Partitioning of high-latitude energy input: Polar cap vs. auroral zone

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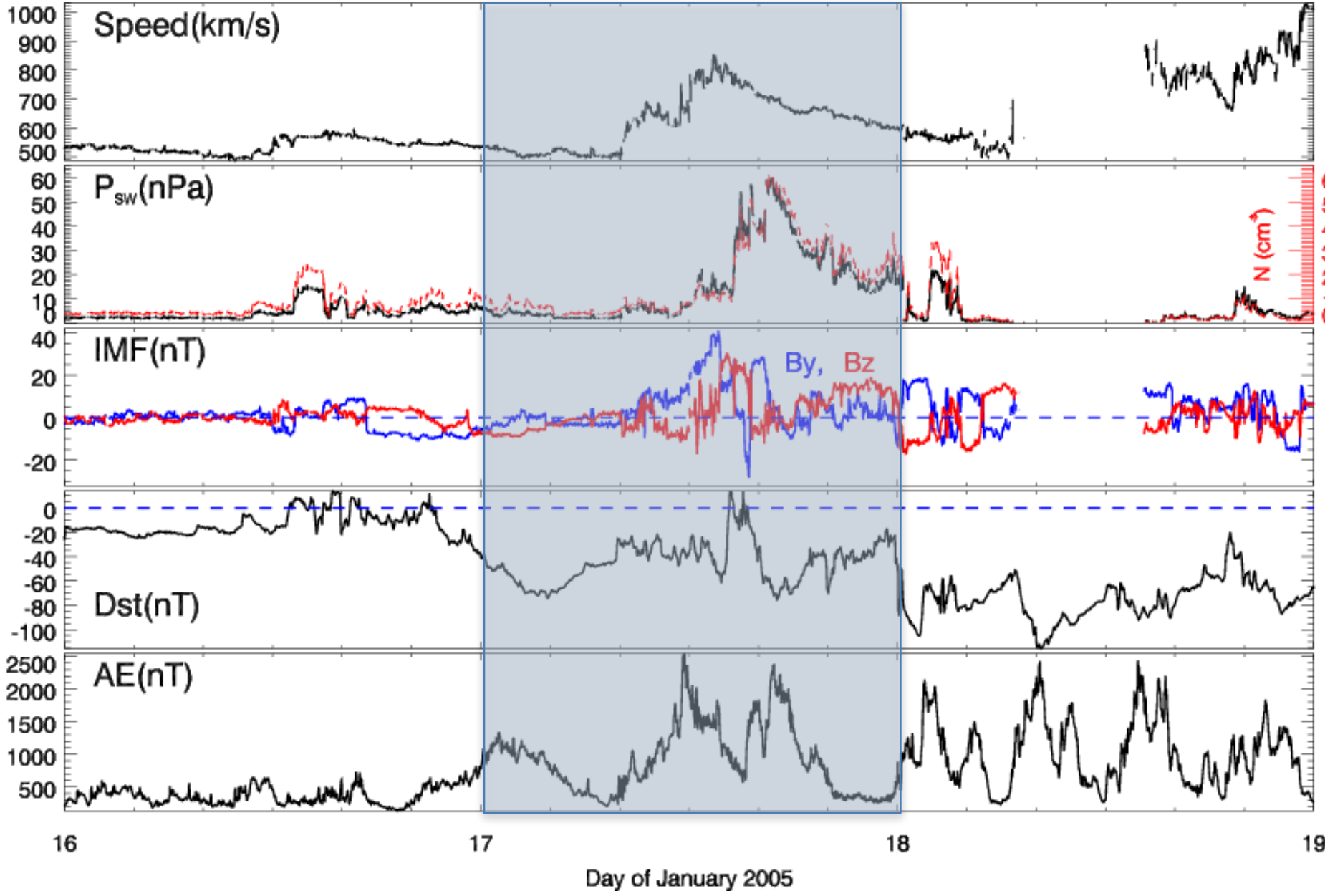
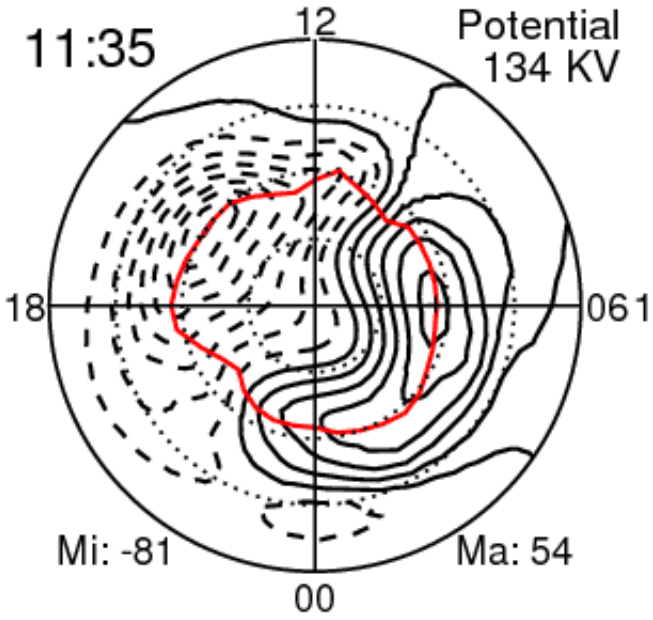
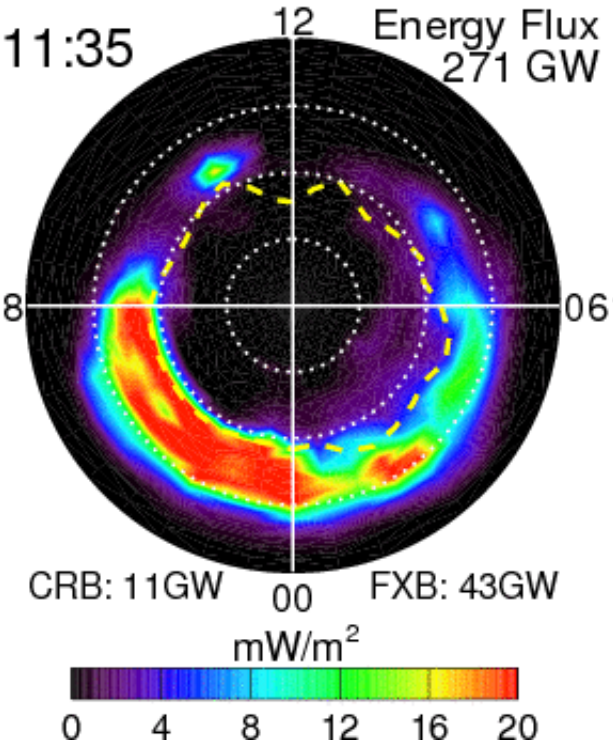
HAO/NCAR

