Super DARN symposium, Oct. 16, 2018, Nagoya

サブストームの磁場トポロジー

Magnetic topology inducing the substorm

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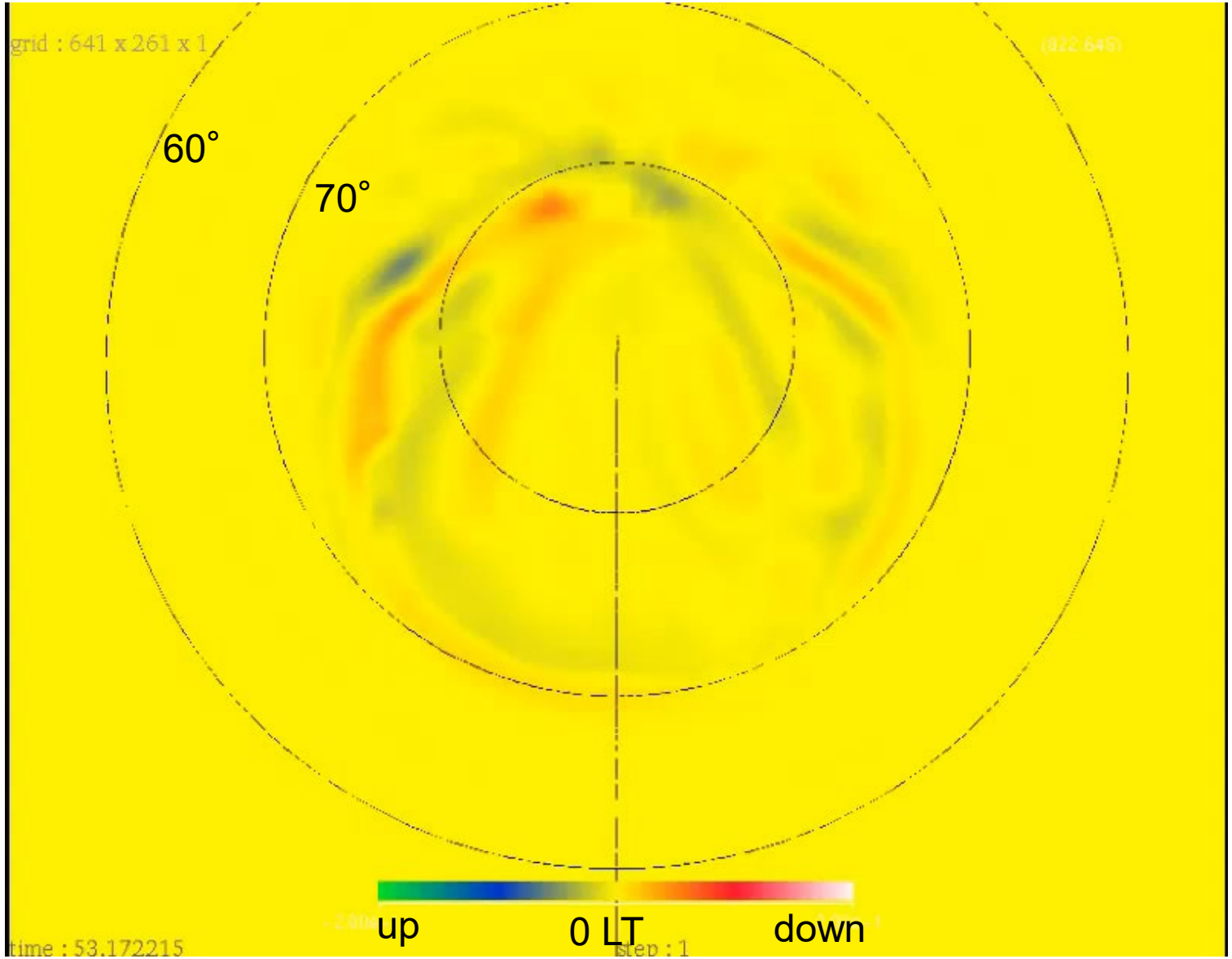
Key points - tow aspects of magnetospheric simulation

(1) Reproduction of dynamics (FAC & dynamo)

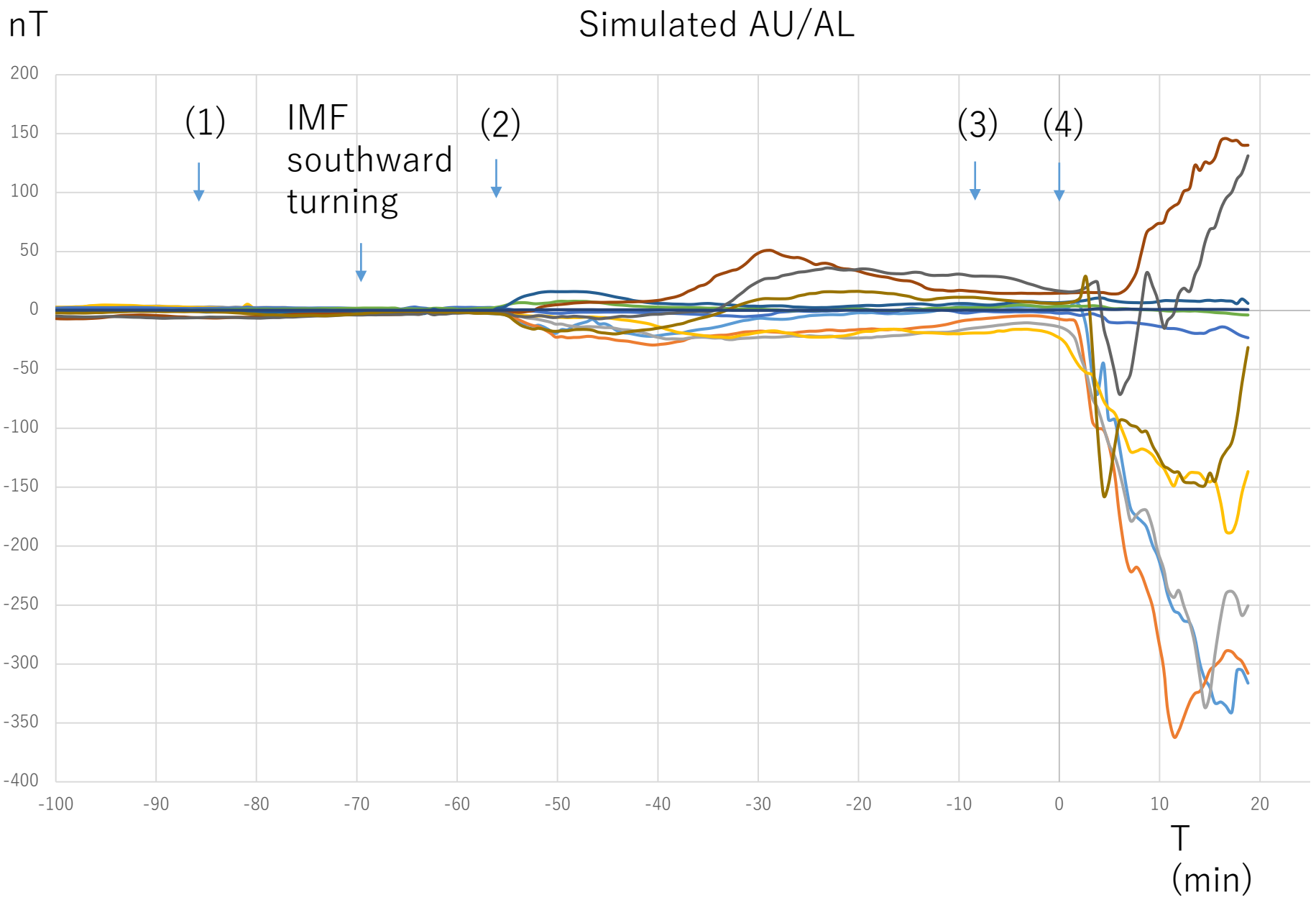
(2) Reproduction of topology (null-separator)

High-resolution simulation of the substorm FAC

(sun-aligned arc, quiet arc, initial brightening, WTS, omega)



