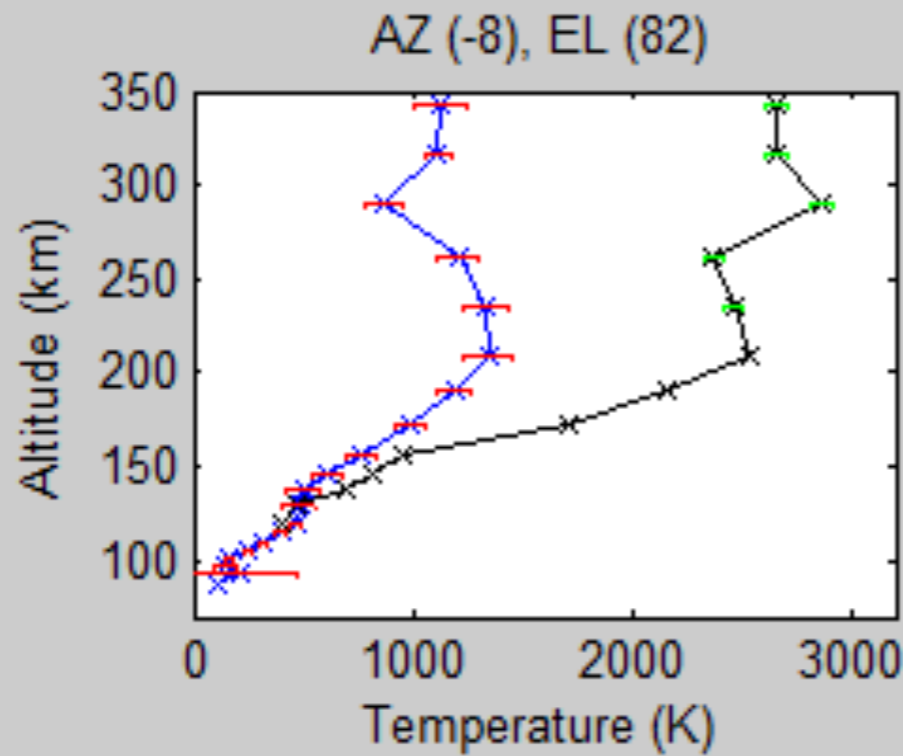


What did PFISR see?



Alternating Code
Electron Density

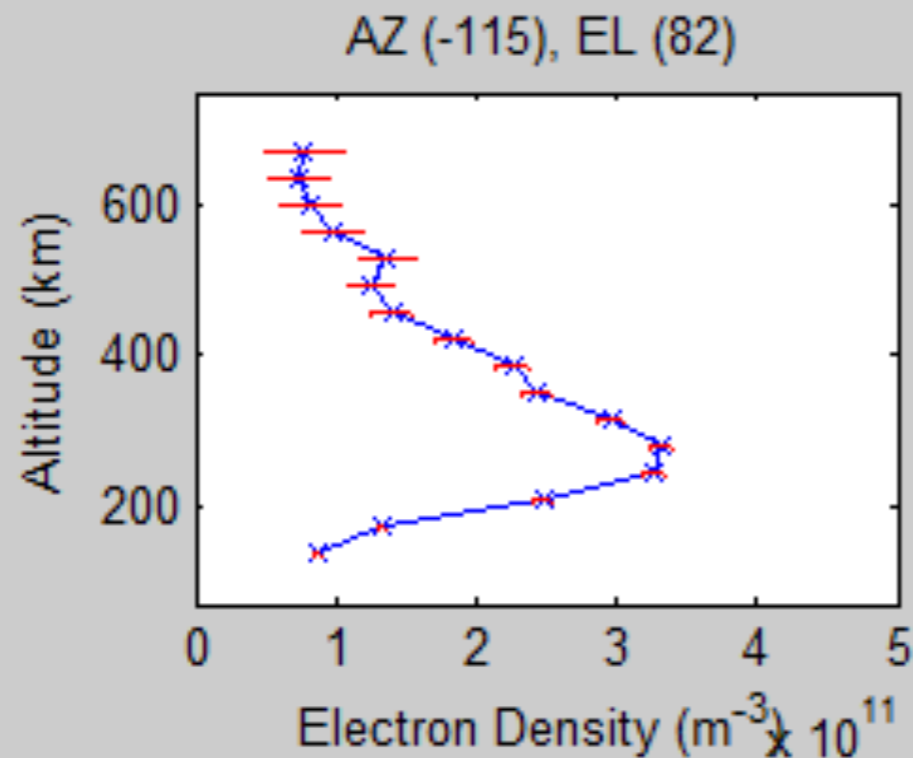
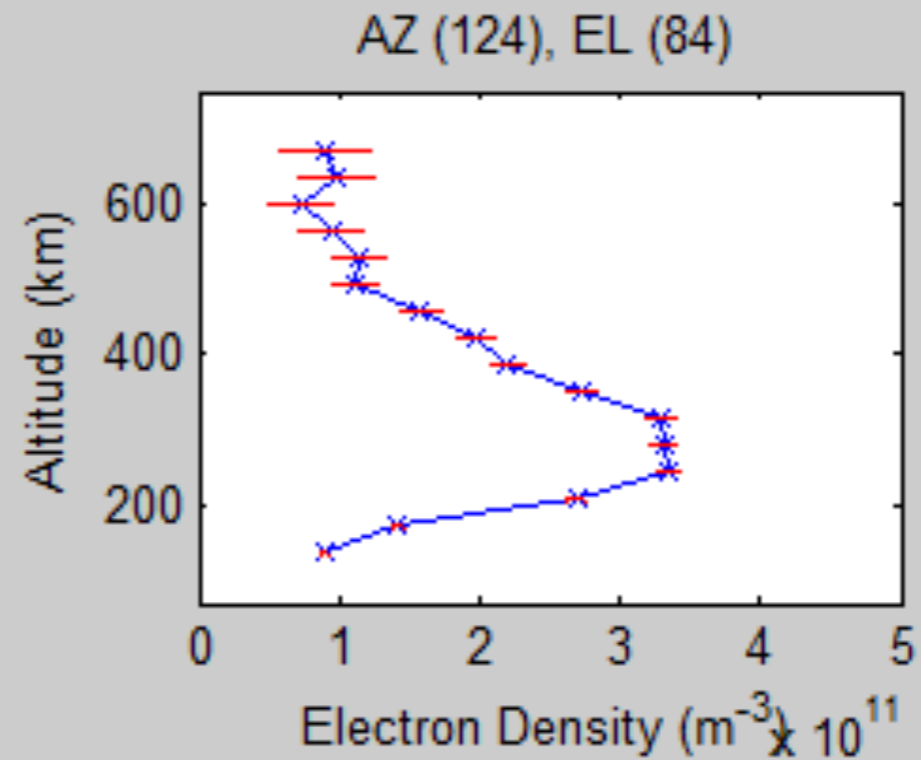
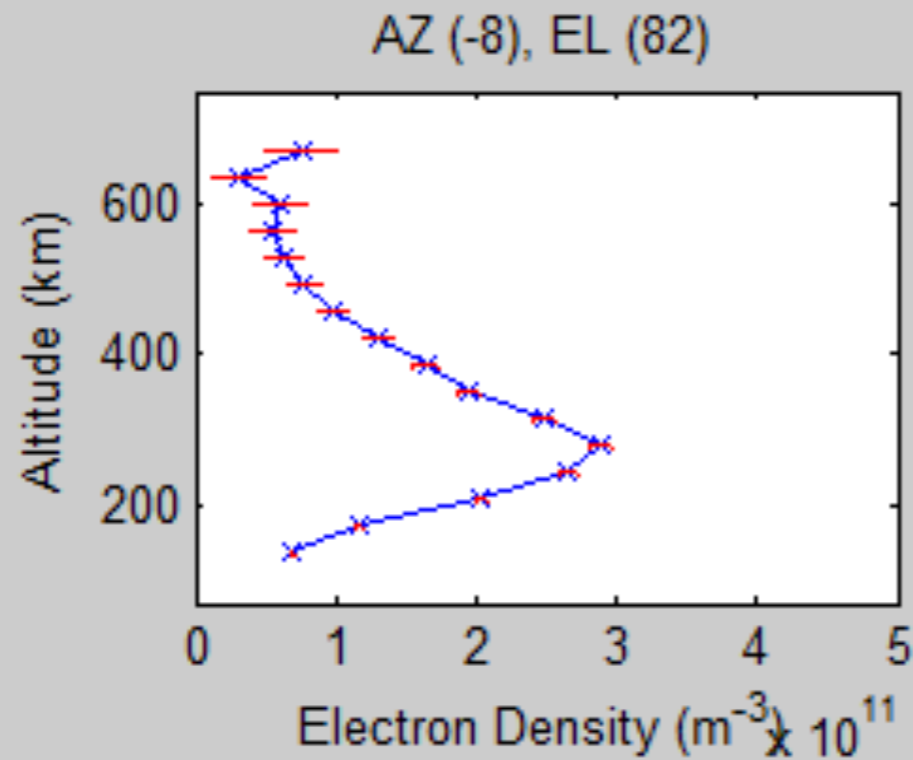
What did PFISR see?



