Polar Cap Convection during Moving Trans Polar Arc Event

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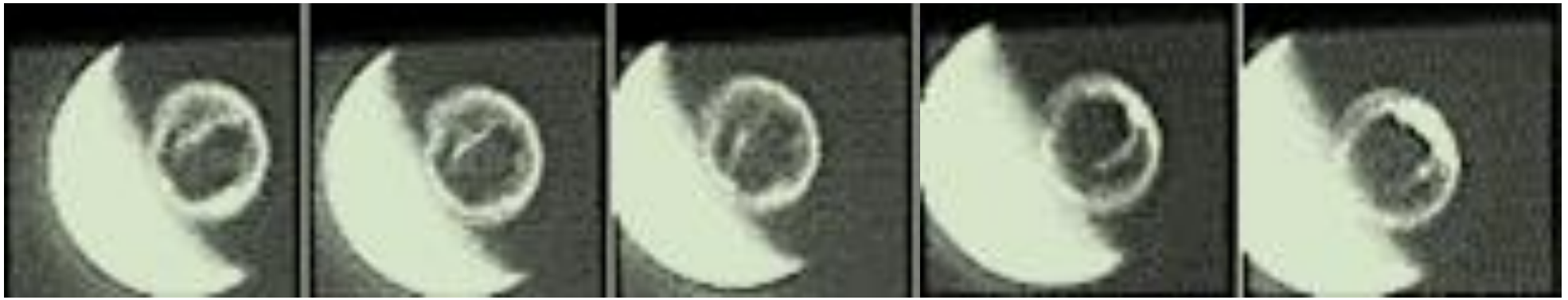
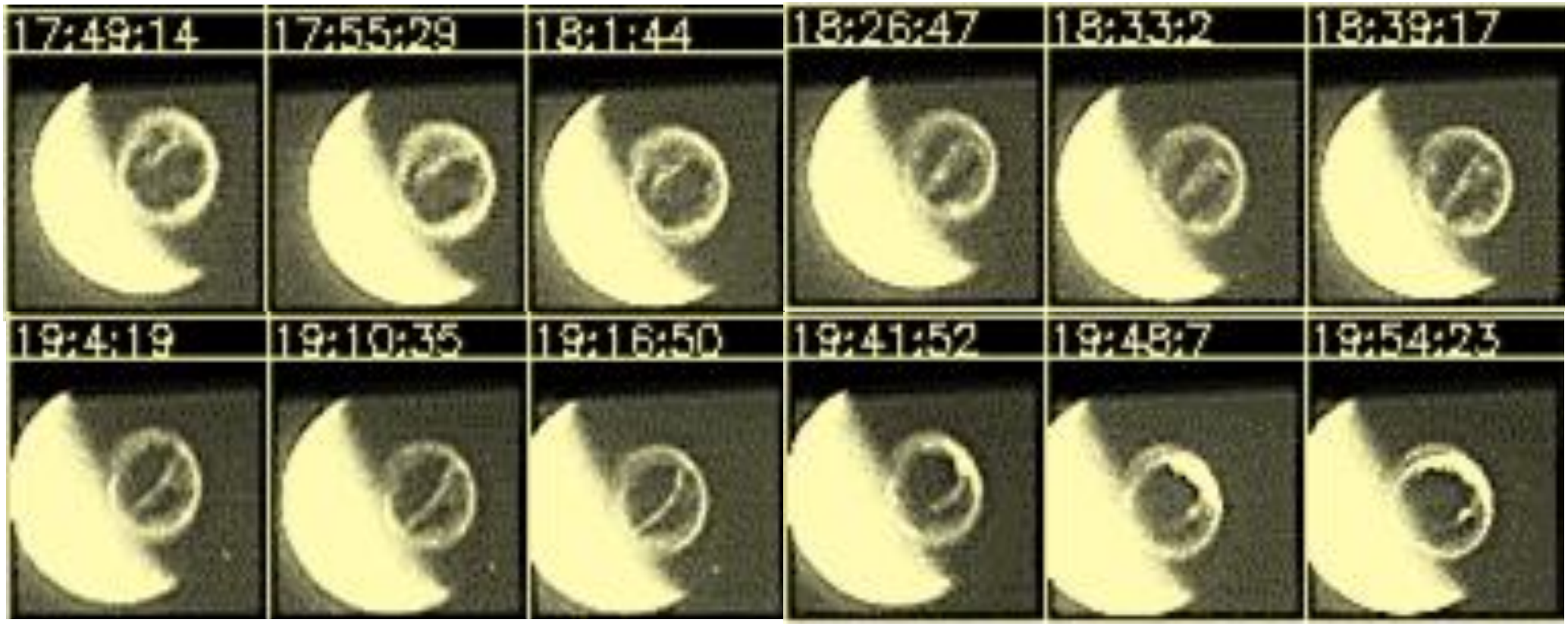
1) Tohoku University, 2) NiCT



Acknowledgement: Dr. Shing Fung (NASA GSFC)