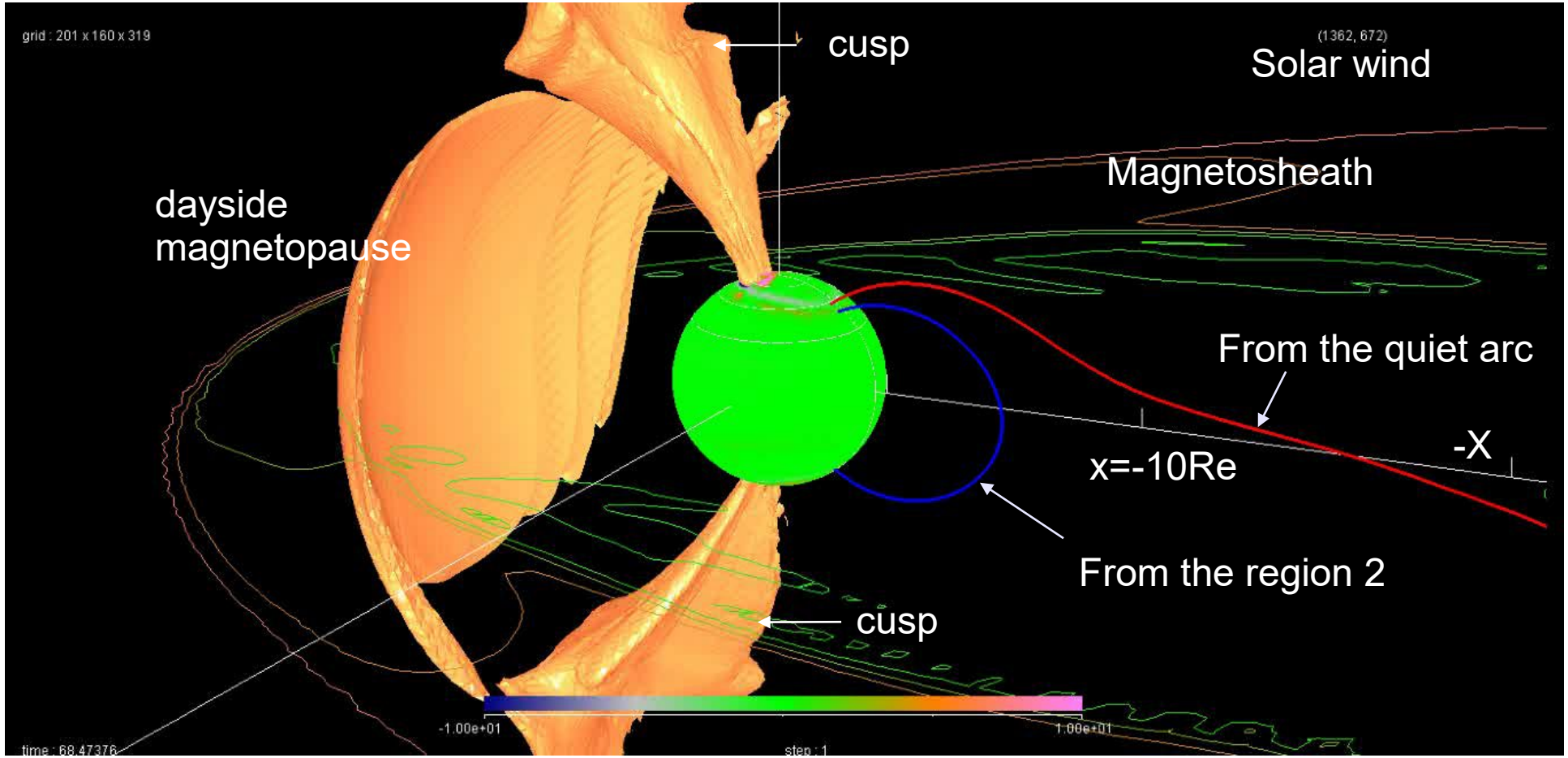
サブストームFACの変動


nT
Simulated AU/AL
(1)
IMF
southward
turning
(2)
(3)
(4)
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
-400
-100
-90
-80
-70
-60
-50
-40
-30
-20
-10
0
10
20
T
(min)

Transition from the growth phase to the expansion phase

(orange; iso-pressure surface, contour; Vx on the equatorial plane, color; FAC on the 2.6 Re surface, red and blue lines; magnetic field)

Z



Y

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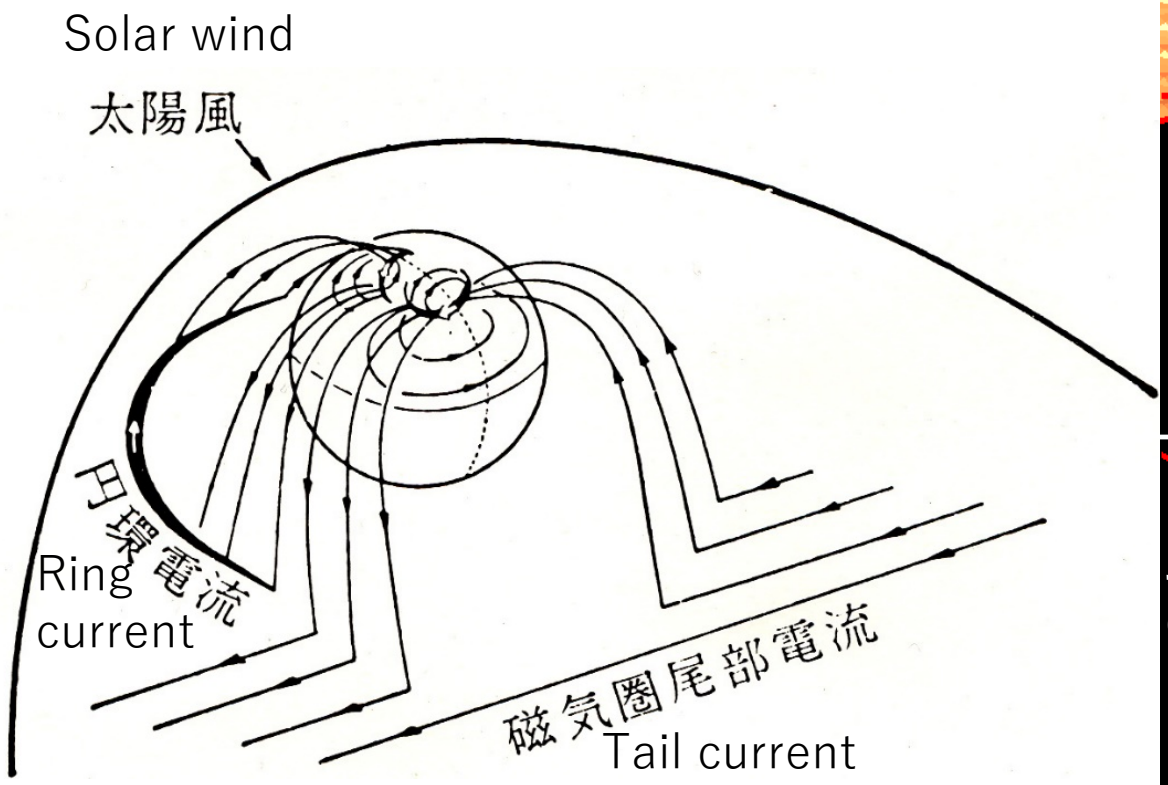
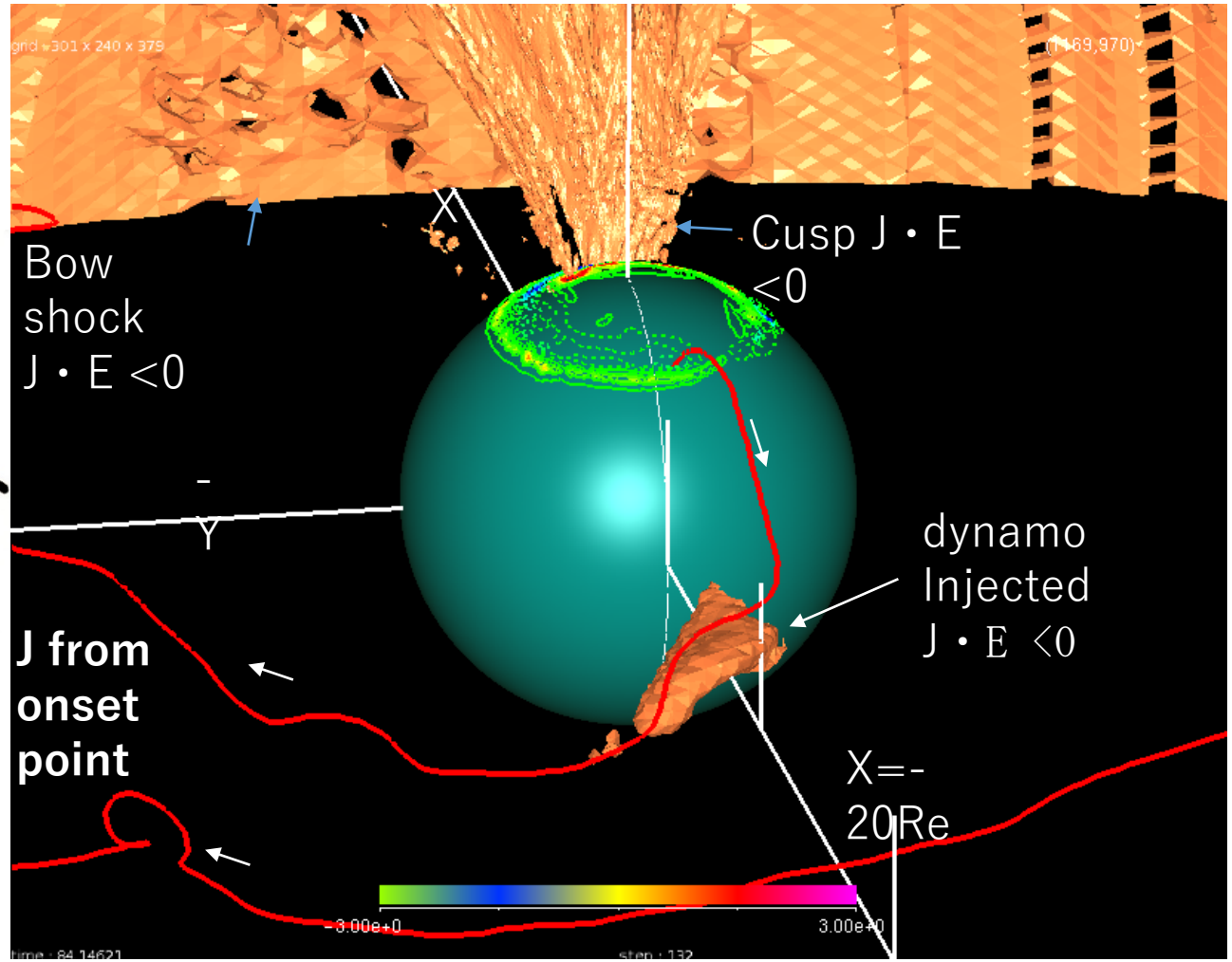
Current wedge（left） and Near-Earth Dynamo (right)