Alternating Code
Temperature

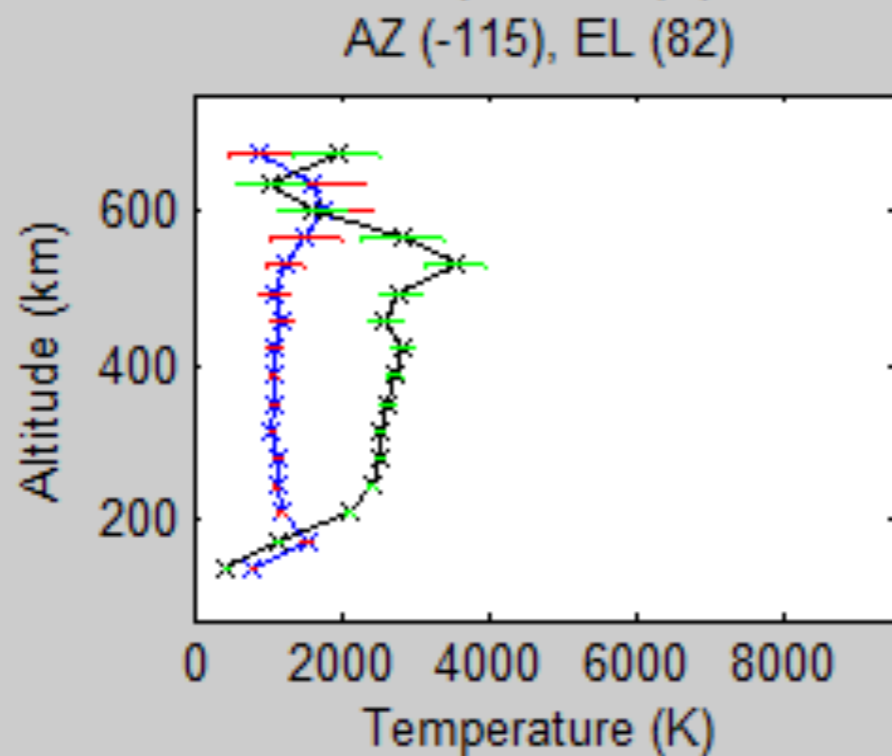
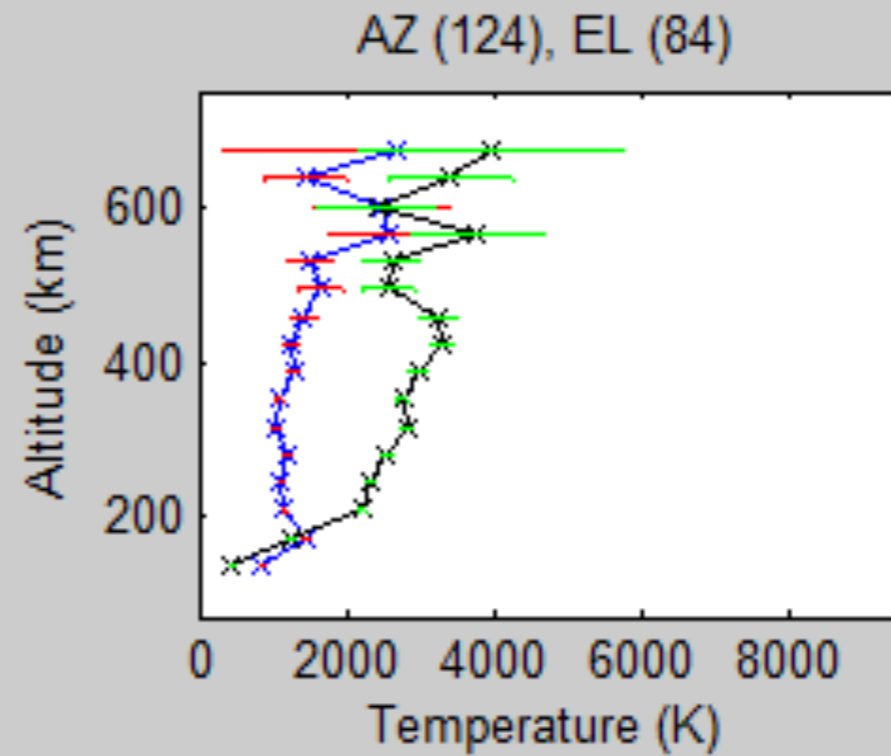
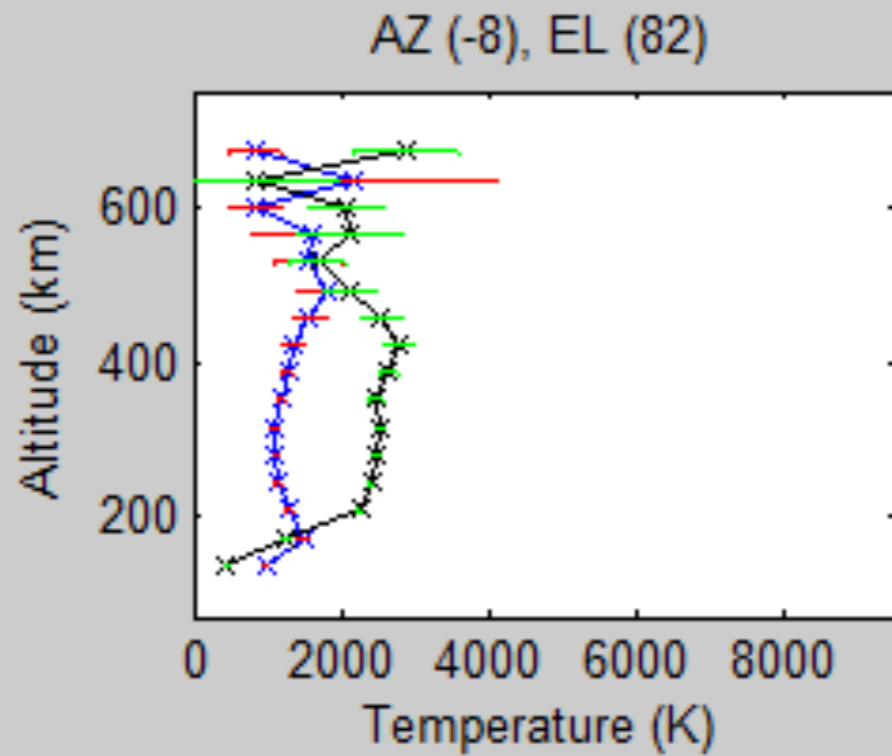


What did PFISR see?