IMF By sign change: negative ⇒ positive

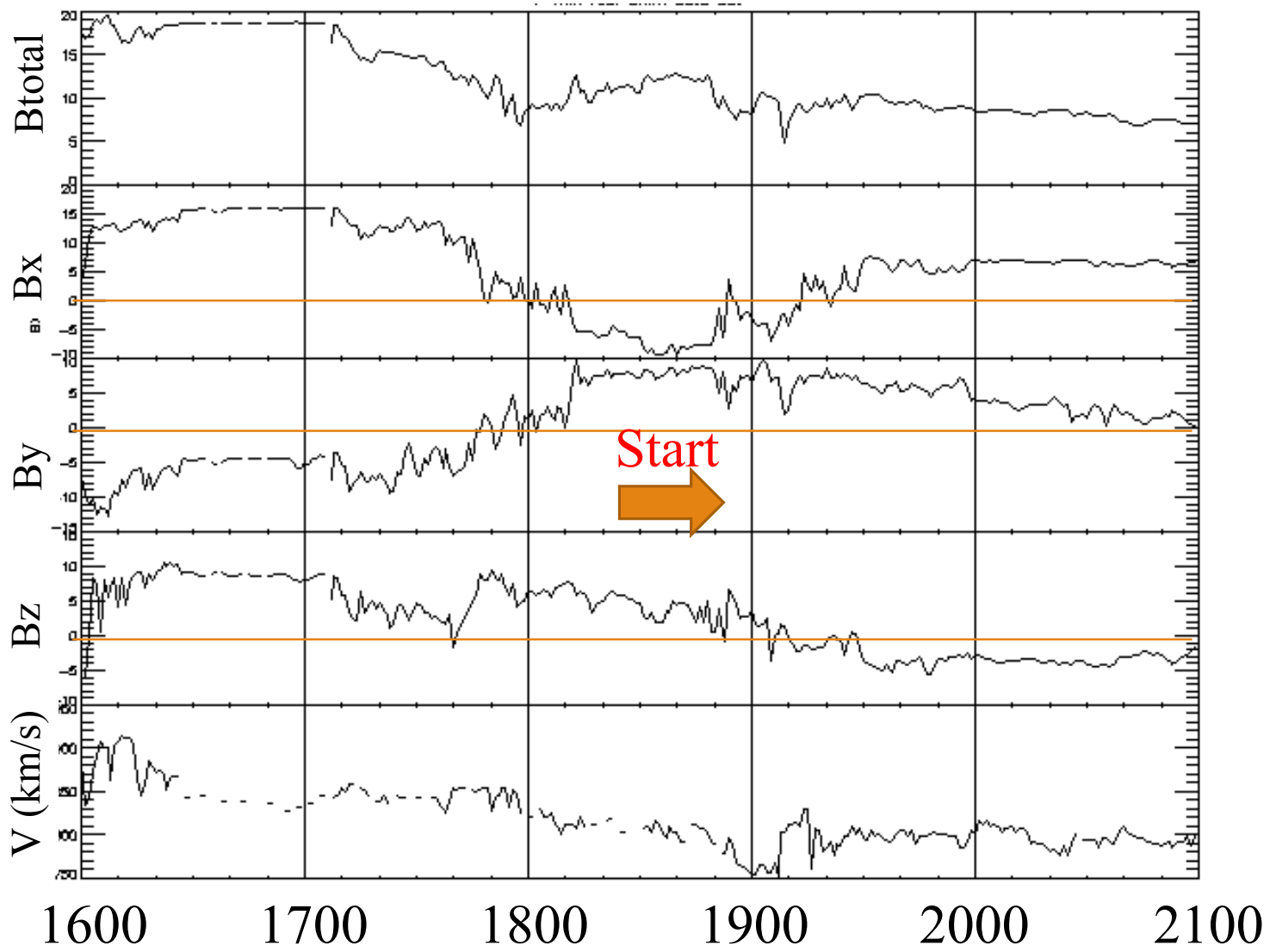


2005.9.15 17:49 :14 – 19:54:23

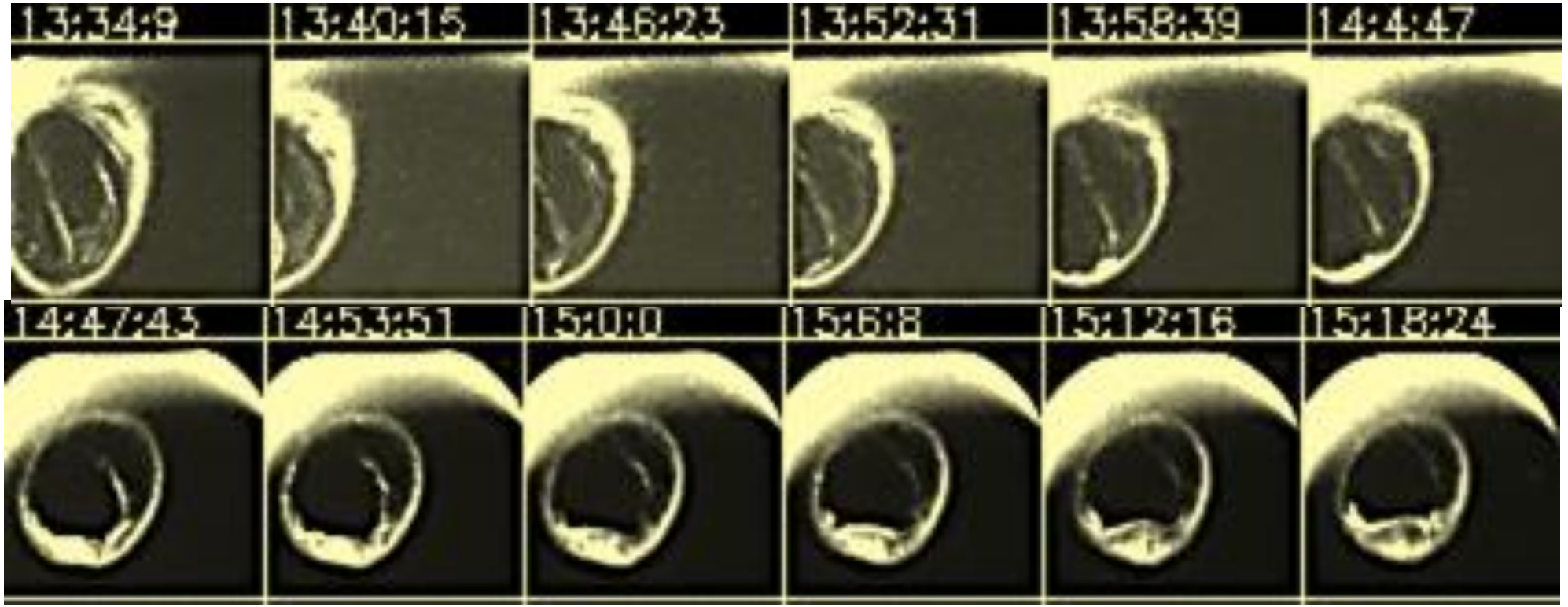
From South

Dawn ward movement of theta aurora

2005.9.15　16UT – 20UT



IMF By sign change: positive ⇒ negative

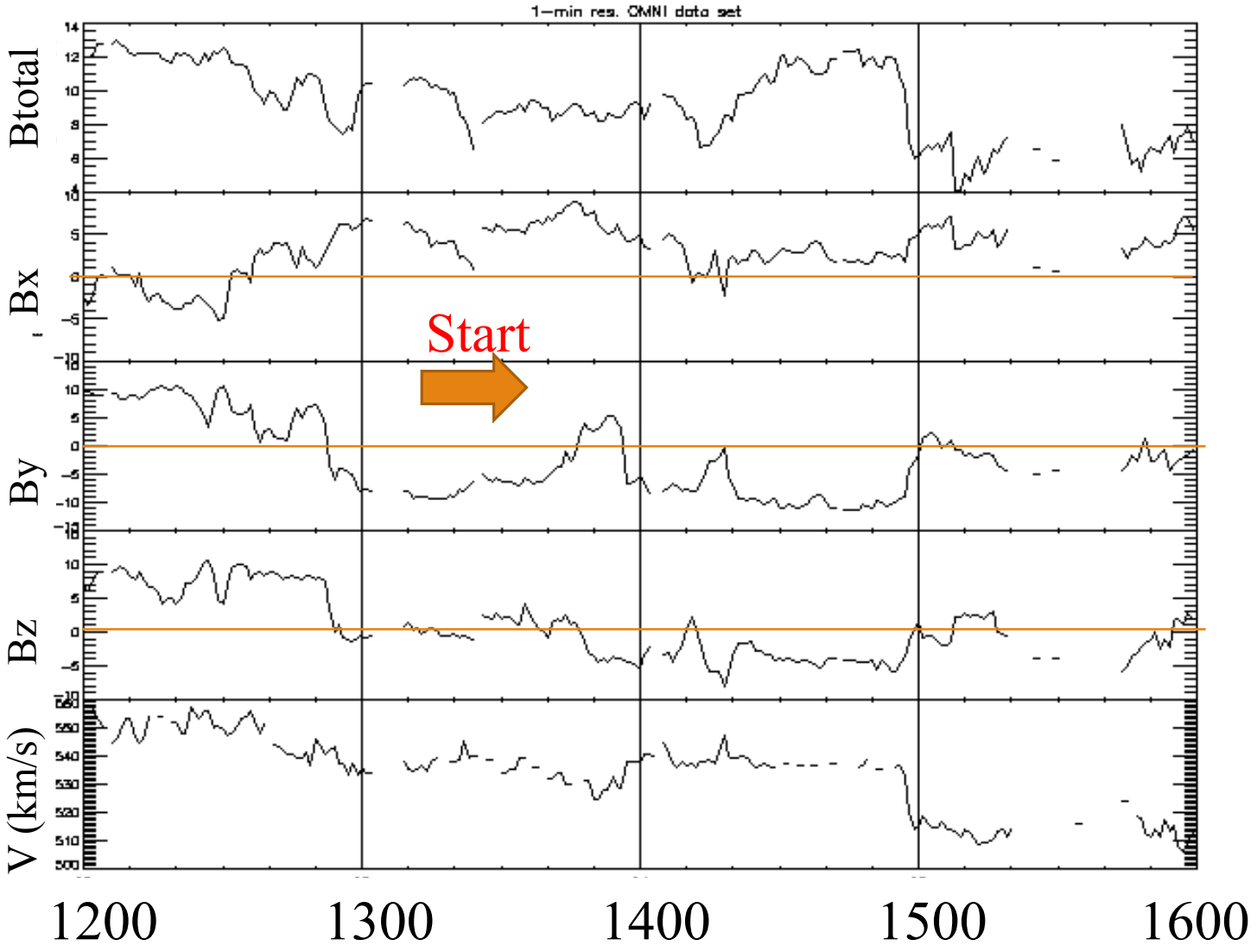


2001.1.23　14:10 :55 – 15:18:24

From North

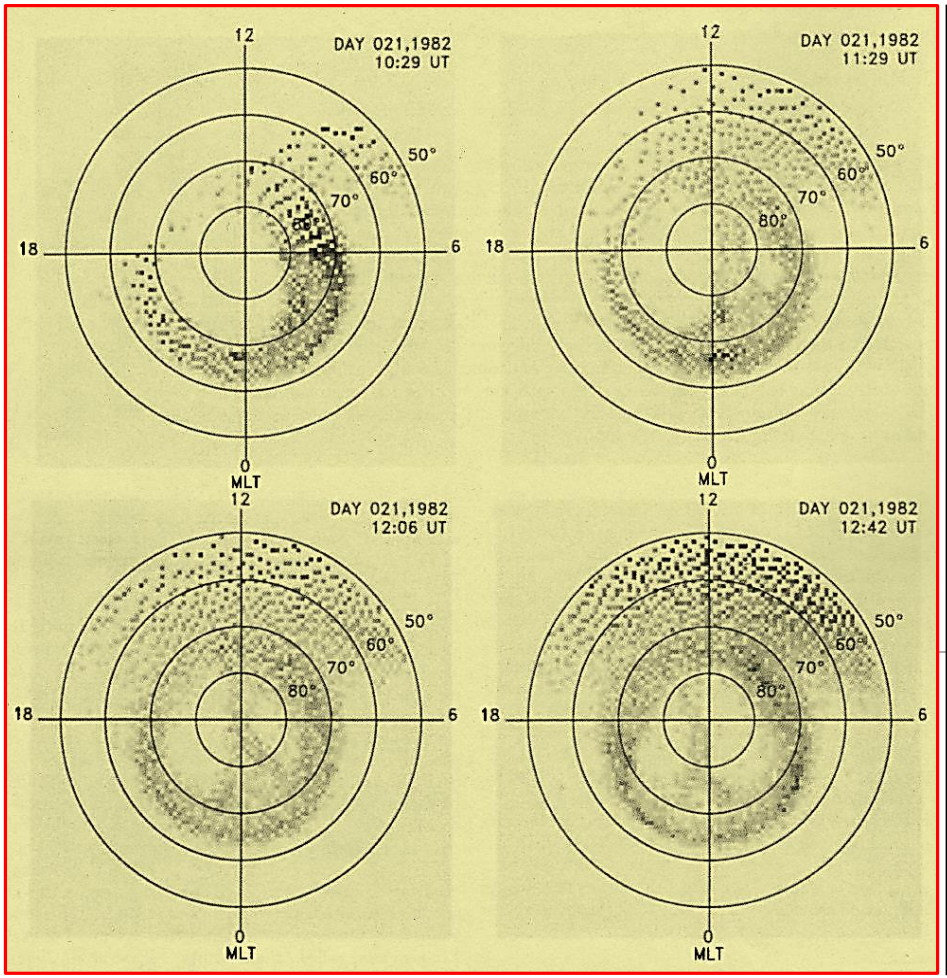
