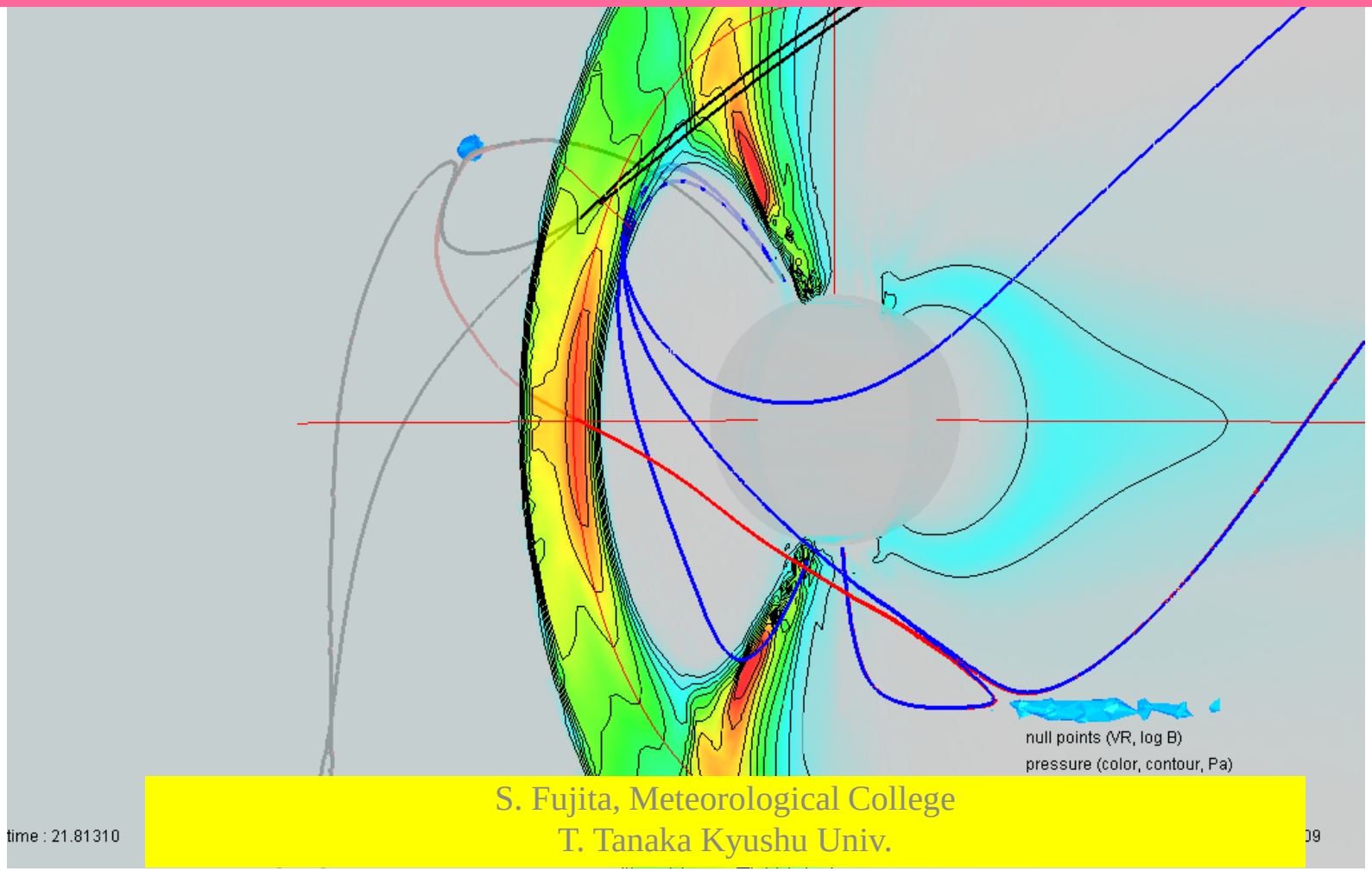
A driving mechanism of the MI coupling convection
The separator reconnection in SW-MS interface