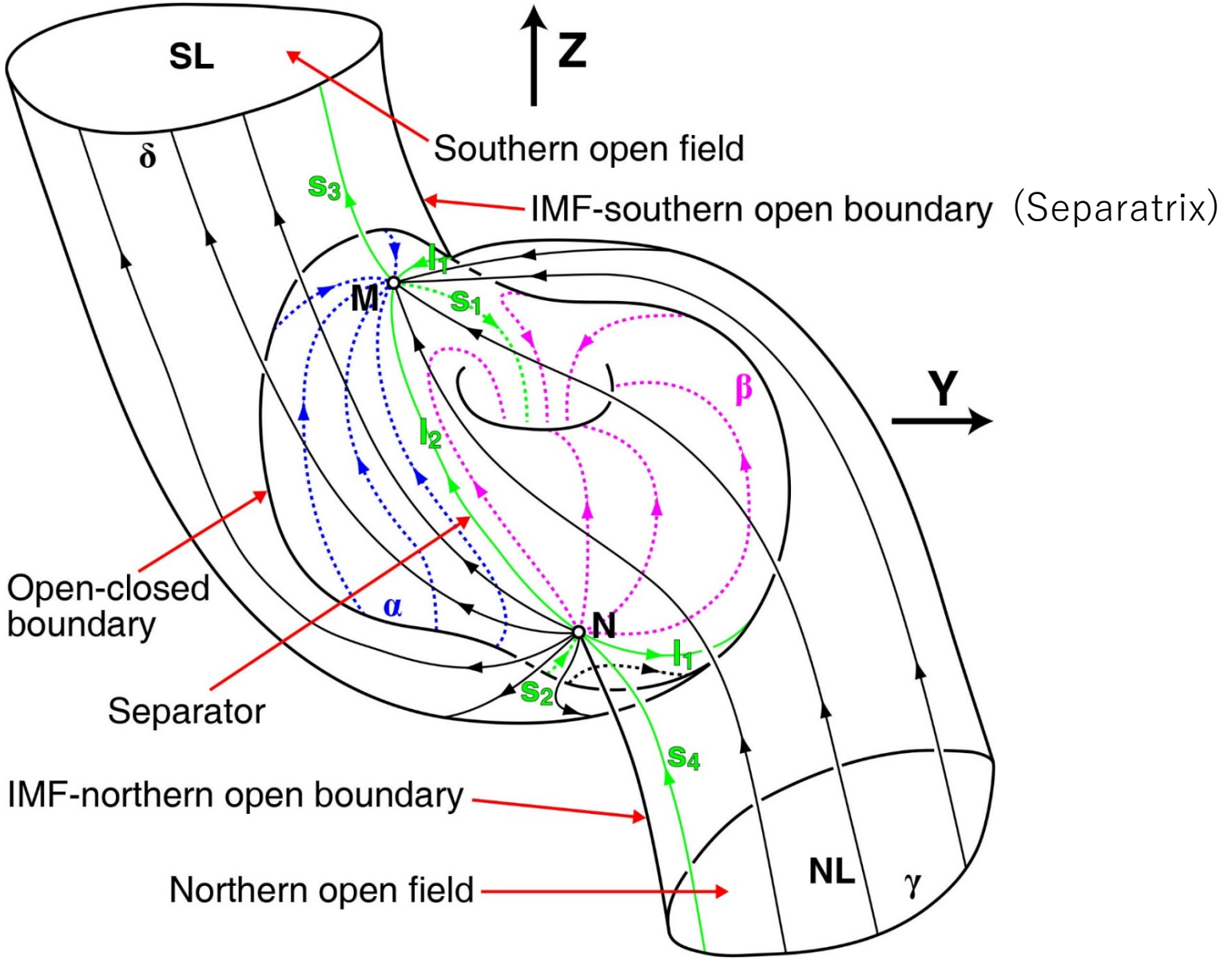
(Onset current / initial brightening)





Magnetic topology : superposition of dipole field and uniform IMF

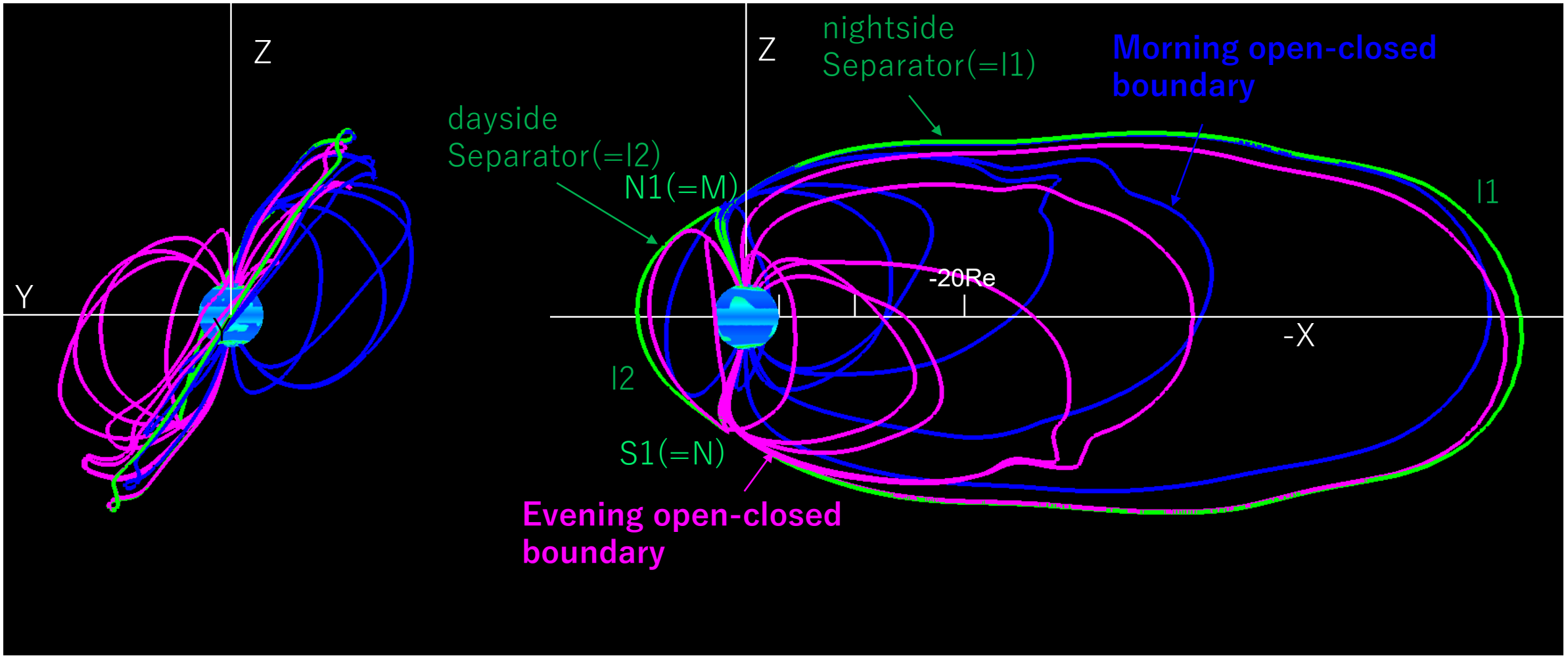
1. Detached (IMF)
2. Norther open
3. Southern open
4. closed



Figure

Open-closed boundary under the northward IMF reproduced from the global simulation

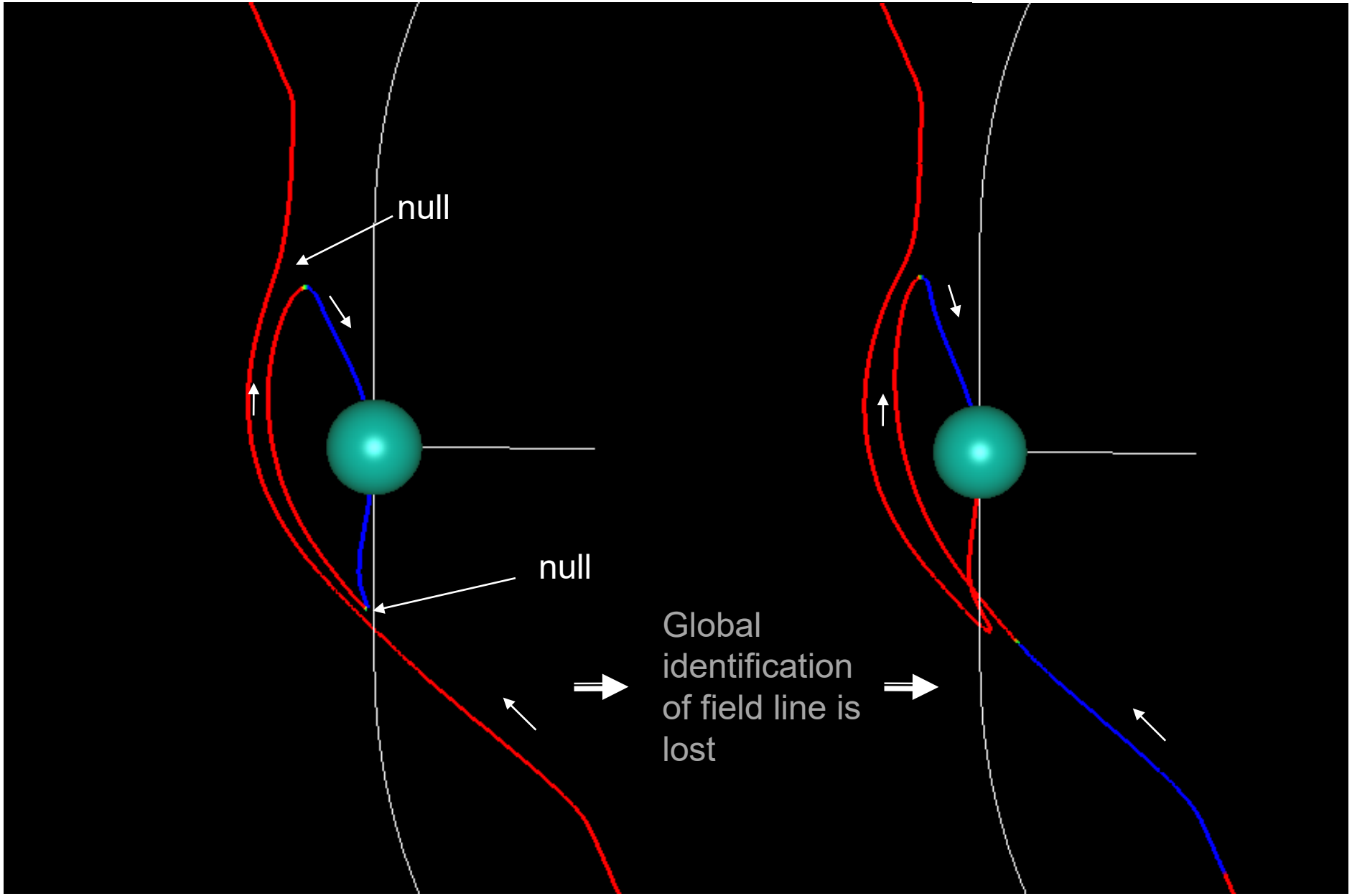
(topology + dynamics)