Dawn ward movement of theta aurora

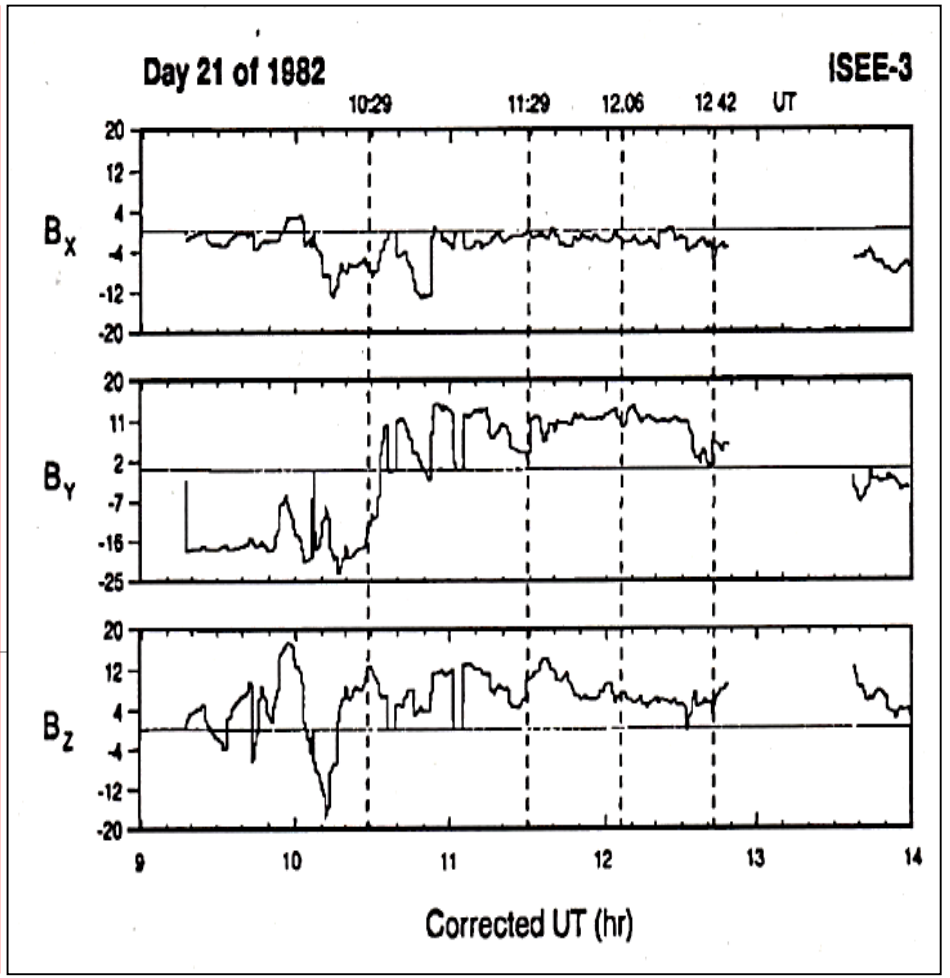
2001.1.23 13UT – 18UT



IMF By < 0 to *By* > 0

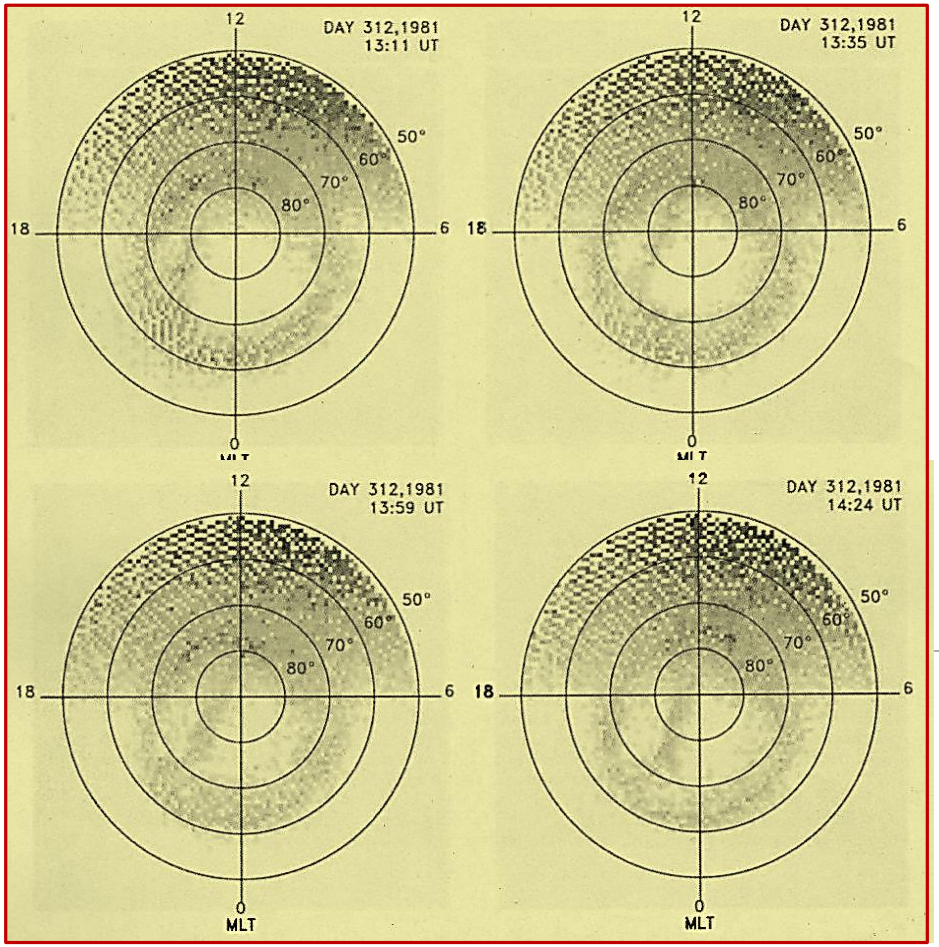
From North

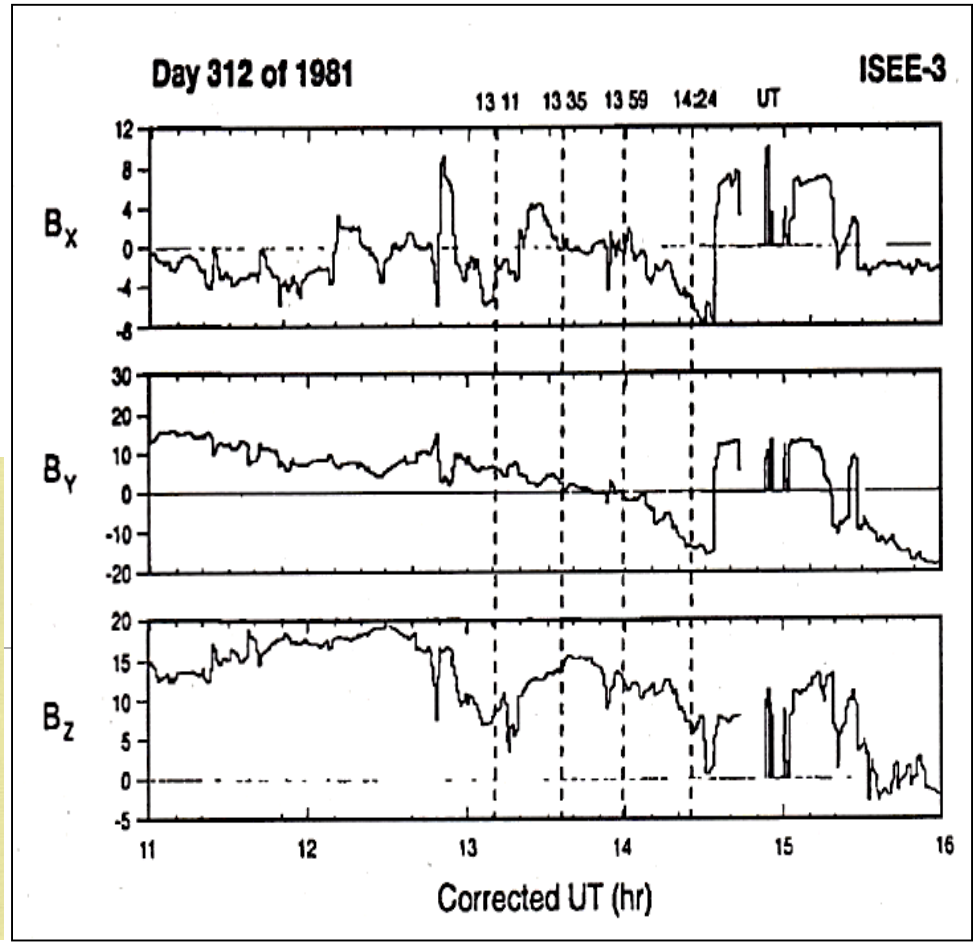




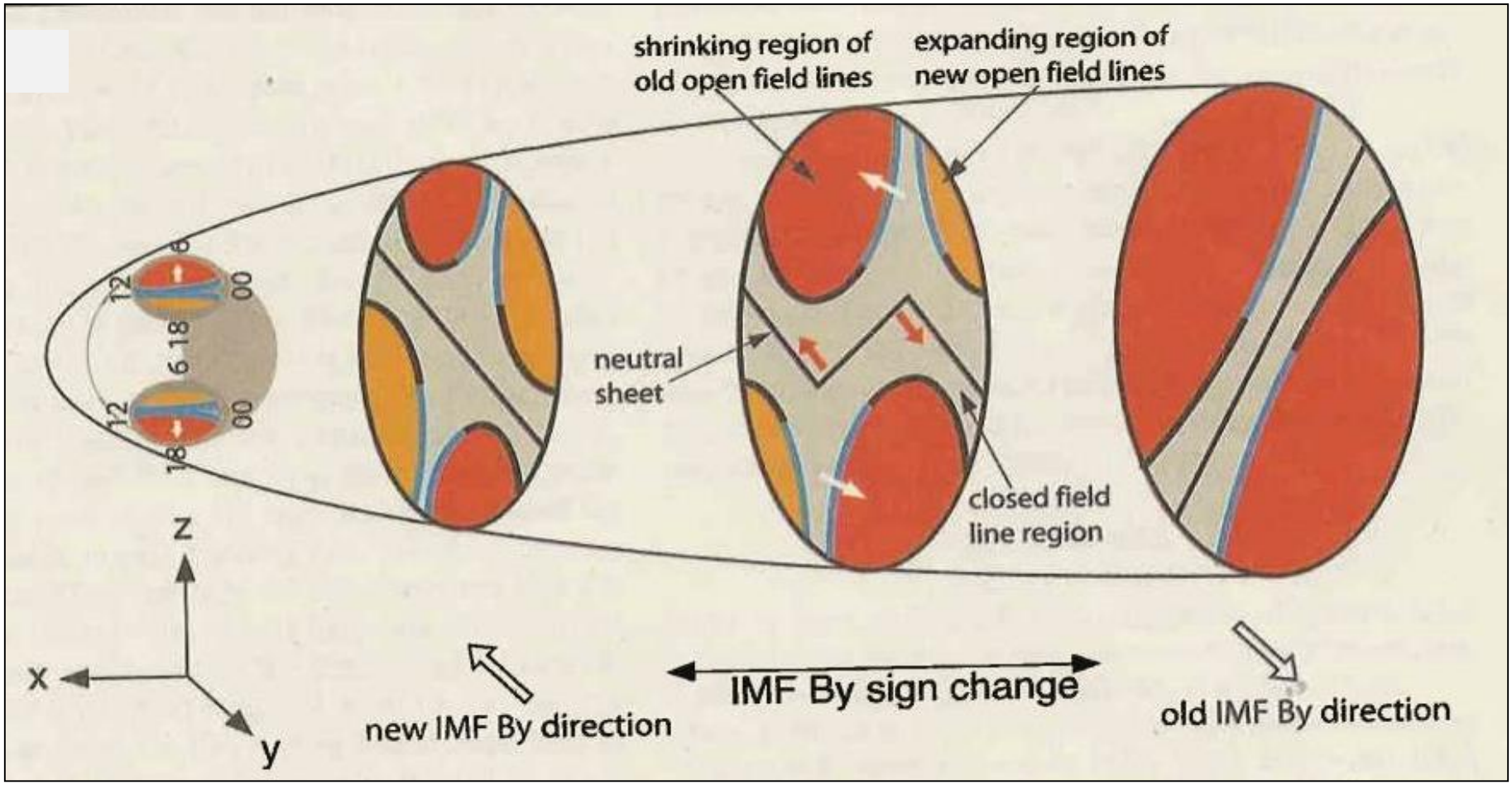
IMF By > 0 to *By* < 0

From North





Summary and Recent Results by A.Kullen (AGU Monograph 2012)