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contents

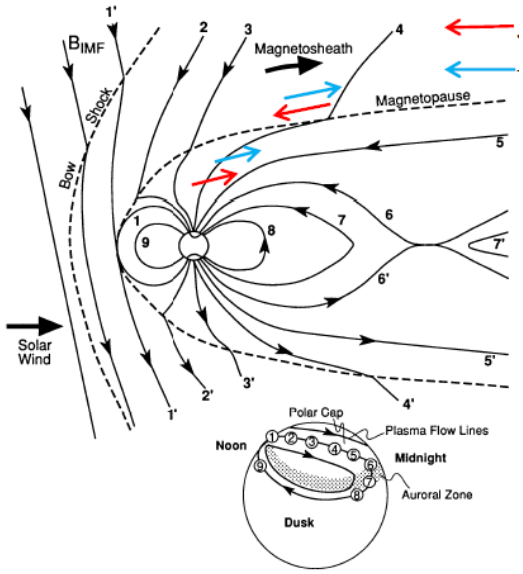
I. Magnetic field merging on the dayside magnetopause (southward IMF)

II. A driving mechanism of the magnetosphere-ionosphere coupling convection.

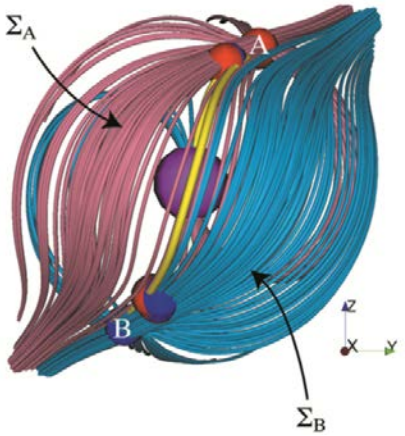
III. The separator reconnection in the solar wind-magnetosphere interface

IV. Summary

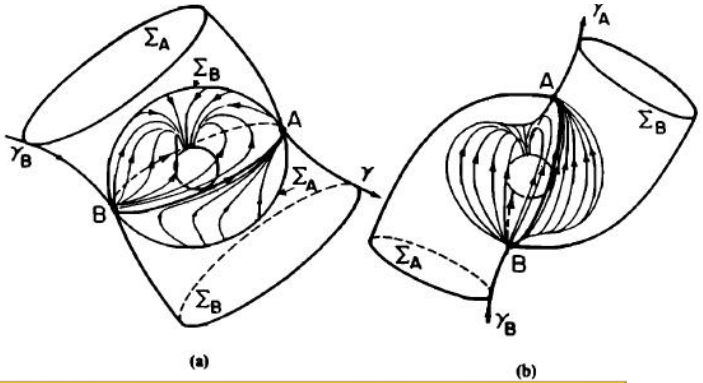
What is the separator reconnection? Previous works



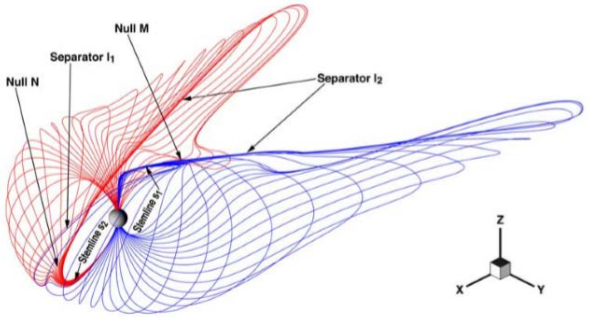
Dungey (1961)



Dorelli et al [2007]