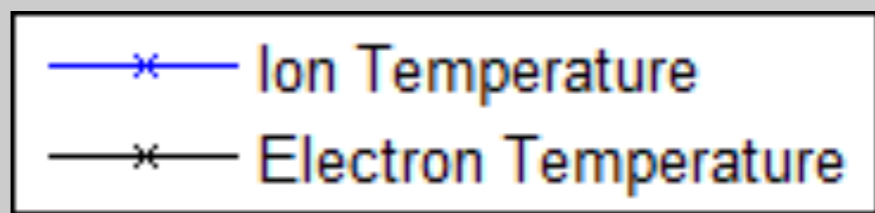


Long Pulse
Electron Density

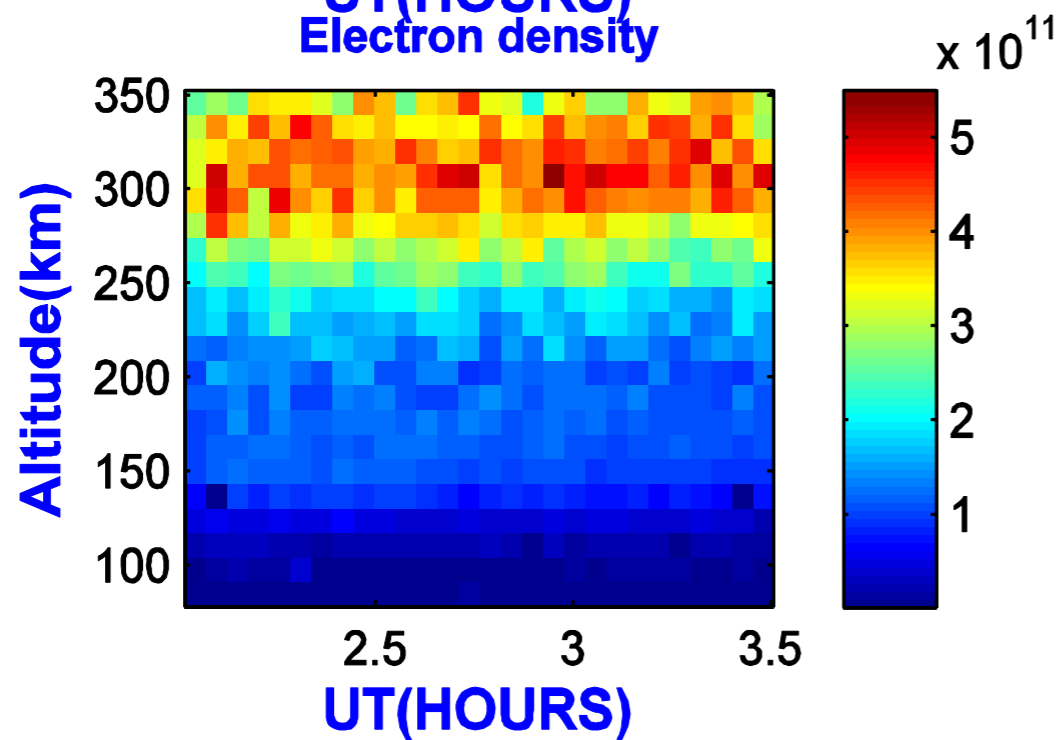
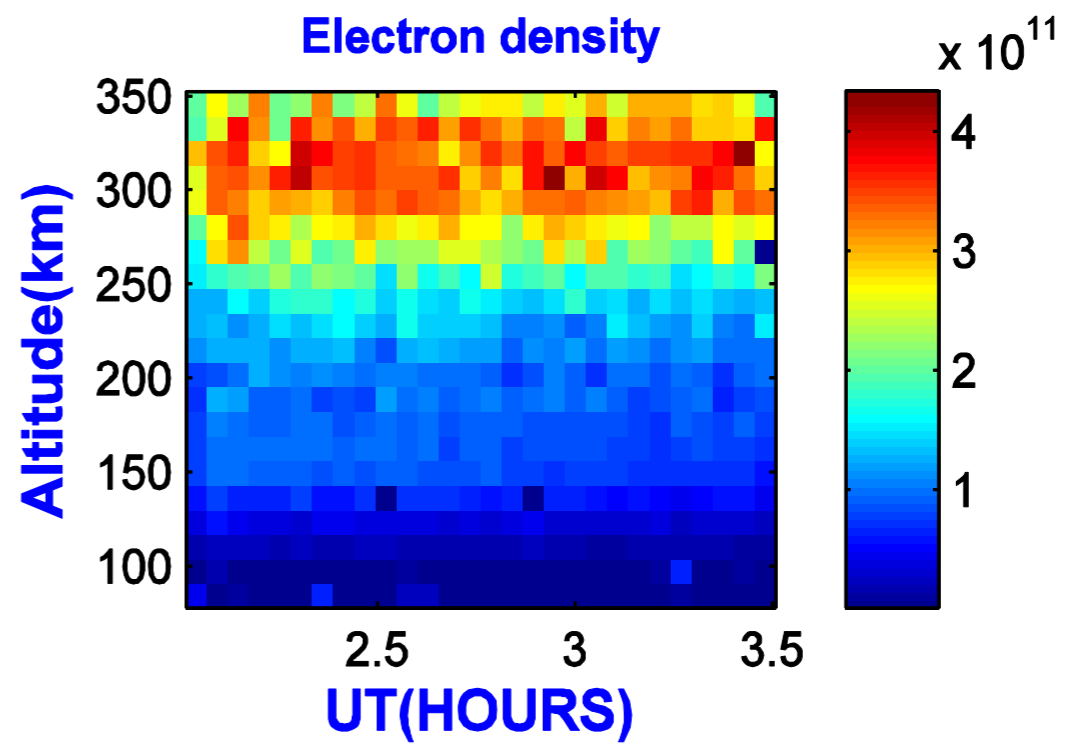
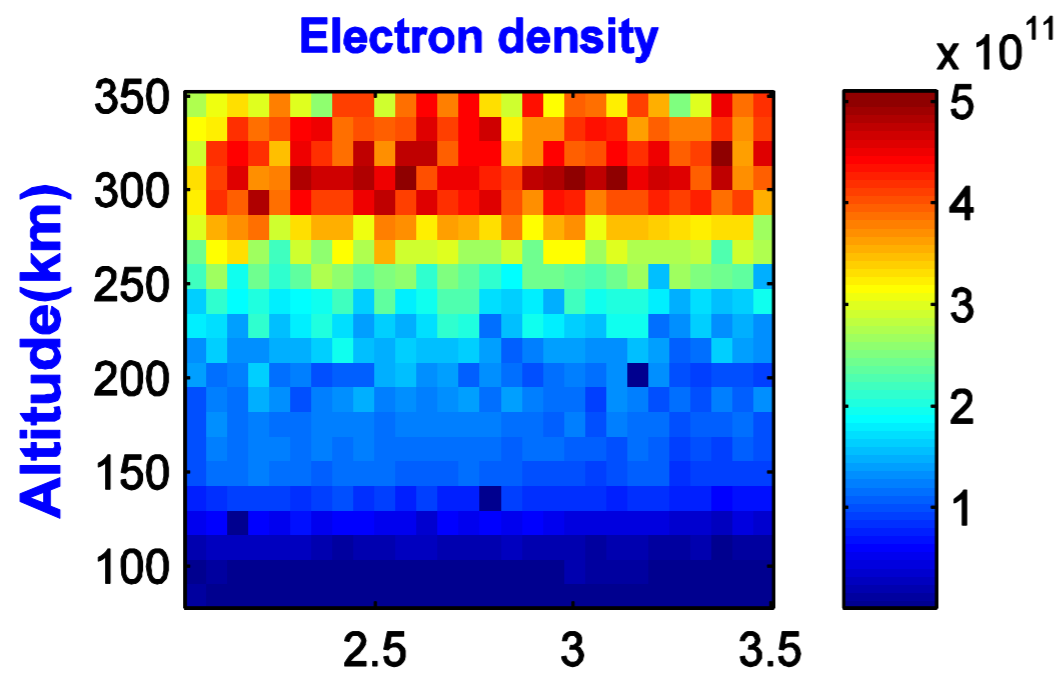
What did PFISR see?



