

2013.10.1 極端宇宙天気研究会

極端宇宙天気シミュレーション

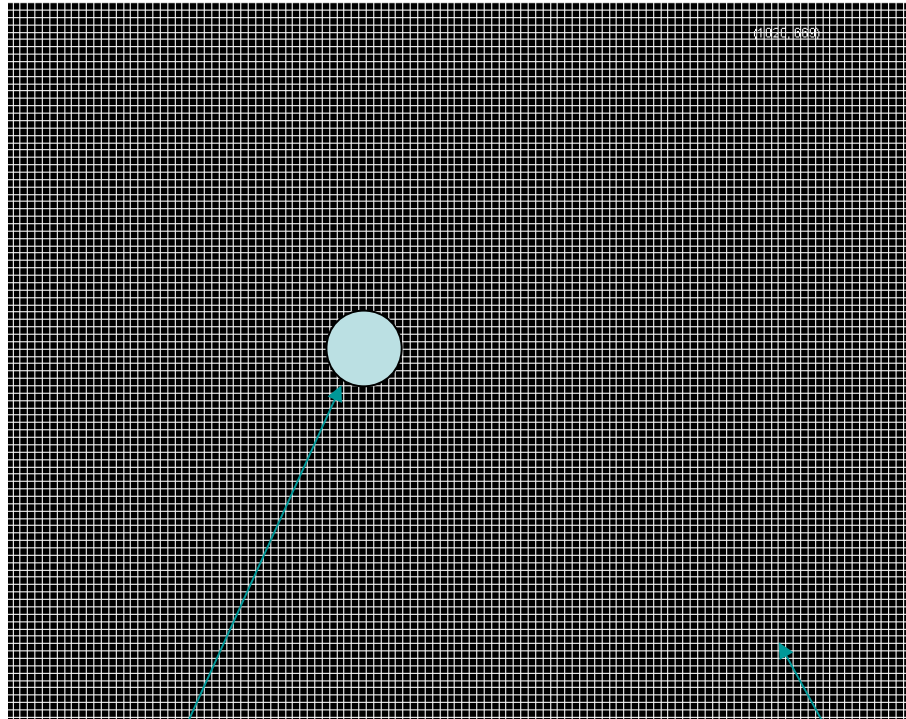
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田中高史

NICT
田 光江

対流構造を再現するM-I結合シミュレーション

(要点: 対流およびFACの空間分解能)

子午面



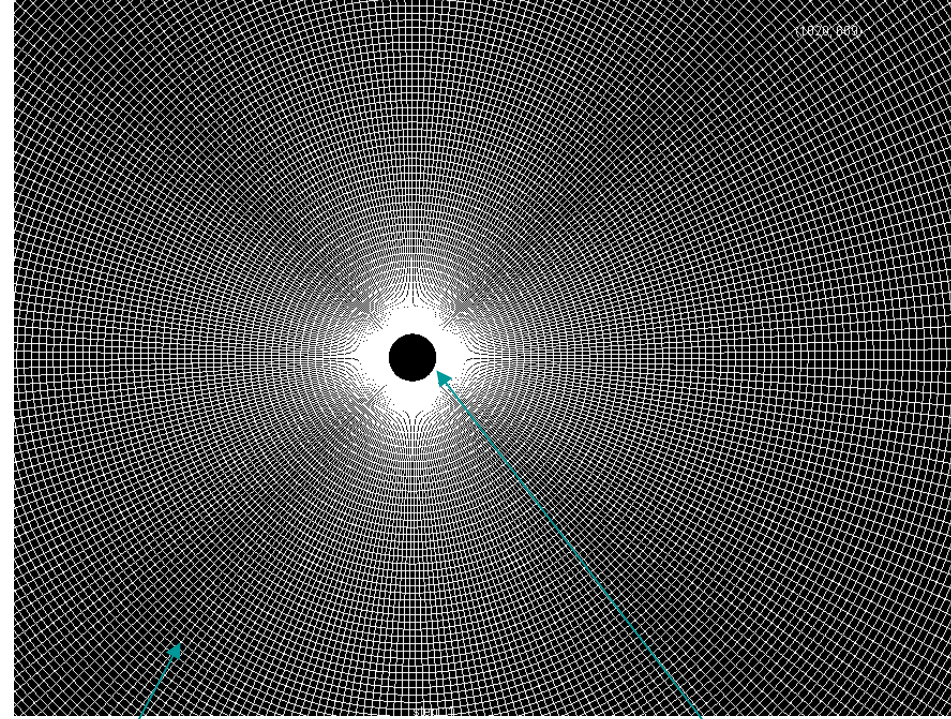
10^2

電離圏

100^3

磁気圏

子午面



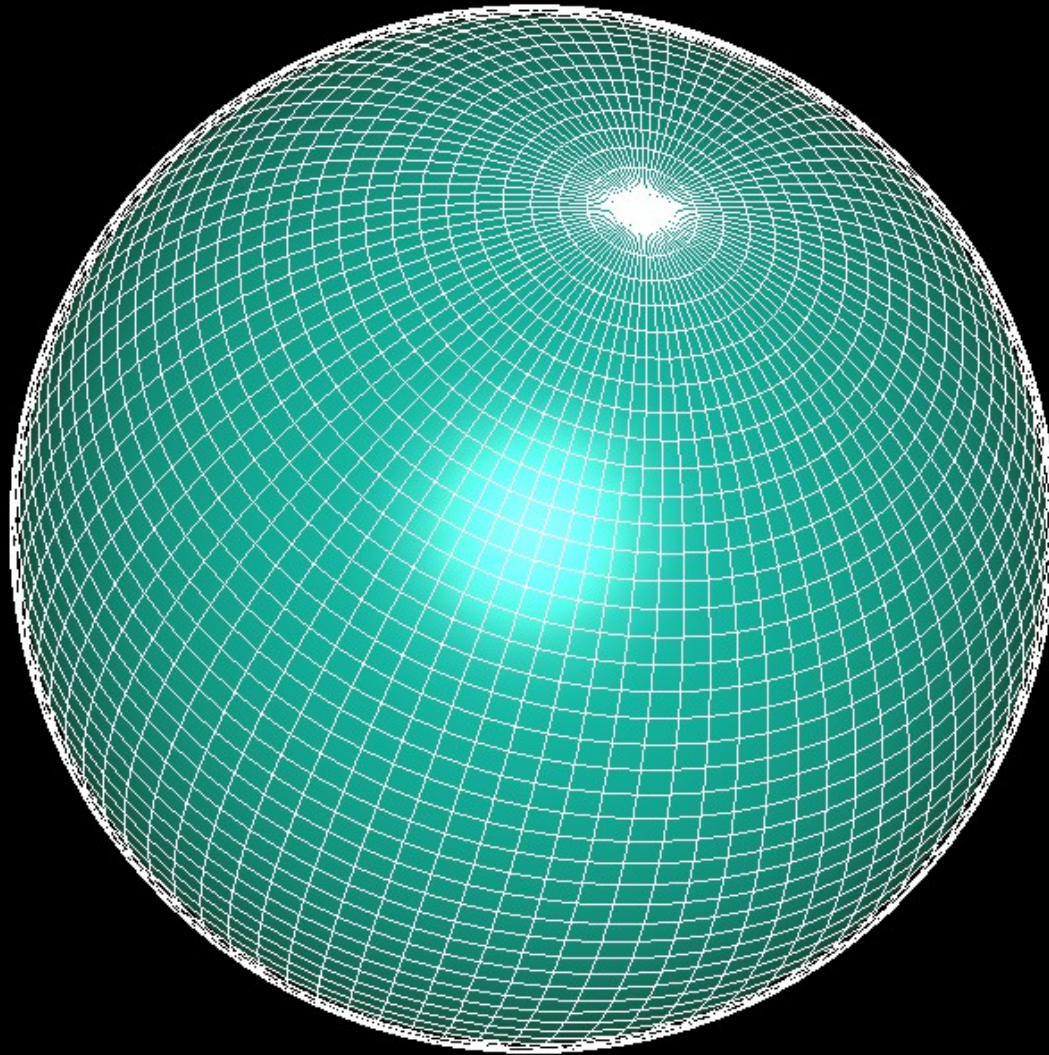
100^2

電離圏

2次元球面上の格子と見かけの特異点 (第1作、同心球の積み重ね→3D格子)