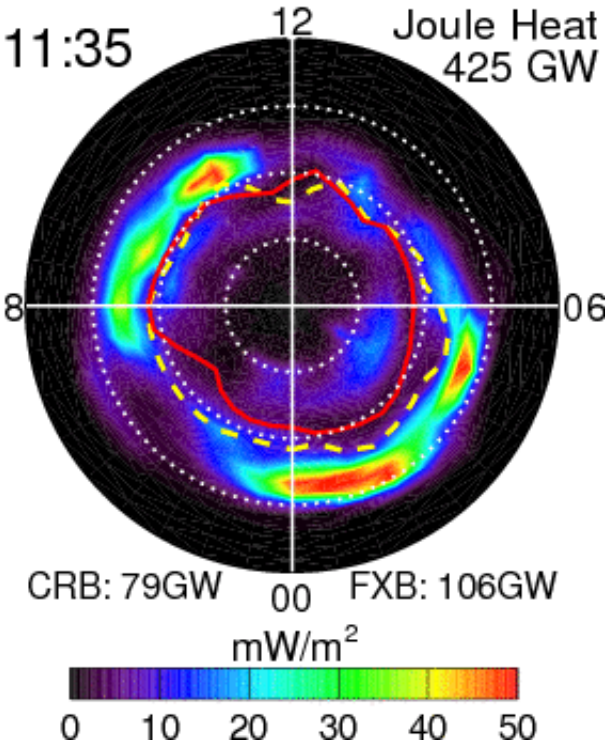
2016 CEDAR Workshop MIT Coupling/Driver Session


Speed(km/s)
1000
900
800
700
600
500
P_{sw}(nPa)
60
50
40
30
20
10
0
N (cm^{-3})
60
50
40
30
20
10
0
IMF(nT)
40
20
0
-20
By, Bz
Dst(nT)
0
-20
-40
-60
-80
-100
AE(nT)
2500
2000
1500
1000
500
16
17
18
19
Day of January 2005