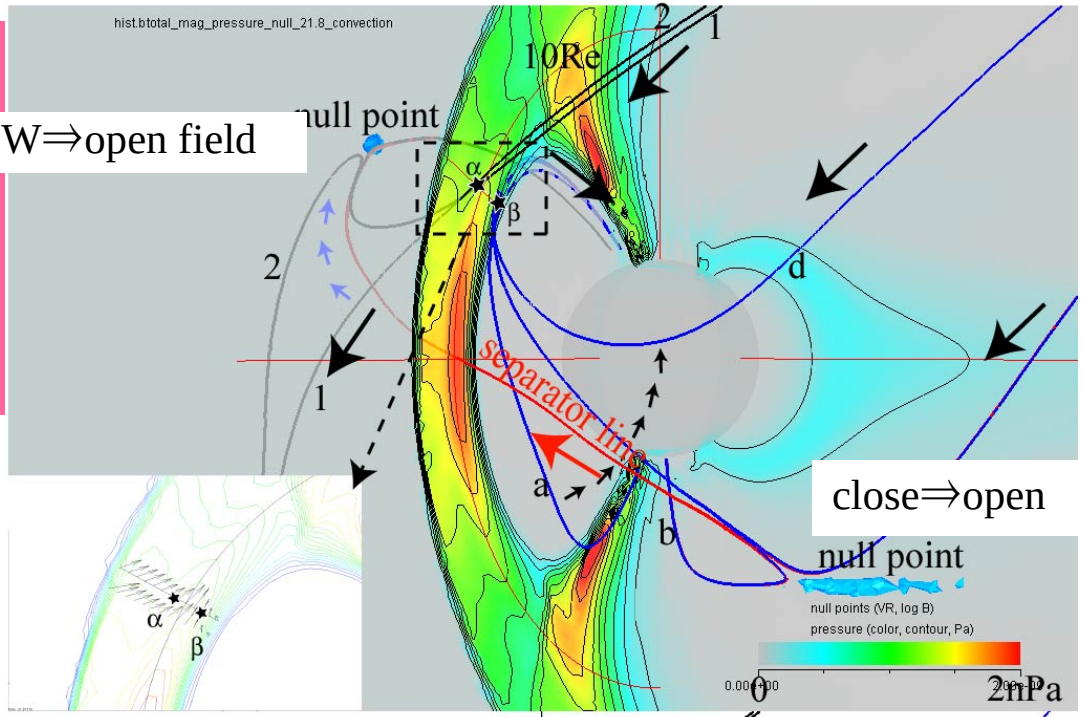
Wang and Bhattacharjee [1996]



Watanabe et al. [2007]

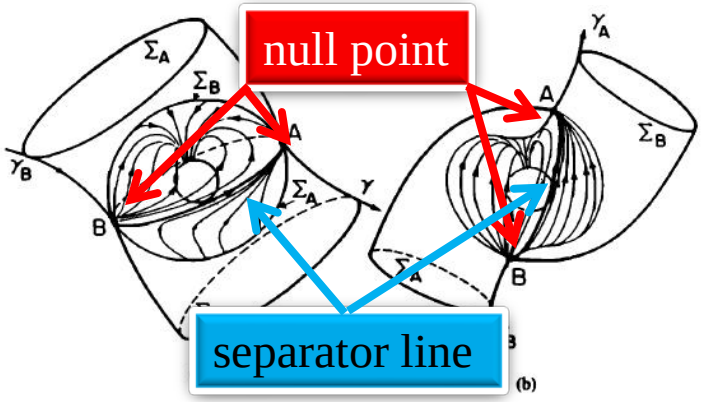
The magnetic field merging and migration in the dayside magnetosphere (IMFBz<0, IMFBy≠0)

SW⇒open field



Wang and Bhattacharjee [1996]