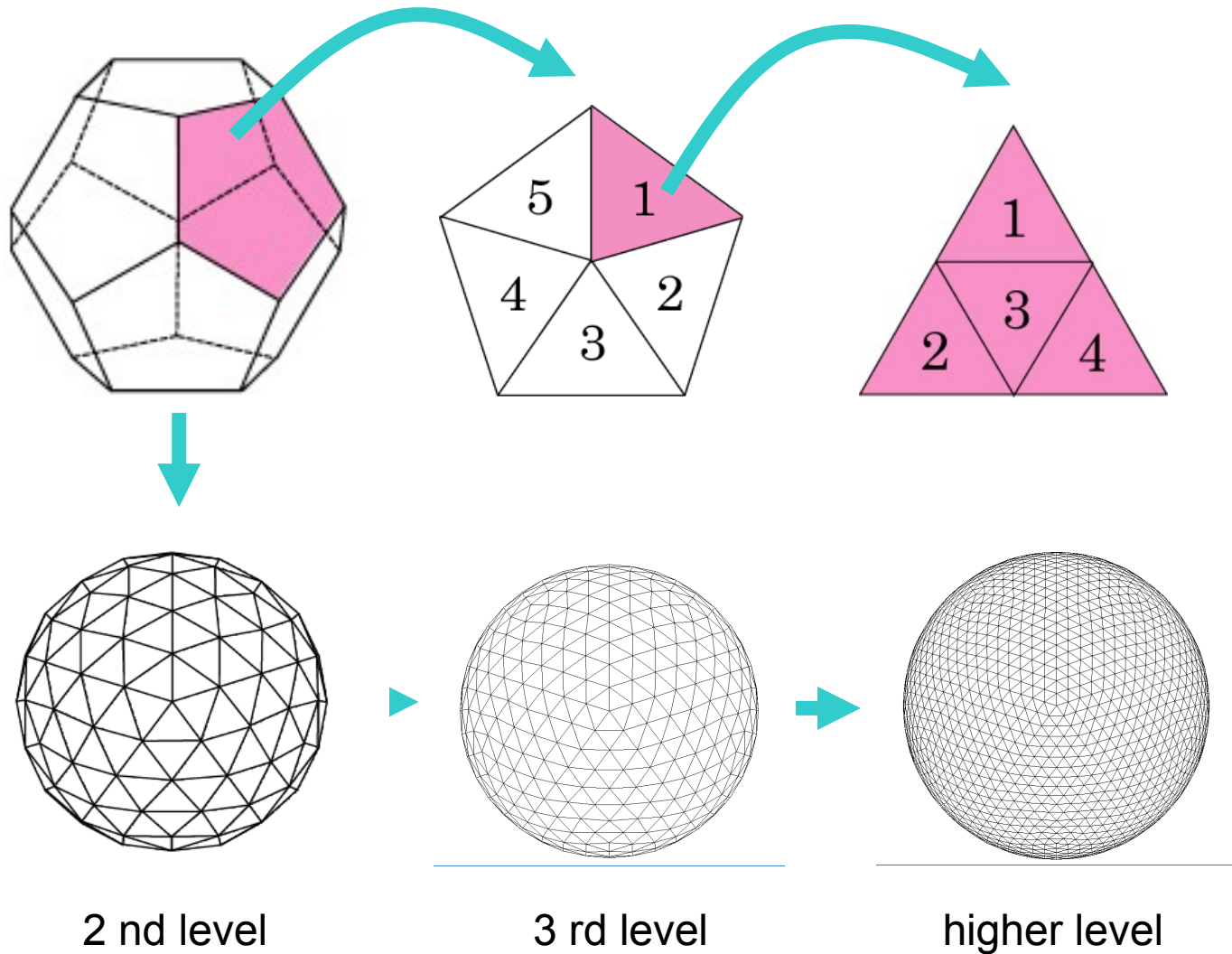
grid : 89 x 60 x 199

(1020, 669)



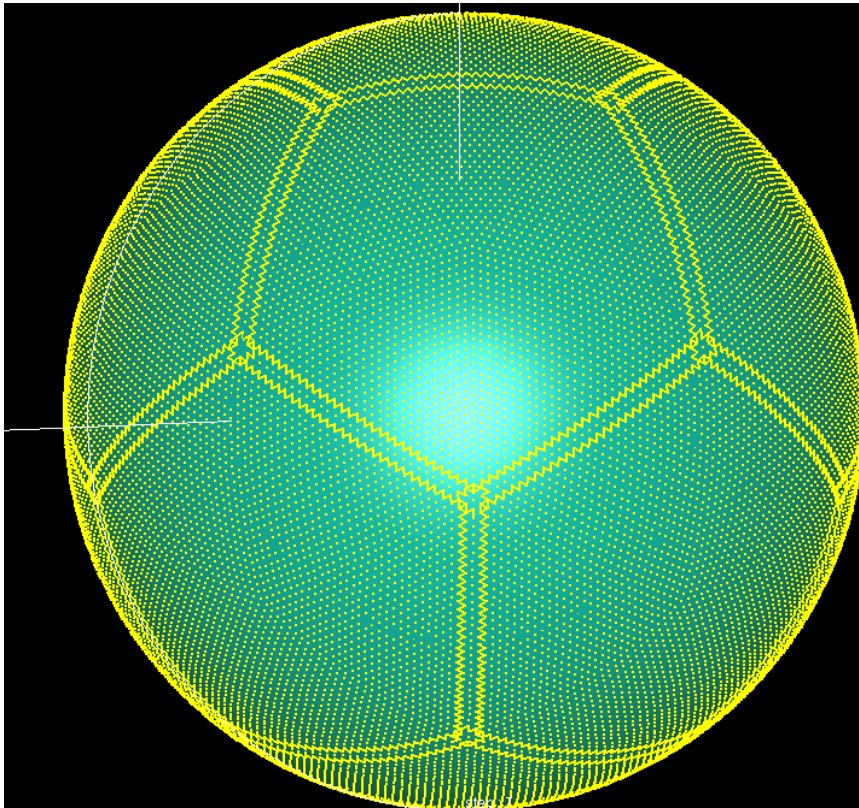
Generation of the triangular grid system from a dodecahedron

(stacking co-central spheres $\rightarrow$ 3D)

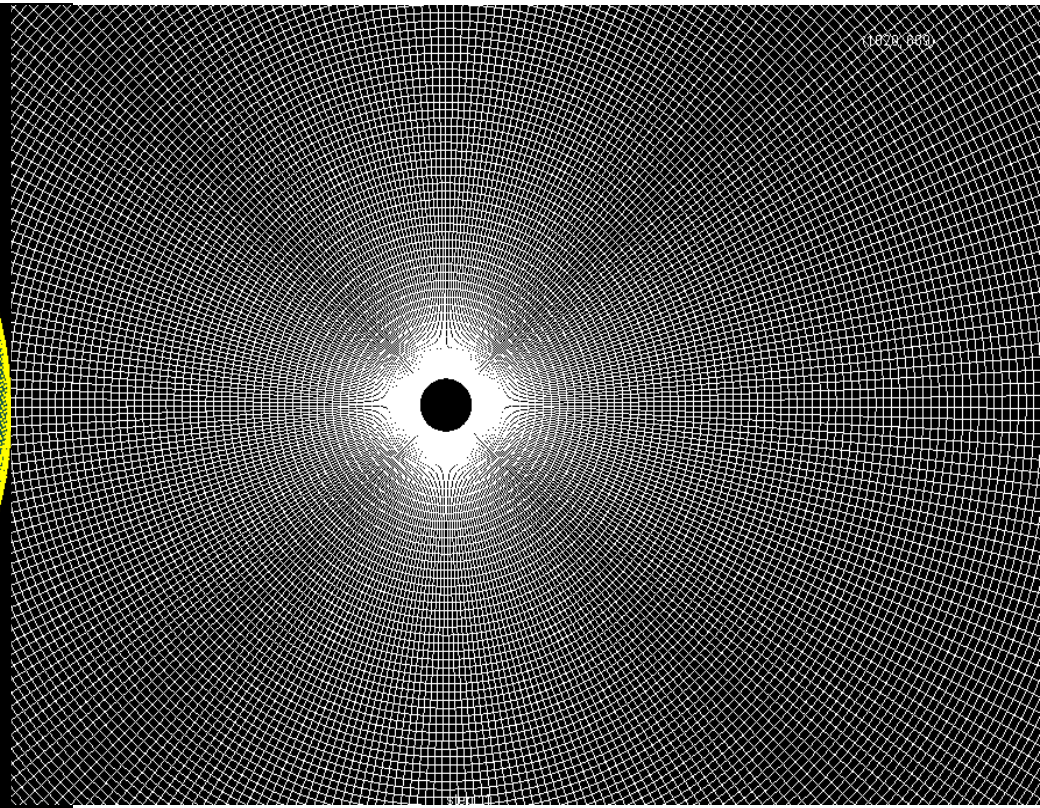


3D grid system (level 6) for parallel simulation

(data connected by lines must be transmitted between blocks)



6th level



stacking

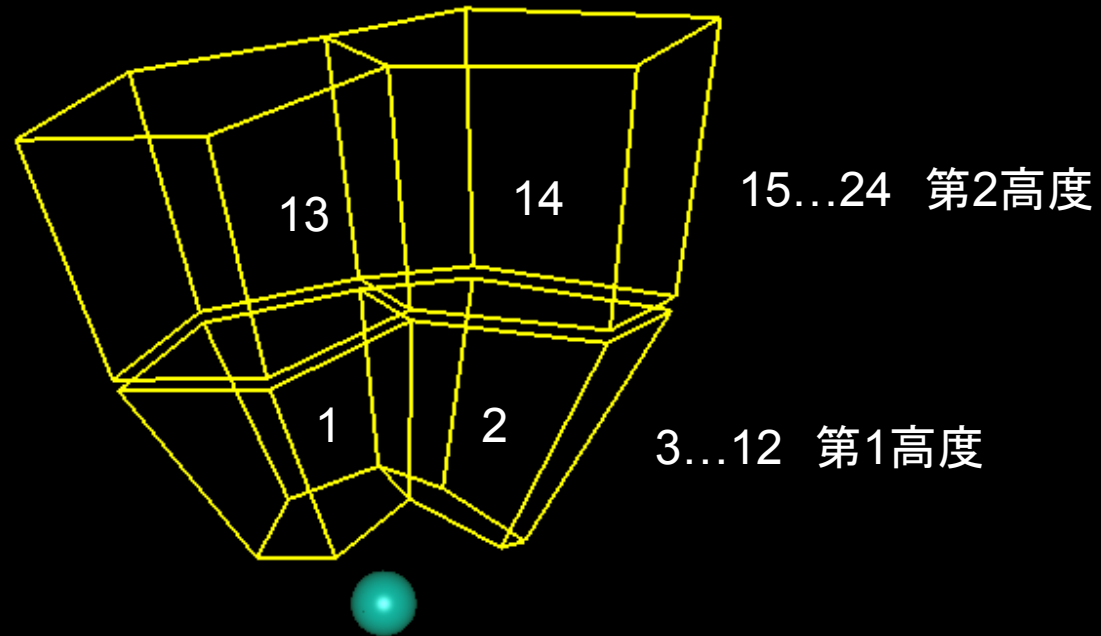
MPIブロック構造(4つのみ表示)