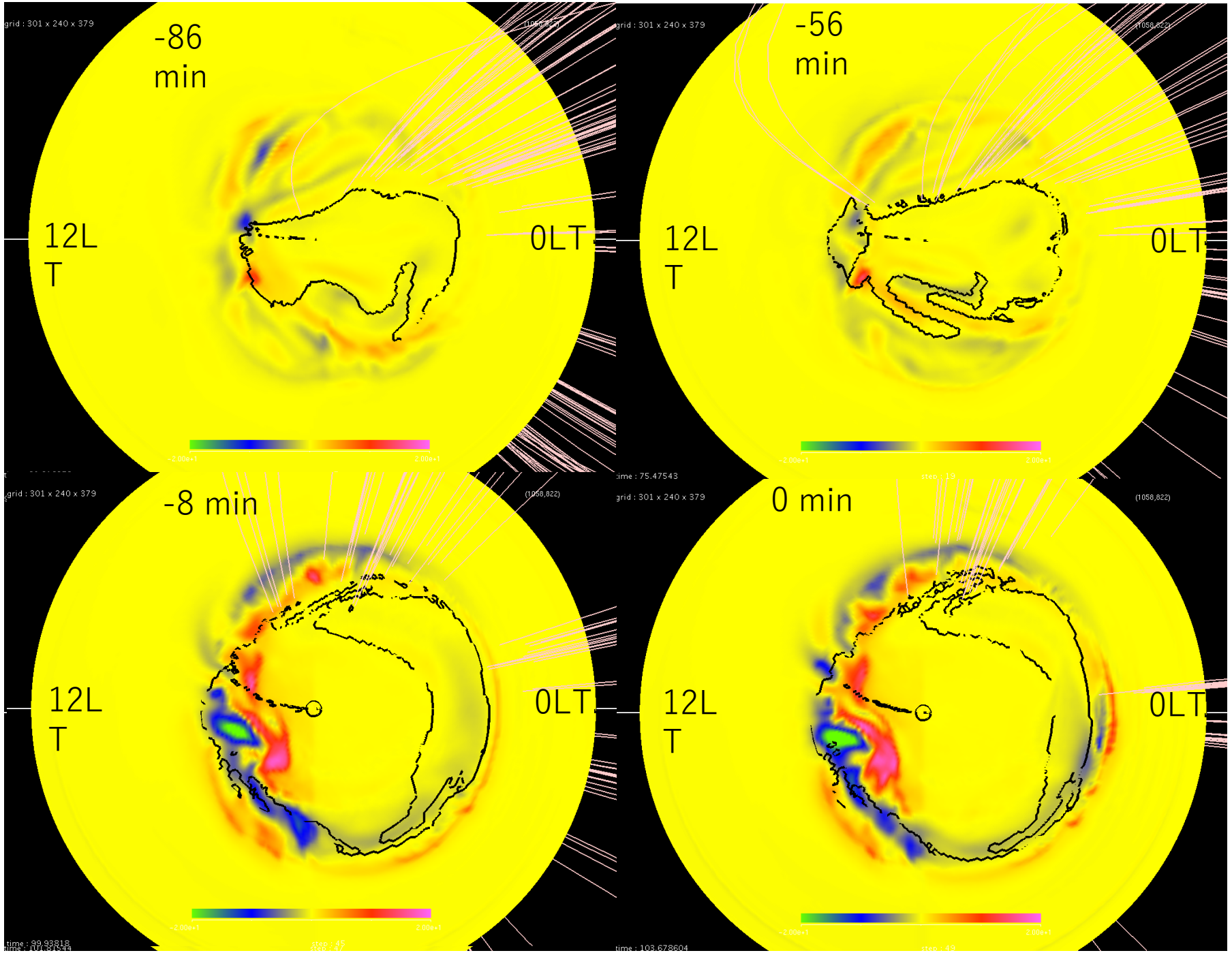
Figure

Dayside 3D separator reconnection (northward IMF)

Solar wind – magnetosphere interaction

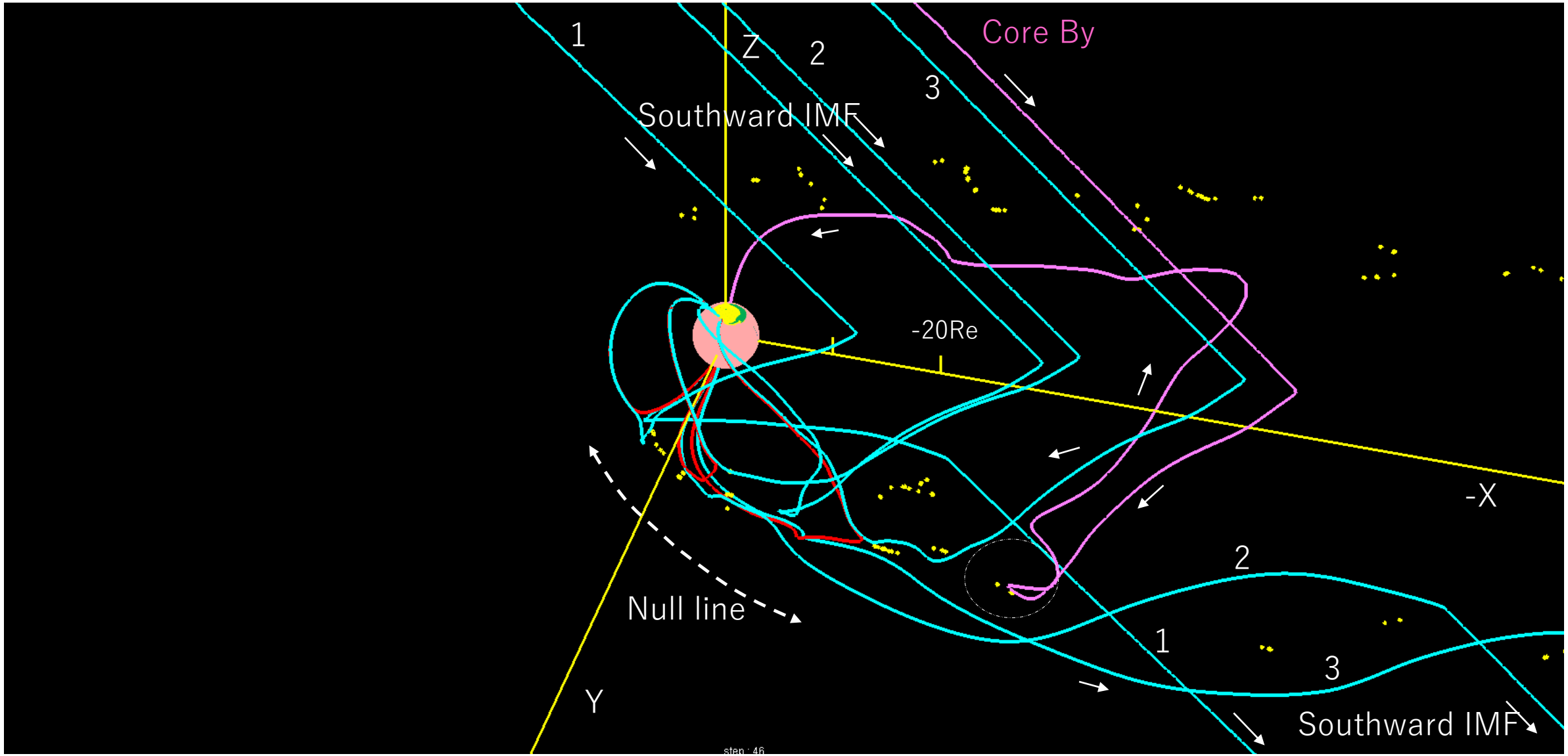


Ionospheric
Open region (black line)
Closed region (black line)
FAC(color)



First open field lines connected to the southward IMF

(NSO first open + C last closed + null line + core By)