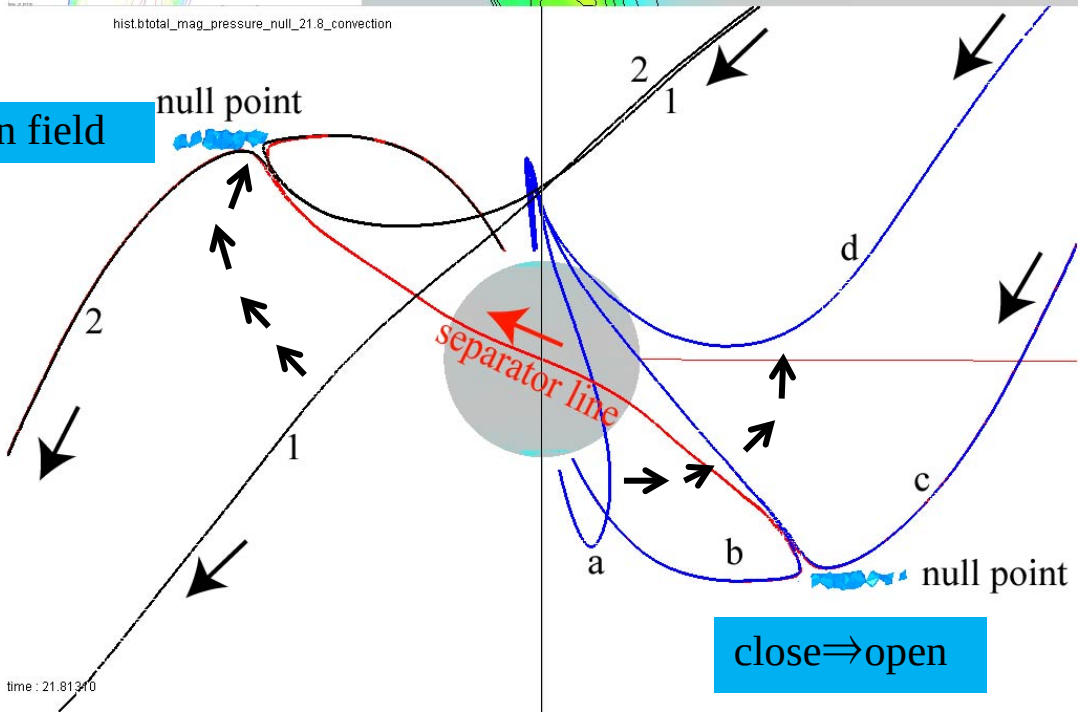
null-separator structure



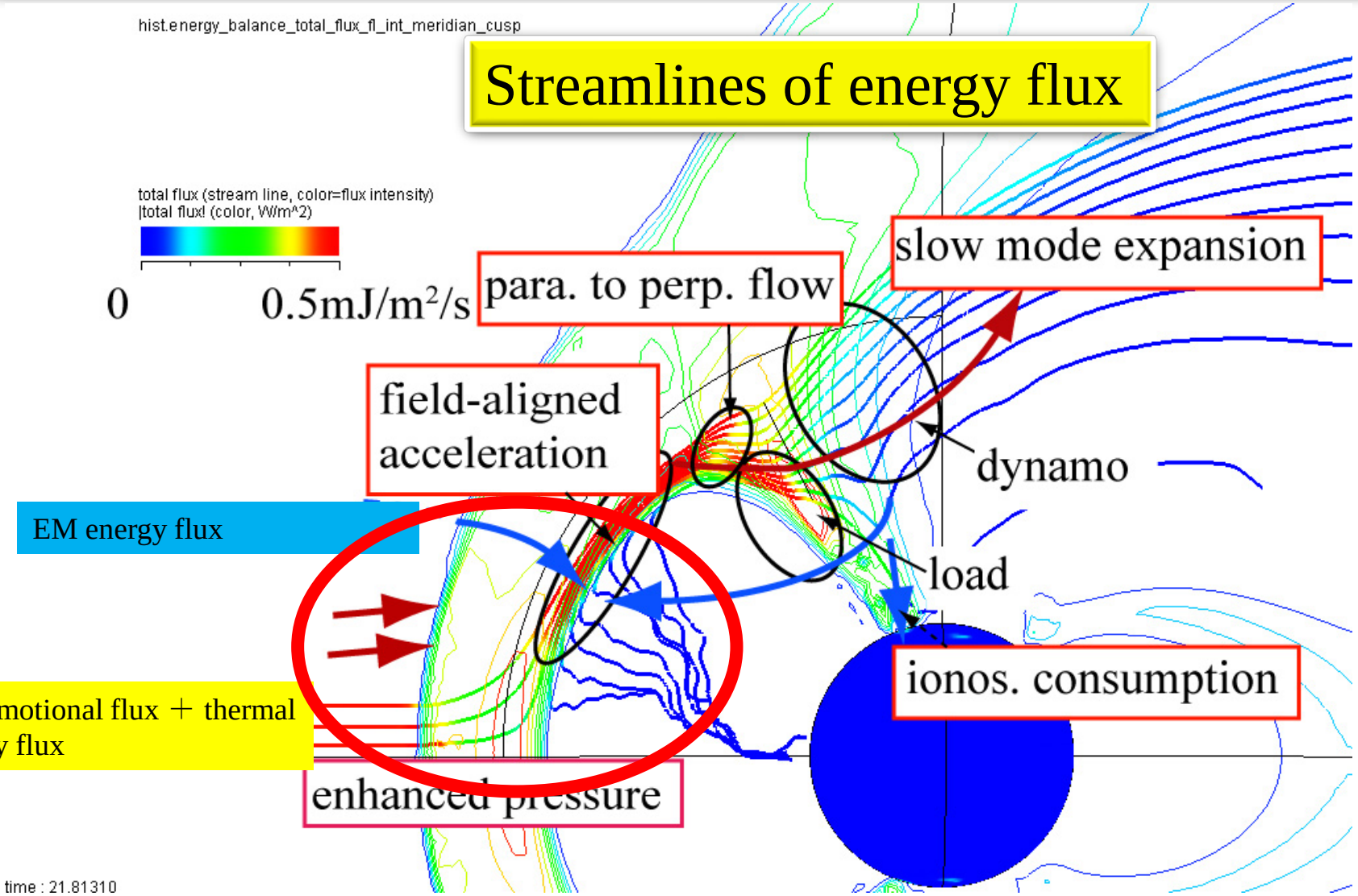
southward IMF

northward IMF

SW⇒open field



A driving mechanism of the convection



What is the separator reconnection? anti-parallel reconnection (2D)