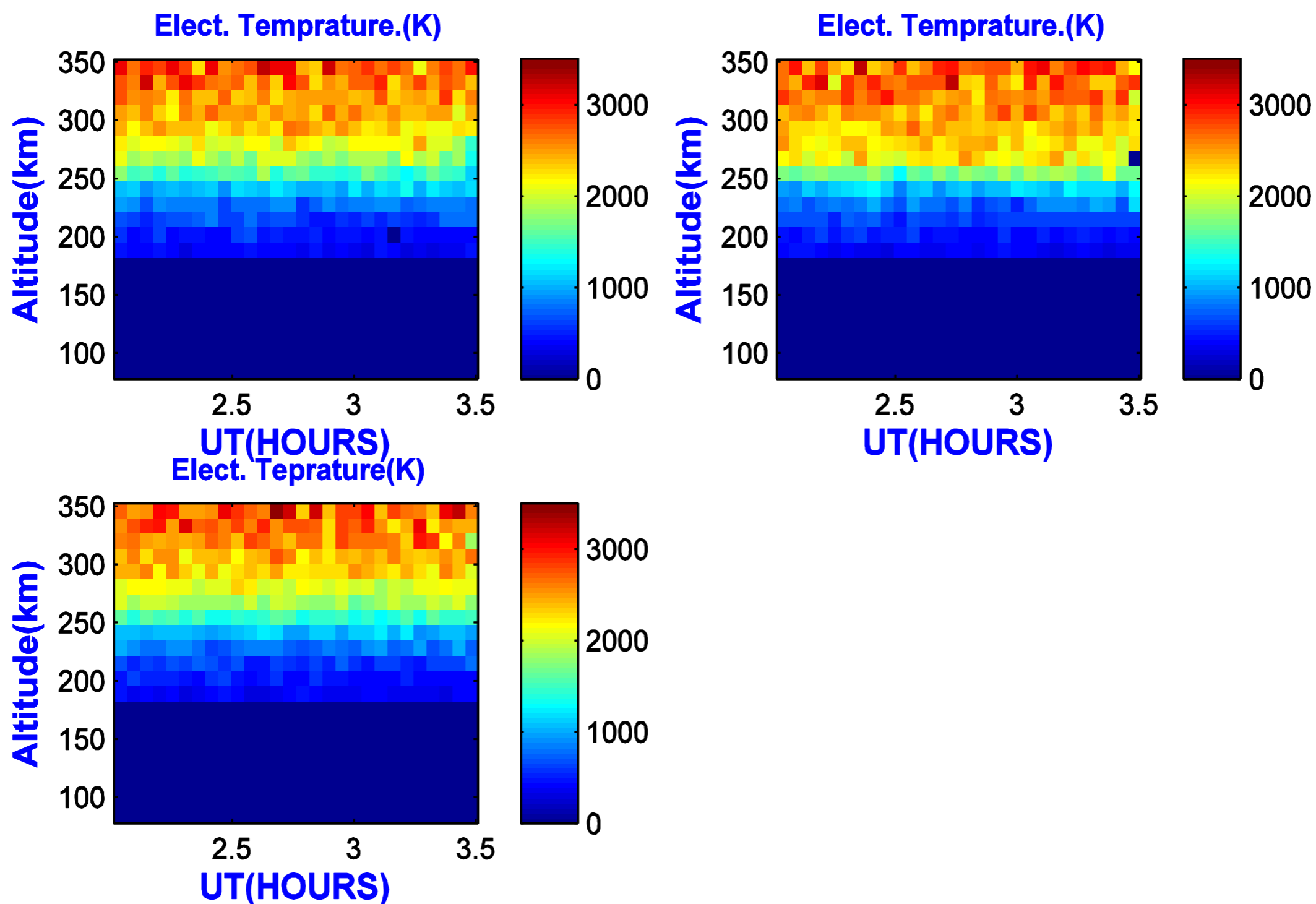
Long Pulse
Temperature



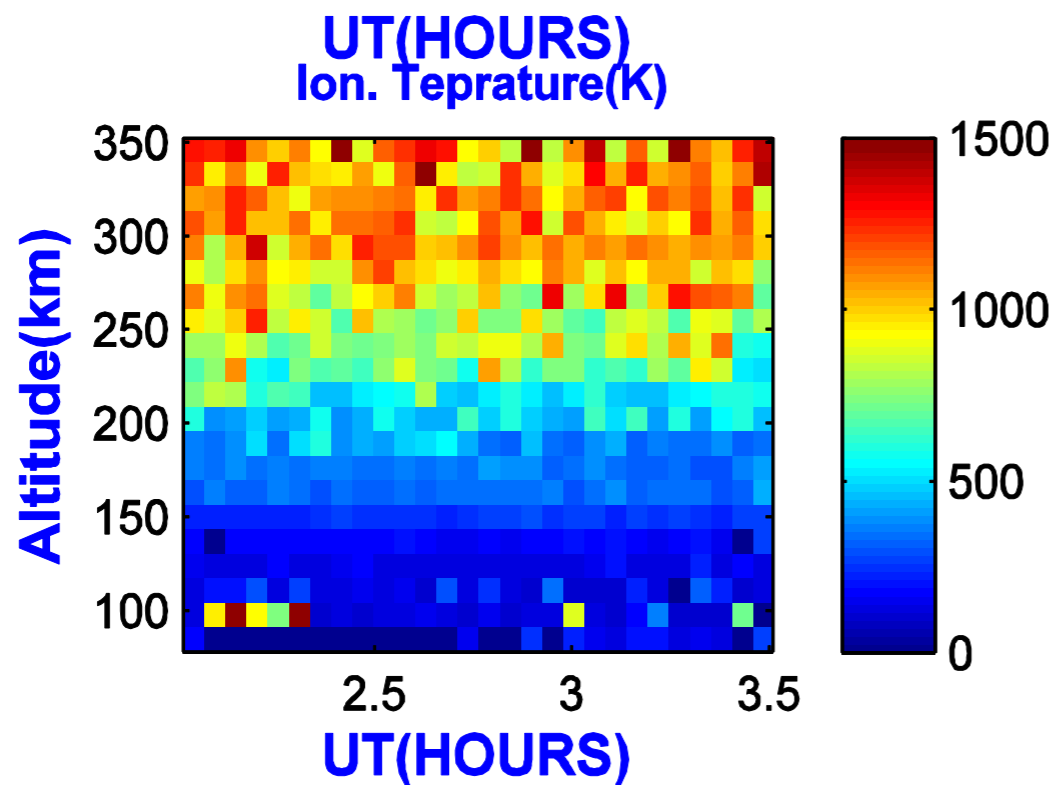
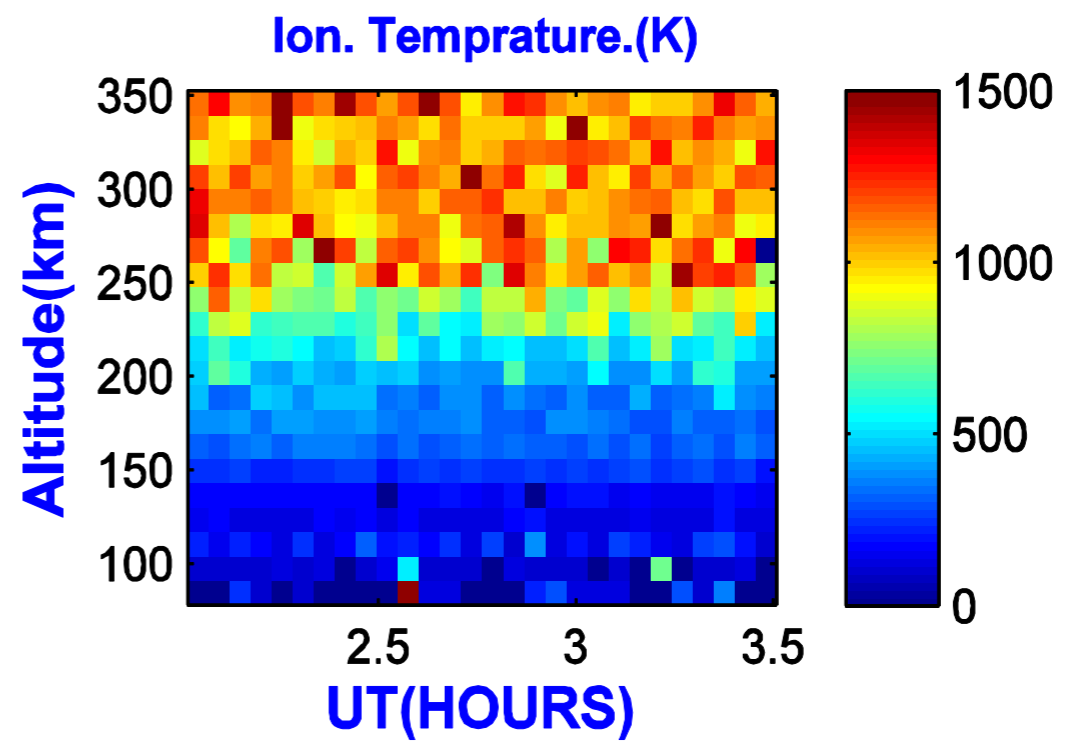
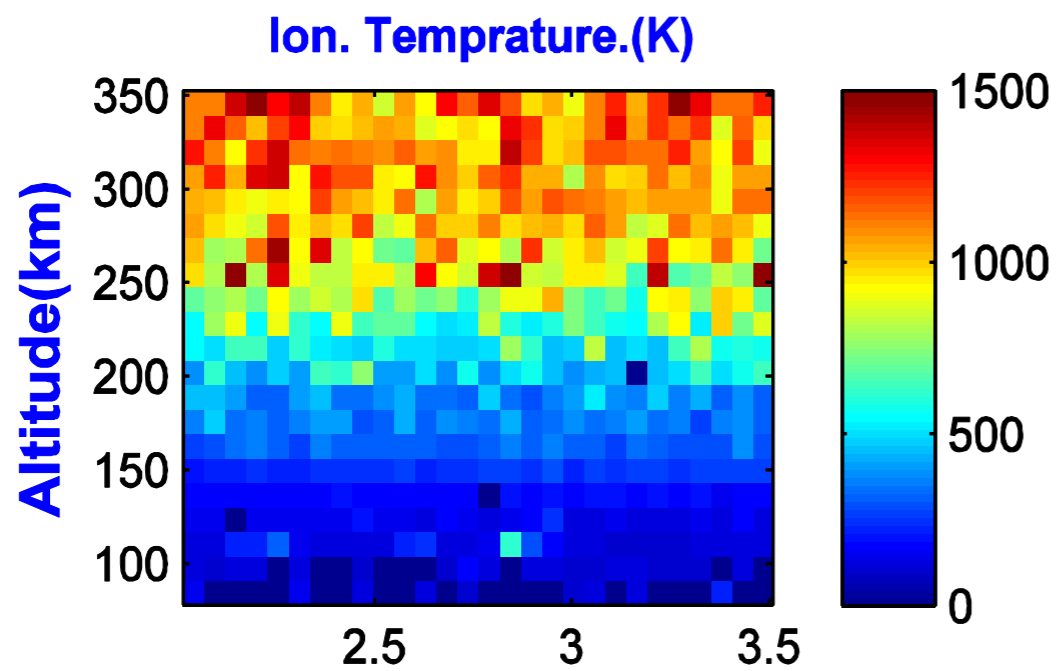
Electron Density