全MPI数 = $12 \times$ 高度ブロック数

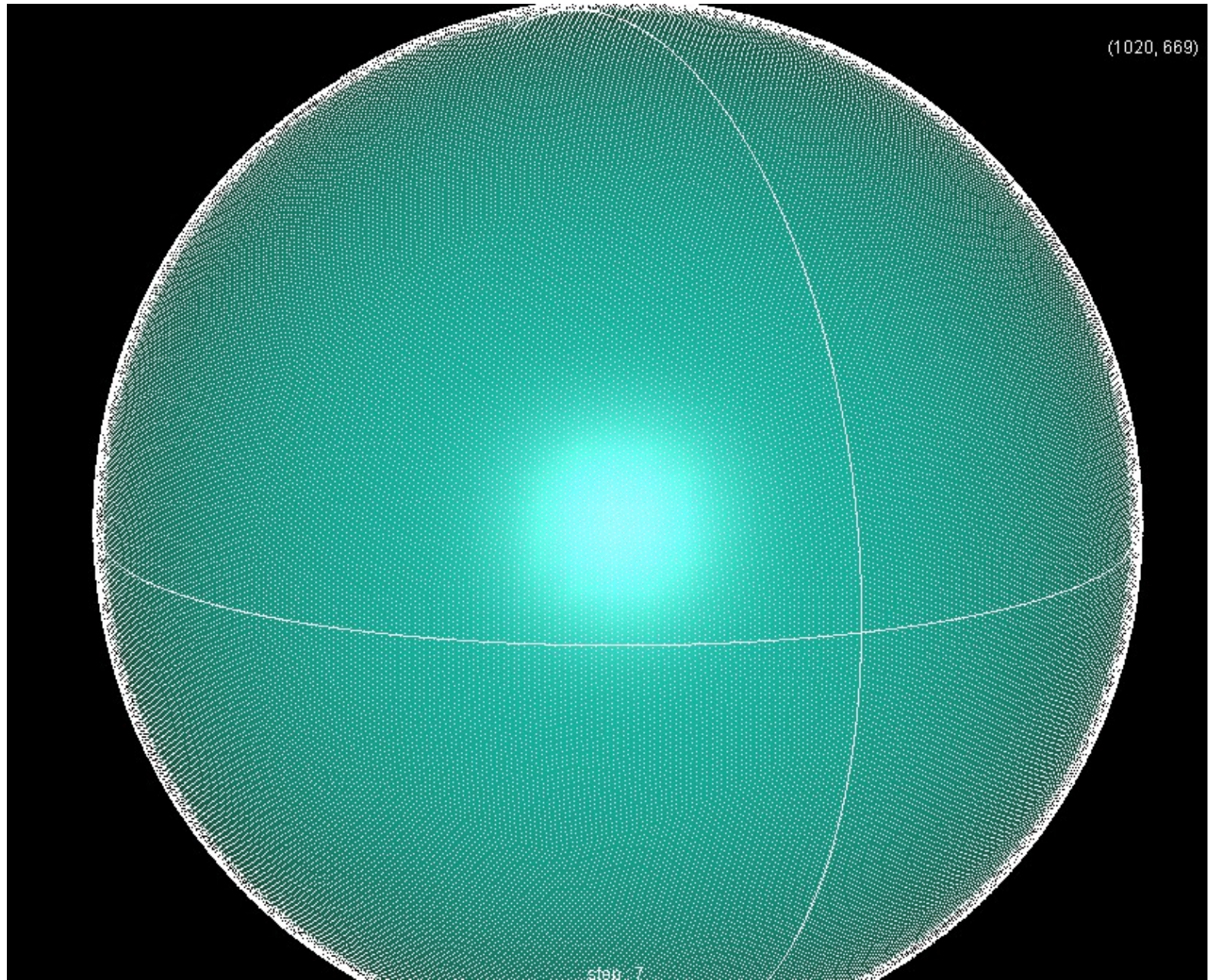
全並列数 = 全MPI数 $\times$ ブロック内OMP数

25...36 第3高度ブロック

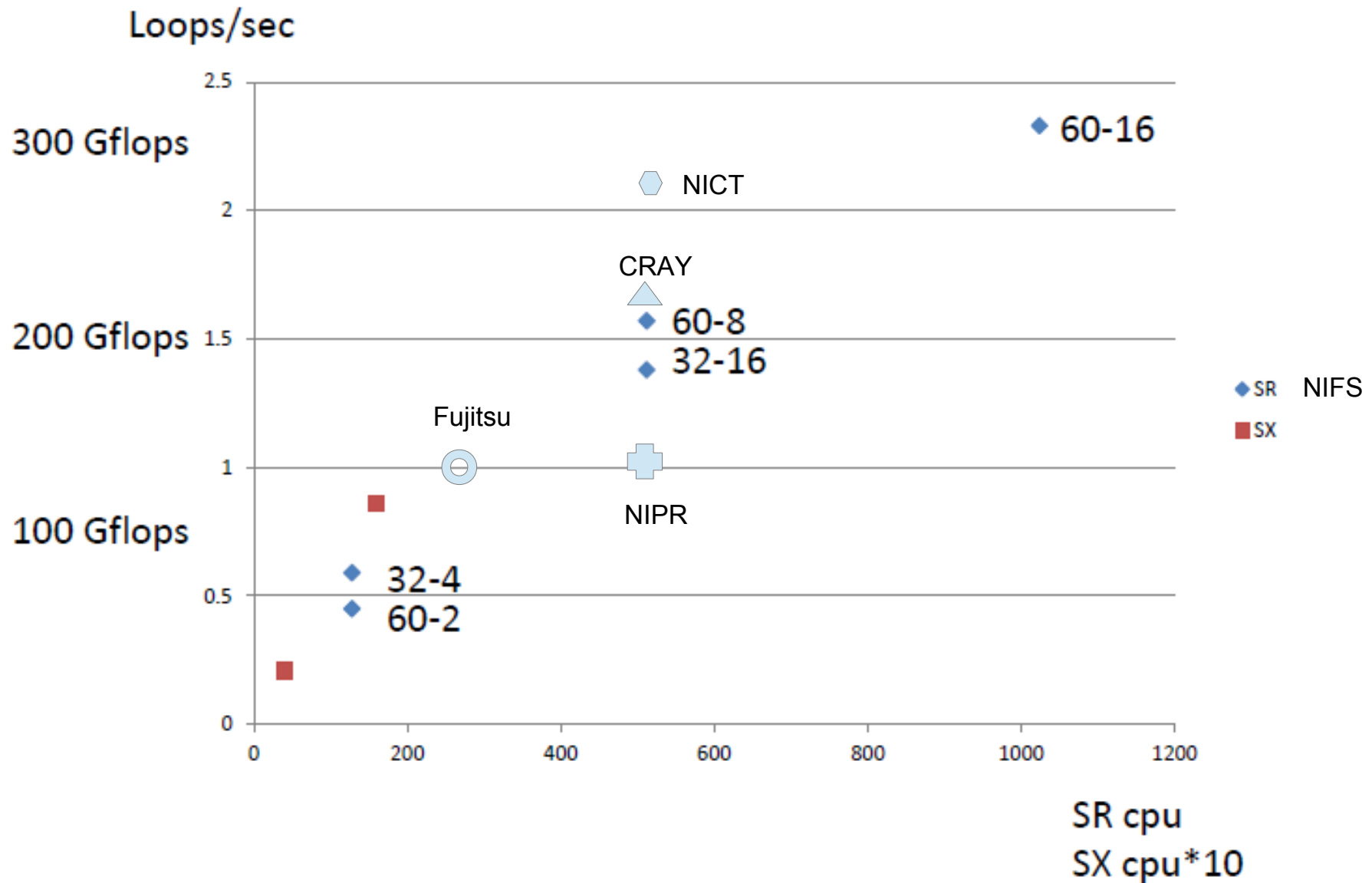
(1020, 669)



Grid system generated from a dodecahedron (level 7)



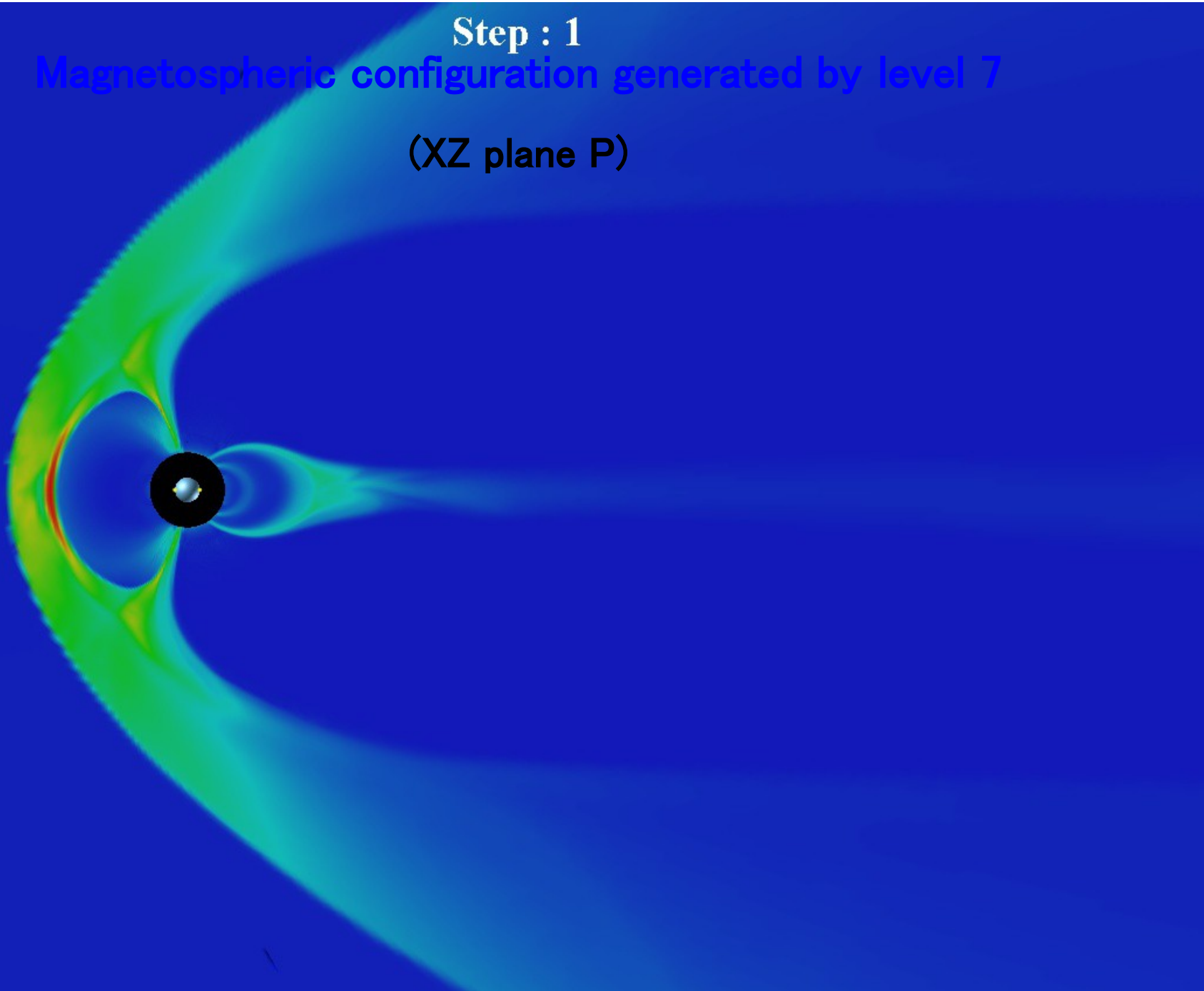
Mpi-ompハイブリッド並列一計算速度(レベル6)