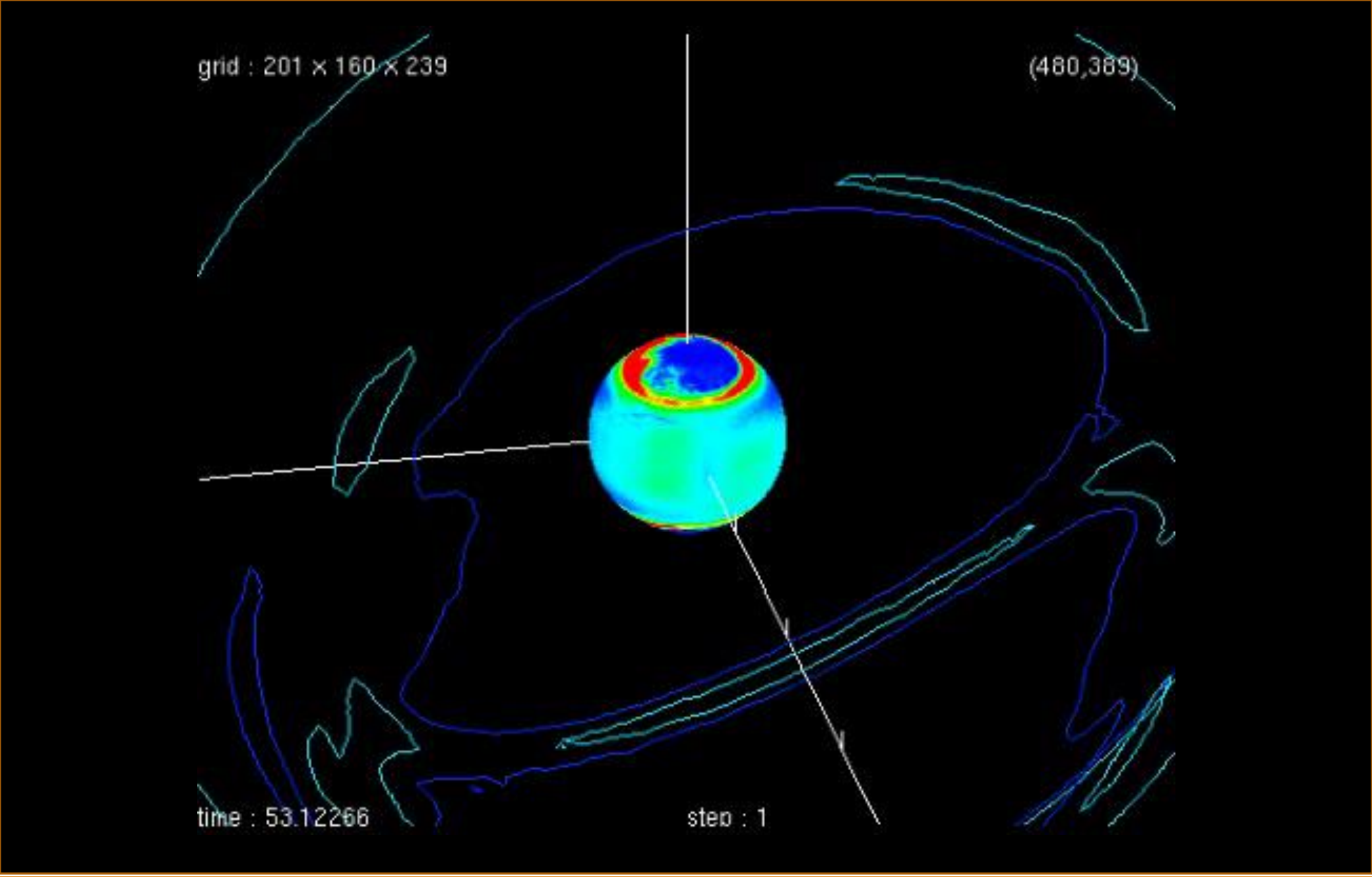
Simulation is started from a stationary condition under the following condition; i.e.

Bx =0 nT, By = - 7.5 nT, and Bz = 13.29 nT

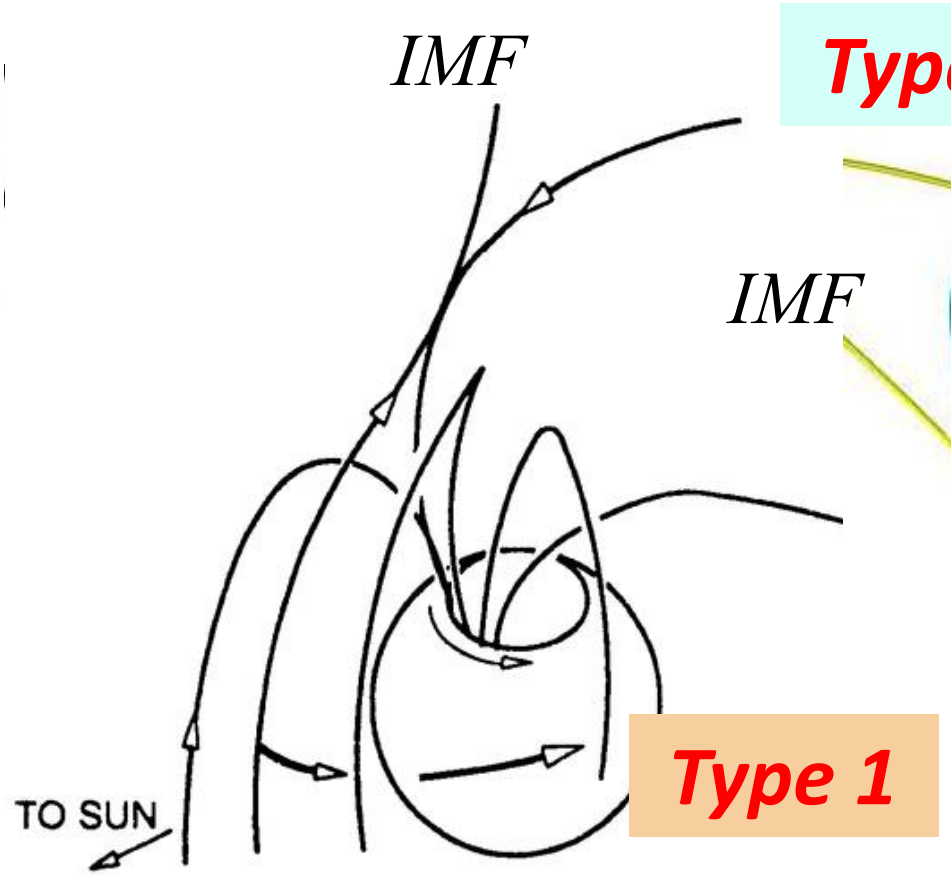
In the successive calculation the theta aurora is simulated by abrupt change of the IMF direction to dusk ward ; i.e.

Bx = 0 nT, By = 15 nT, and Bz = 4.4 nT

After a dusk ward turning of the IMF theta aurora is generated with a time delay of 25 min or so.