AMIE Patterns at 11:35 UT





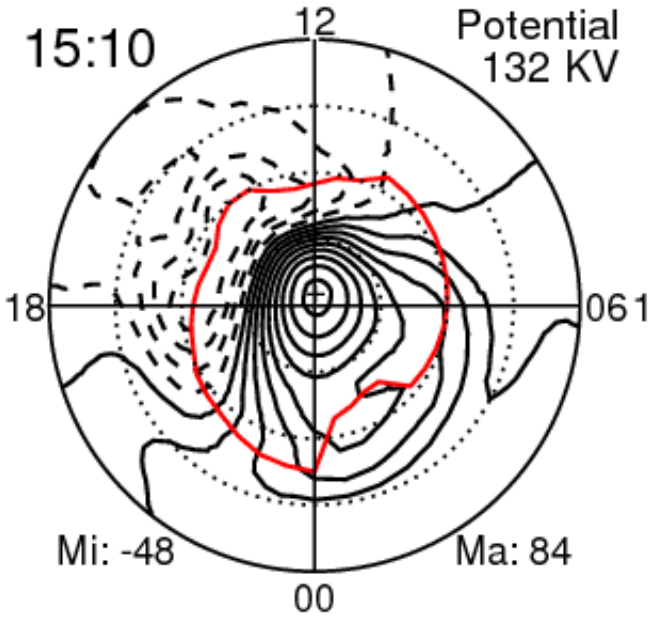


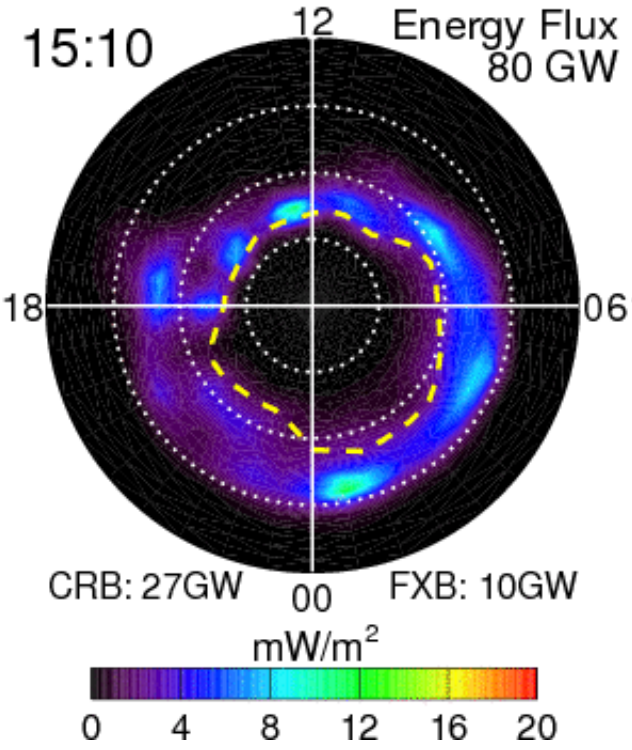
HP_CRB/HP_total = 0.04
HP_FXB/HP_total = 0.16

JH_CRB/JH_total = 0.19
JH_FXB/JH_total = 0.25

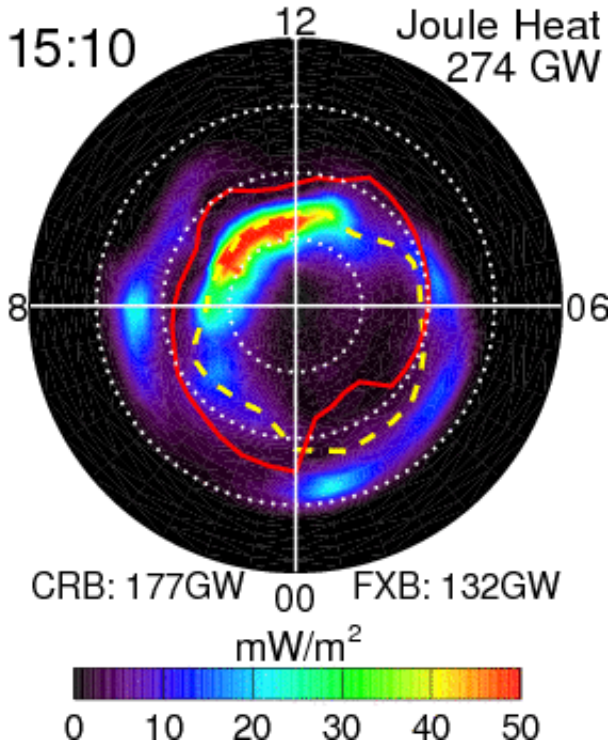
Red solid line: Convection Reversal Boundary (CRB)
Yellow dashed line: Poleward auroral FluX Boundary (FXB)