Step : 1

Magnetospheric configuration generated by level 7

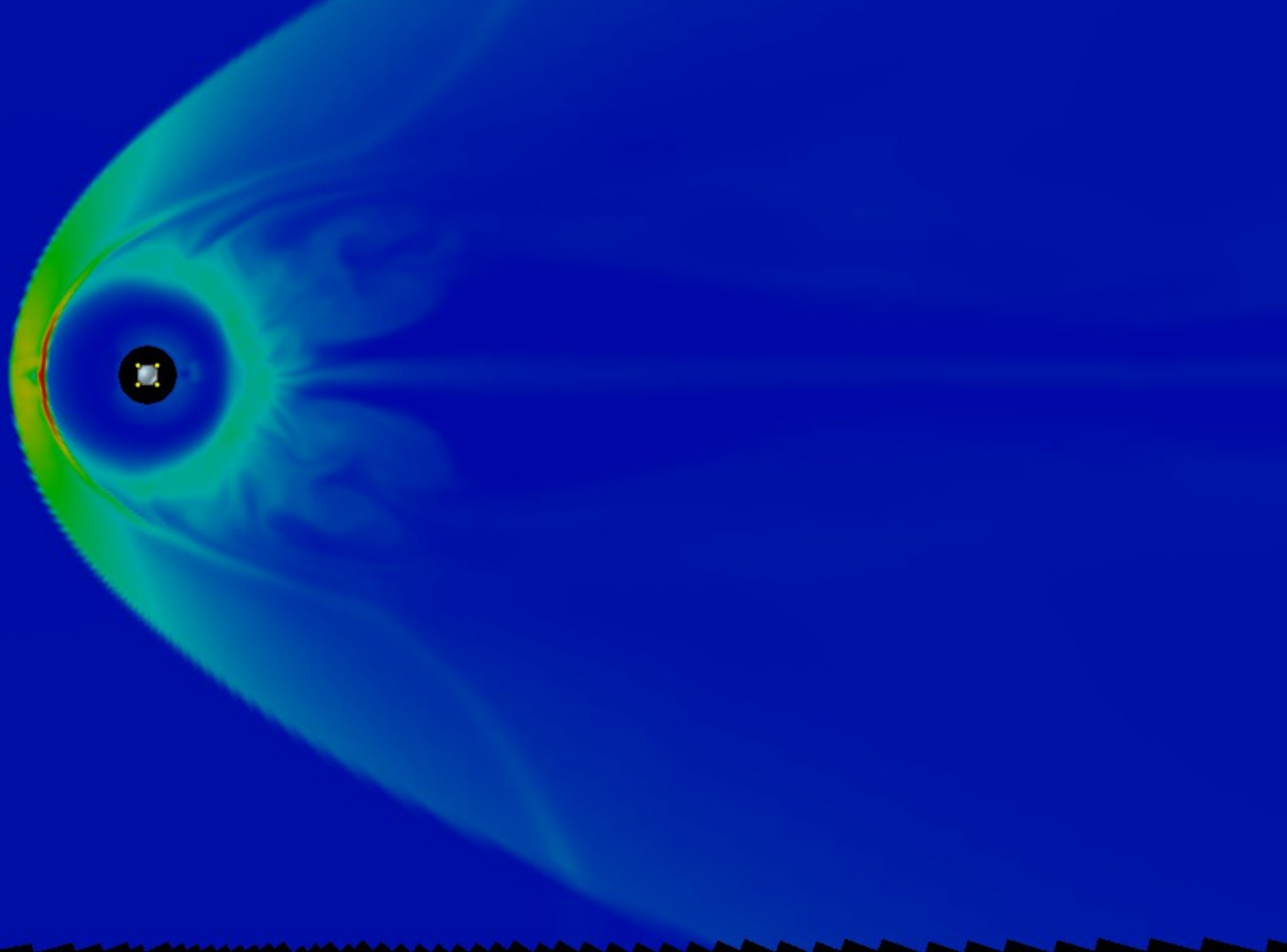
(XZ plane P)



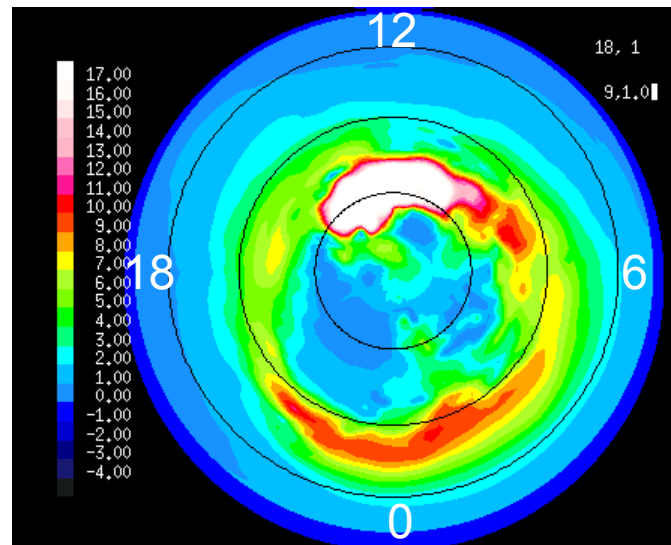
Step : 1

Magnetospheric configuration generated by level 7

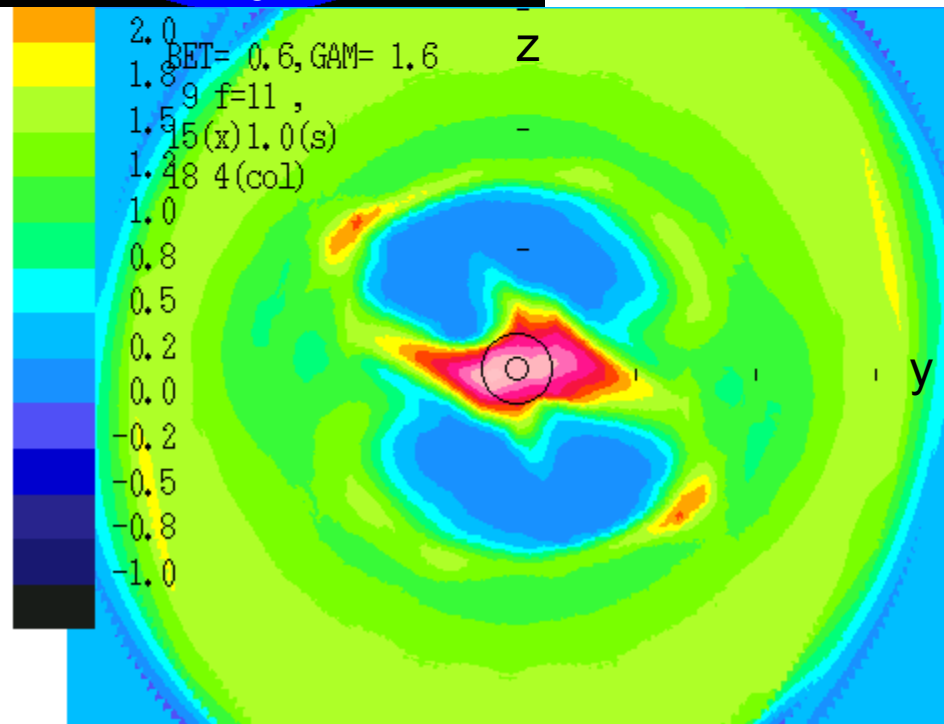
(XY plane P)