Electron Temperature

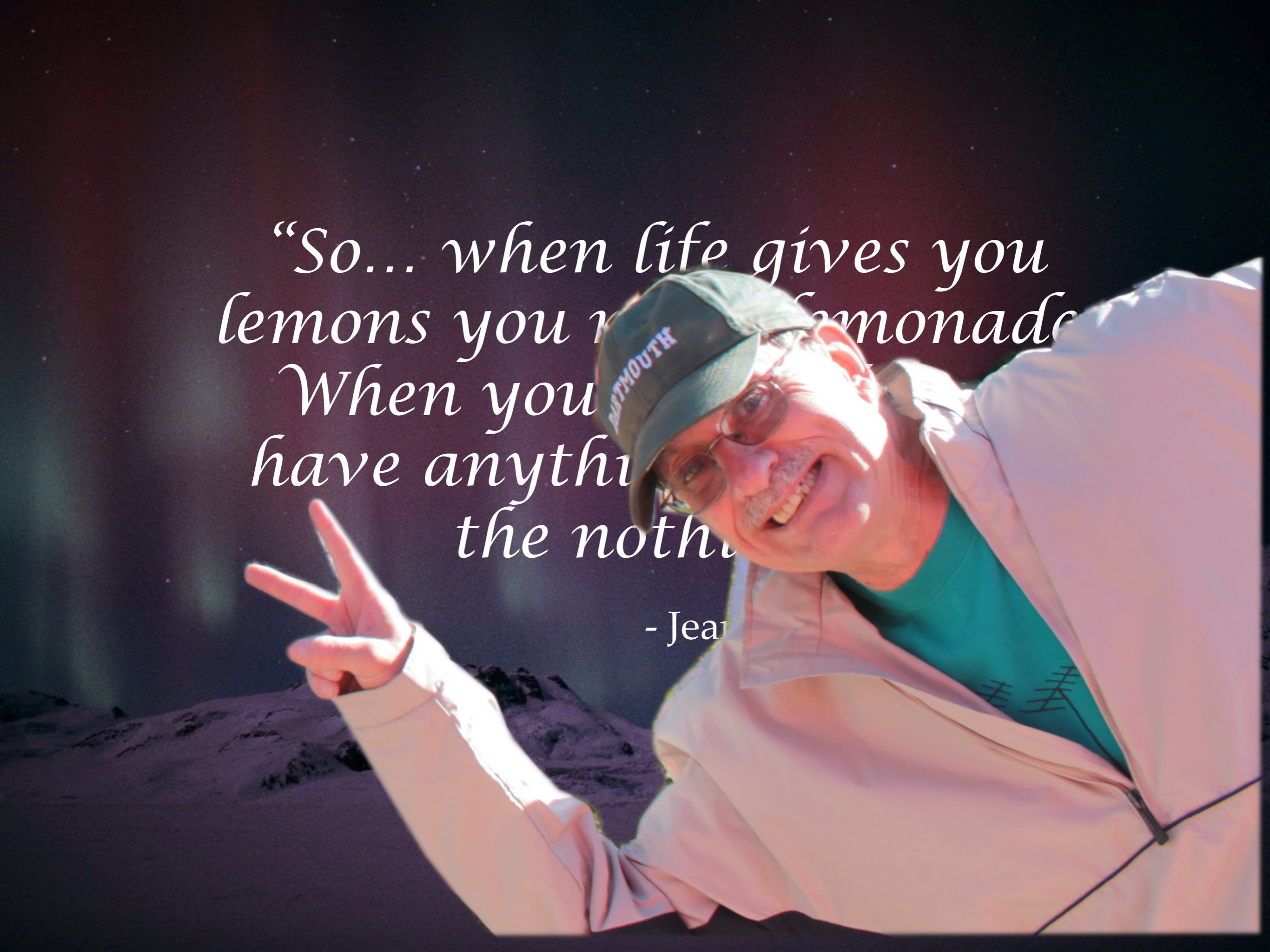


Ion Temperature

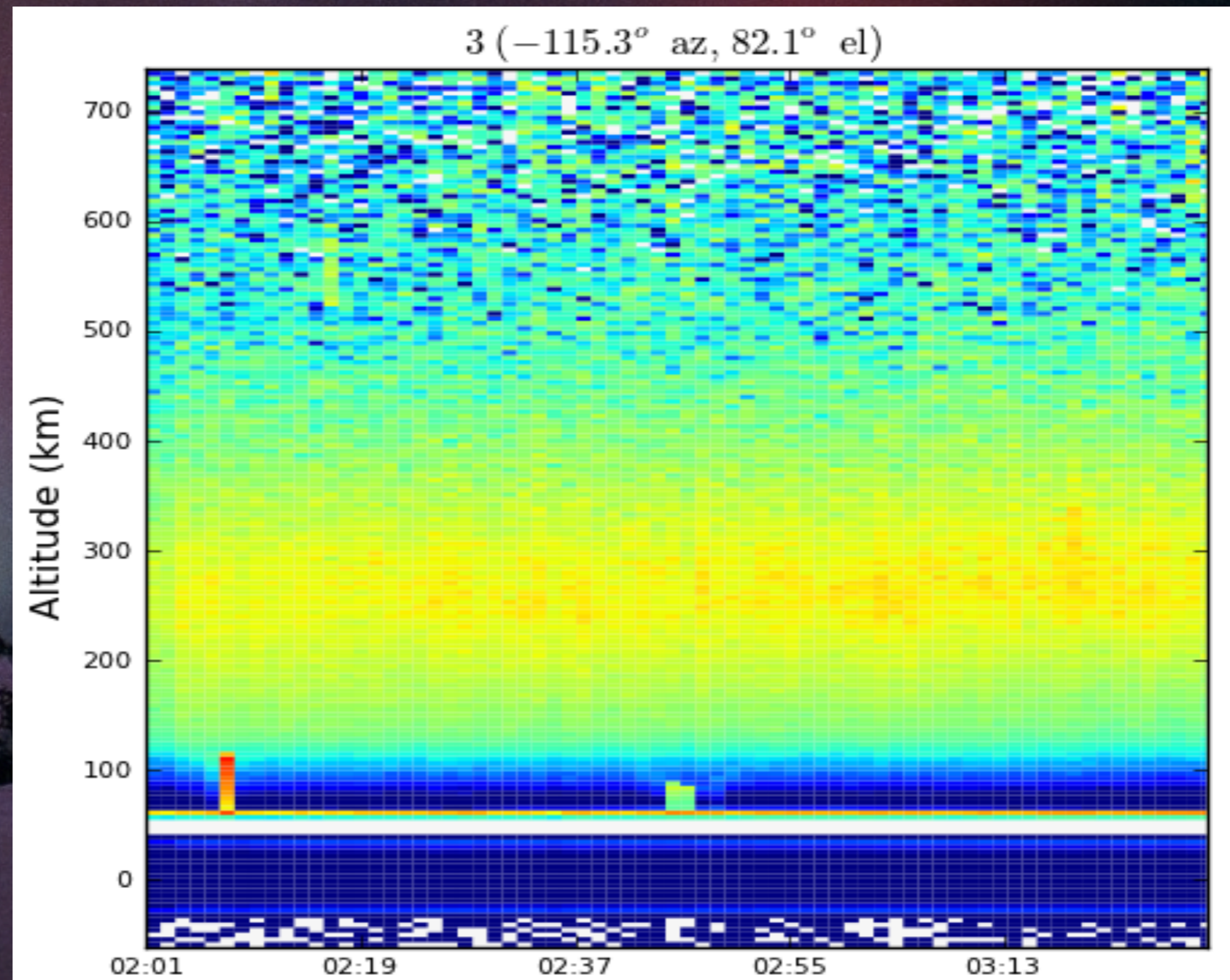
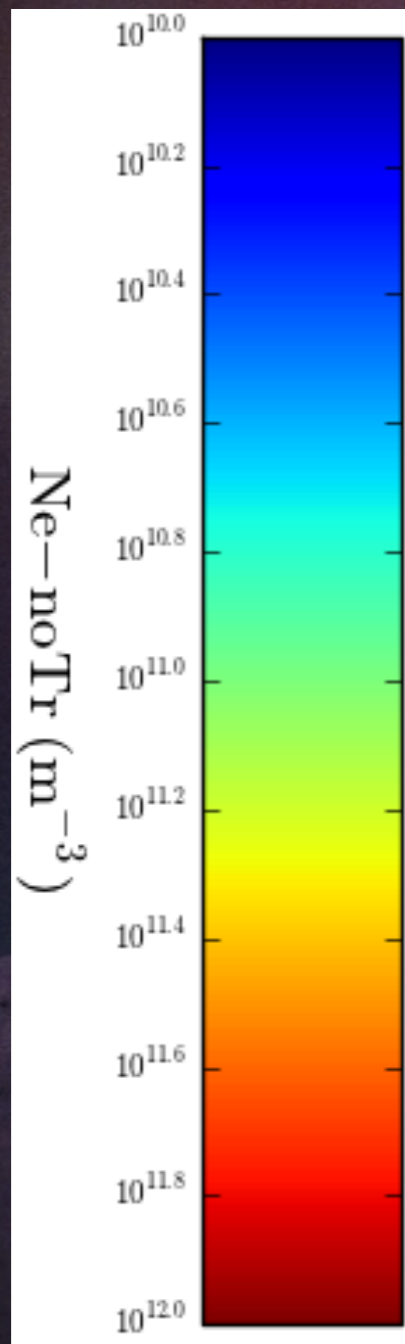


*“So... when life gives you
lemons you make lemonade.
When you
have anything
the nothing*

- Jean



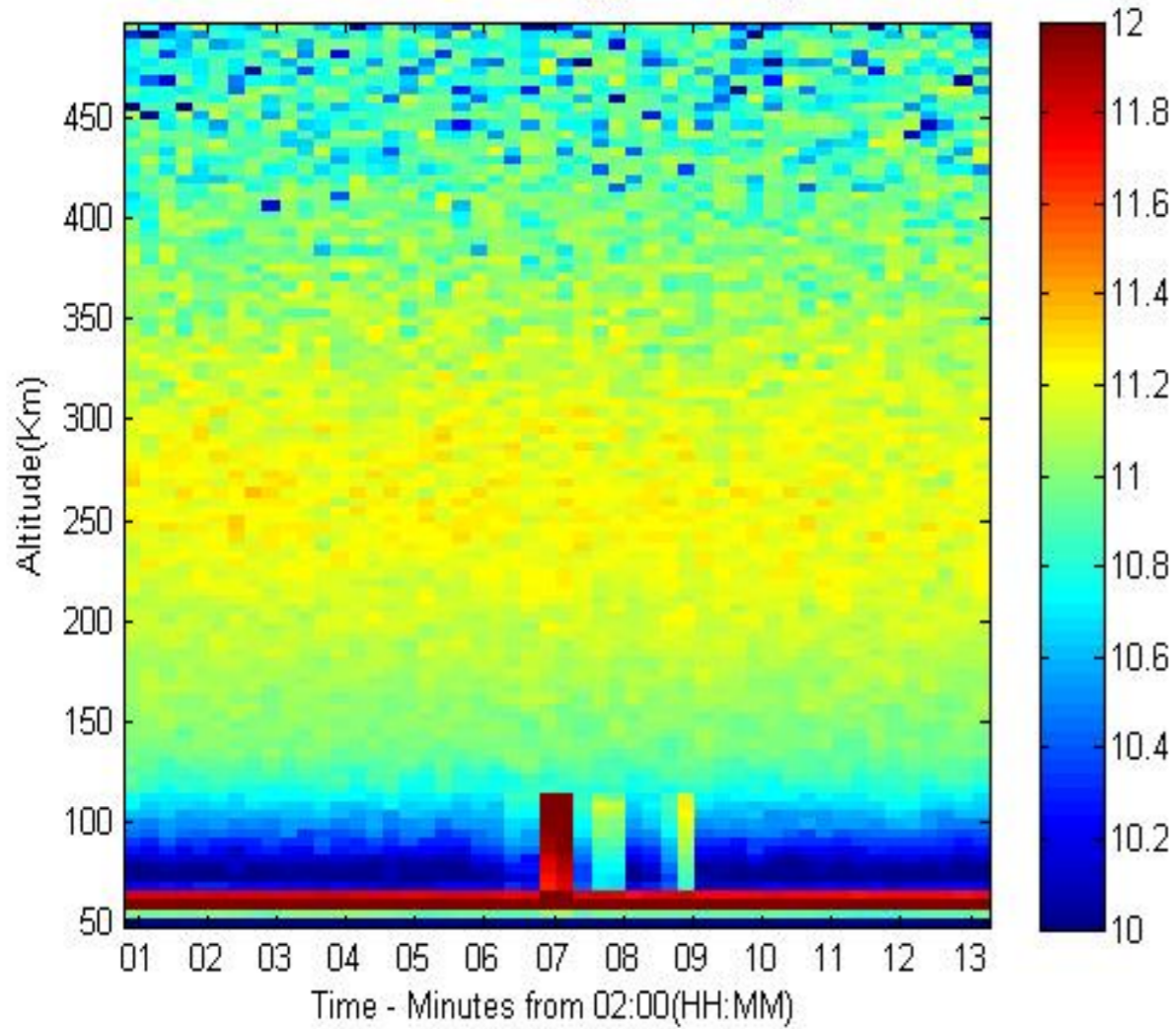
So...did we see anything in the “Nothing”?



Case 1:

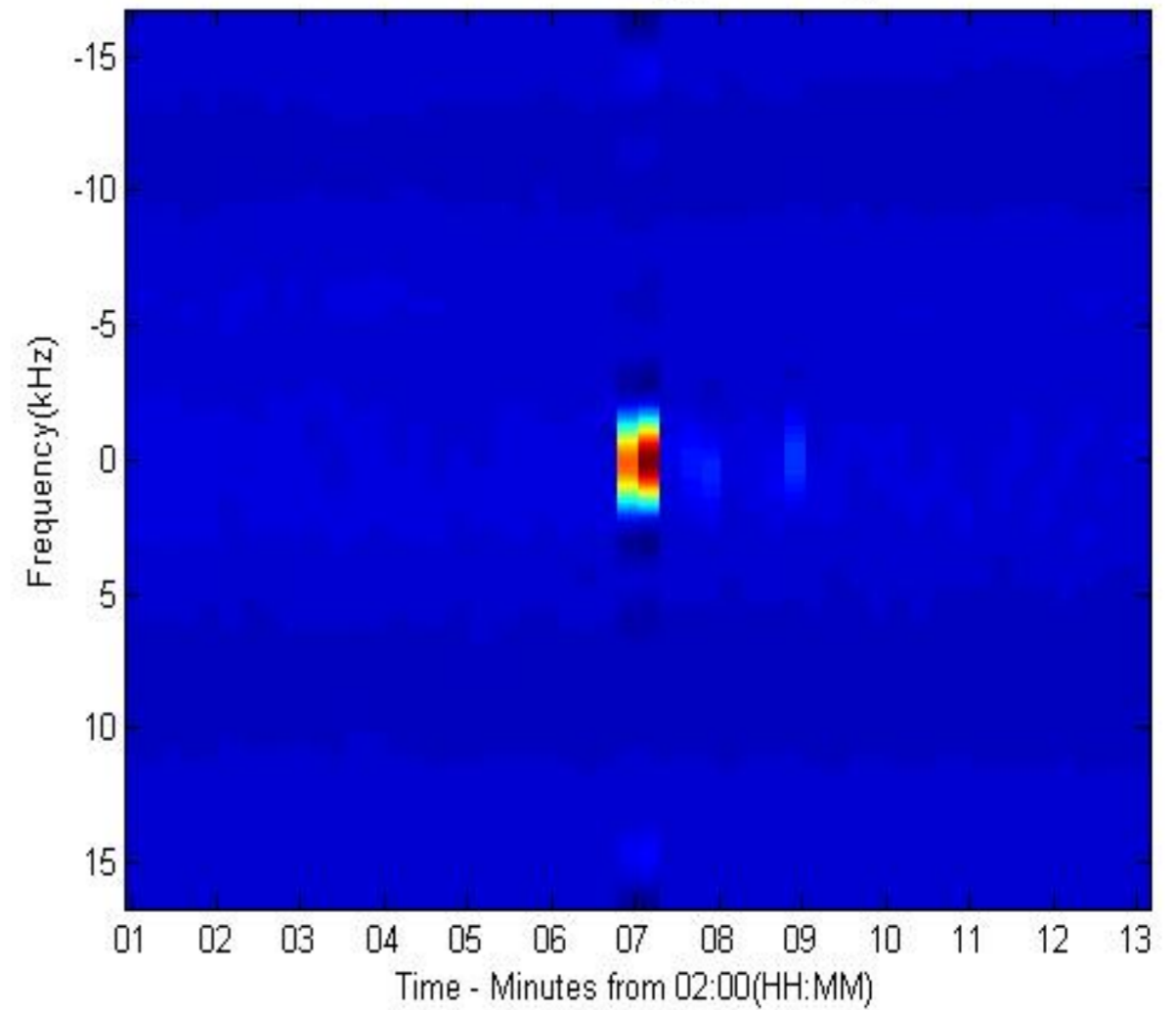
Raw Electron Density

Beam Direction [deg]: $\phi_{Az} = -8.31^\circ$, $\theta_{El} = 82.4^\circ$



Power Spectral Density

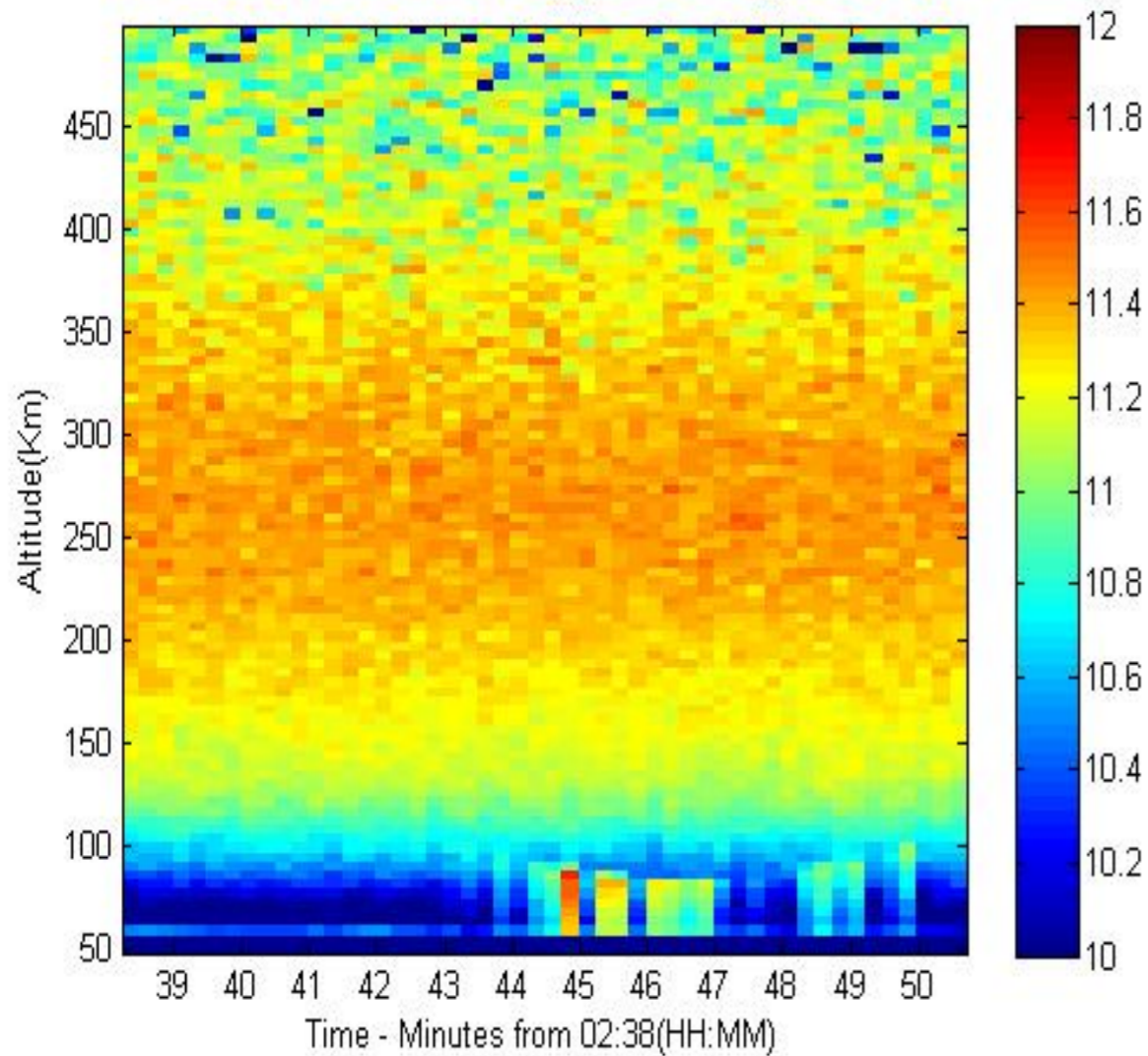
Beam Direction [deg]: $\phi_{Az} = -8.31^\circ$, $\theta_{El} = 82.4^\circ$



Case 2:

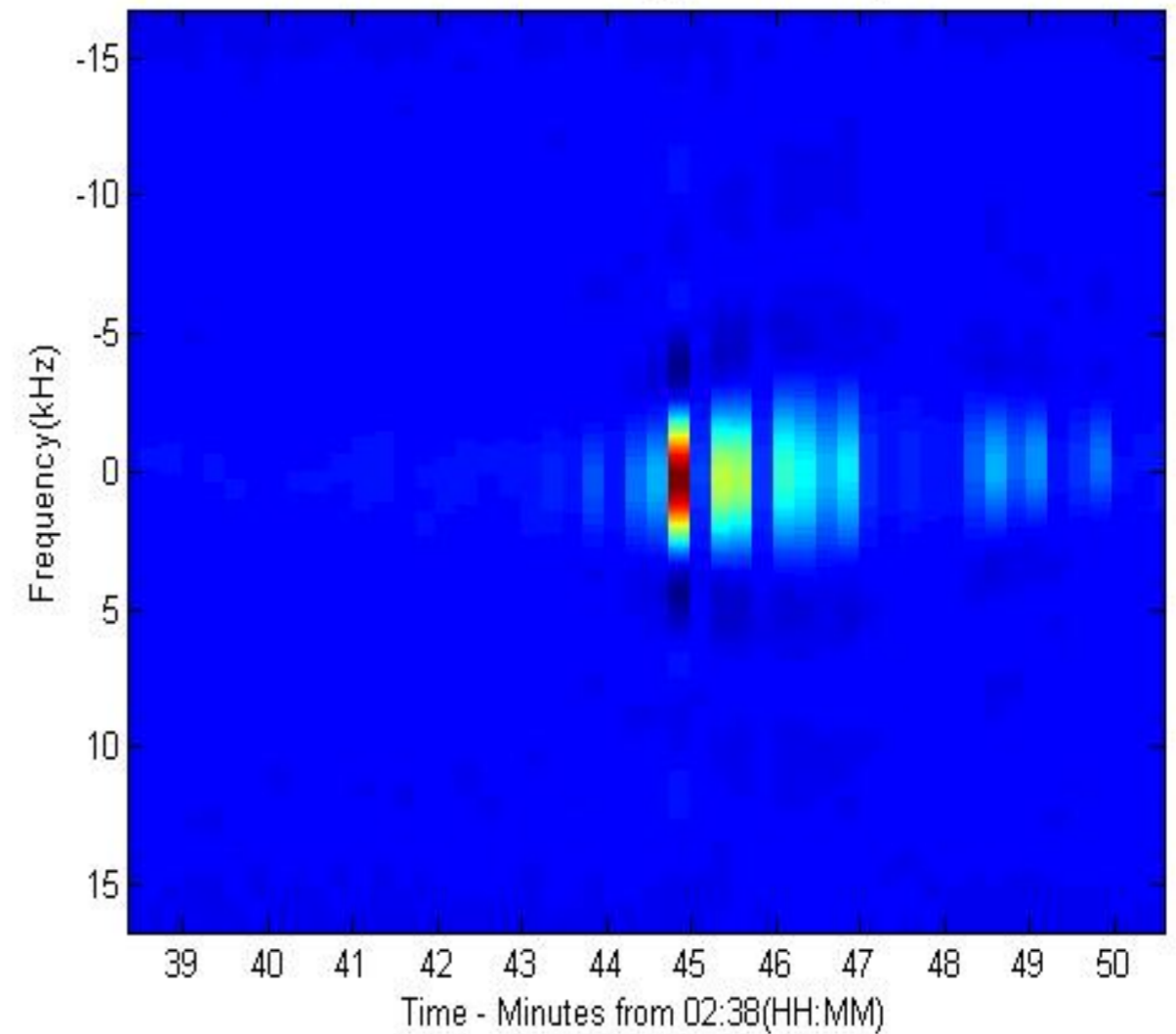
Raw Electron Density

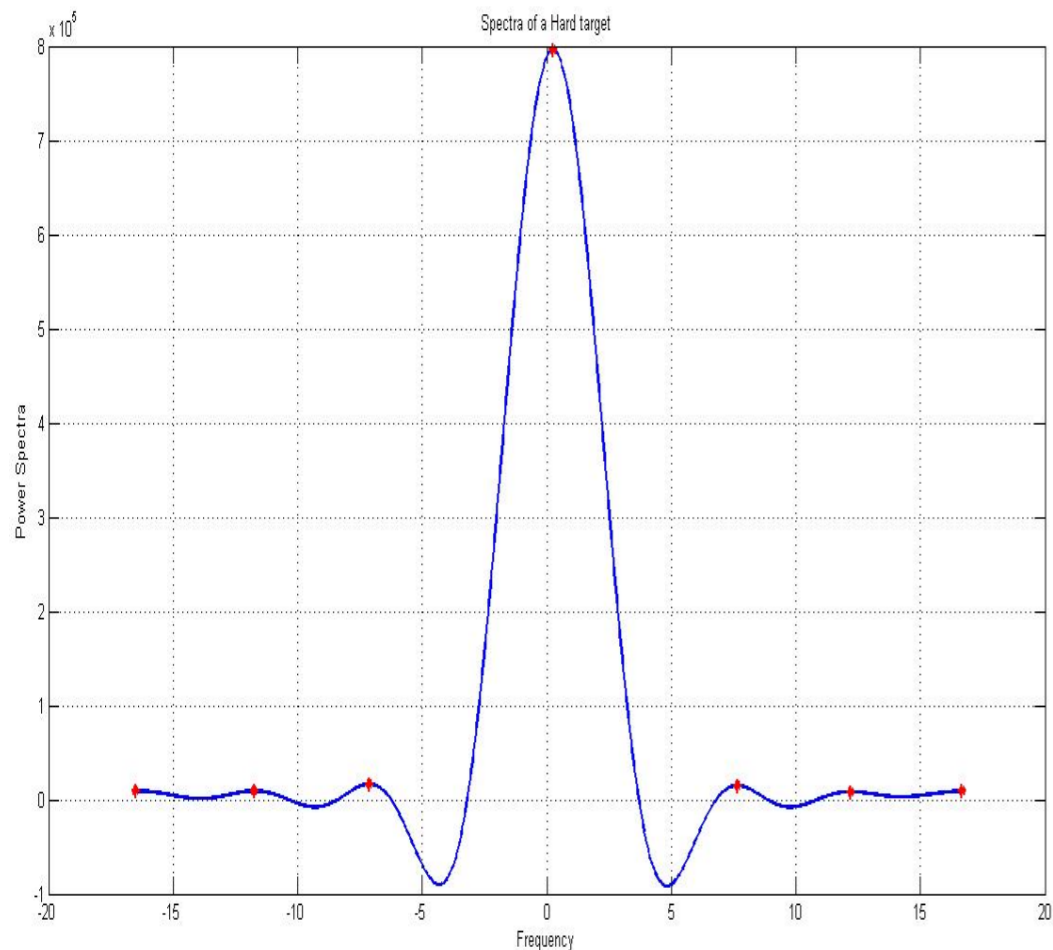
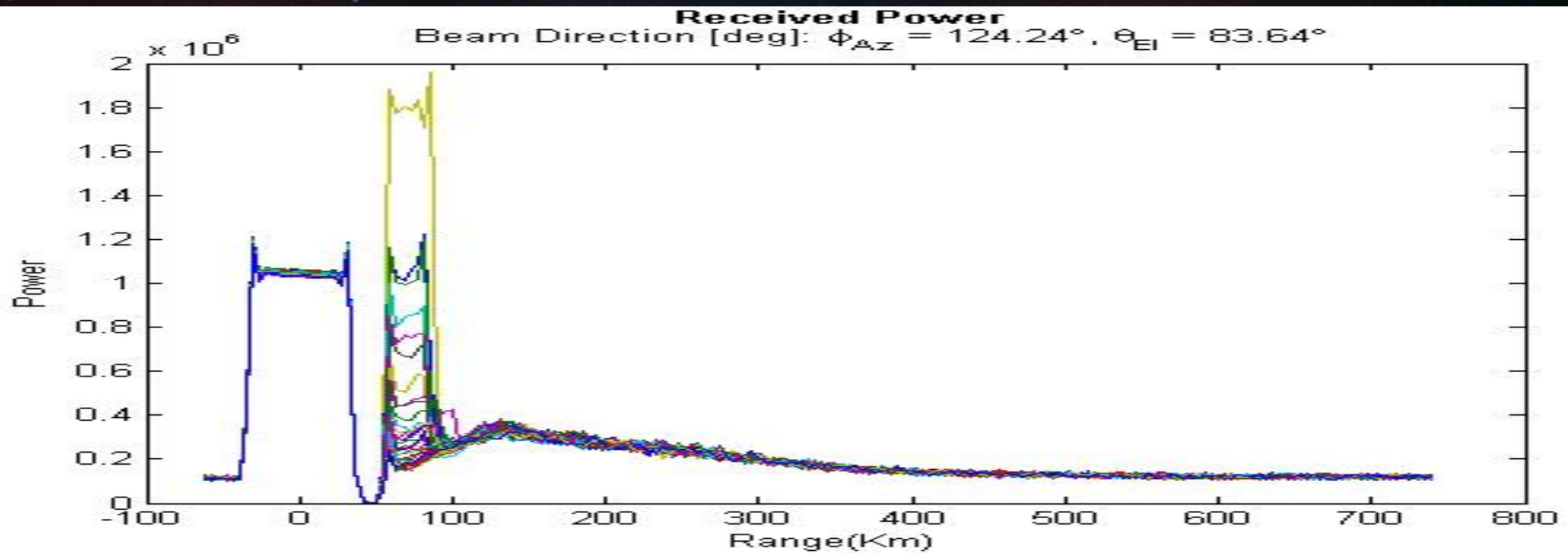
Beam Direction [deg]: $\phi_{Az} = 124.24^\circ$, $\theta_{El} = 83.64^\circ$



Power Spectral Density

Beam Direction [deg]: $\phi_{Az} = 124.24^\circ$, $\theta_{El} = 83.64^\circ$





Frequency Shift: 293 Hz
Doppler Velocity: 98 m/s

For all the cases the Doppler velocity (line of sight velocity) ranged from 20 m/s to 100 m/s

Conclusions?

Possible meteor?

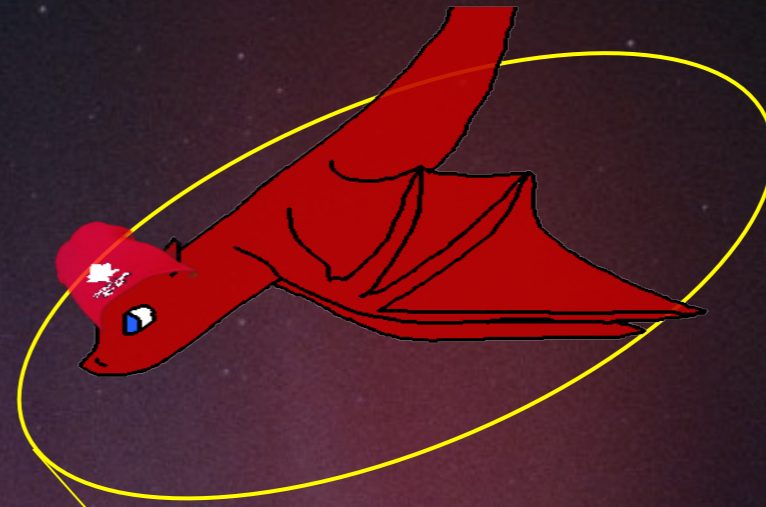
Possible Polar Mesospheric Summer
Echo?

It must be a...

