Recent Poker Flat FPI Measurements of the 732-nm O^+ Emission

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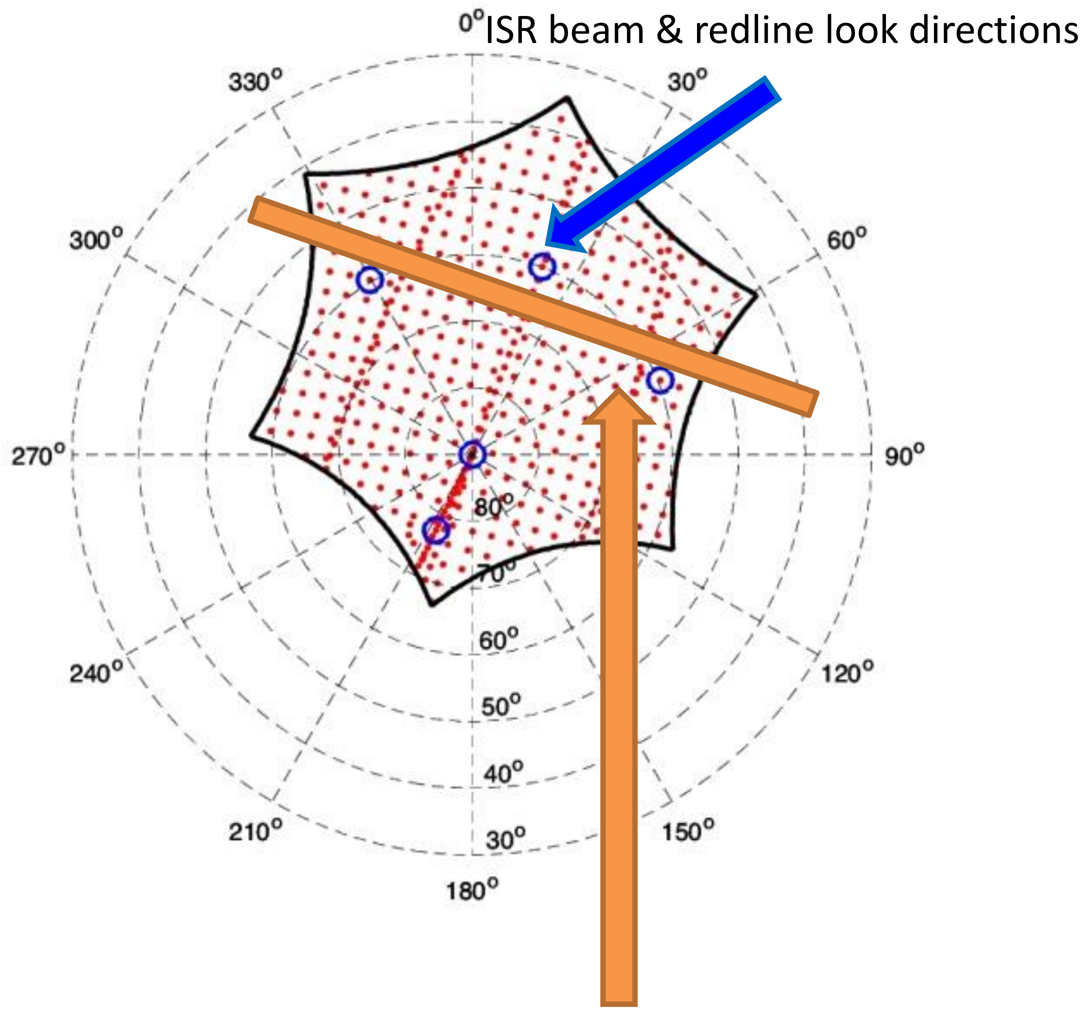
Outline

- Campaign overview
- O^+ production in polar thermosphere
- Measurements and results
- Questions

16-21 March 2015 Poker Flat FPI/ISR Campaign:

- Install the 732-nm filter, a six position filter wheel, implement a new observing strategy, pray for O^+, and collect good data.
- Compare results with PFISR measurements, redline measurements from PKZ, EAA, FYU
- Examine the ion frictional heating connection to thermospheric upwelling



Additional 732nm observations to obtain more horizontal coverage of the plasma flow

O^+ twilight and dayglow emission is generated by photo-ionization of O,

i.e., O + EUV -> $O^+(^2P)$

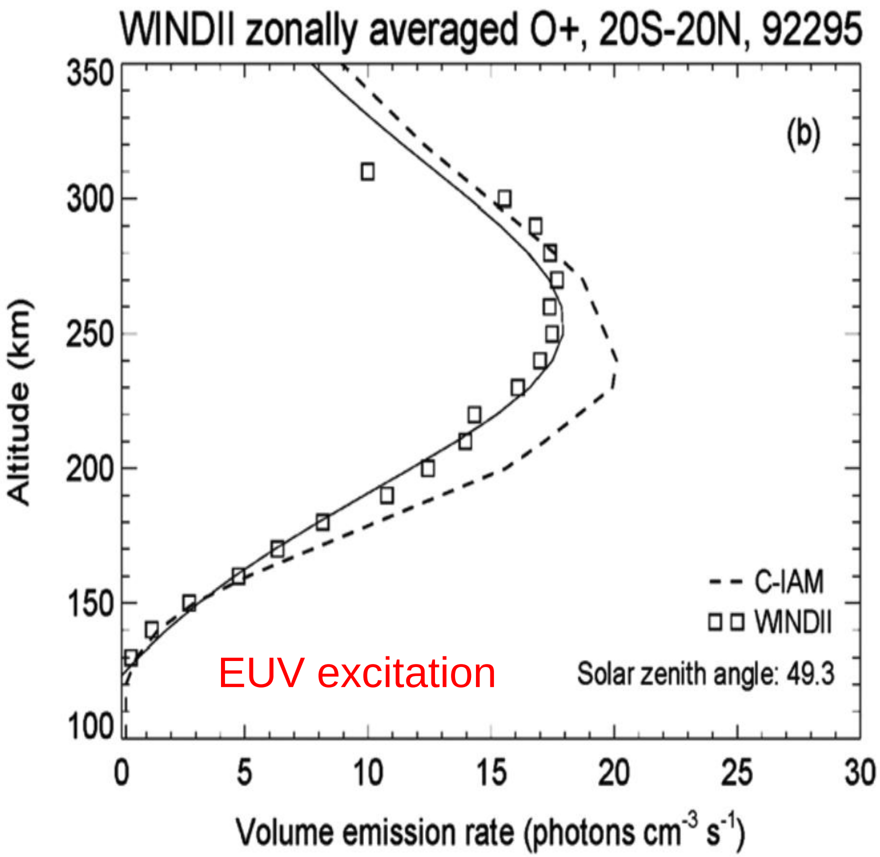
Quenching by N_2 and radiation are the only significant loss mechanisms,

$O^+(^2P)$ -> $O^+(^2D)$ + 732,733 nm photons

- Observations of O^+ Doppler shifts are indicative of plasma ion dynamics because the ion produced immediately follows the ExB drift of its gyrocenter.

Table 1: Spectroscopic data for the two O^+ doublet emissions and adjacent OH emissions (from *Sharpie et al.* [2004]). *The normalized intensity is relative to the sum of all multiple line intensities.

Emission feature	□□□□-□□□□□□□ (nm)	Normalized intensity*
$O^+(^2P_{1/2}$-$^2D_{5/2})$	731.9044	0.14±0.05
$O^+(^2P_{1/2}$-$^2D_{3/2})$	732.0121	0.43±0.03
$O^+(^2P_{3/2}$-$^2D_{5/2})$	732.9675	0.20±0.04
$O^+(^2P_{3/2}$-$^2D_{3/2})$	733.0755	0.23±0.03
$OH(P_{12}(1.5)$	731.621	
$OH(P_{22}(2.5)$	732.915	



From *Shepherd et al*.[2014]