Θ aurora reproduced by the old version 2004



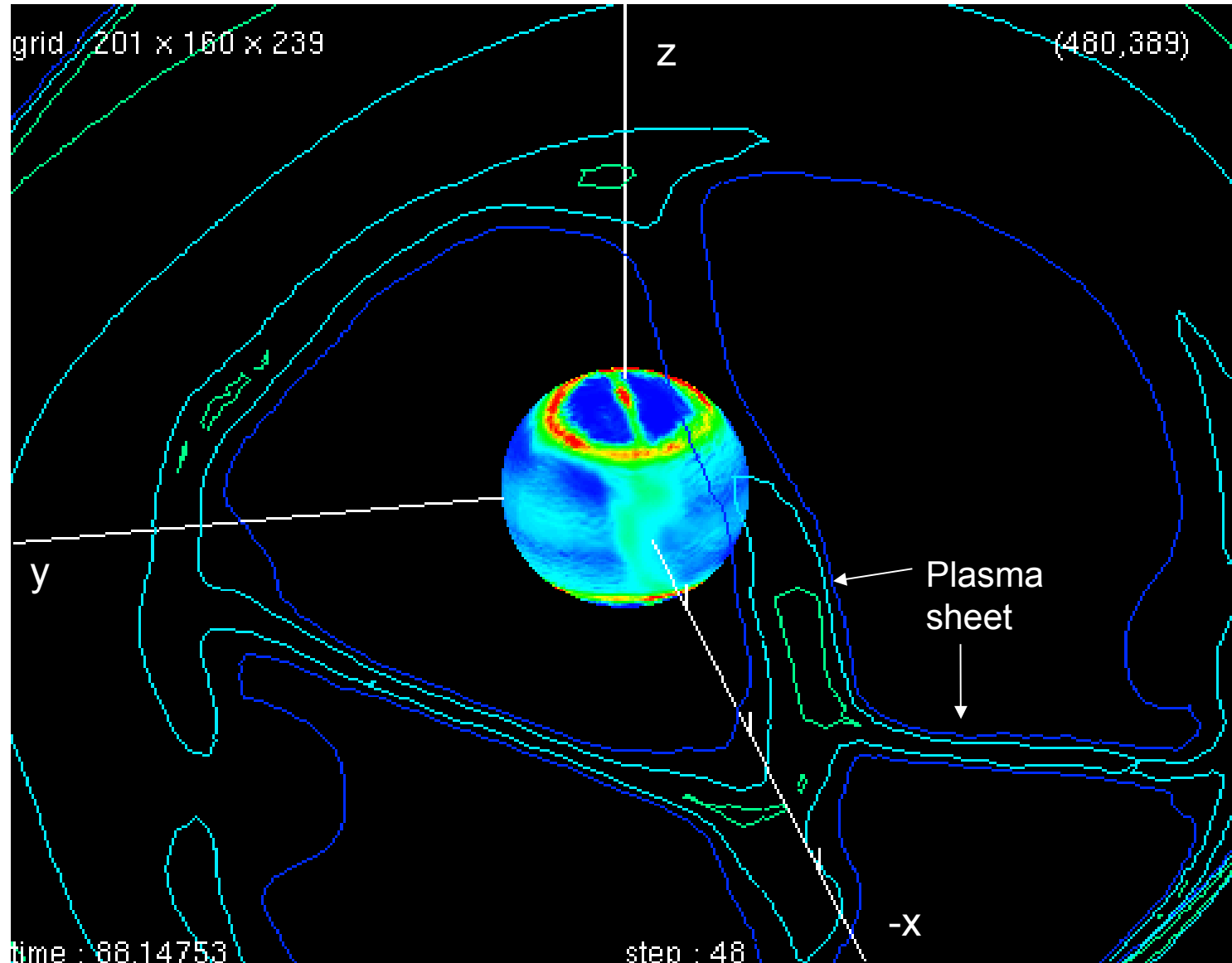
ionosphere



plasma
sheet

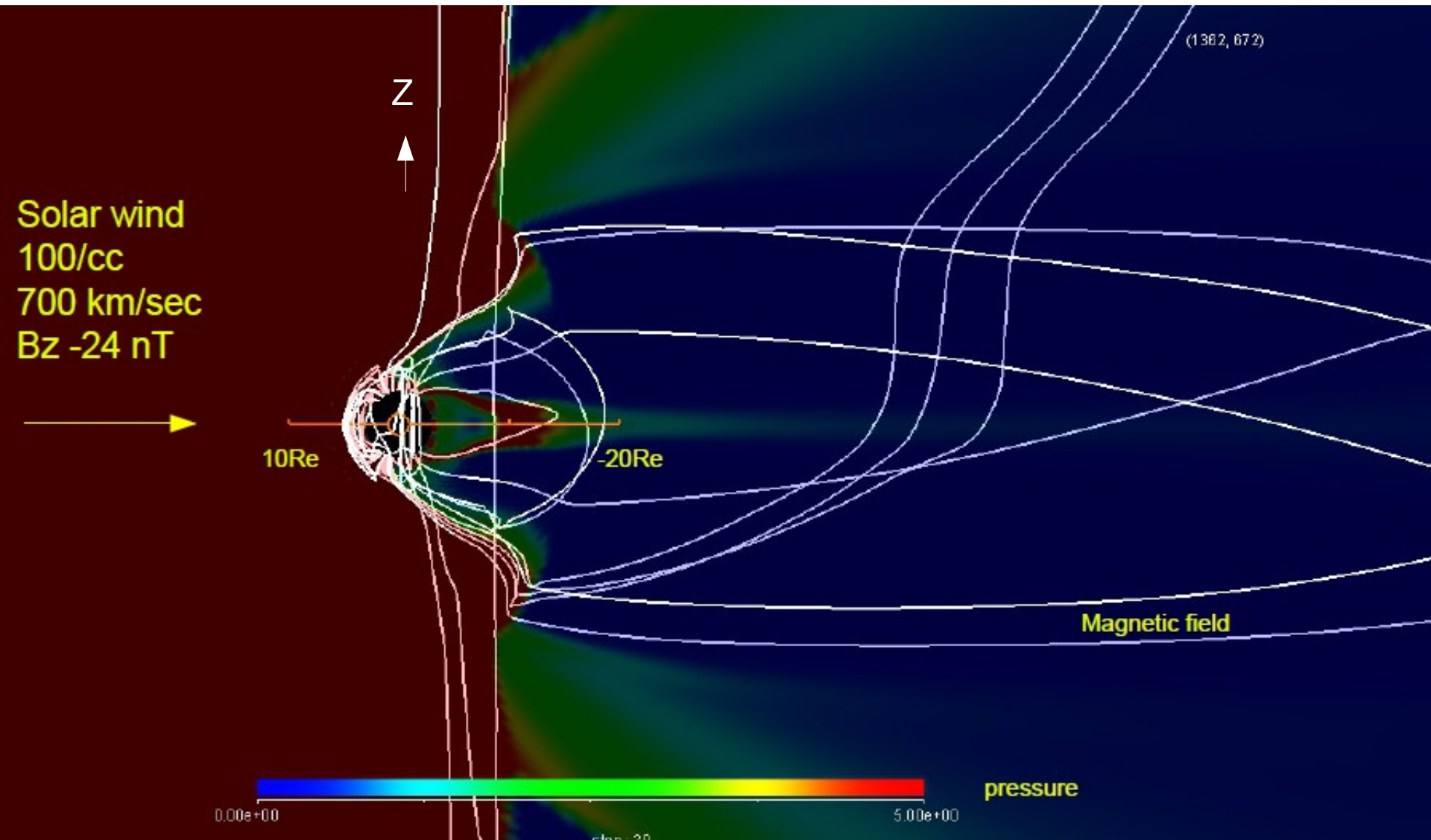
Θ aurora reproduced by MHD simulation (level 6)

(IMF B_y : 10 nT $\rightarrow$ -10 nT)



A CME attacking the earth (level 6)

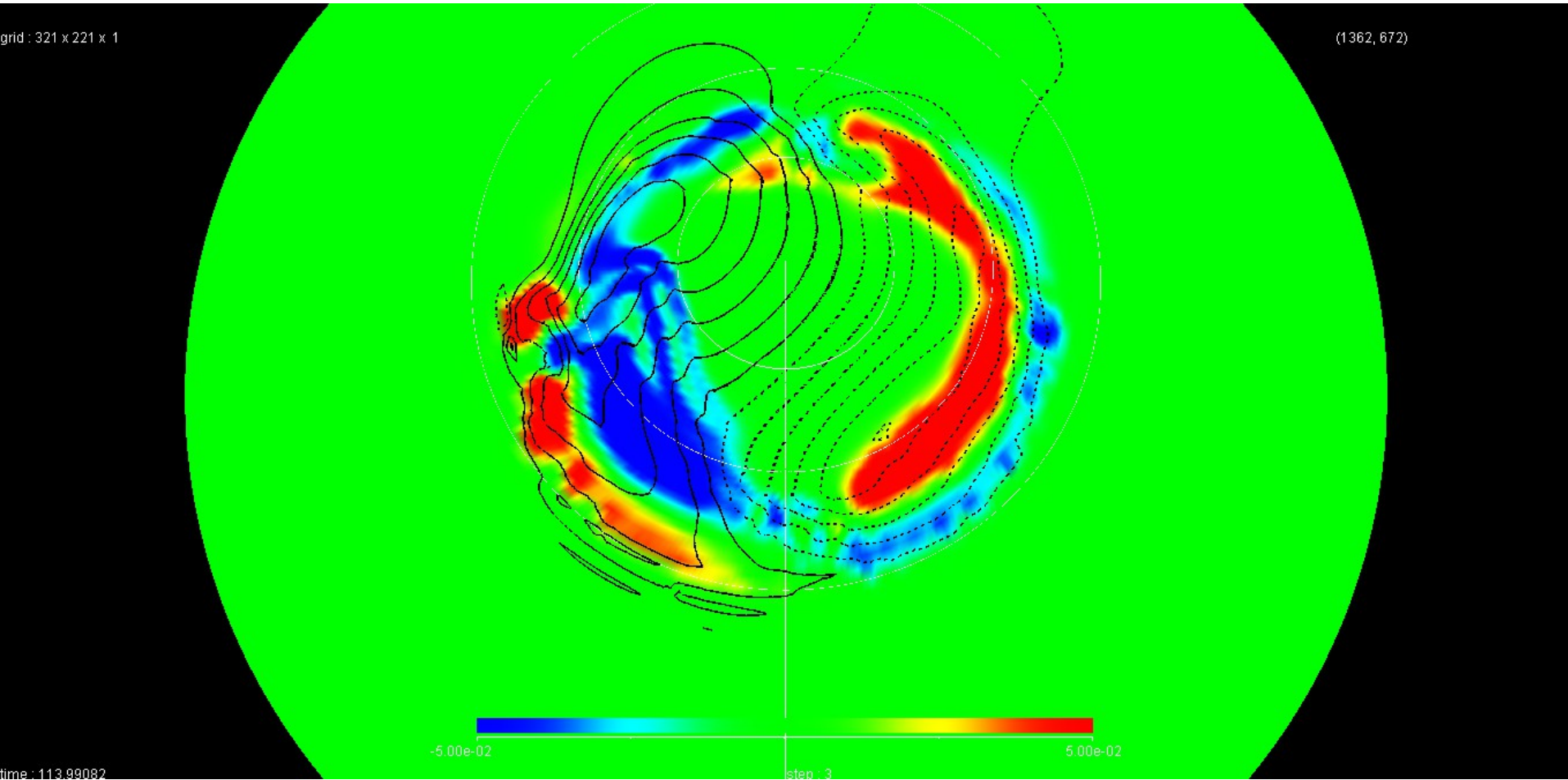
(Base magnetosphere → SW: 5/cc, 350 km/sec, Bz 5 nt, shading: P)