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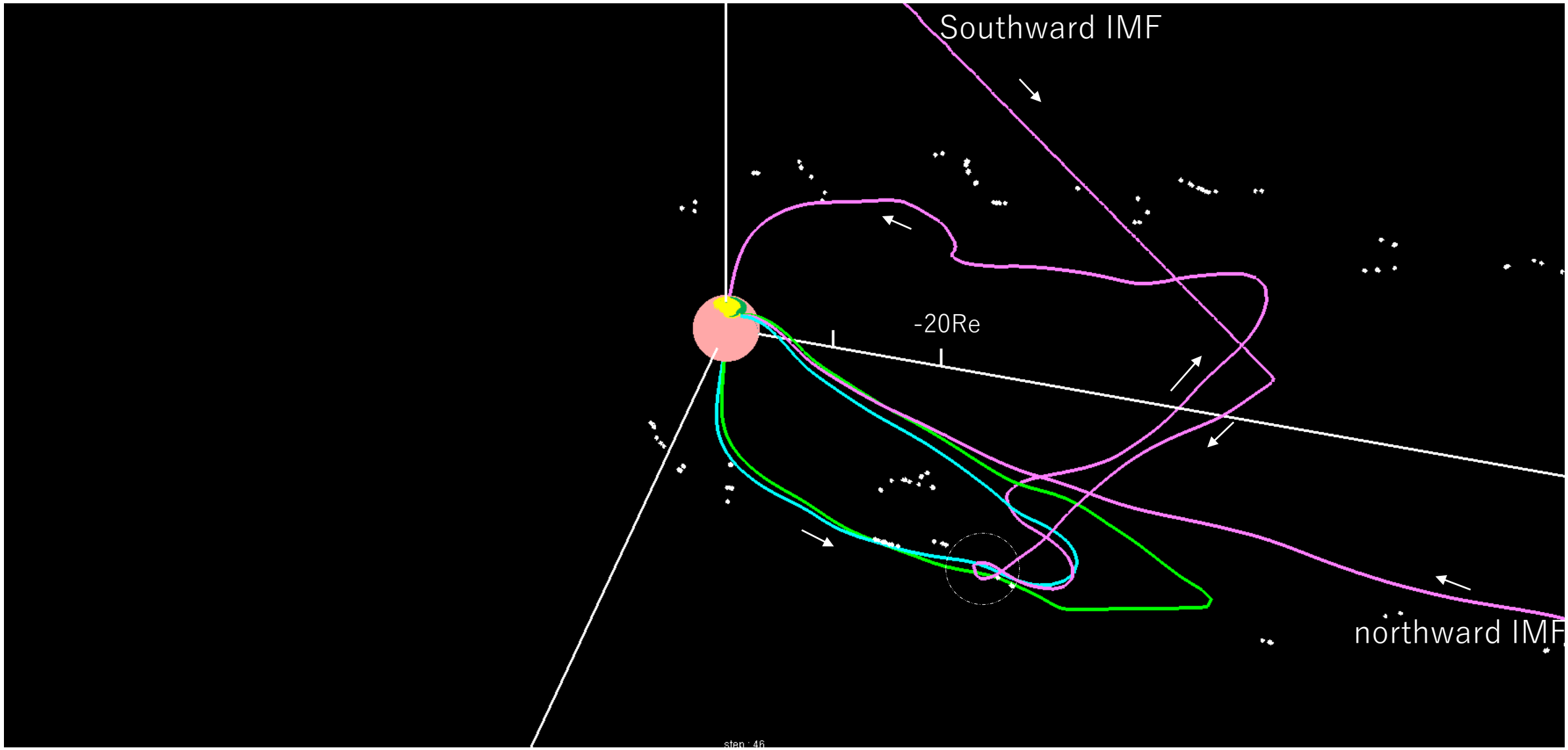
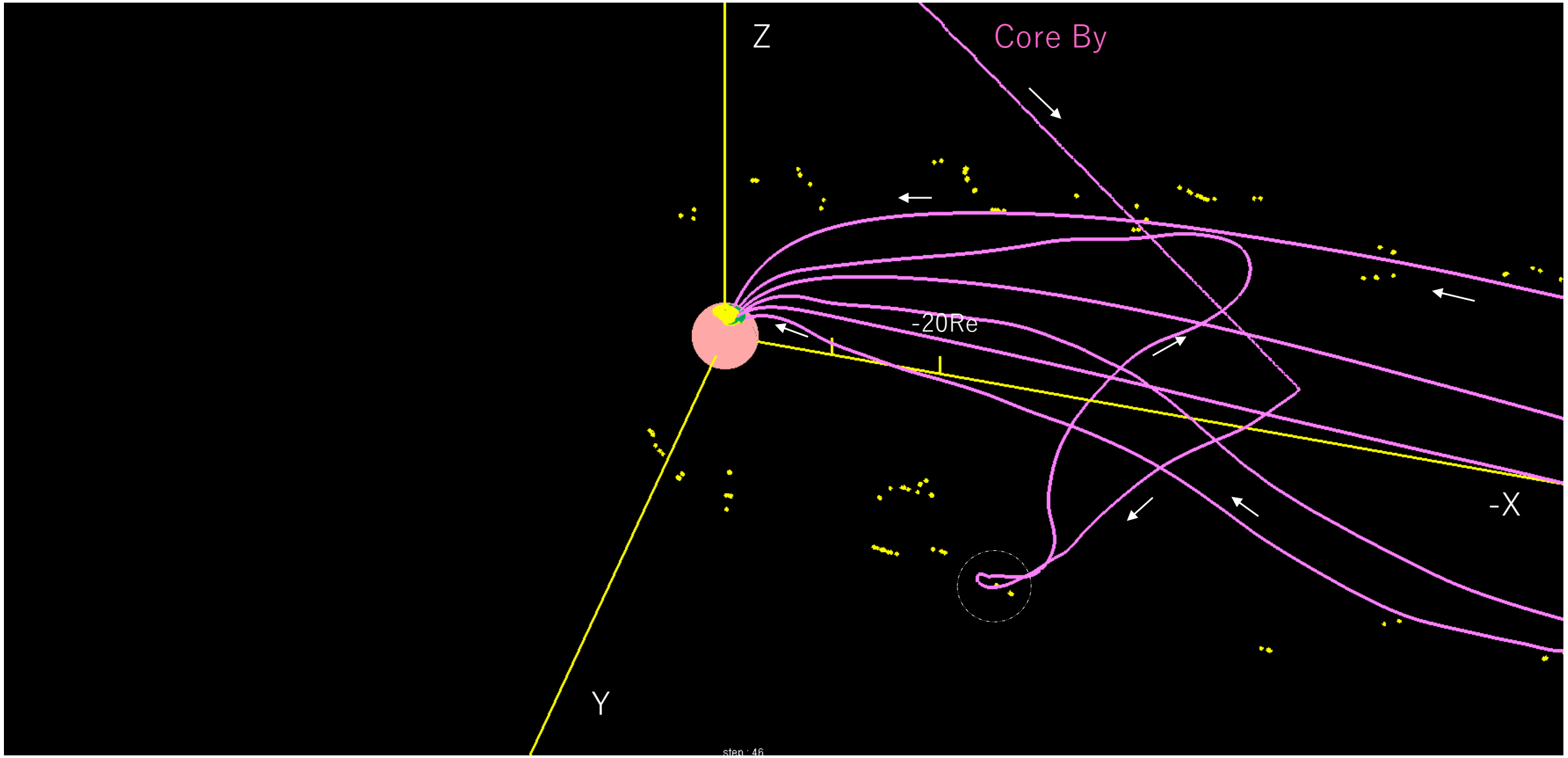
Magnetic field lines leading to the triple points on the ionosphere

(color: topology)



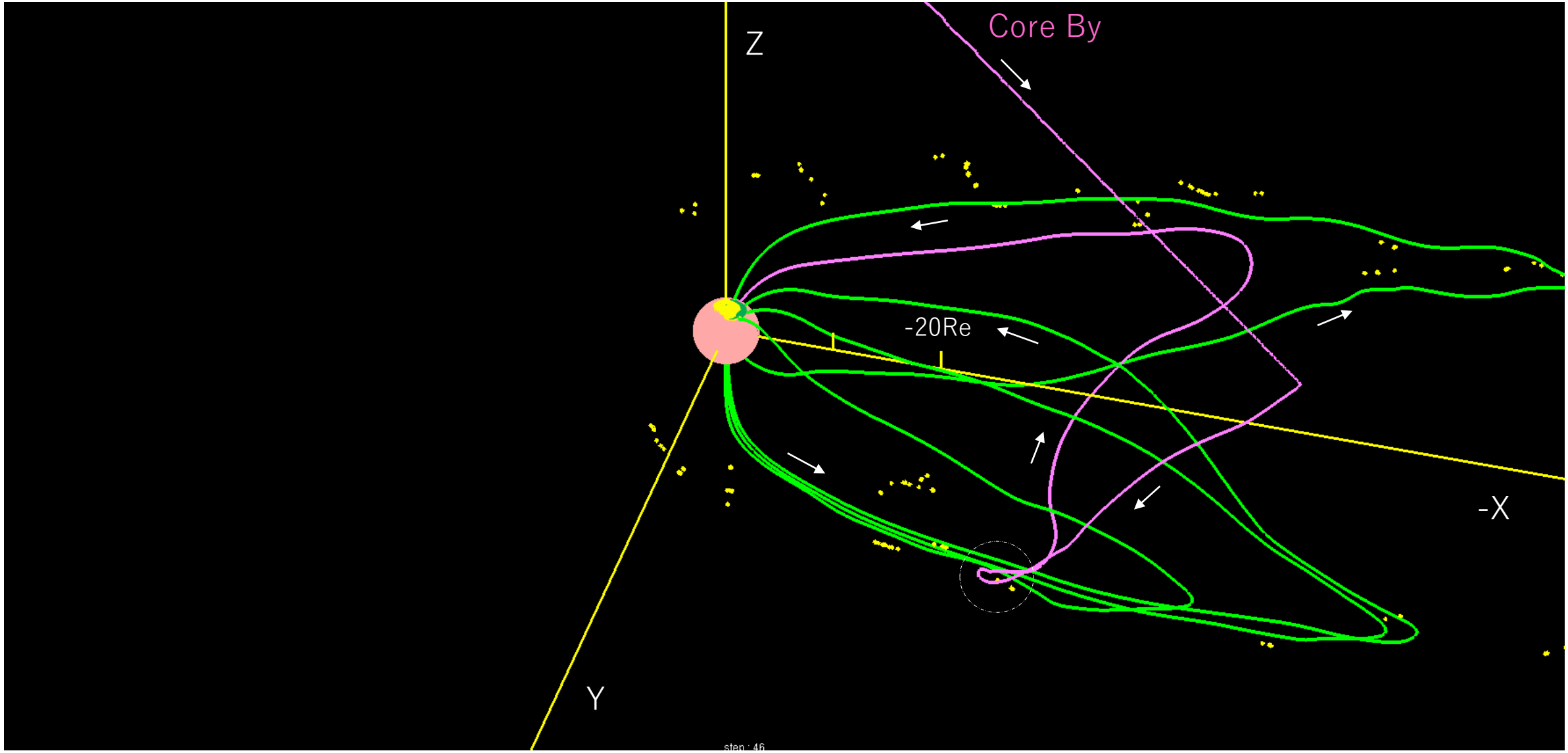
Open field lines connected to the northward IMF