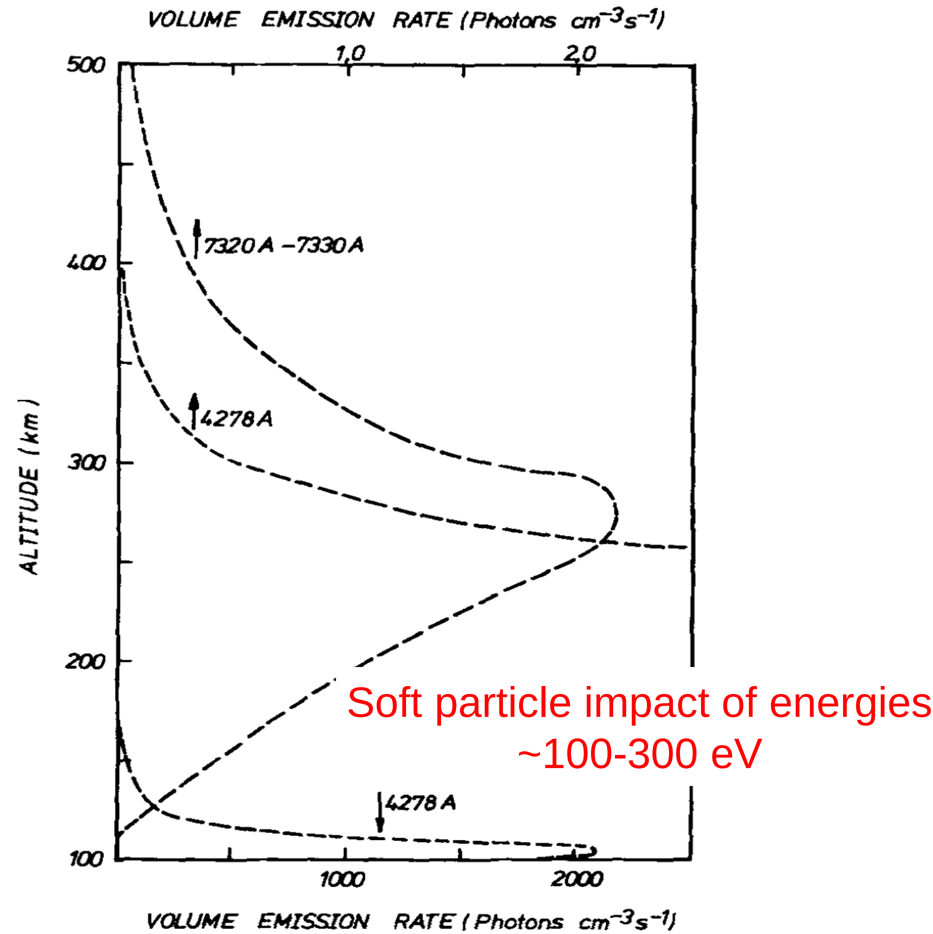