FAC and potential at the expansion phase (level 6)

blue: upward FAC, red: downward FAC

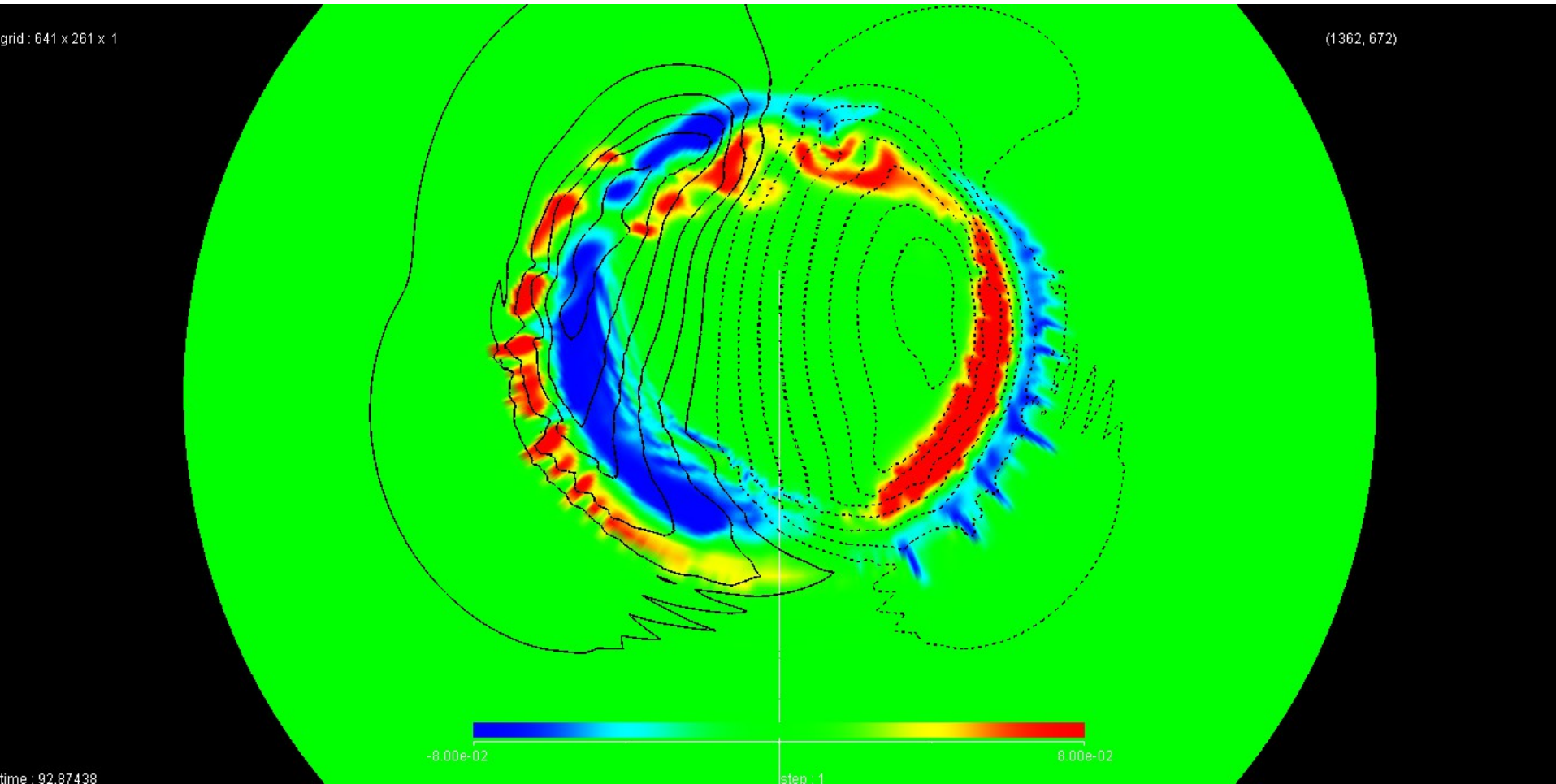
black line: ionospheric potential



FAC and potential at the expansion phase (level 7)