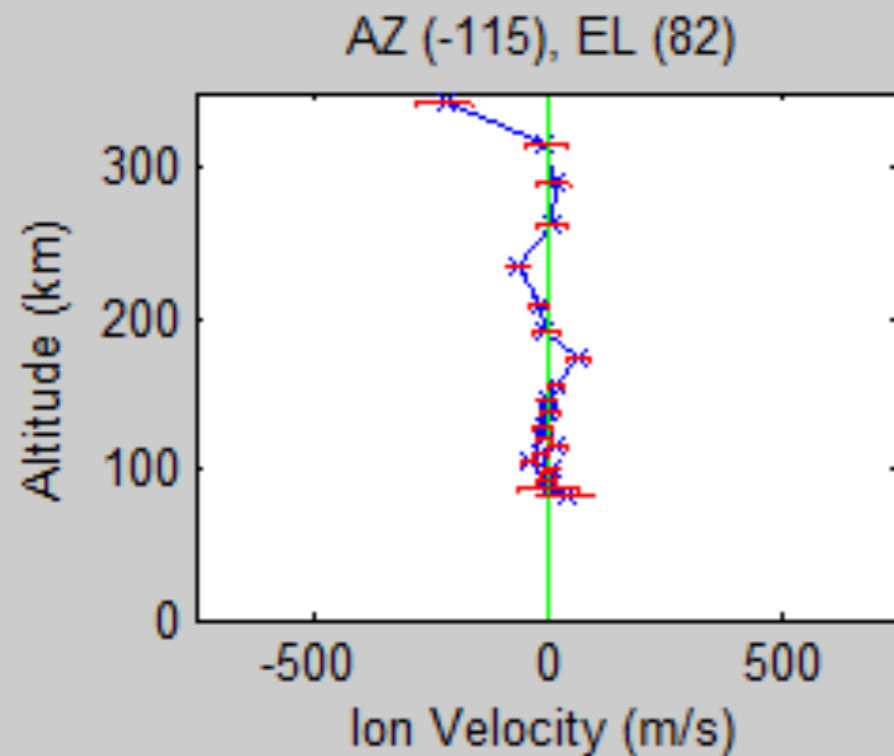
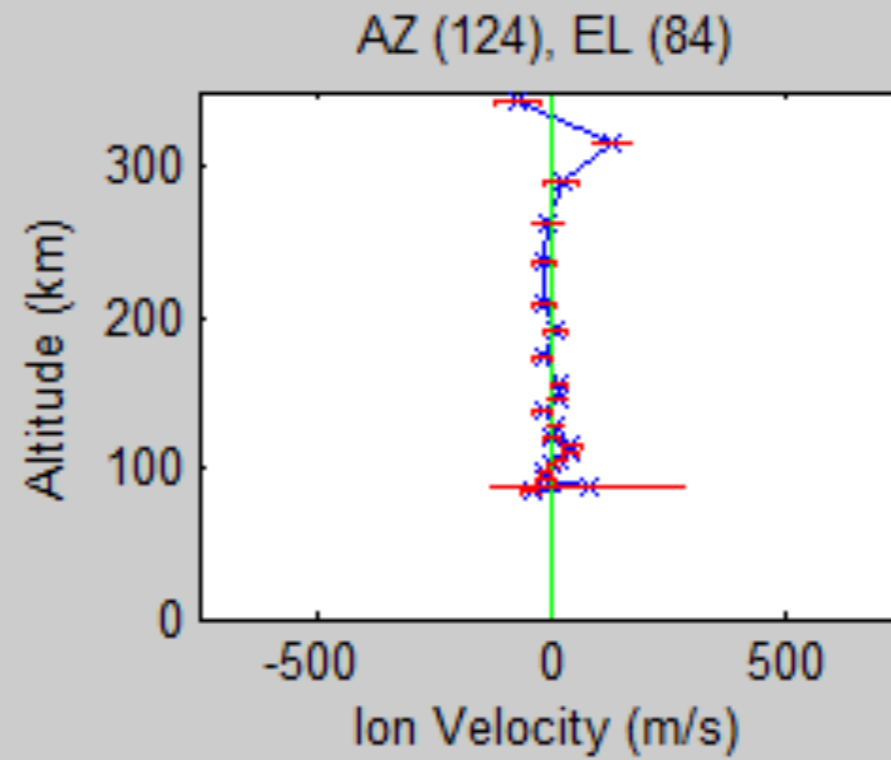
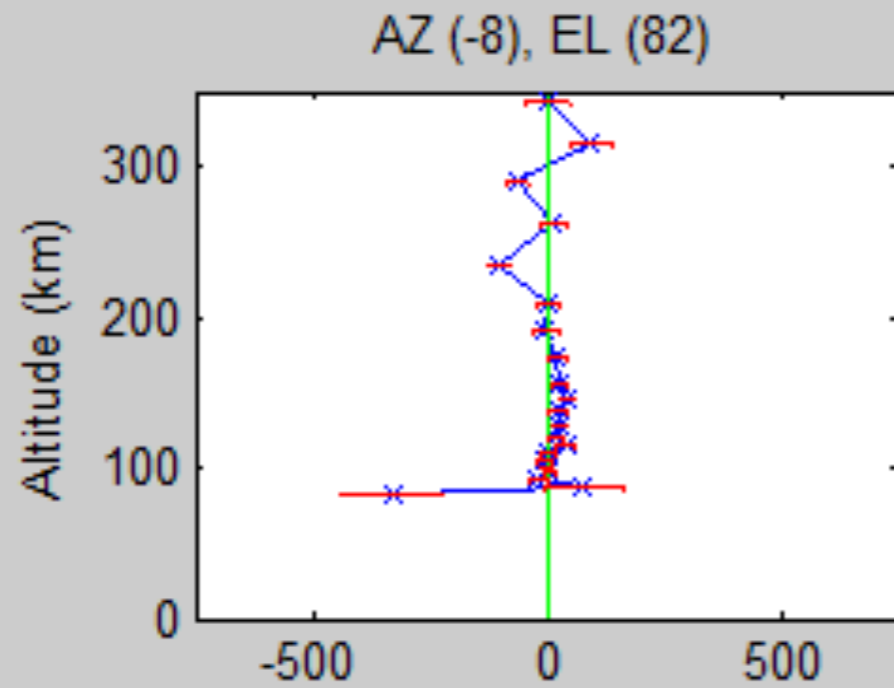
...Dragon!

Looks like a
hard target
to me!

Questions?

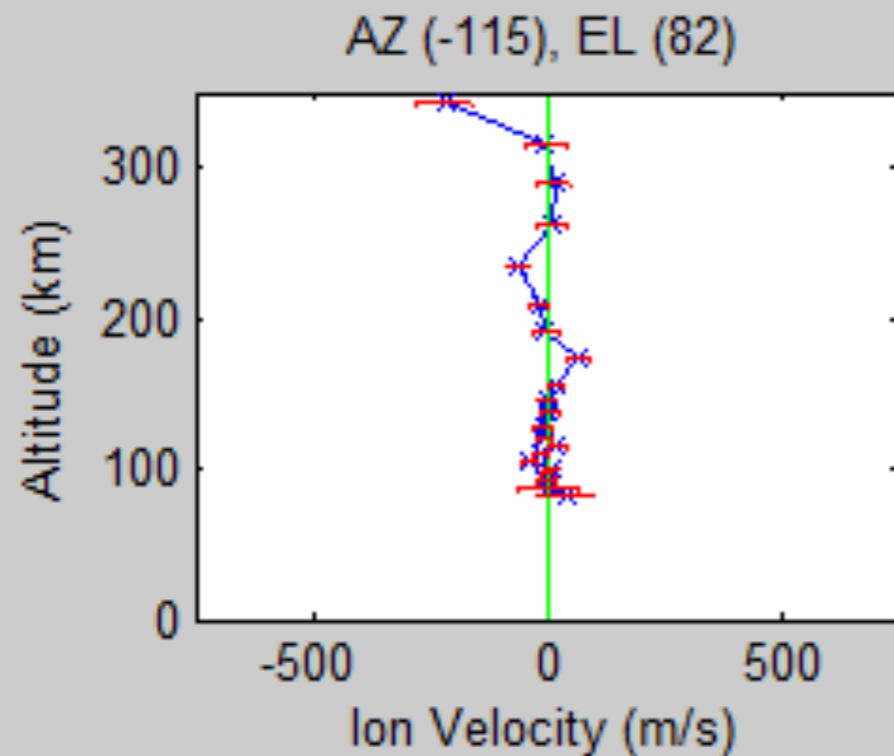
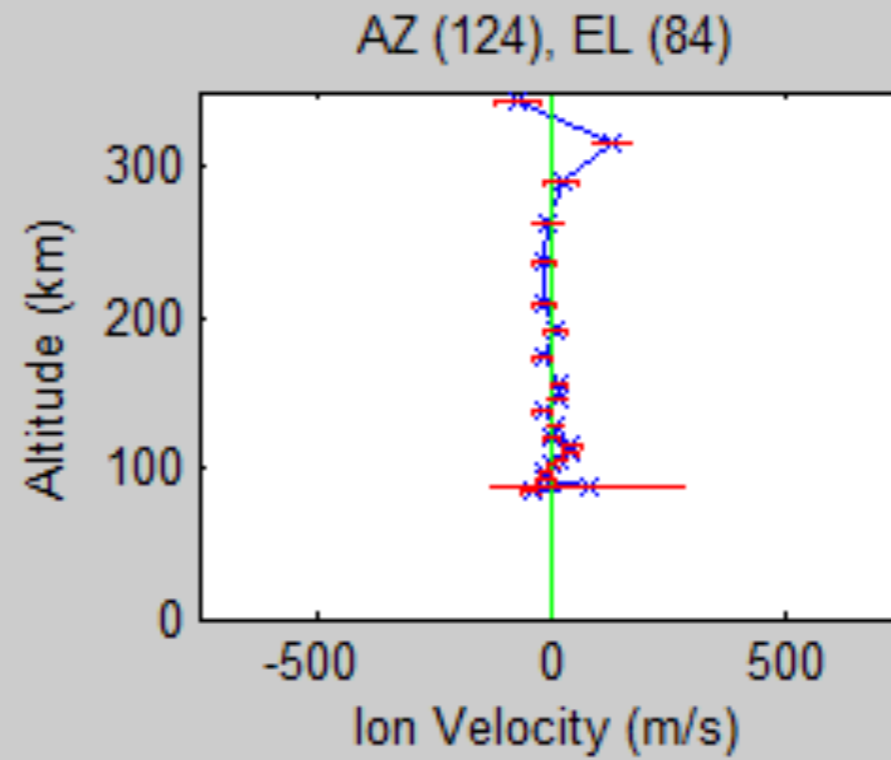
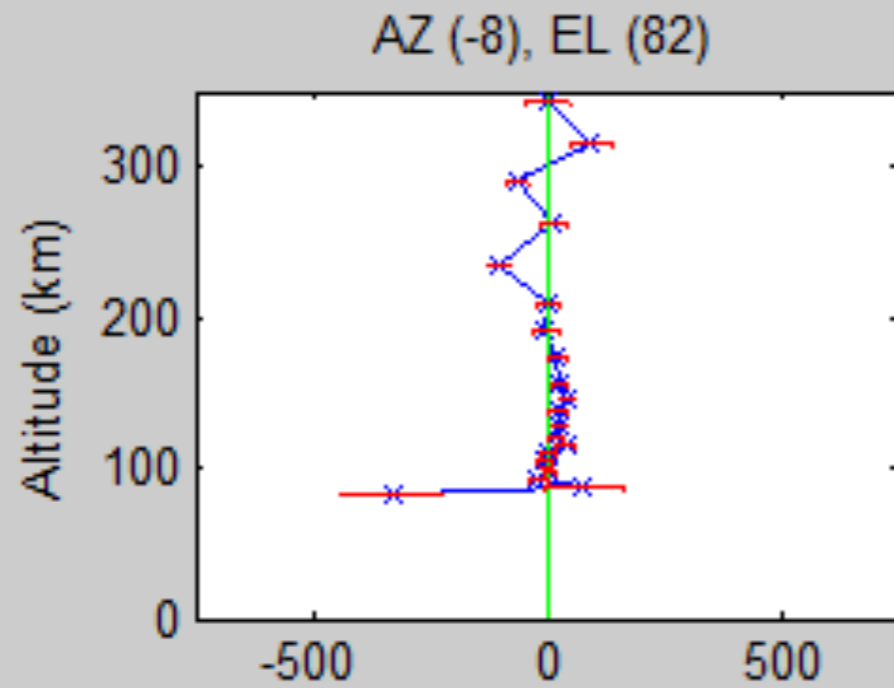


What did PFISR see?



Alternating Code
Ion Velocity

What did PFISR see?



Alternating Code
Ion Velocity