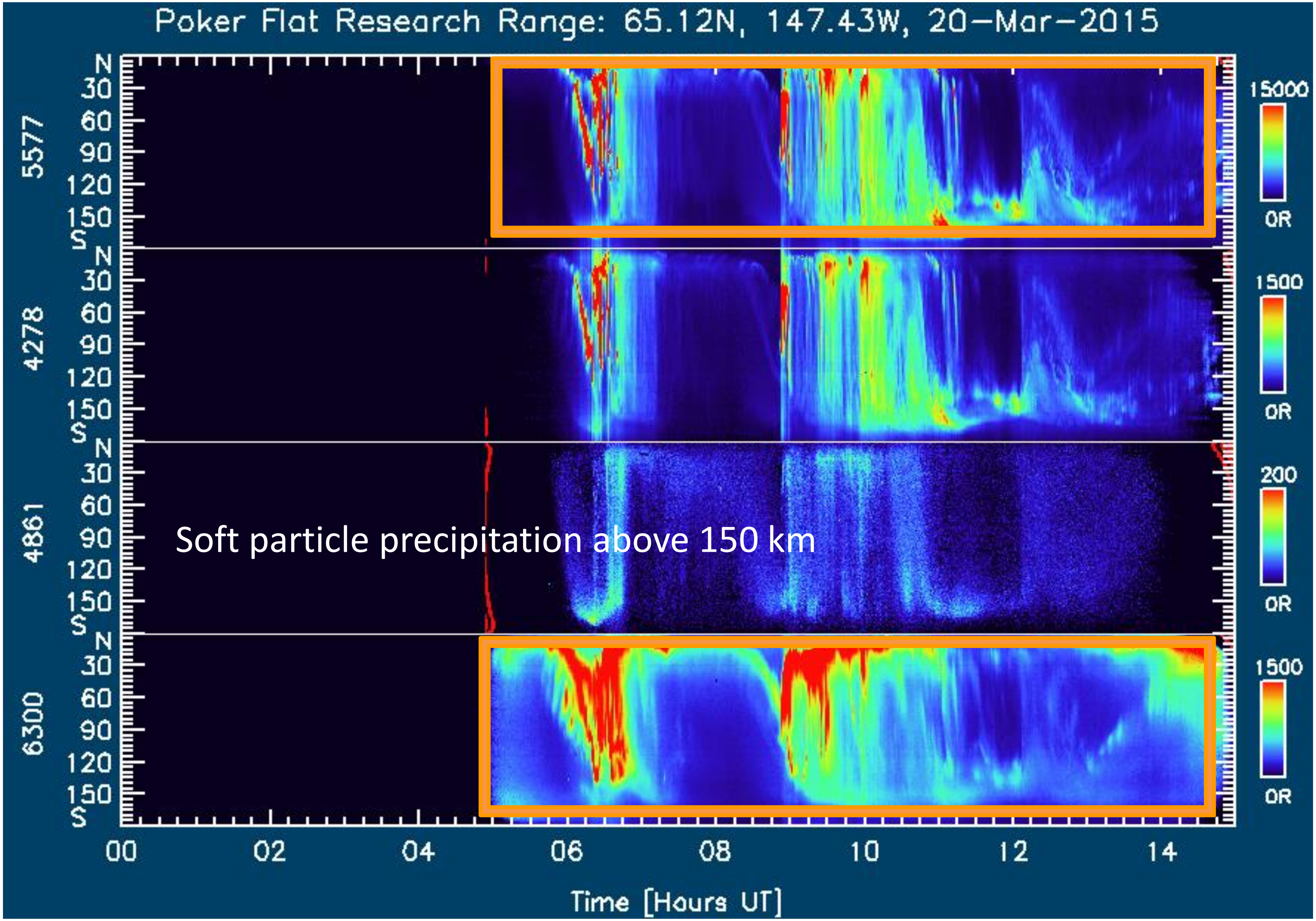