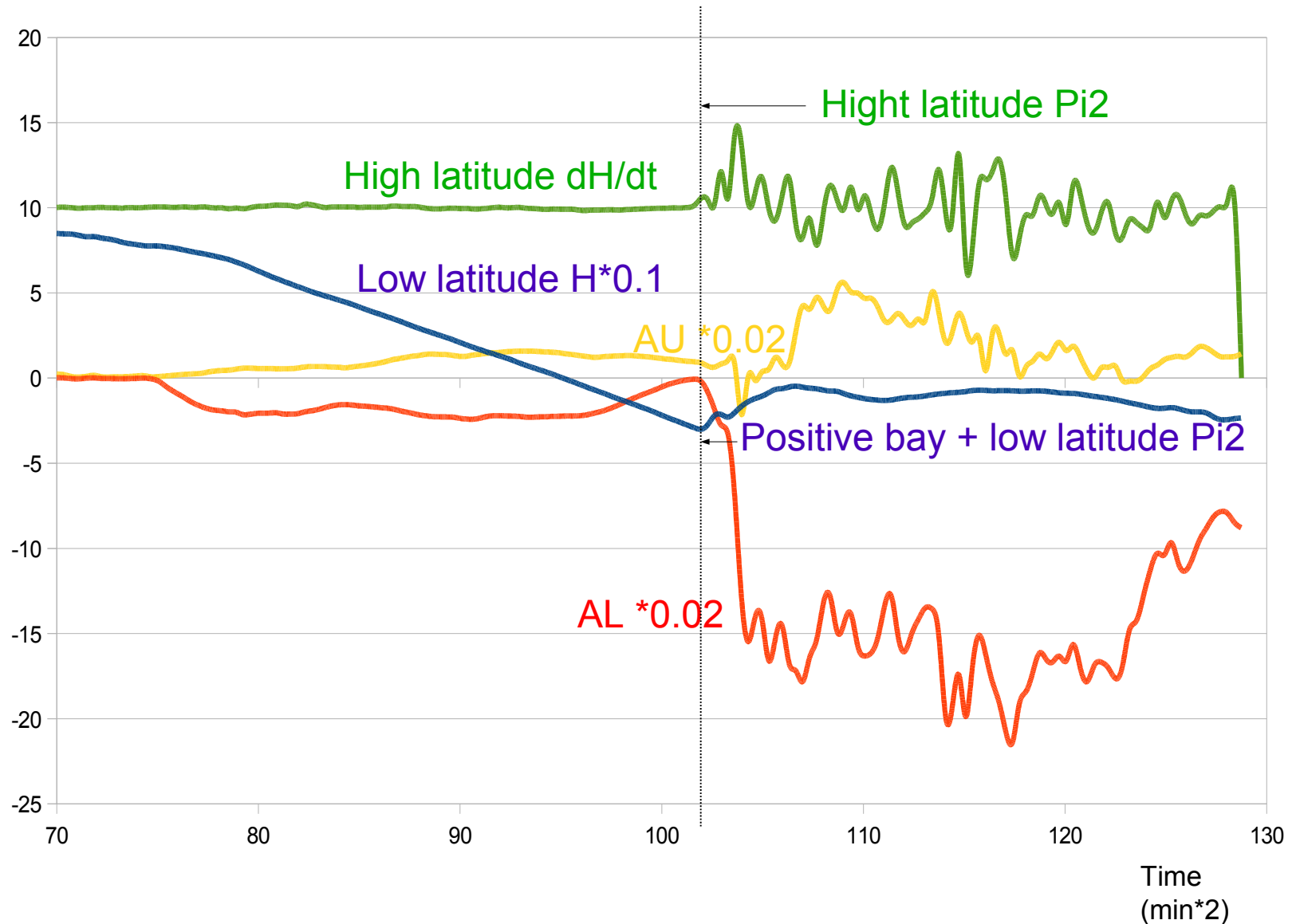
blue: upward FAC, red: downward FAC

black line: ionospheric potential

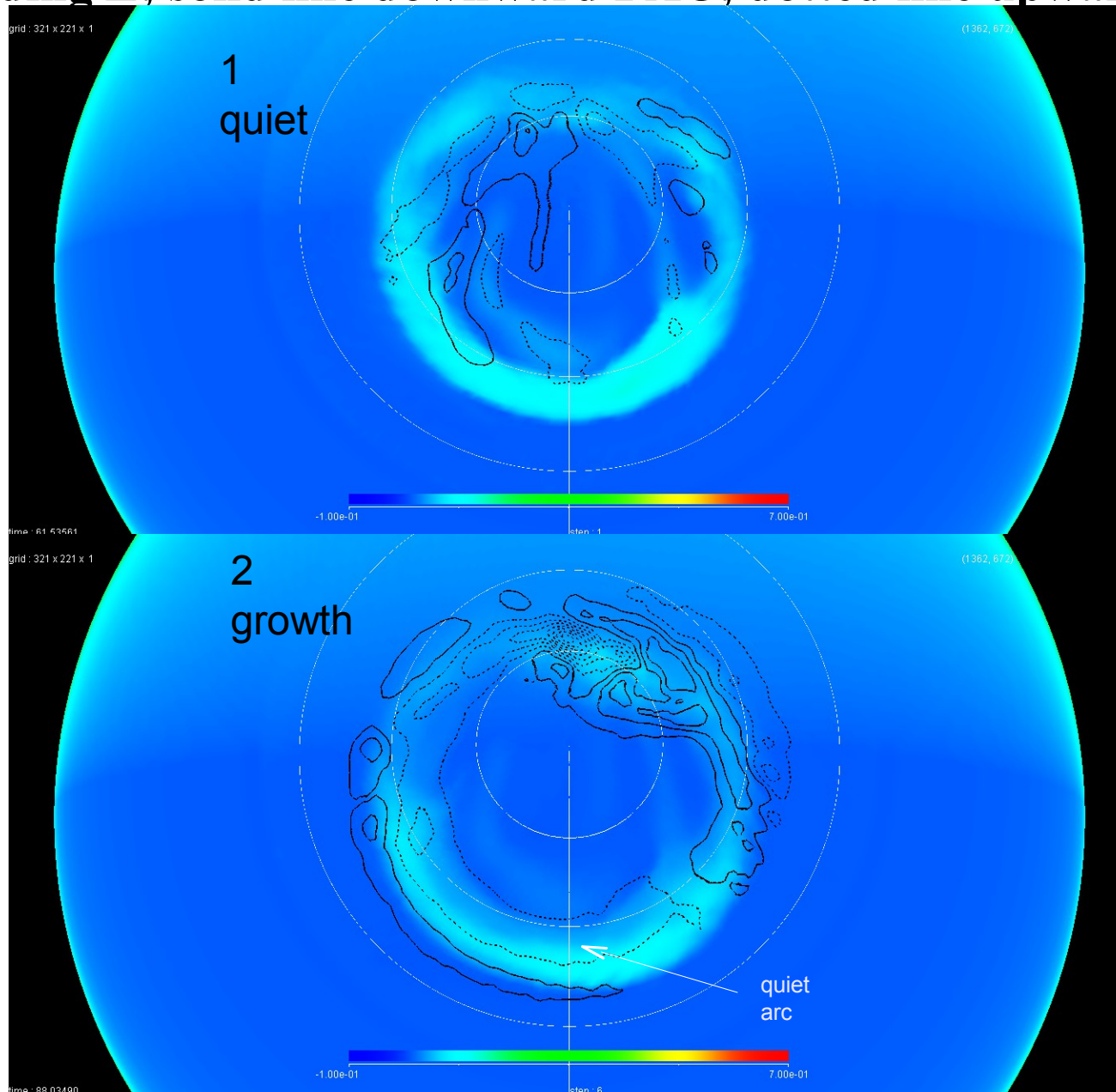


Simulated magnetic field data (level 6)

(AL, AU, Pi2, Positive bay, required computational time 2days)

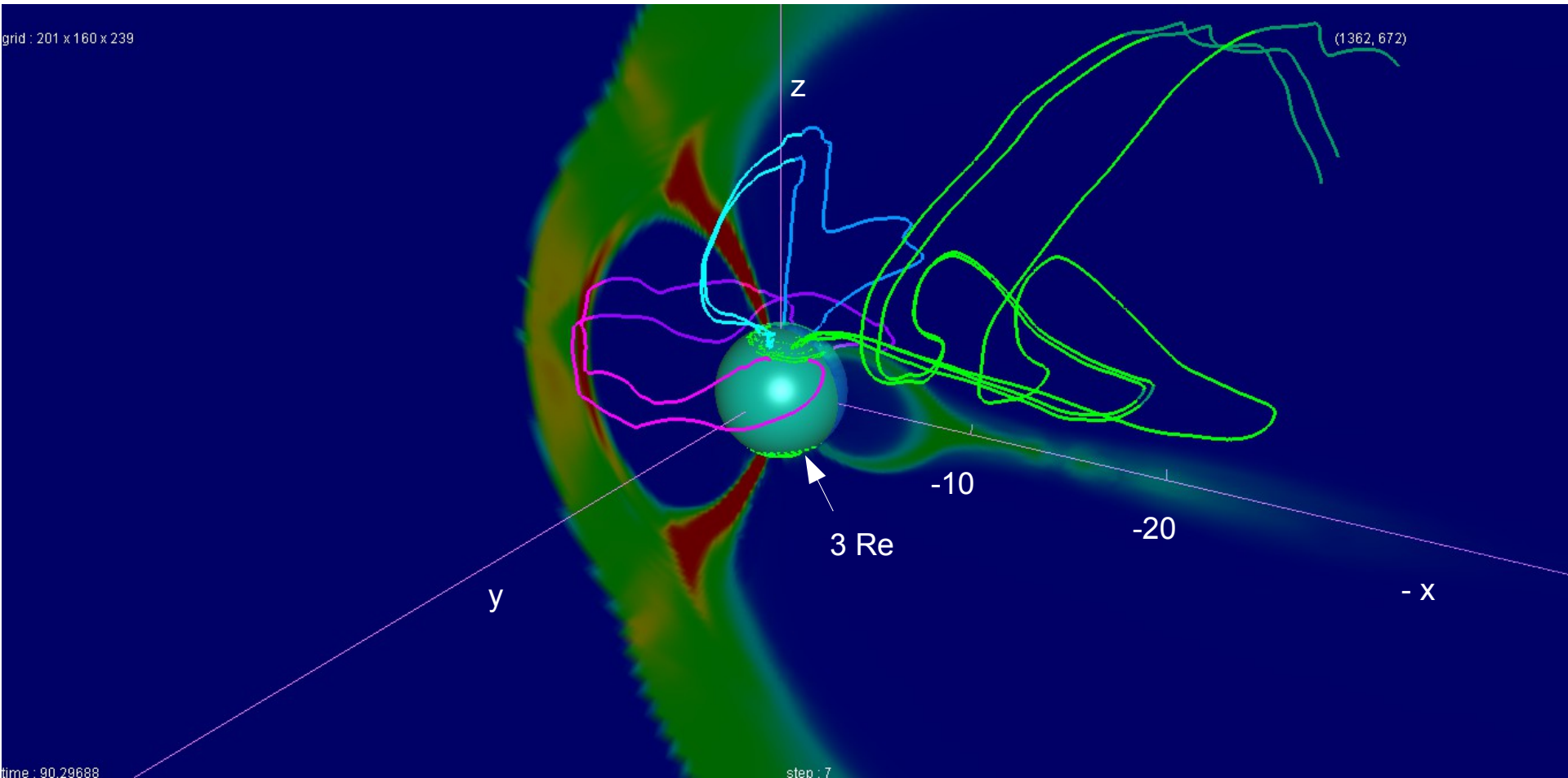


Growth phase signature of the substorm in the ionosphere
(shading Σ ; solid line downward FAC; dotted line upward FAC)



```
/nict2
/test
/data8i.psd2
hist.10.i3a
```

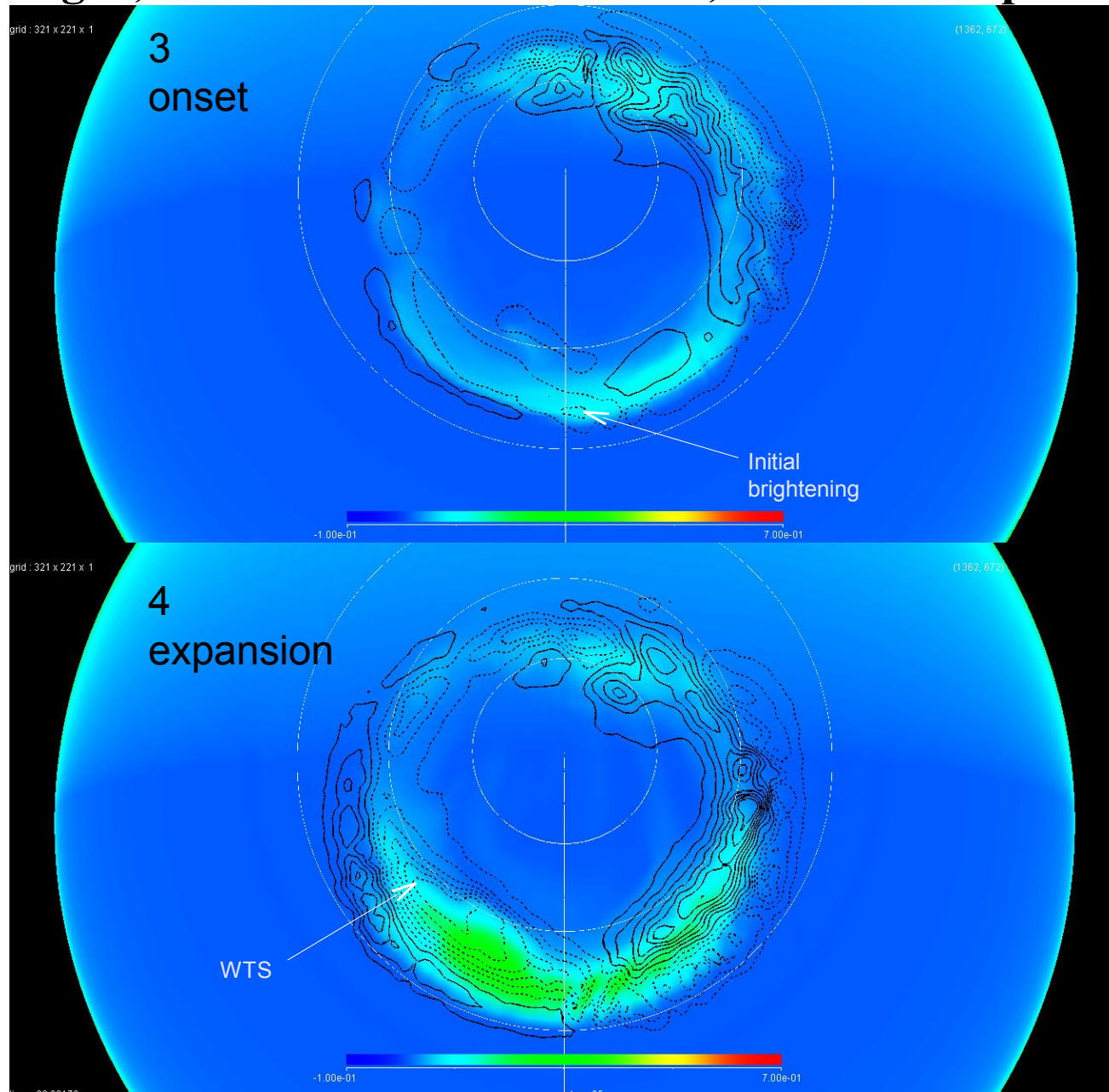
Current system during the growth phase (shading P; blue and green region 1; red region 2)