AMIE Patterns at 15:10 UT

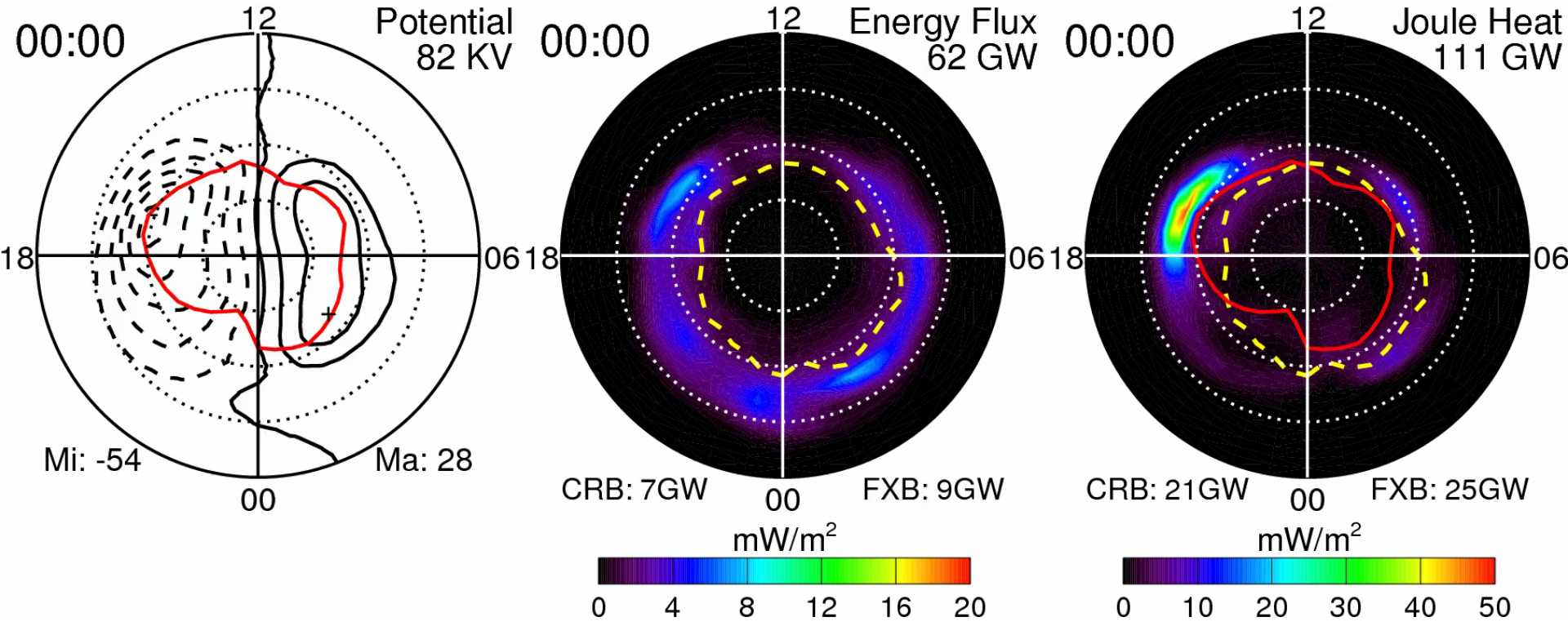


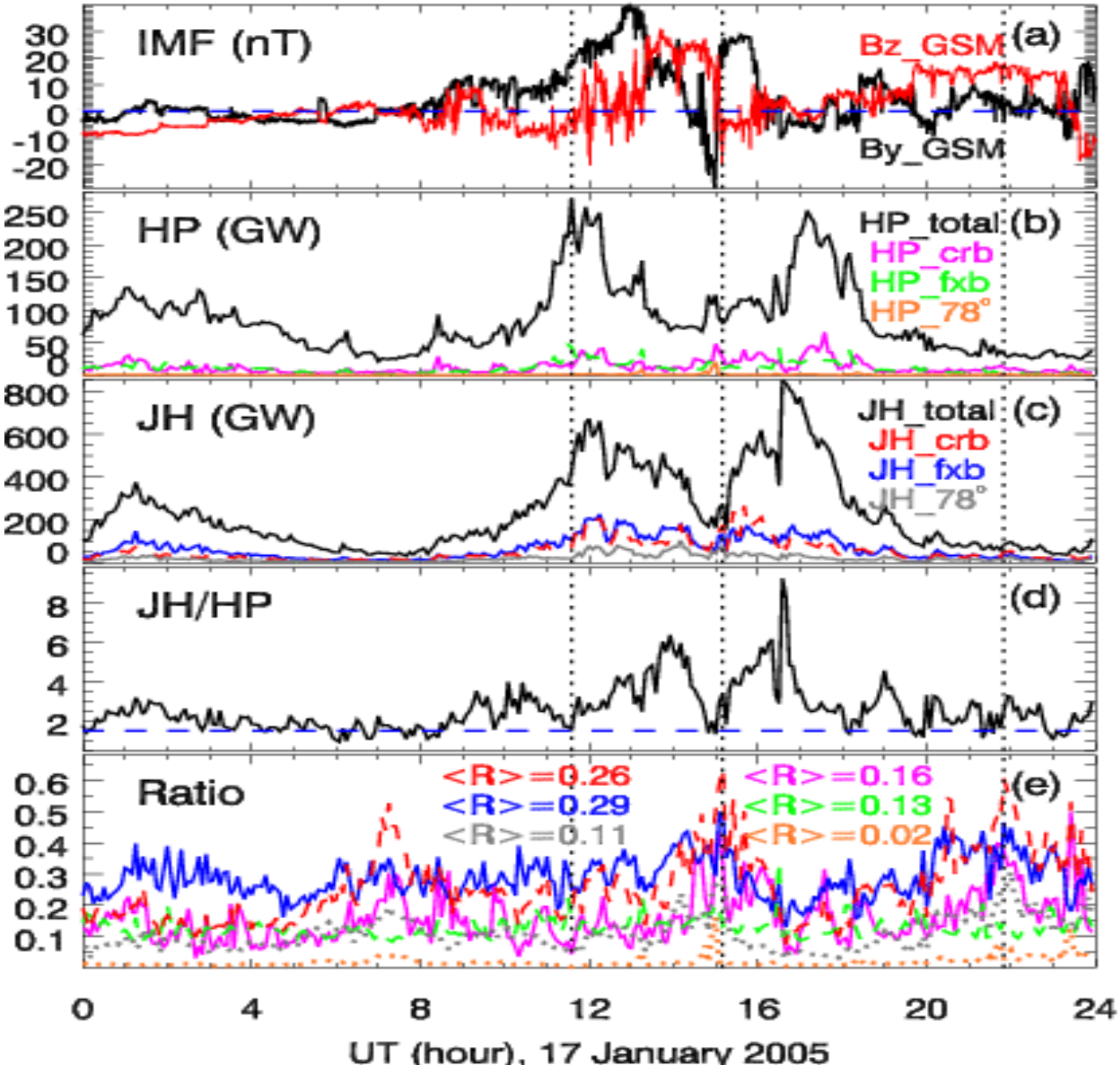


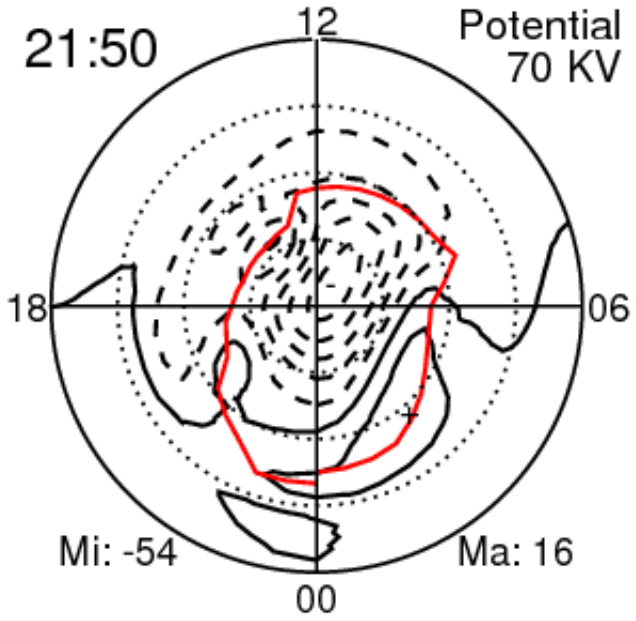
HP_CRB/HP_total = 0.34