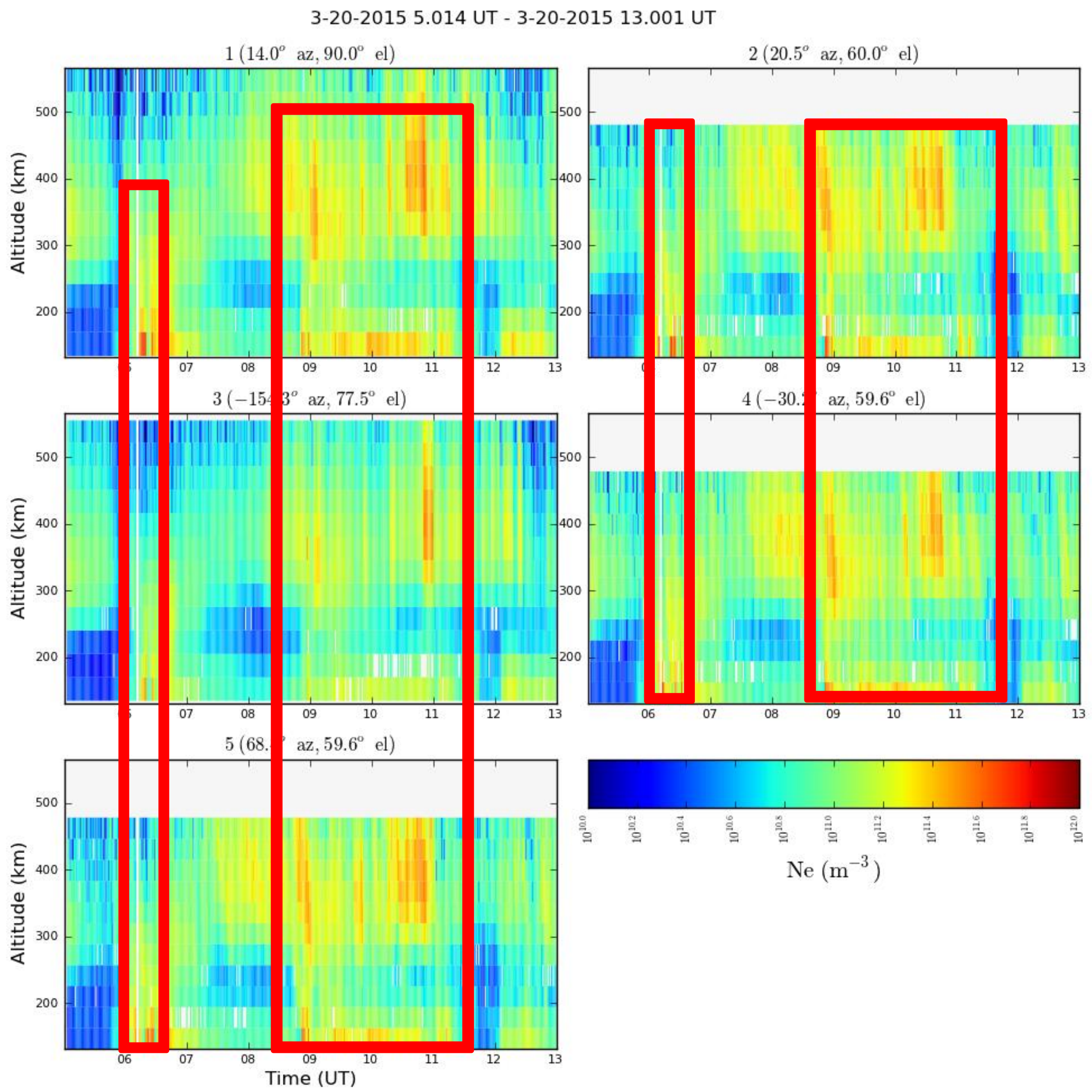
Figure 1. Volume emission profile of 732.0-nm emission in aurora (from *Cogger et al*.[1987]).