/nict3/data5i.wt3,hist.10.wt3a

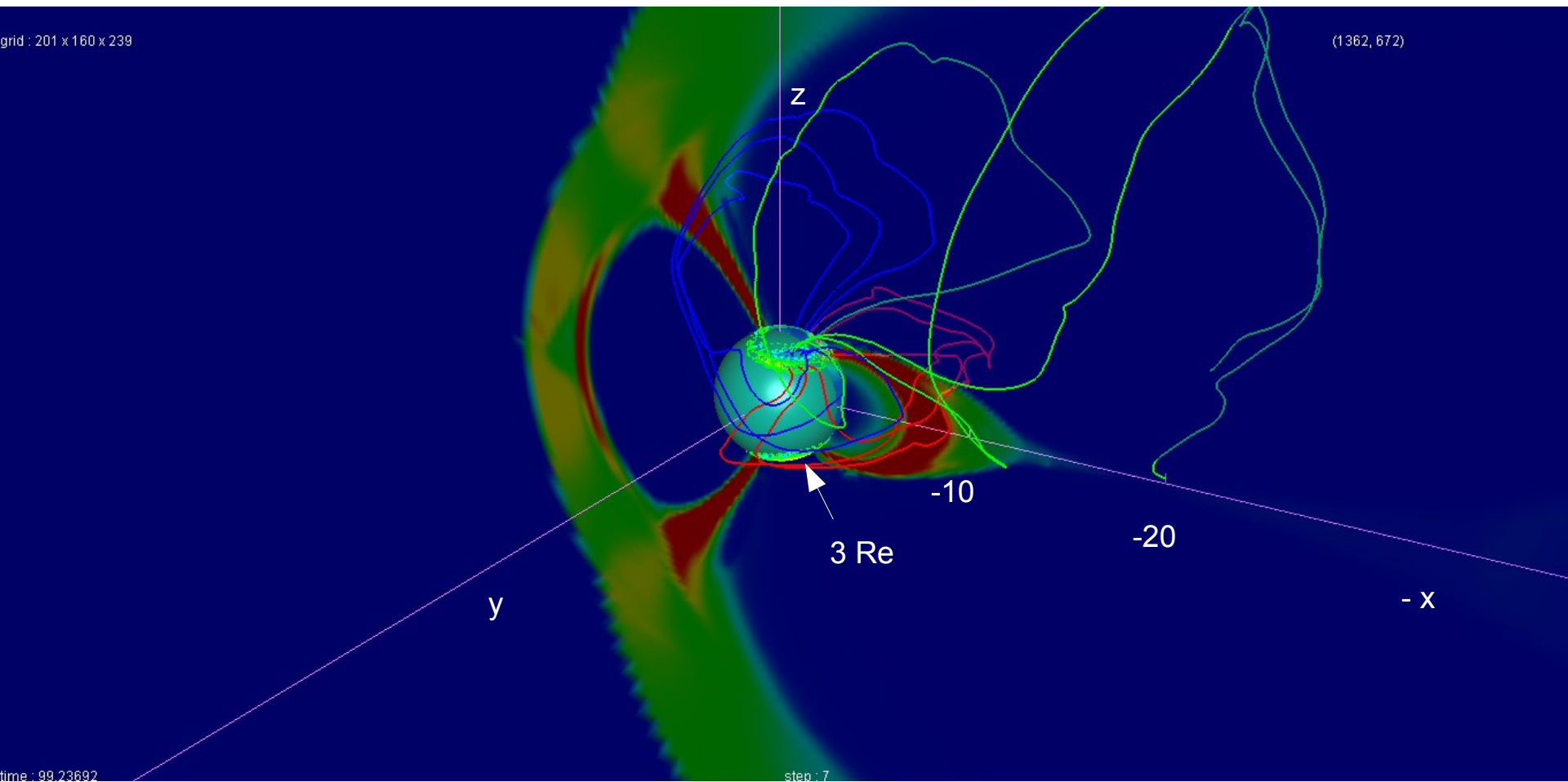
Onset signature of the substorm in the ionosphere (level 6)

(shading Σ ; solid line downward FAC; dotted line upward FAC)



/nict2
/test
/data8i.psd2
hist.10.i3a

Current system at the substorm onset (shading P; blue and green region 1; red region2)



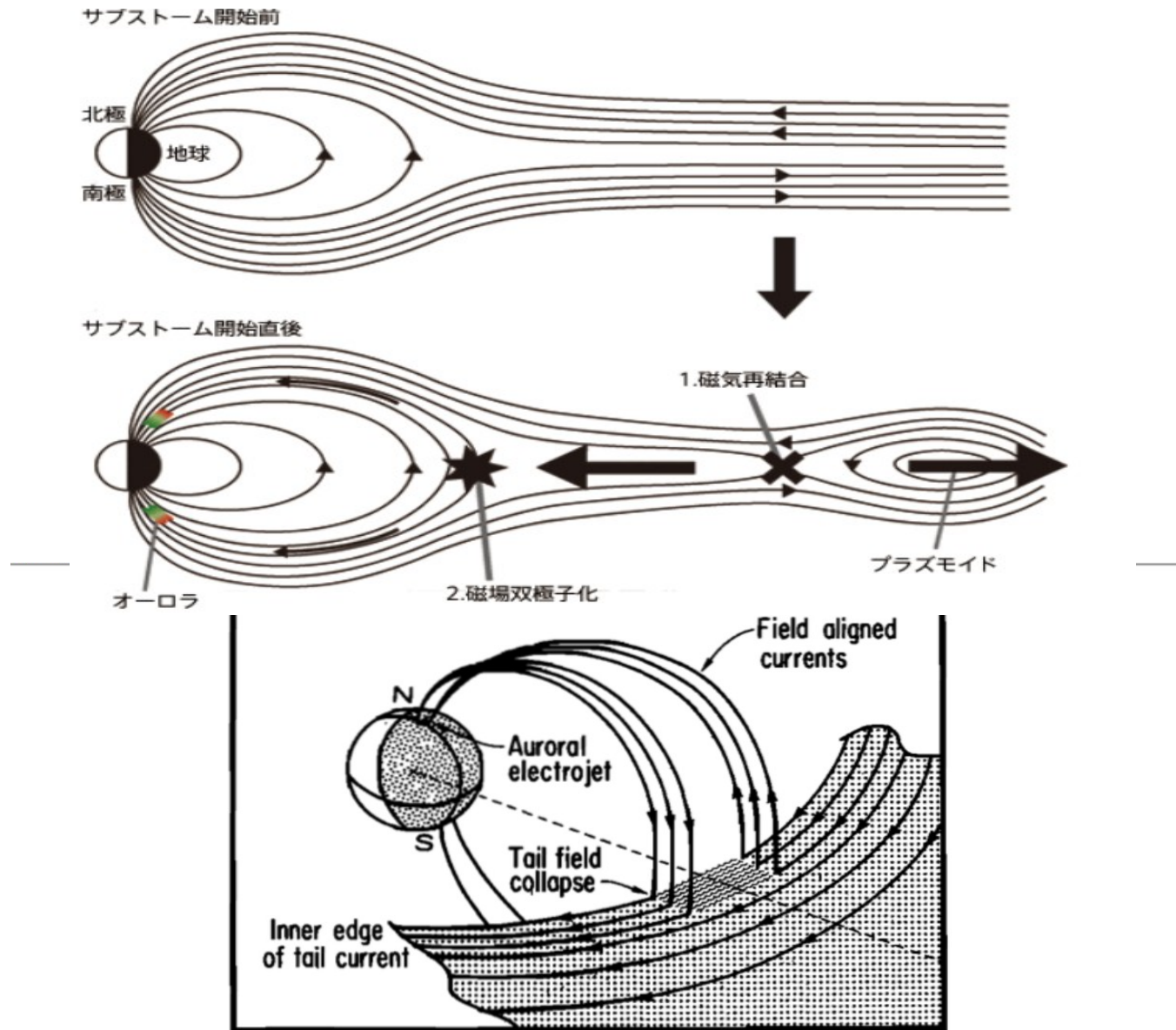
/nict3/data5i.wt1,hist.10.wt1a

Pseudo breakup followed by the onset

(shading P; solid line antisunward flow; dotted line sunward flow)



部分(キープロセス)から理解しようとするサブストーム



Energy conversion driving magnetospheric convection