(2nd layer open + core By)



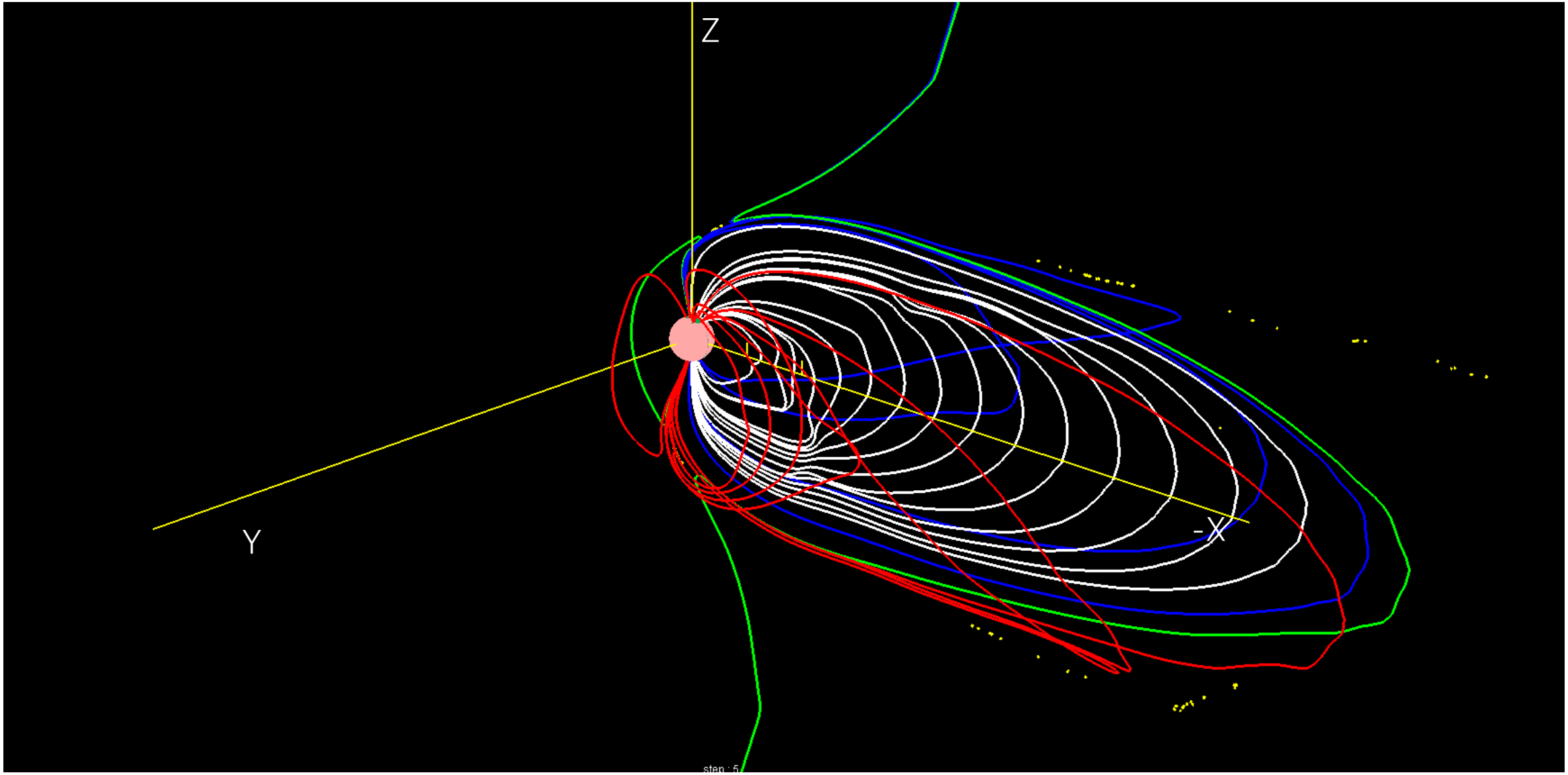
Last closed field lines in the northward IMF region

(3rd layer closed + core By)



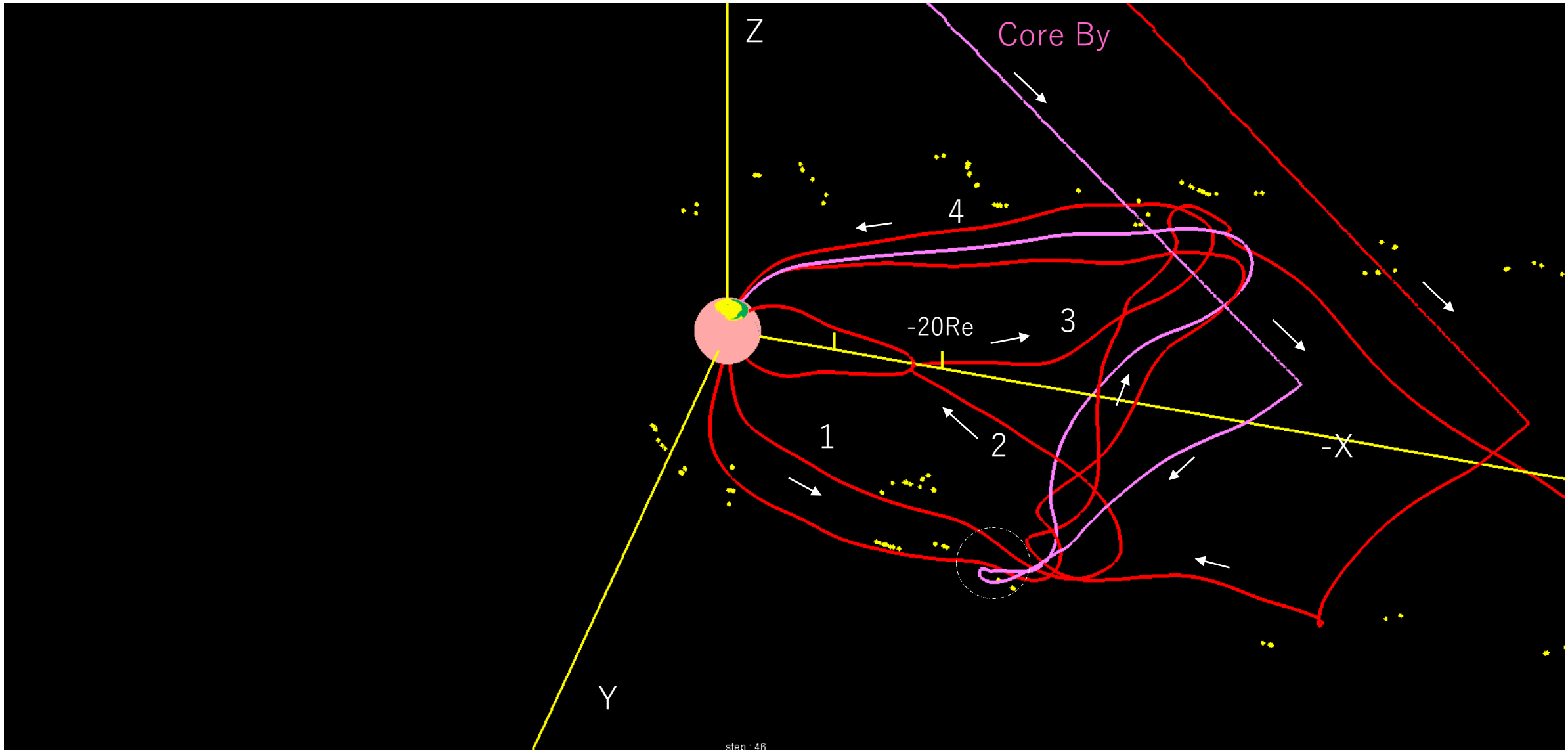
2 null 2 separator configuration under the northward IMF