anti-parallel reconnection

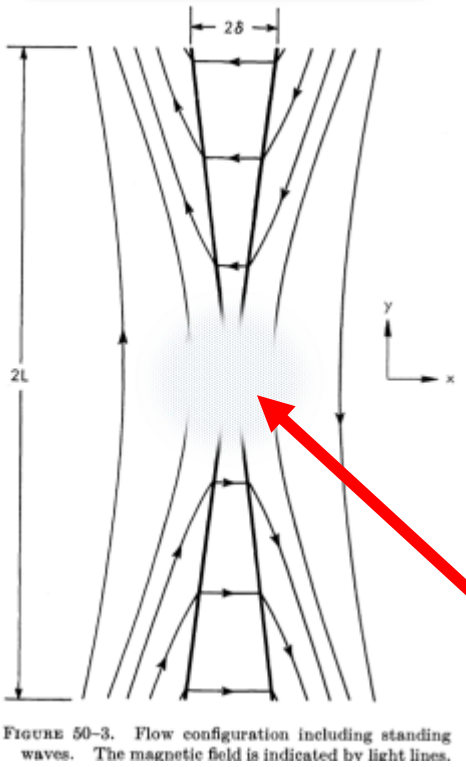


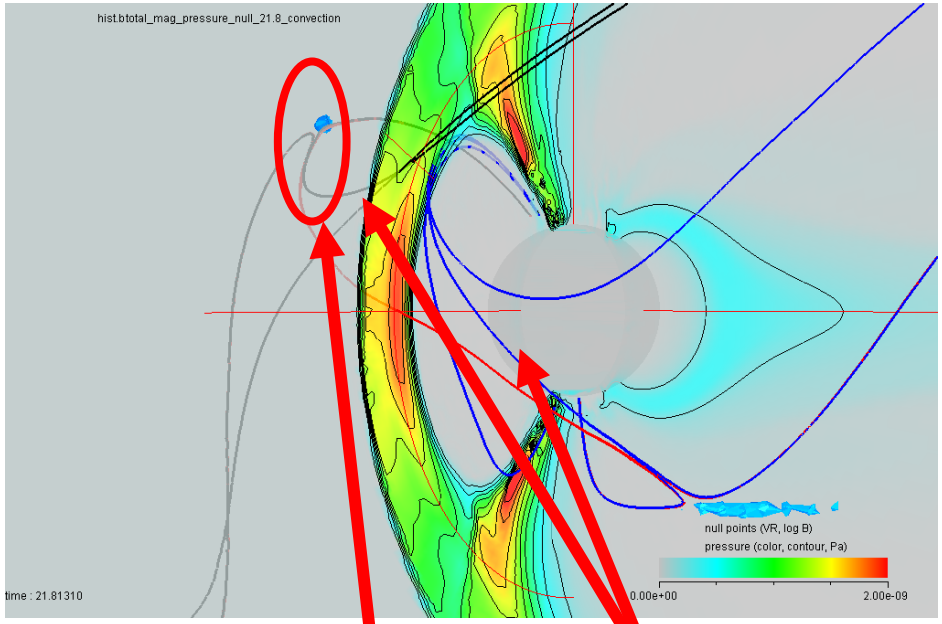
FIGURE 50–3. Flow configuration including standing waves. The magnetic field is indicated by light lines.

Petschek [1964]

- Diffusion region is located in the center of the system (X point/X line).
- Magnetic annihilation is caused by plasmas. Sweet-Parker process does provide insufficient reconnection rate in the collisionless-plasmas.
- Petschek's stationary slow shock invokes effective reconnection rate.
- This structure essentially assumes a 2D configuration.