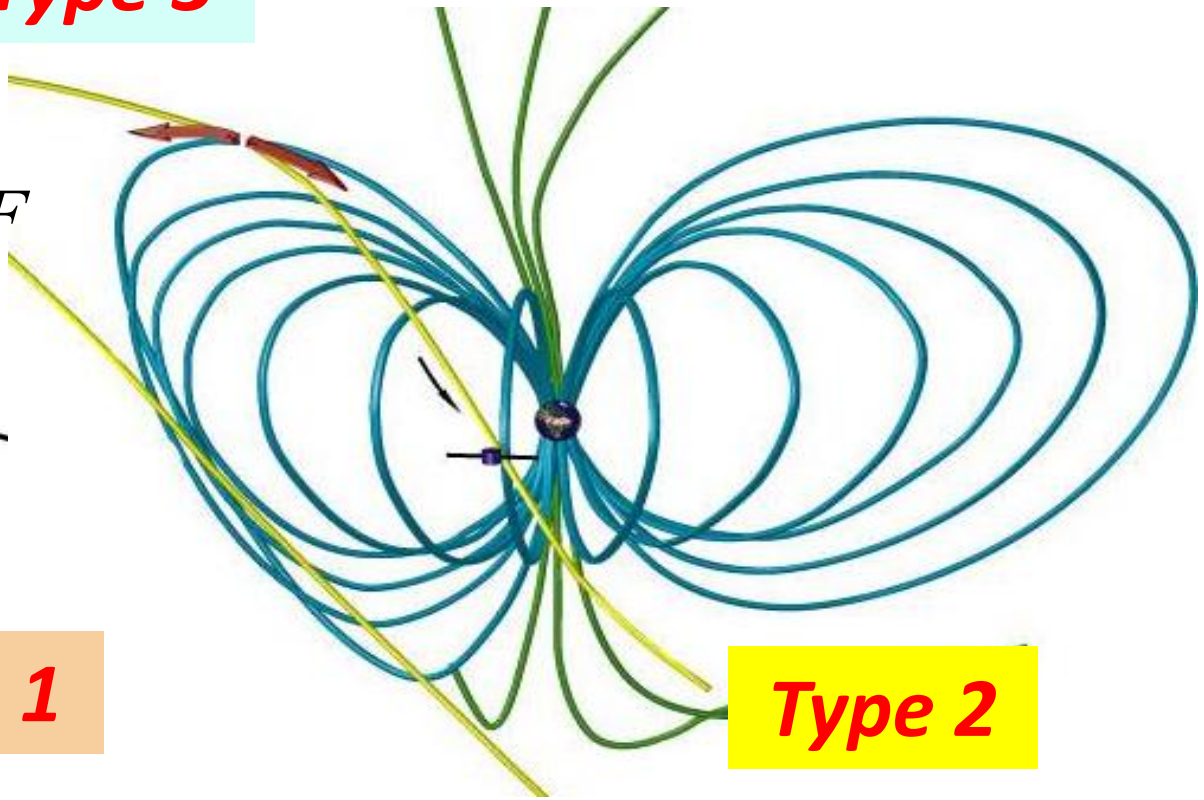

grid : 201 × 160 × 239
(480,369)
time : 53.12266
step : 1

Three Types of Magnetic Field Lines



Type 3

Type 1



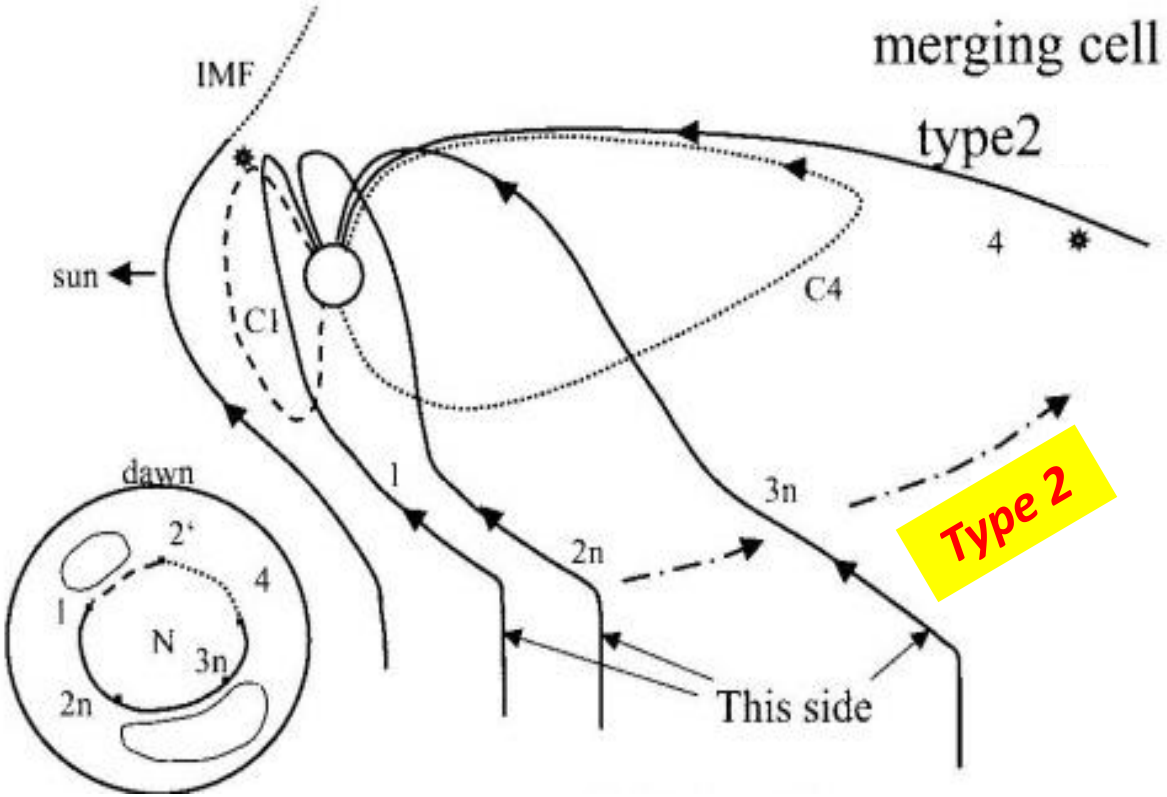
Type 2

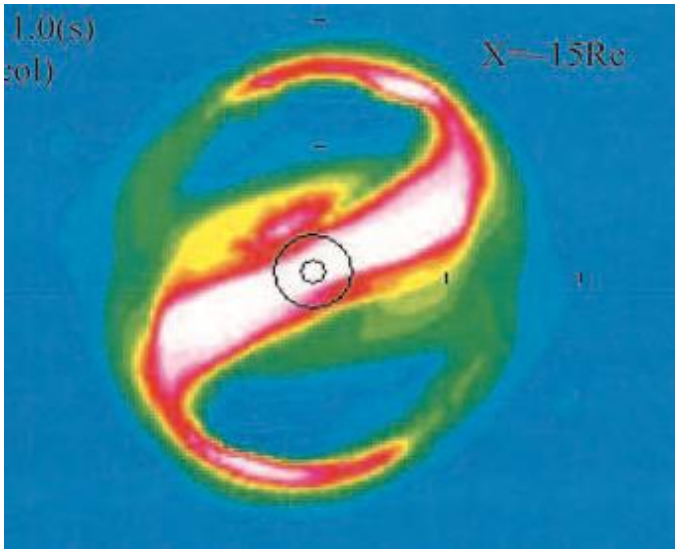
$|Bz| >> |Bx|, |By|$

$|By| >> |Bx|, |Bz|$

シータオーロラ形成のシナリオ

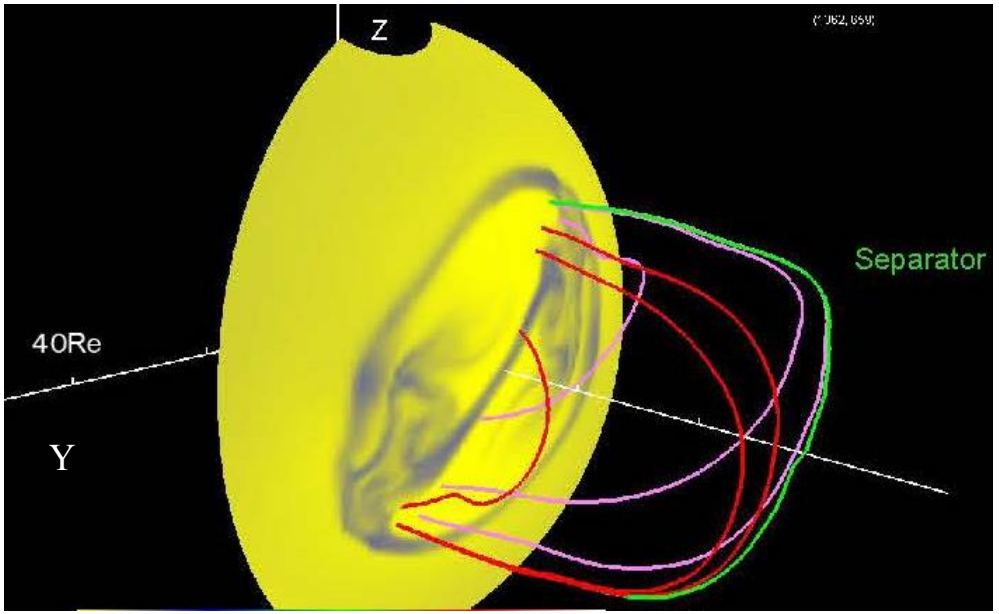
Type 2 field line in the merging cell acts a major role in the formation of TA. The most important feature of merging cell is that it includes a convection path of closed field lines.

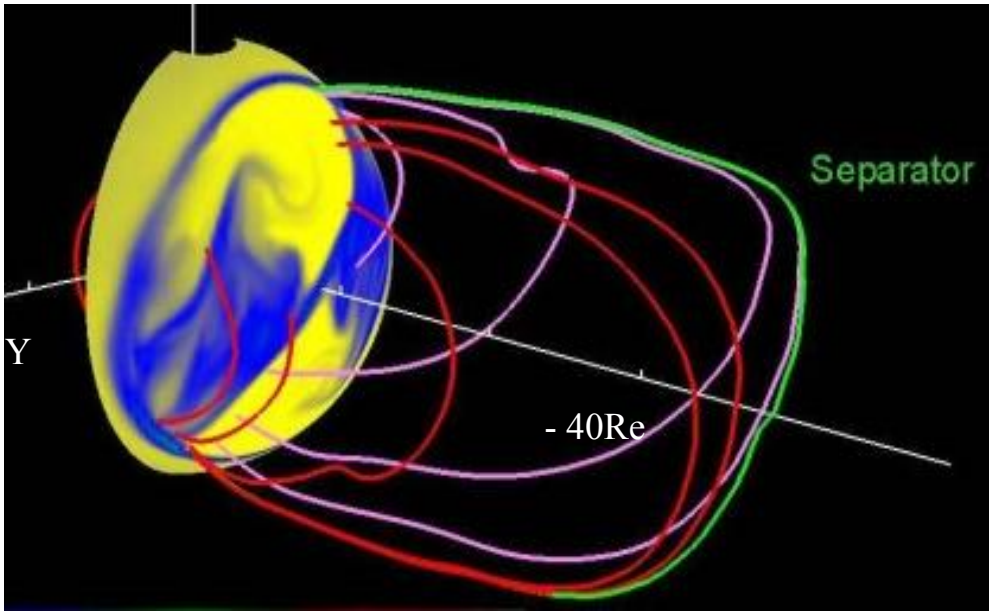




Cross section at
x = -15 Re seen
from the tail

There will be plasma sheet in the region equatorward of the last closed field line.

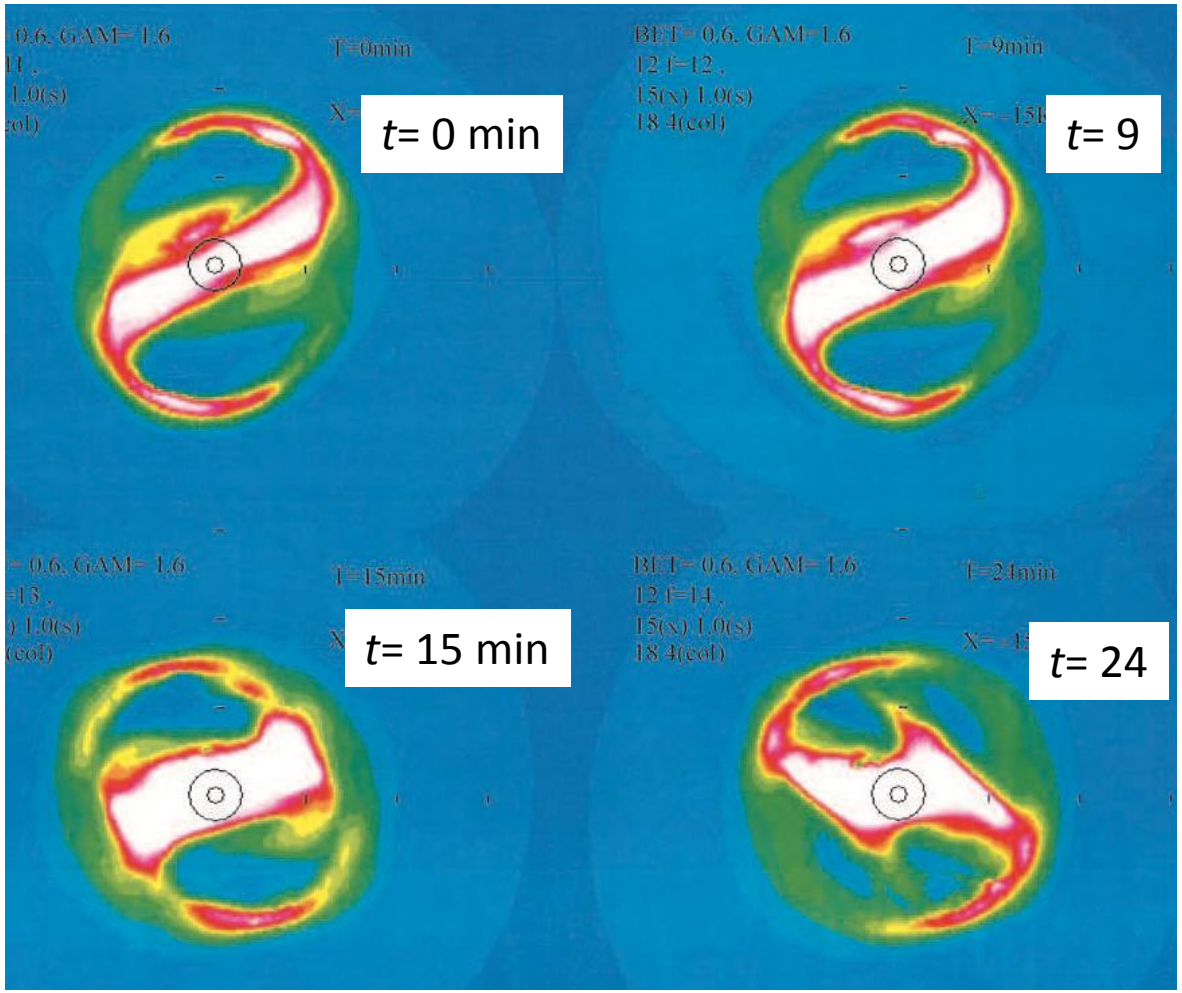




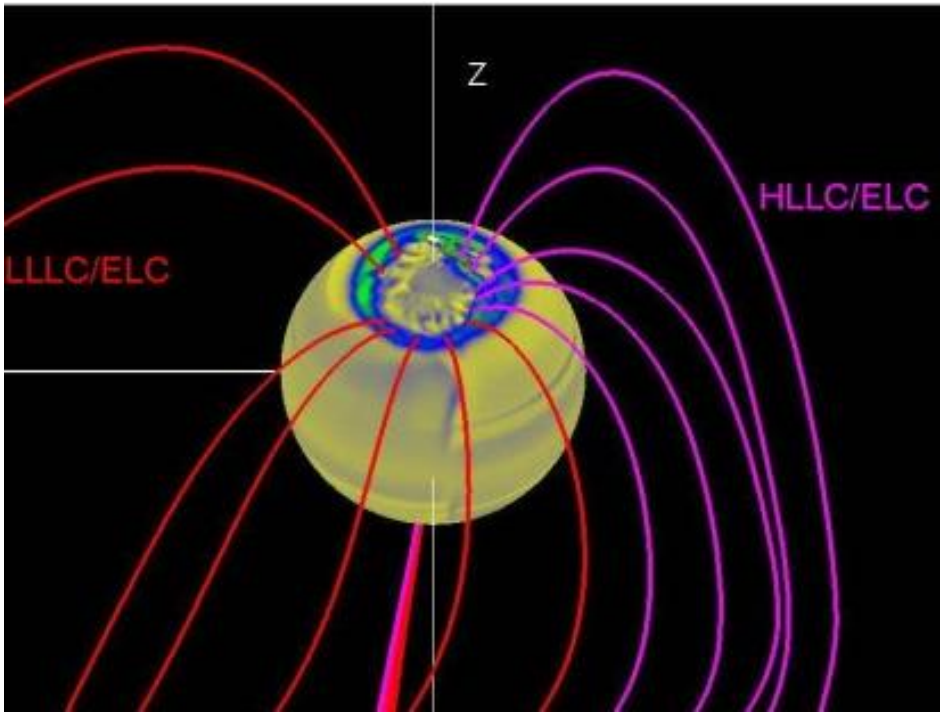
Left; Cross-section of the magnetotail in far region. Plasma sheet inclines due to the negative IMF By. Separator line as well as closed lines pass through this sheet.