HP_FXB/HP_total = 0.13

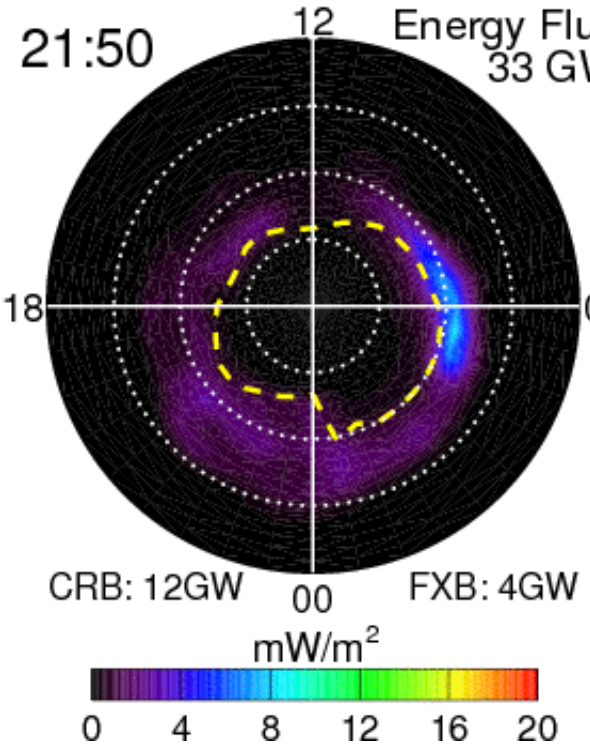


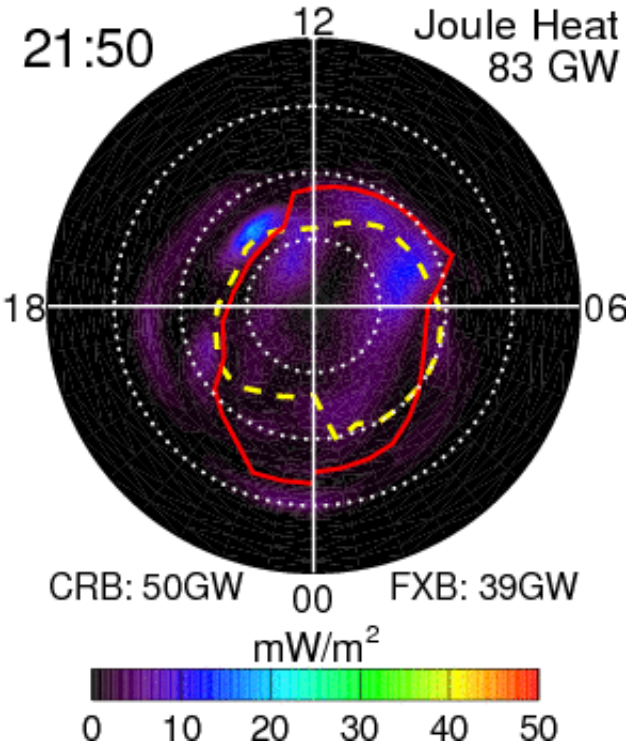
JH_CRB/JH_total = 0.65
JH_FXB/JH_total = 0.48