(green: separator, red and blue: last closed, white: plasma sheet center)



Plasma sheet magnetic field lines

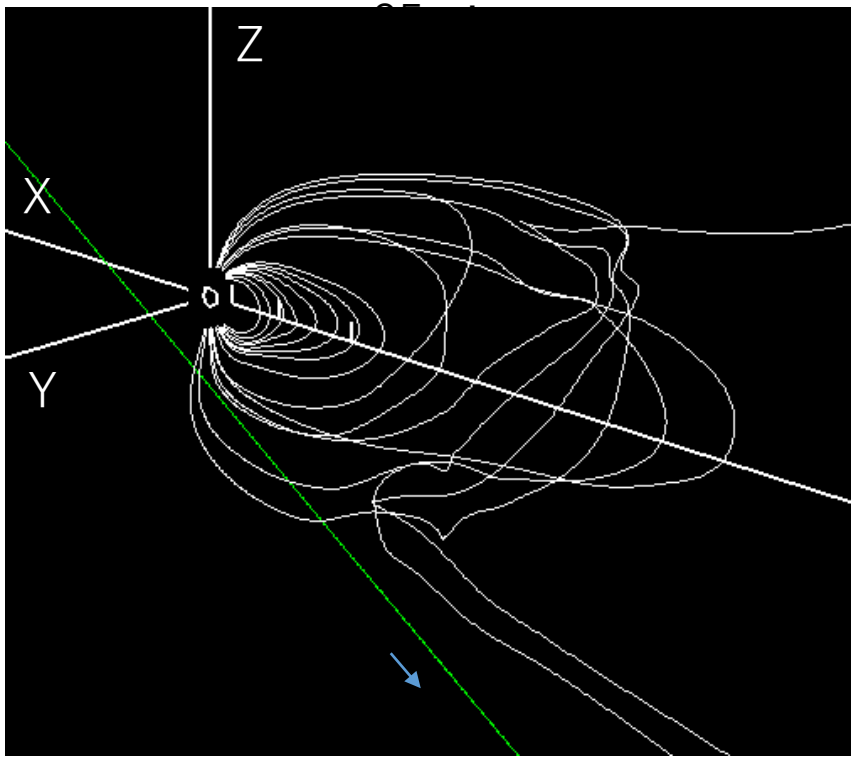
(3rd layer closed + core By + W-form)



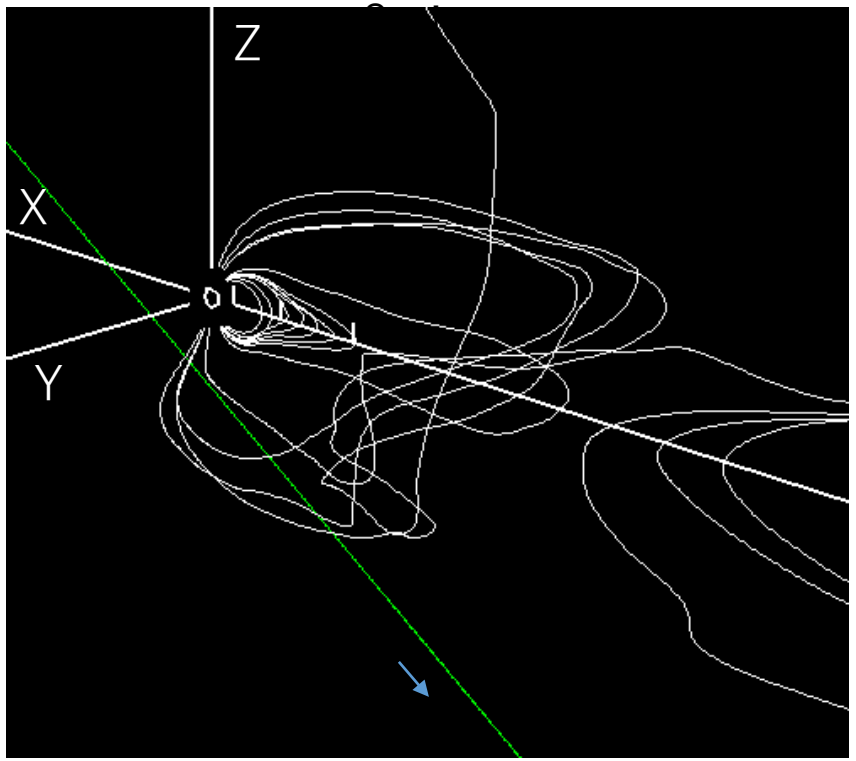
Three stages of tail reconfiguration to the onset

interchange of plasma sheet field by retreating nulls
plasma sheet reconnection in the W form
NENL and plasmoid with the reconnection line