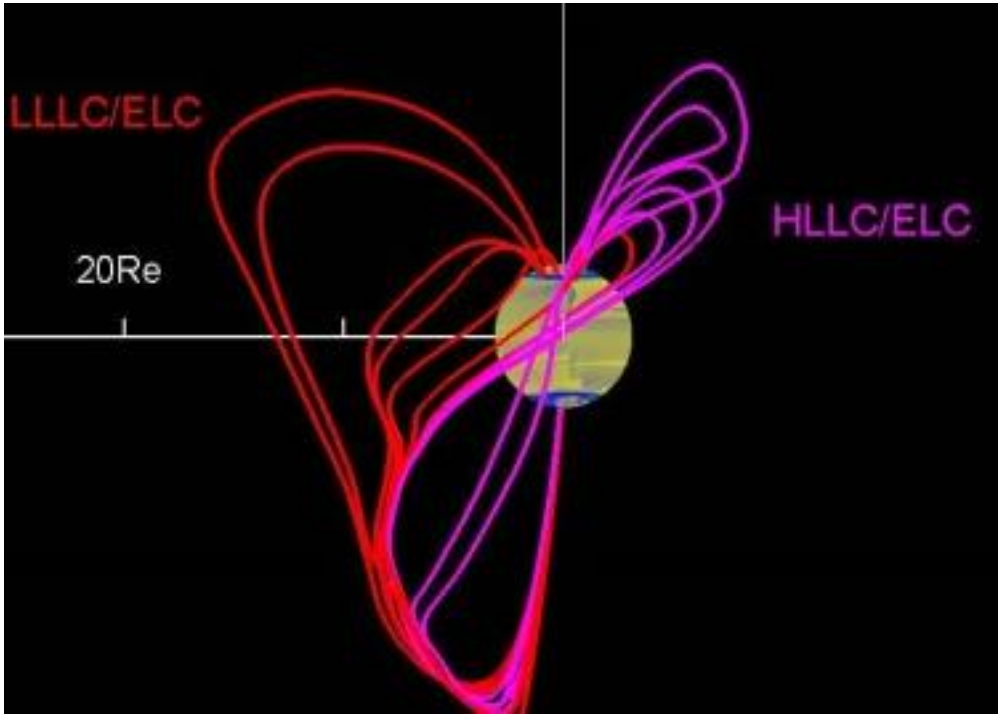
Right; Cross-section of the magnetotail in near region. Separator and closed lines are seen.

A time sequence of the temperature distribution in the tail cross section at x = - 15 Re seen from the tail.



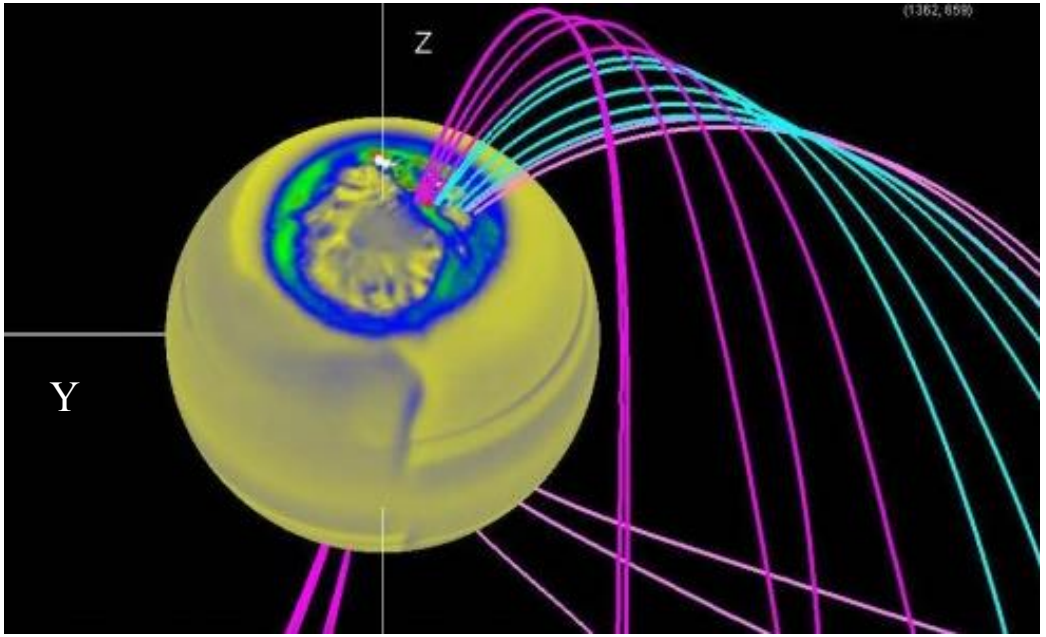
Delay time ~25min. Is consistent with Observations (Obara, 1997)

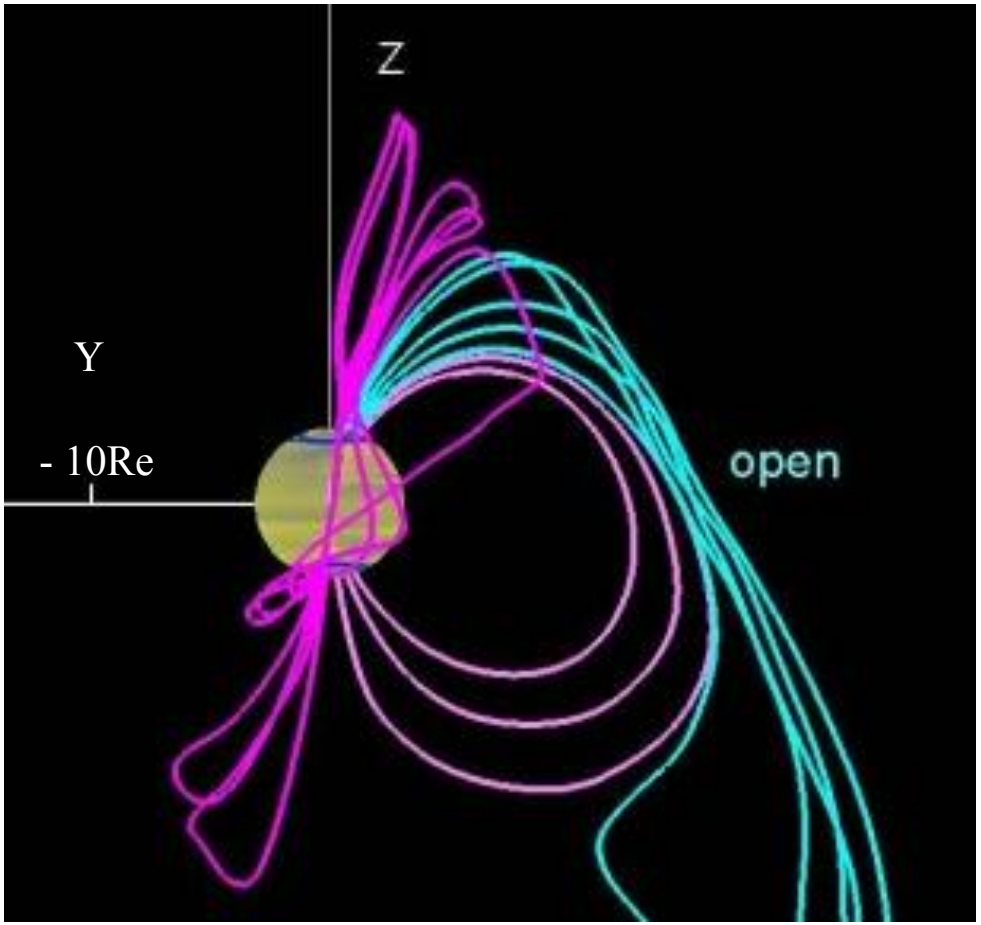




Left; HLLC (magenta) shifted on the theta element. This means that HLLC contributes very much for the formation of the theta aurora.

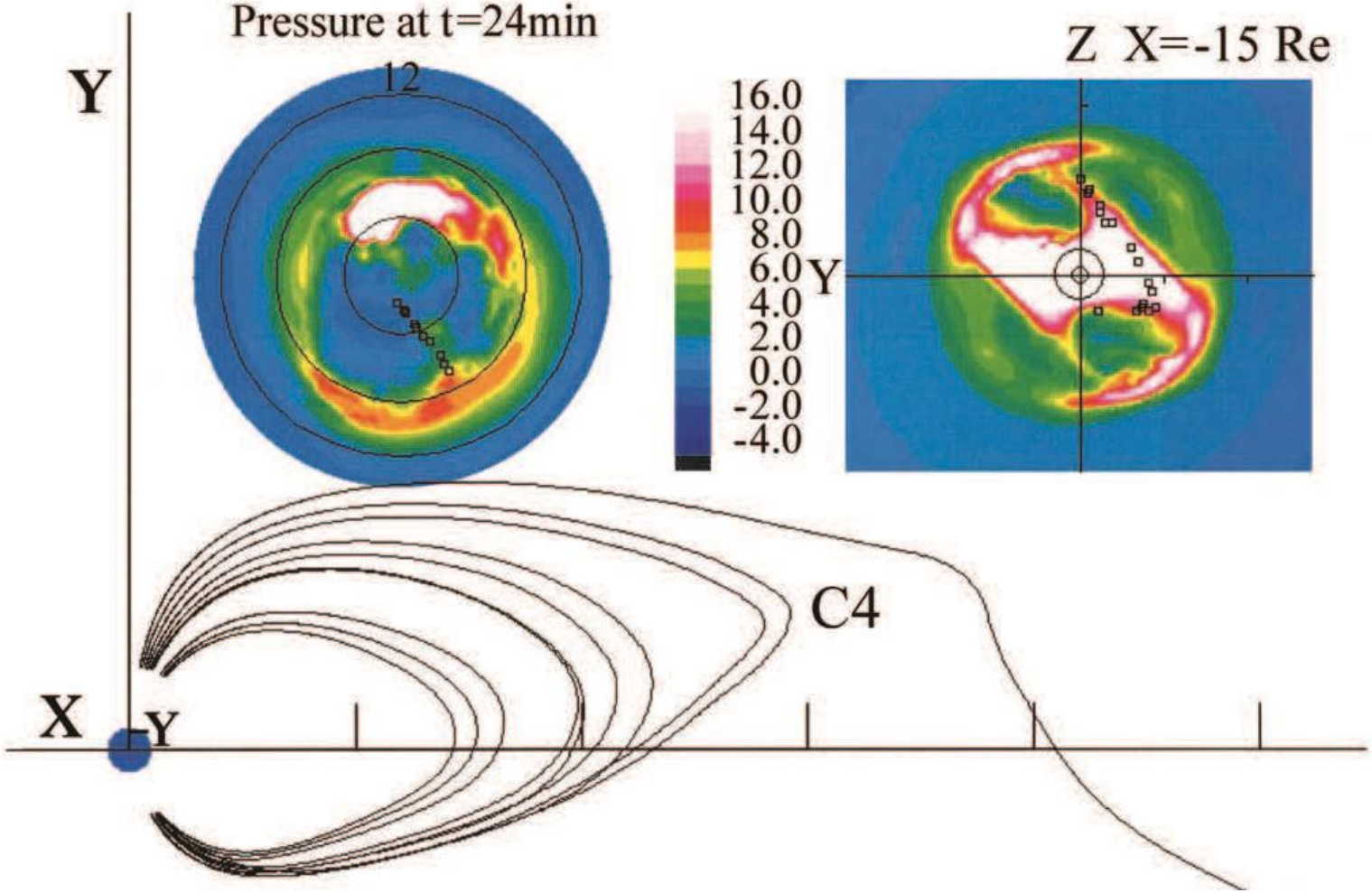
Right; Last close field lines in the evening sector have been given.