00:00
12
Potential
82 KV
18
06
Mi: -54
Ma: 28
00
00:00
12
Energy Flux
62 GW
18
06
CRB: 7GW
FXB: 9GW
00
mW/m2
0
4
8
12
16
20
00:00
12
Joule Heat
111 GW
18
06
CRB: 21GW
FXB: 25GW
00
mW/m2
0
10
20
30
40
50


IMF (nT)
Bz_GSM
By_GSM
(a)
HP (GW)
HP_total
HP_crb
HP_fxb
HP_78°
(b)
JH (GW)
JH_total
JH_crb
JH_fxb
JH_78°
(c)
JH/HP
(d)
Ratio
<R>=0.26
<R>=0.29
<R>=0.11
<R>=0.16
<R>=0.13
<R>=0.02
(e)
UT (hour), 17 January 2005


21:50
12
Potential
70 KV
18
06
00
Mi: -54
Ma: 16


21:50
12
Energy Flux
33 GW
18
06
00
CRB: 12GW
FXB: 4GW
mW/m2
0
4
8
12
16
20

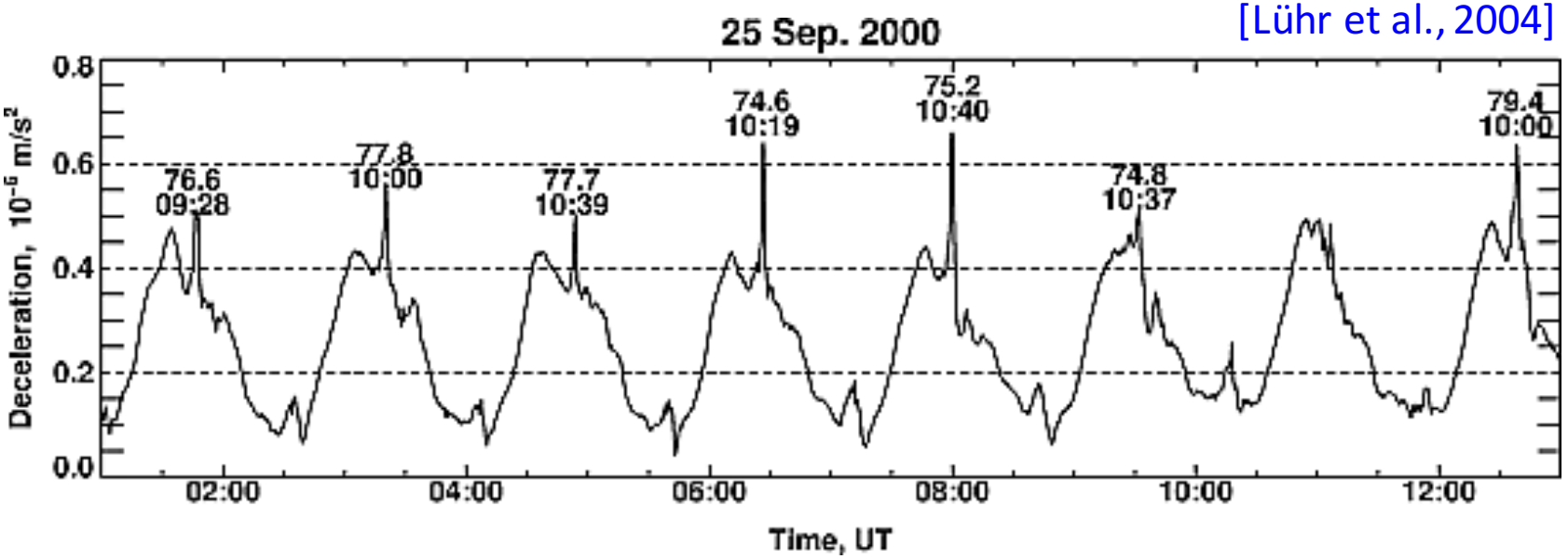

21:50
12
Joule Heat
83 GW
18
06
00
CRB: 50GW
FXB: 39GW
mW/m2
0
10
20
30
40
50

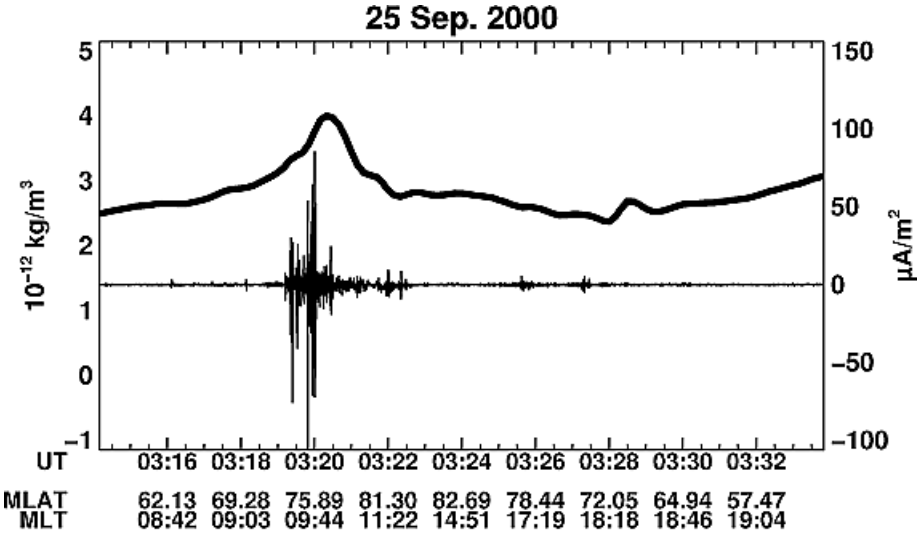