Diffusion region

What is the separator reconnection? Solar wind-magnetosphere interface



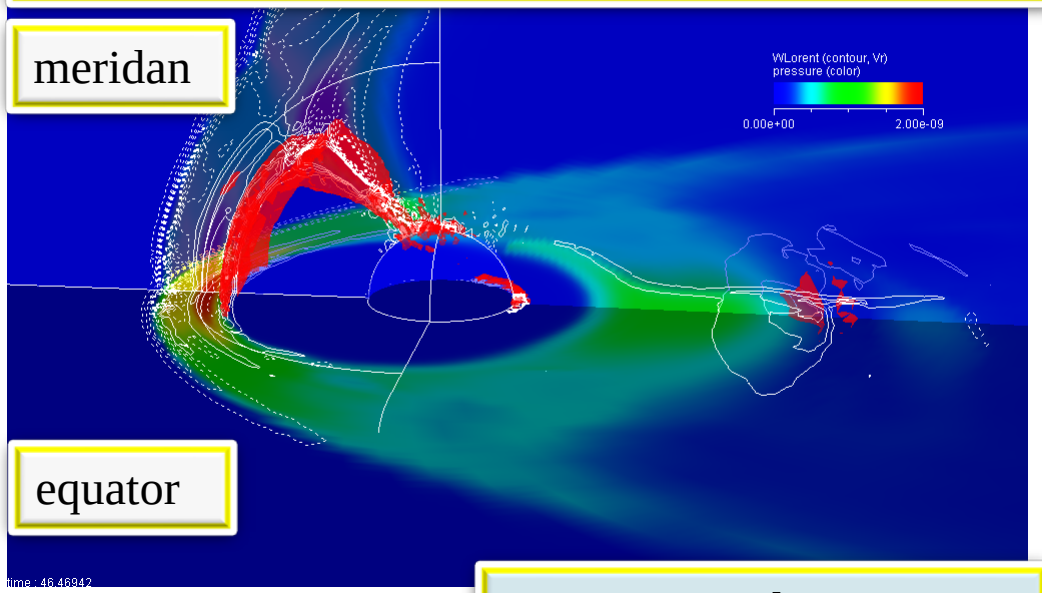
Bending field lines

Diffusion region

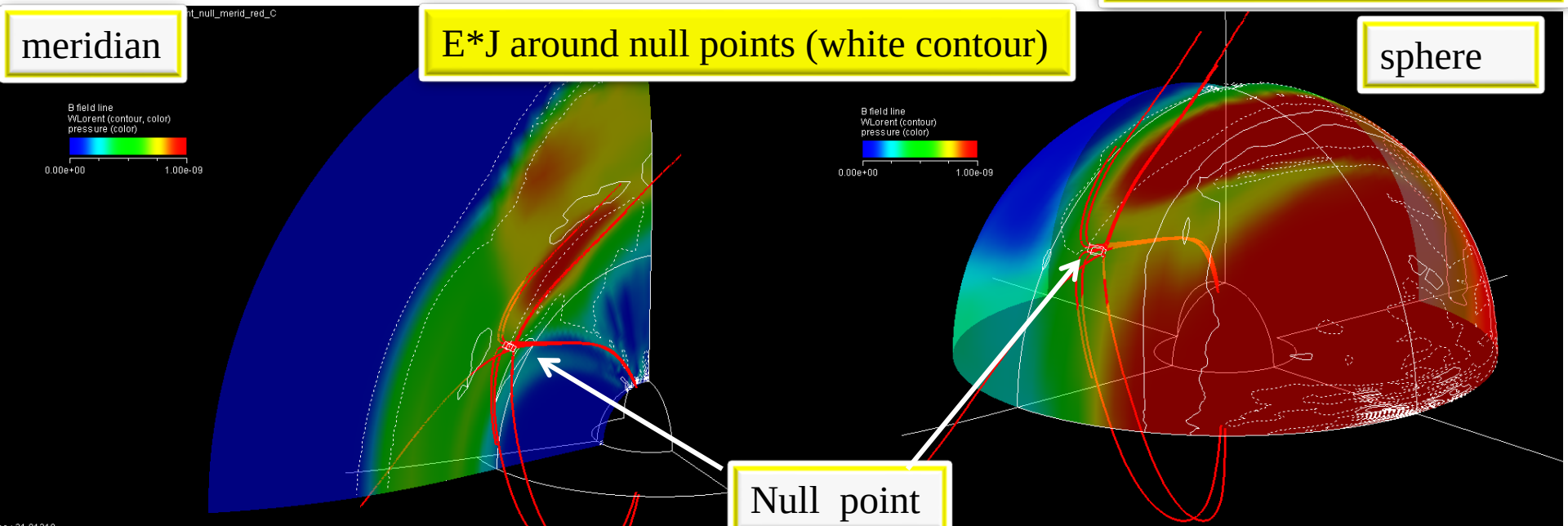
- The field line merges at the null point.
- The null point is externally given.
  - Only Sweet-Parker process becomes significant. The slow shock (Putsches, 1964) does not appear after Dorelli et al. (2004).
- Diffusion appears not only in the vicinity of the null point and along the separator line.
- Bending magnetic field peeled from the separator line invokes Lorentz force. This force accelerates plasmas in the magnetosheath. This mechanism is parallel to the slow shock by Petschek [1964].

work done by Lorentz force

E*J for substorm onset (white contours and VR)