WINDI and DE measurements of 732-nm volume emission profiles in dayglow and aurora

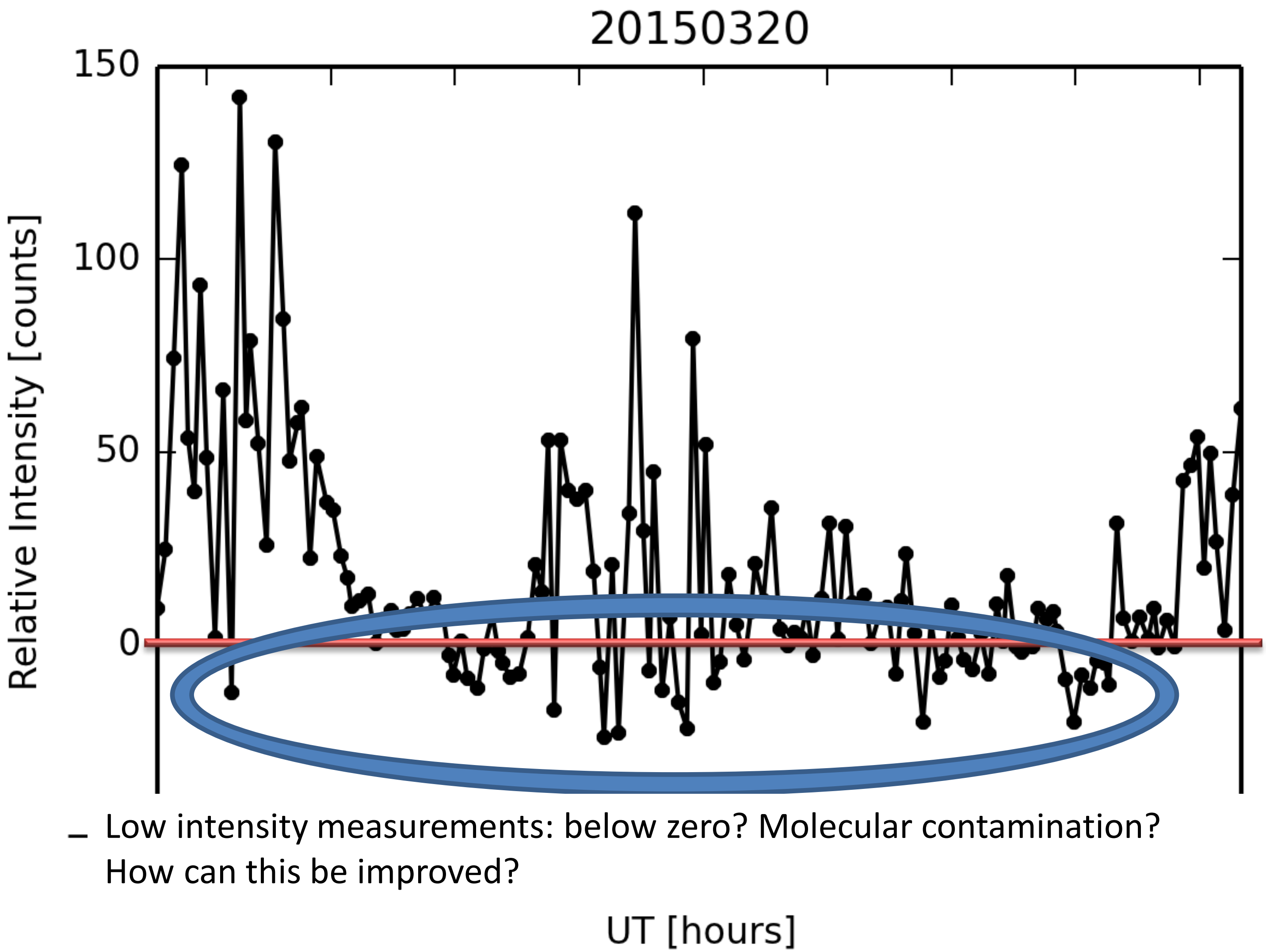


Poker Flat Research Range: 65.12N, 147.43W, 20-Mar-2015
5577
4278
4861
6300
N
30
60
90
120
150
S
15000
1500
200
1500
0R
Soft particle precipitation above 150 km
00
02
04
06
08
10
12
14
Time [Hours UT]

Electron density from PFISR



Intensity calculation for O^+ emission



- Low intensity measurements: below zero? Molecular contamination? How can this be improved?