Summary

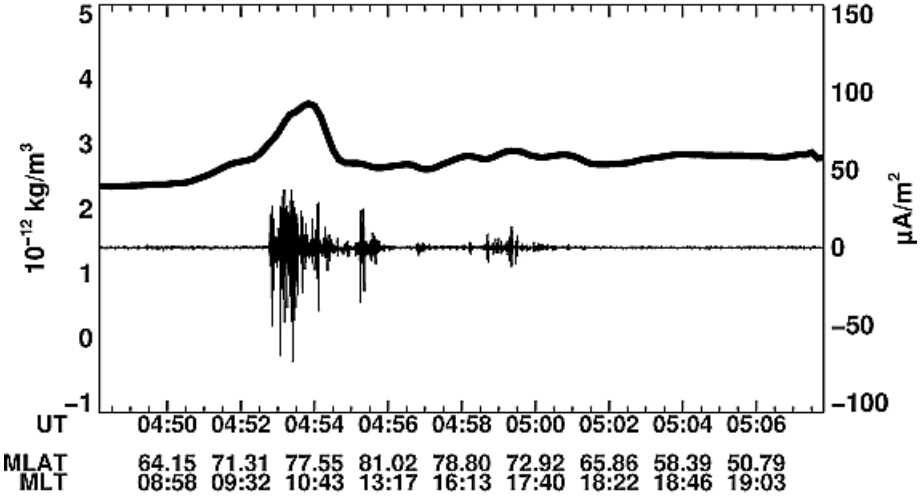
- Joule heating is the dominant form of high-latitude energy input:
  - About 1.5 times of auroral precipitation during quiet time
  - About 9 times of auroral precipitation during active time
- Energy input poleward of the CRB and FXB only occasionally exceeds 50% of its hemispheric integrated values. This occurs when IMF is northward and the overall energy input is very small.
- On average, the polar-cap energy input accounts only 20~25% of the total hemispheric energy input. Therefore, the polar cap is NOT the primary location of solar wind-magnetospheric energy input.

Neutral Mass Density Enhancements near the Polar Cusp

[Lühr et al., 2004]