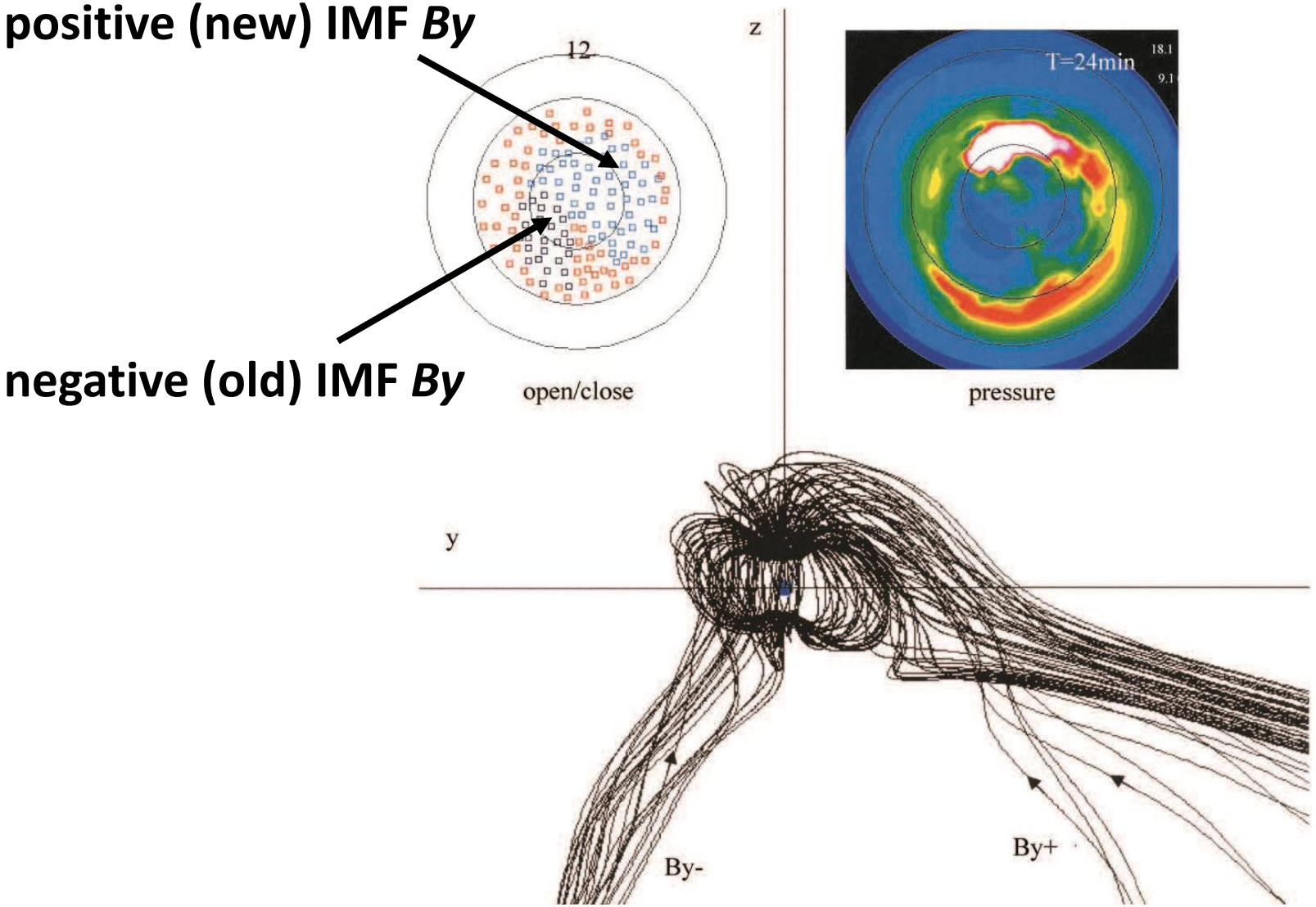


Left; Field lines in the vicinity of theta aurora are given; i.e. theta aurora (magenta), new lobe (light blue) and low latitude closed field lines (pink).

Right; Global view of the field lines, seen from the midnight.

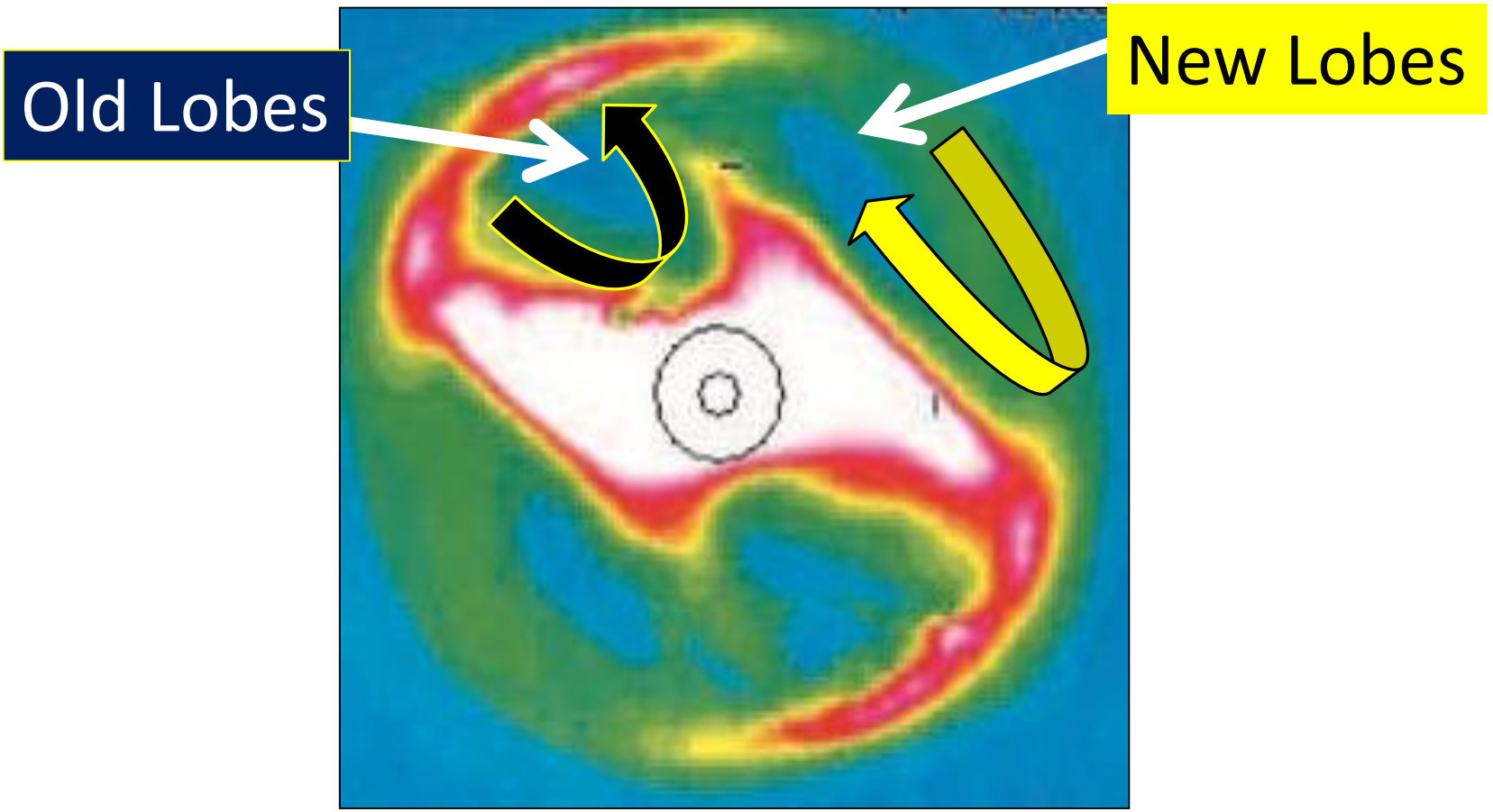


Dots in the two upper panels show foot points of field lines (left) and cross points of closed magnetic field on the yz plane at x = - 15 Re (right) .