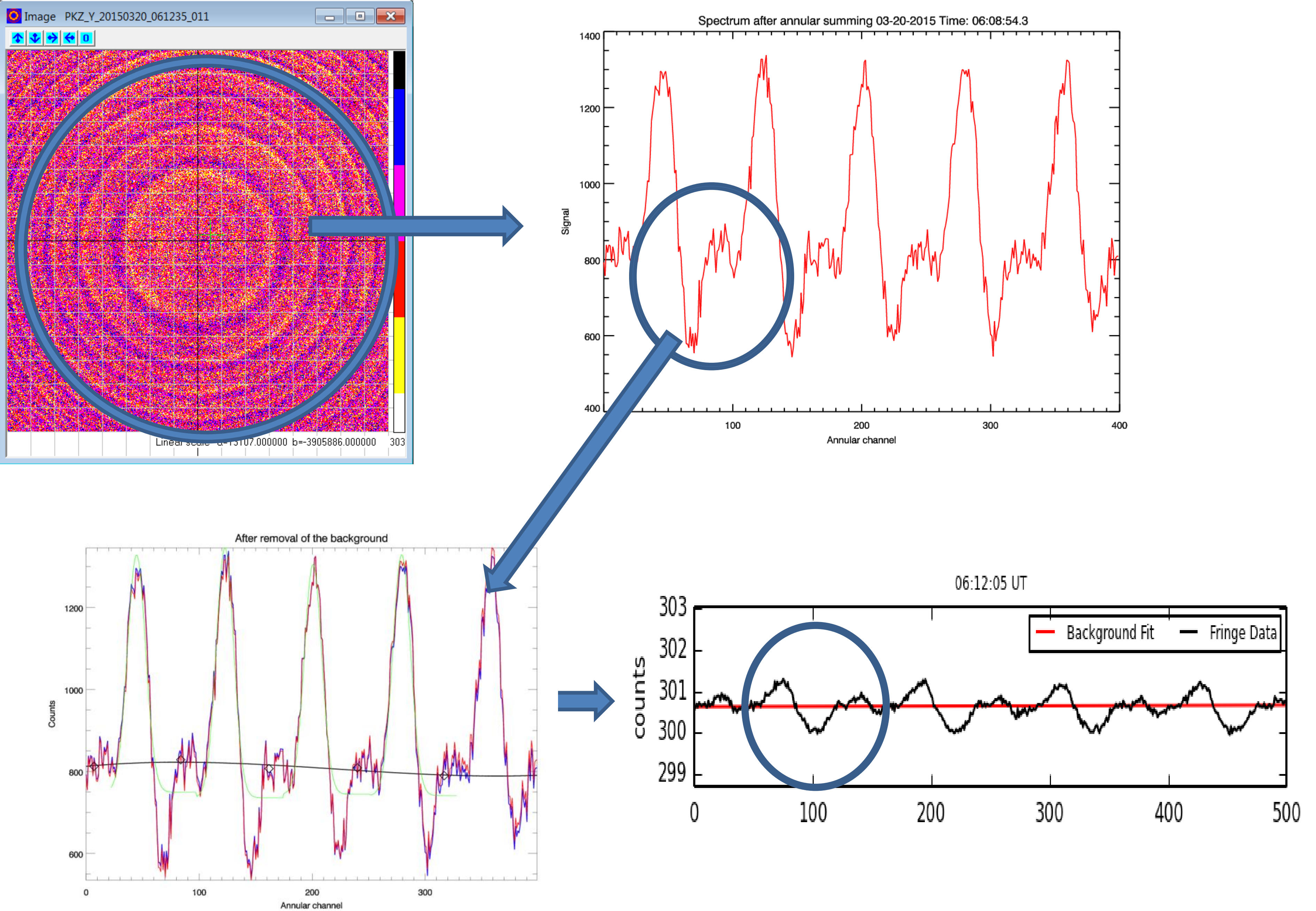
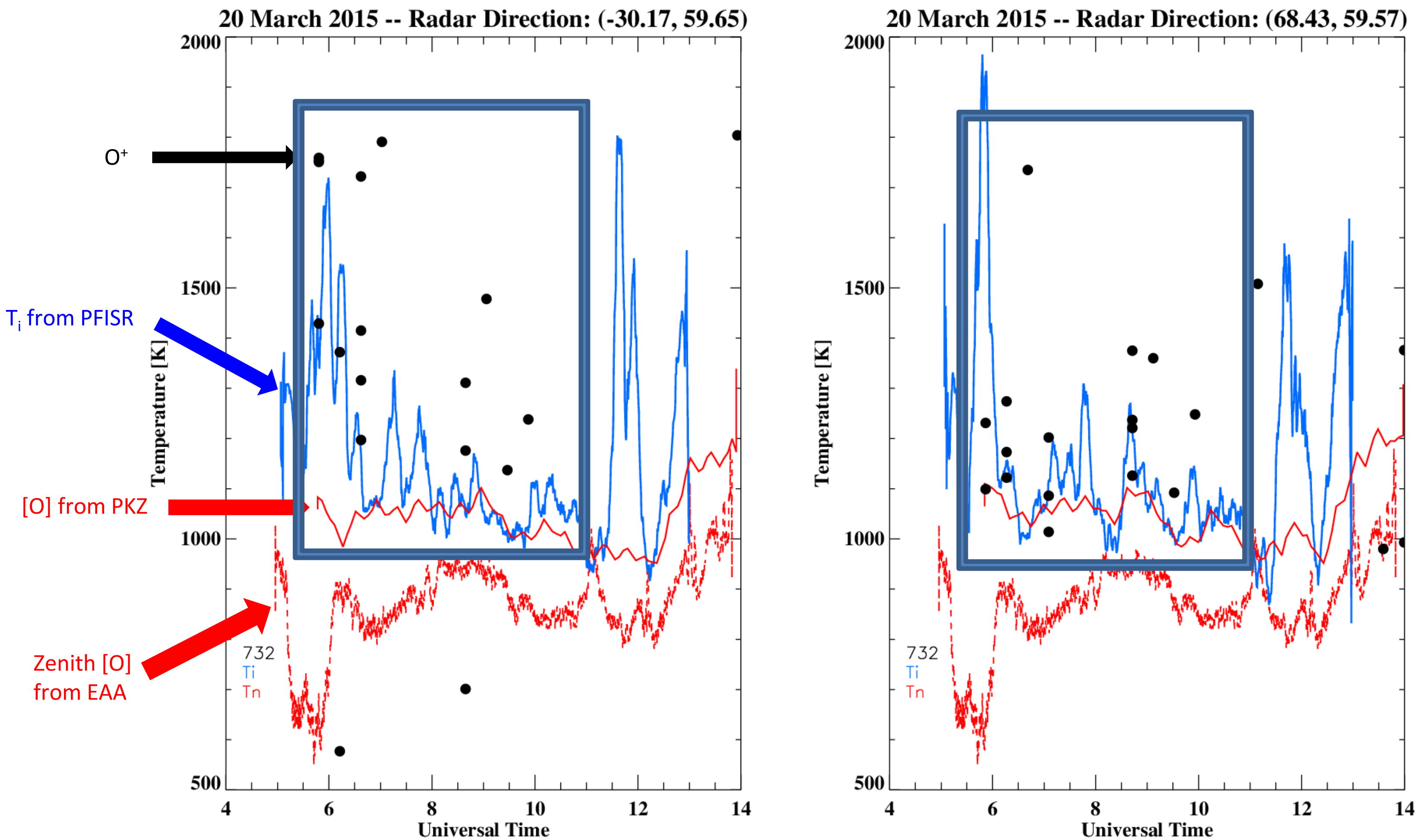


Image PKZ_Y_20150320_061235_011
b=-3905886.000000
303
Spectrum after annular summing 03-20-2015 Time: 06:08:54.3
Signal
1400
1200
1000
800
600
400
100
200
300
400
Annular channel
After removal of the background
Counts
1200
1000
800
600
0
100
200
300
Annular channel
06:12:05 UT
counts
303
302
301
300
299
0
100
200
300
400
500
Background Fit
Fringe Data

Results



20 March 2015 -- Radar Direction: (-30.17, 59.65)
20 March 2015 -- Radar Direction: (68.43, 59.57)
O+
Ti from PFISR
[O] from PKZ
Zenith [O] from EAA
Temperature [K]
Universal Time
2000
1500
1000
500
4
6
8
10
12
14
732
Ti
Tn

Questions

- How to improve observations?
  - Bigger aperture, narrower pass-band filter
- How to handle contamination?
- How to resolve plasma flow for 732nm emission?
- Can ground-based FPI measurements provide reliable plasma parameters?