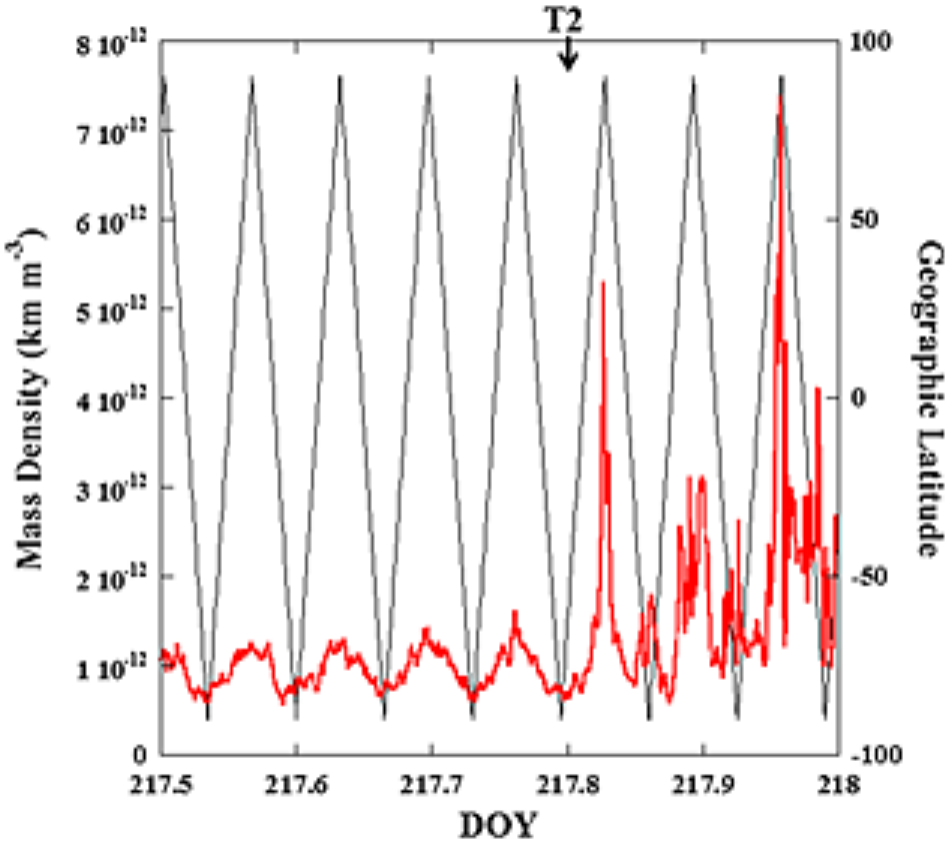


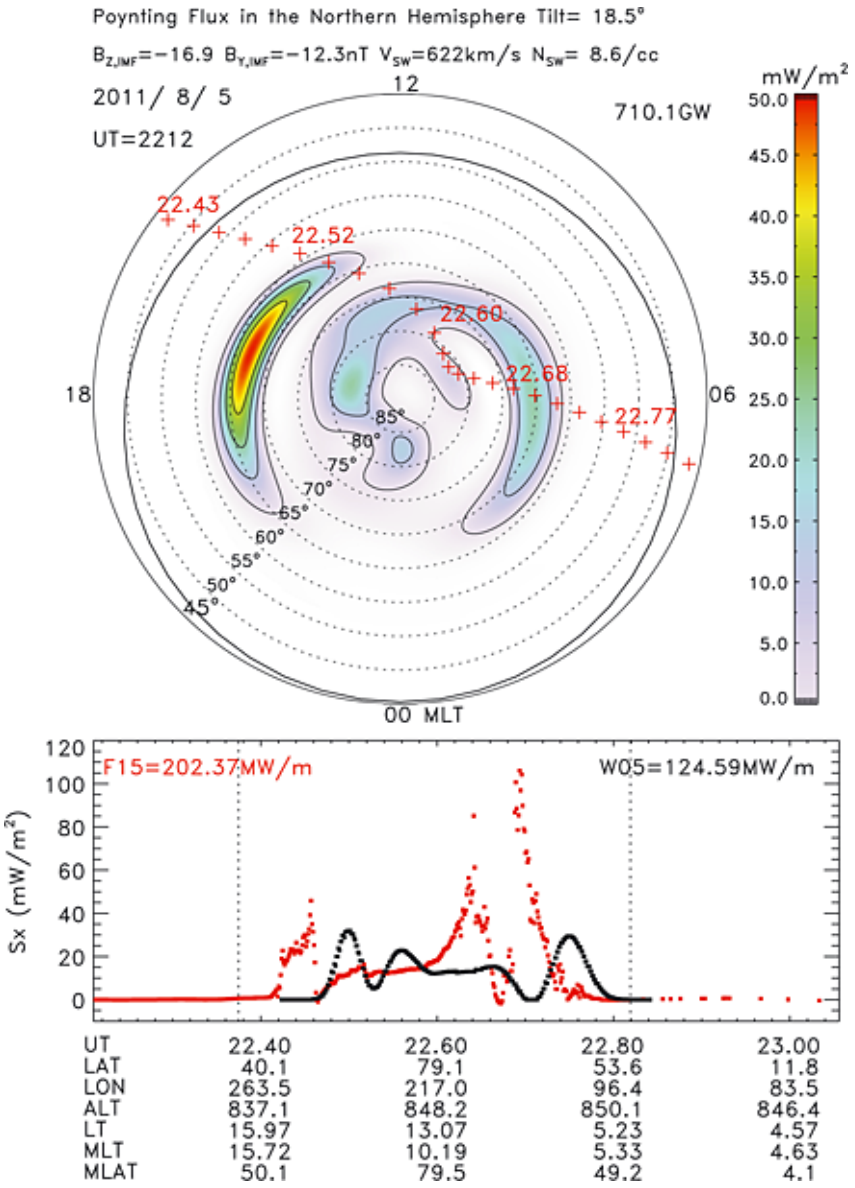




Neutral Mass Density Enhancements over the Polar Cap

[Huang et al., 2014]





➔ the polar cap is the primary location for energy input to the IT system