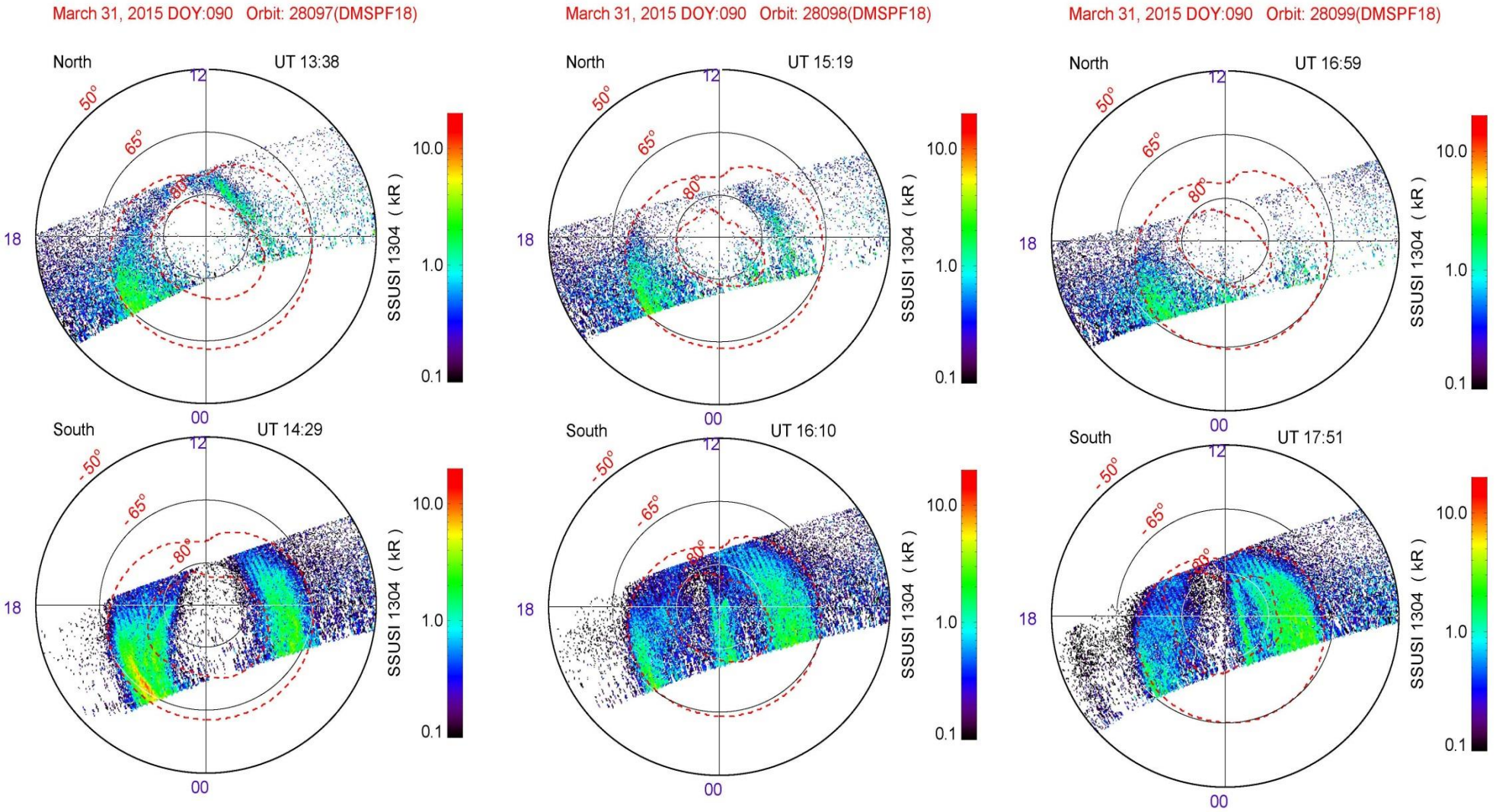


Black and blue points in the top left panel connected to the negative (old) IMF *By* and open field lines to positive (new) IMF *By*, respectively.

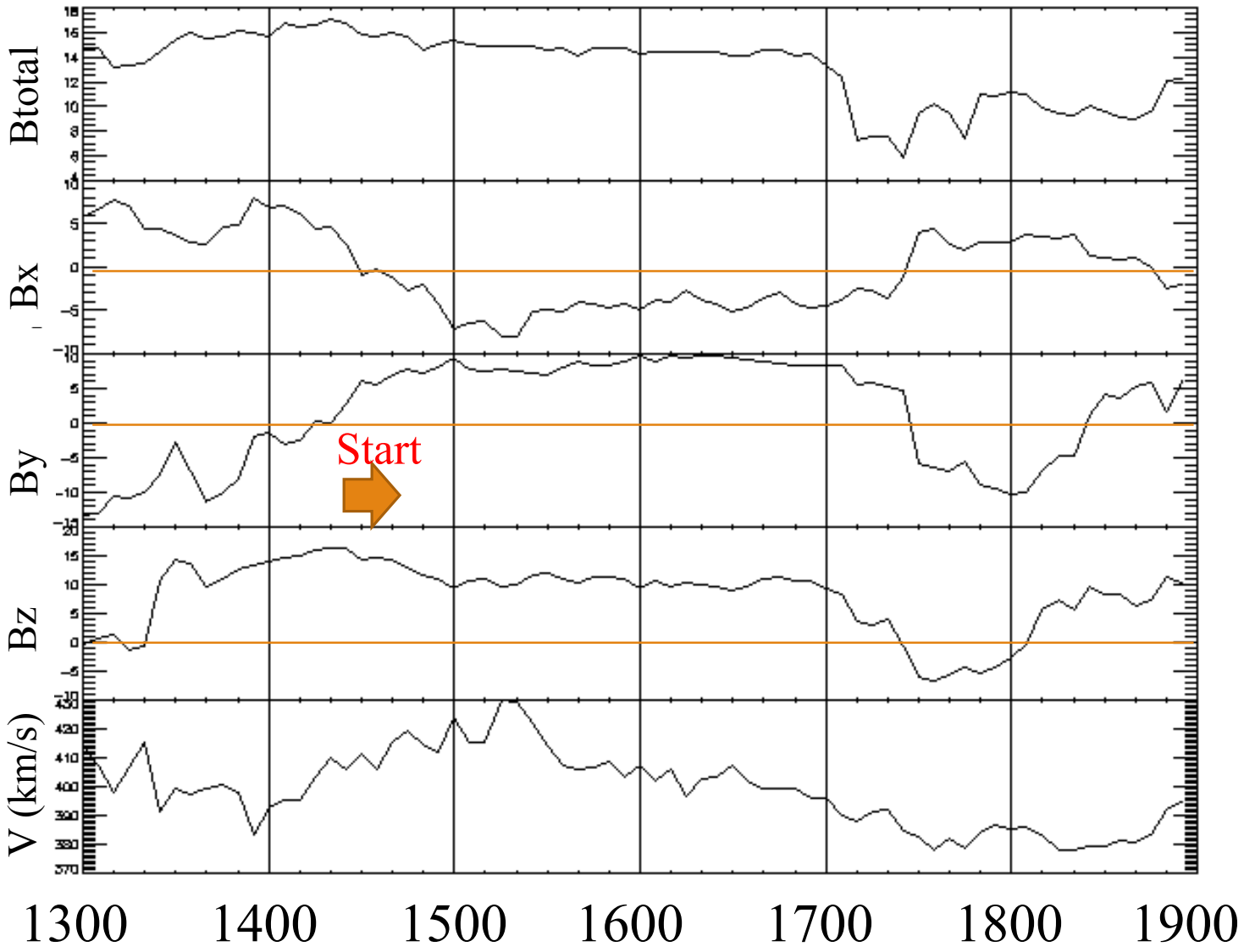
ローブ域で予想される Convection

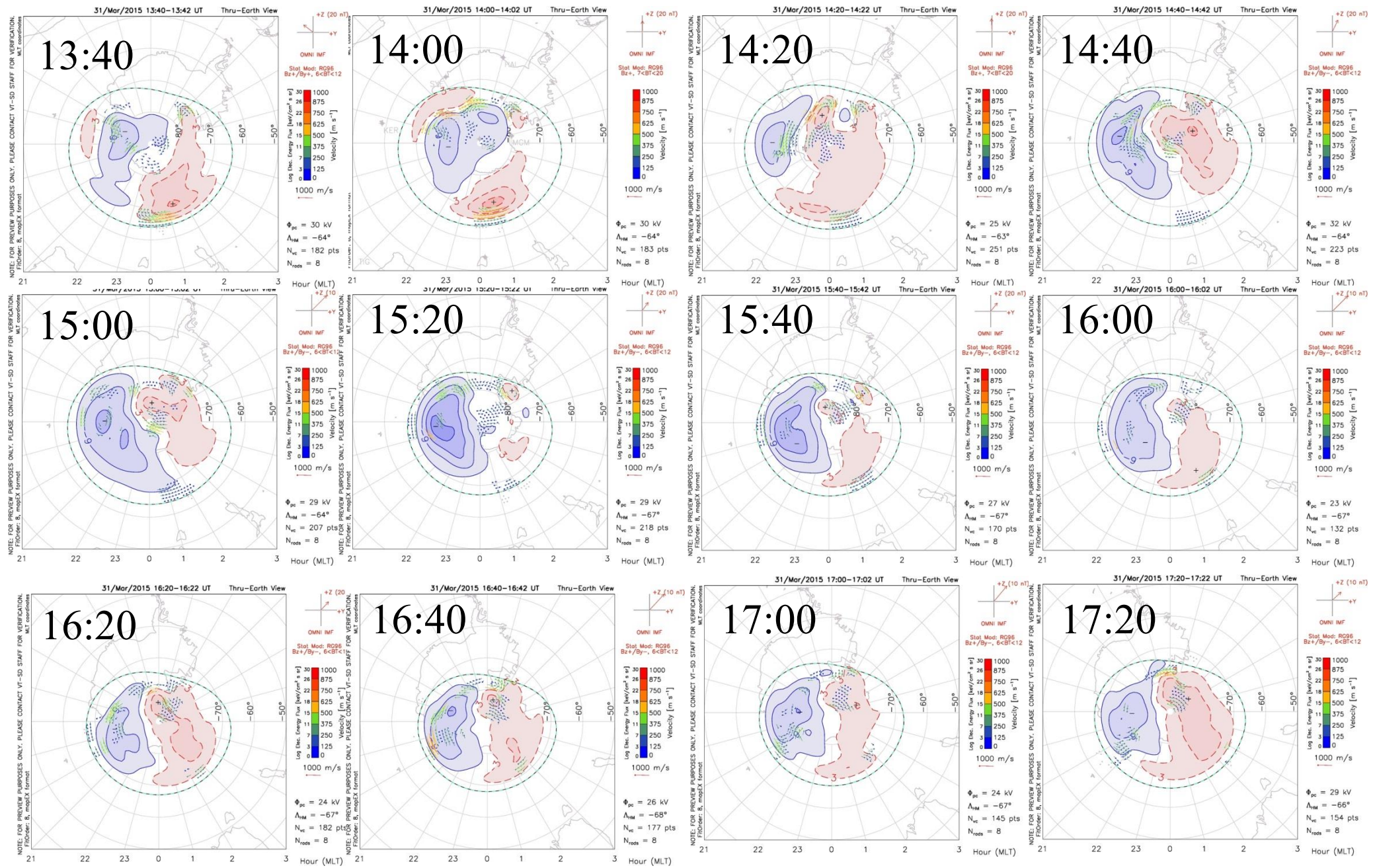


Changing the IMF By blocks the return path. Losing their return path, the closed field lines, generated from old lobes, accumulated on the night side.


March 31, 2015 DOY:090 Orbit: 28097(DMSPF18)
North
UT 13:38
South
UT 14:29
March 31, 2015 DOY:090 Orbit: 28098(DMSPF18)
North
UT 15:19
South
UT 16:10
March 31, 2015 DOY:090 Orbit: 28099(DMSPF18)
North
UT 16:59
South
UT 17:51
12
18
00
50°
65°
80°
-50°
-65°
-80°
10.0
1.0
0.1
SSUSI 1304 (kR)

2015.3.31 13UT – 18UT




13:40
14:00
14:20
14:40
15:00
15:20
15:40
16:00
16:20
16:40
17:00
17:20
Hour (MLT)

Summary and Future Works

In order to assess the MHD simulation results by Tanaka et al.(2004), we have examined observations by the IMAGE satellite by paying a particular attention to the movement of the transpolar aurora.

We identified in total 40 transpolar arcs and found 4 arcs were moving, consistent to Tanaka et al.(2004)

We are going to examine polar cap convection during moving arc event.

We also like to consider major case ;i.e. stagnant trans polar arc, by looking at Super Darn data together with MHD simulation result (probably constant IMF By with large amplitude).