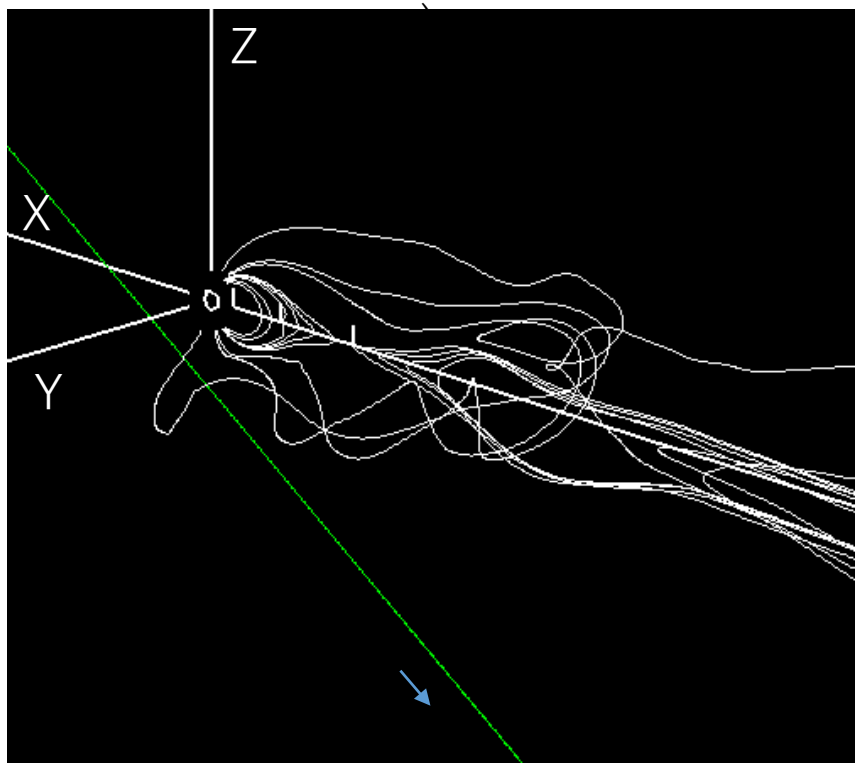
T=-



T=-

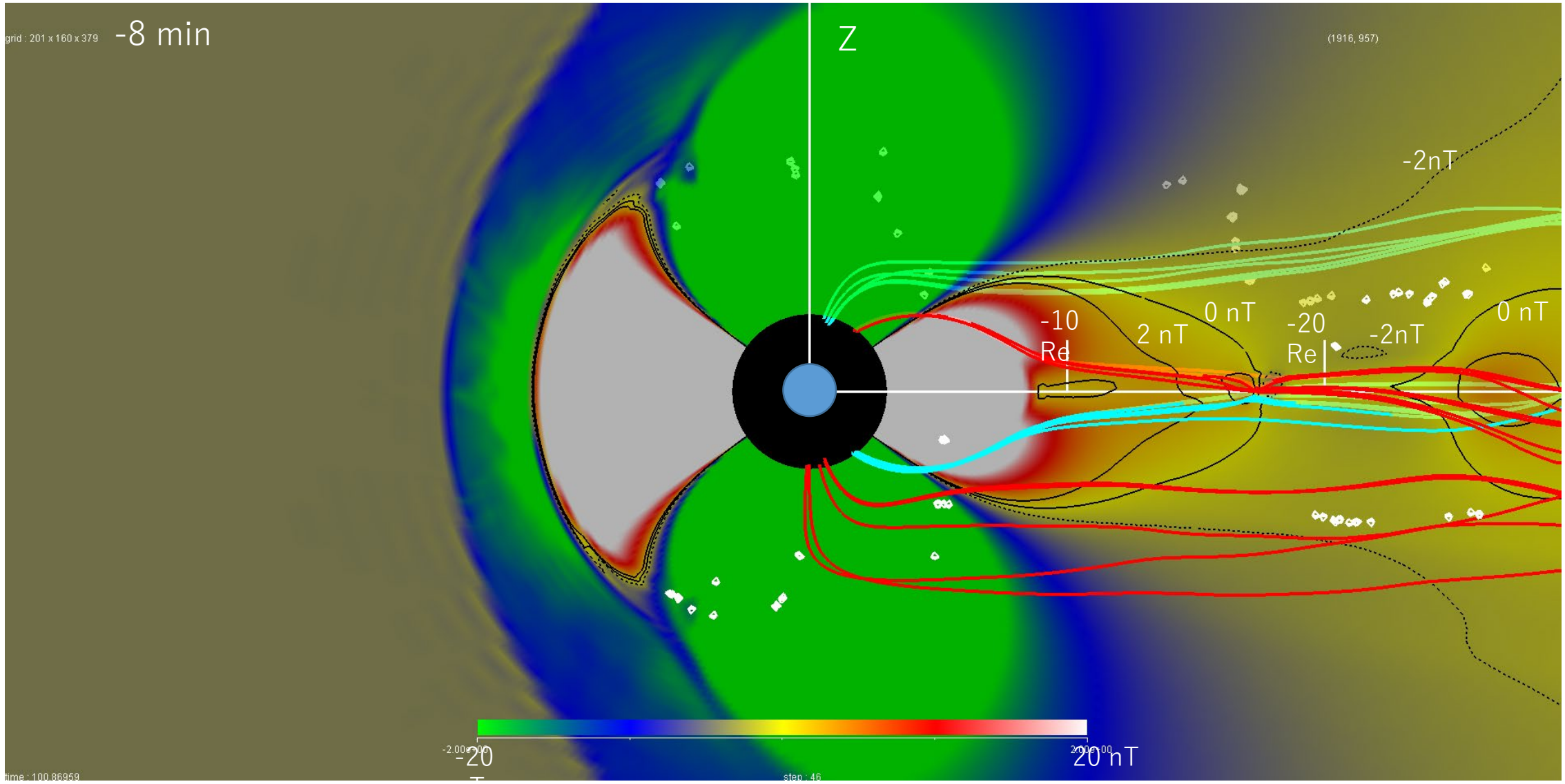


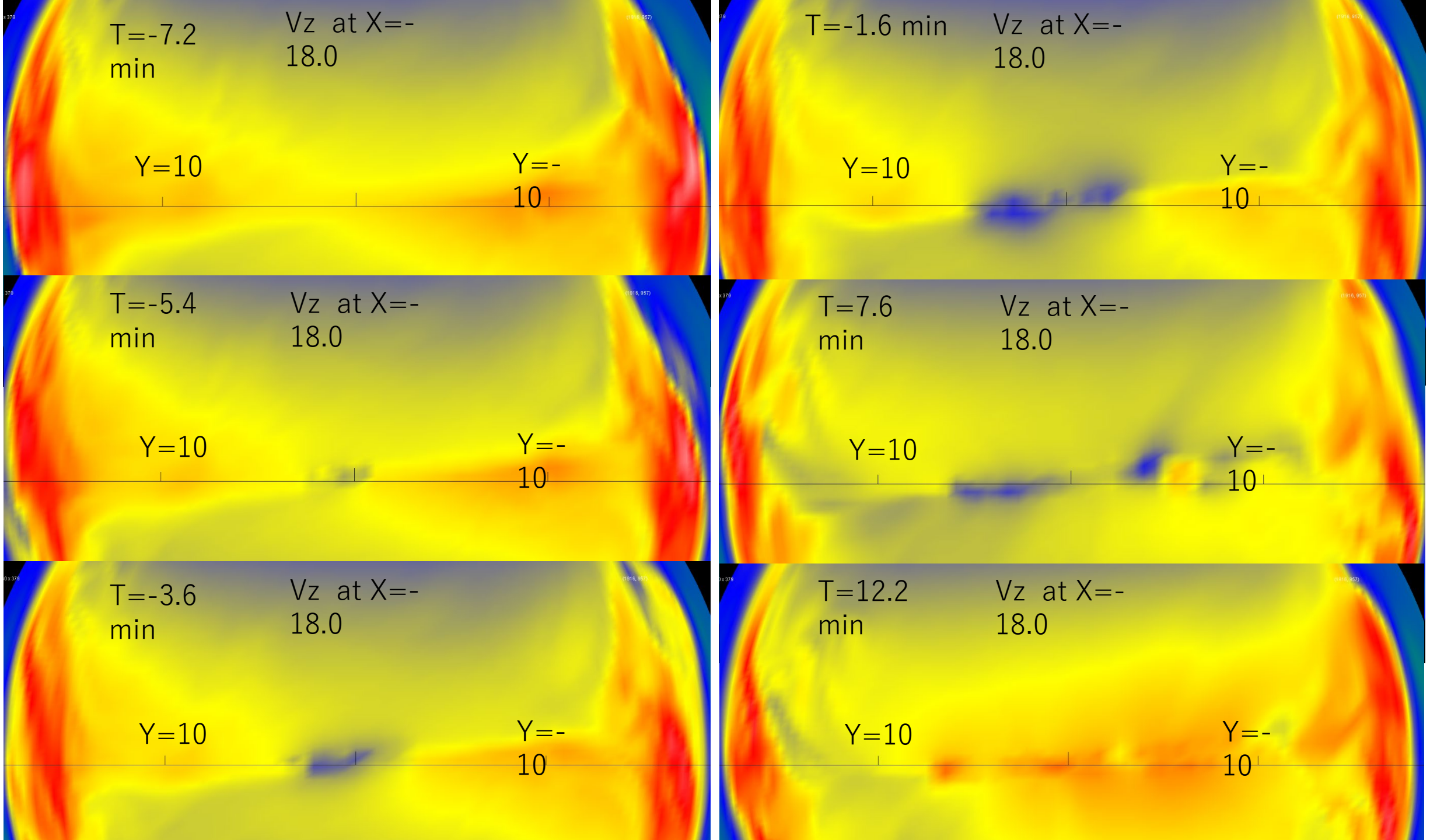
Onset (T=0



Plasma sheet reconnection

(plasma sheet closed field lines, shading Bz, black line Bz=-2, 0, 2)



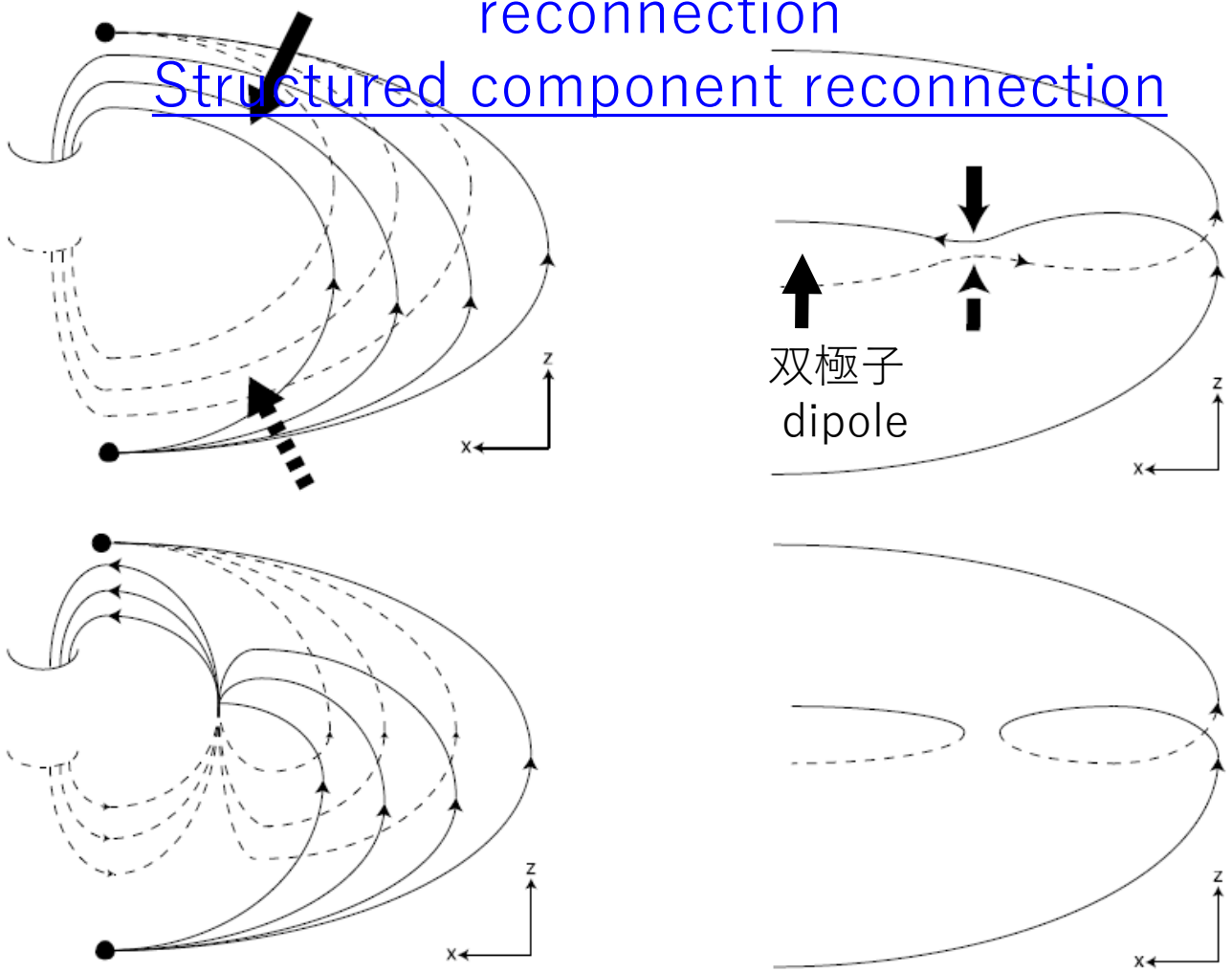

T=-7.2 min
Vz at X=-18.0
Y=10
Y=-10
T=-1.6 min
Vz at X=-18.0
Y=10
Y=-10
T=-5.4 min
Vz at X=-18.0
Y=10
Y=-10
T=7.6 min
Vz at X=-18.0
Y=10
Y=-10
T=-3.6 min
Vz at X=-18.0
Y=10
Y=-10
T=12.2 min
Vz at X=-18.0
Y=10
Y=-10

双極子領域の縁で2つのセパラトリックスの接触によるNENLの誘導

Contact of two separatrices at the edge of the dipolar region

Bzの構造→structured,　By成分の残存→component reconnection

Structured component reconnection



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