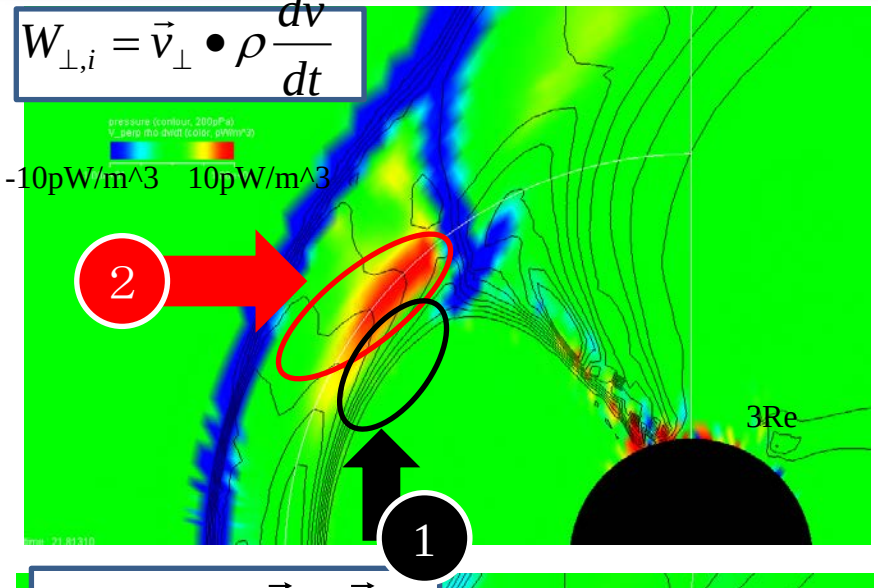


Pressure in color contour

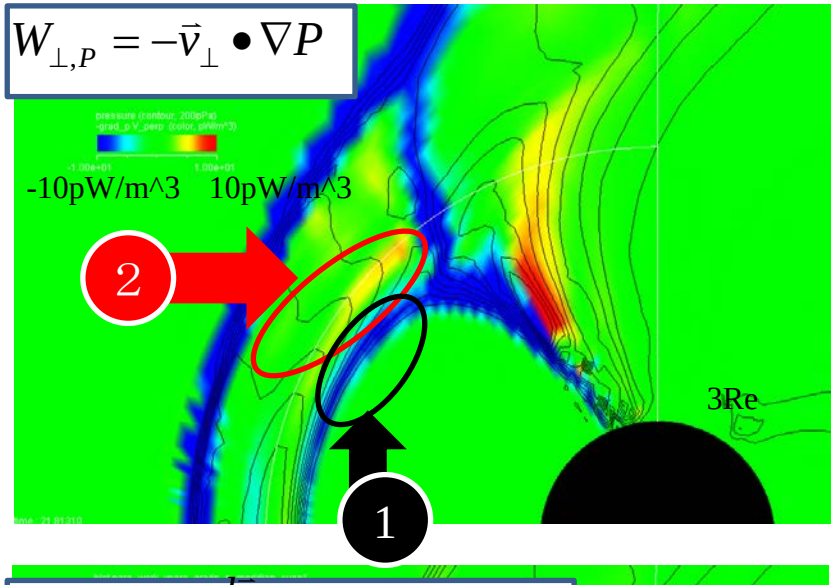


Energy conversion in the magnetosheath-magnetopause region

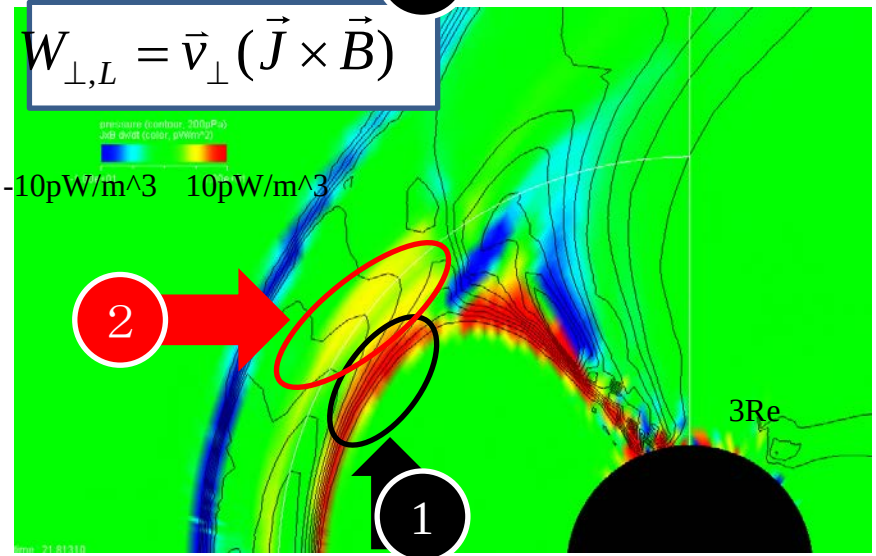
$$W_{\perp,i} = \vec{v}_{\perp} \bullet \rho \frac{d\vec{v}}{dt}$$



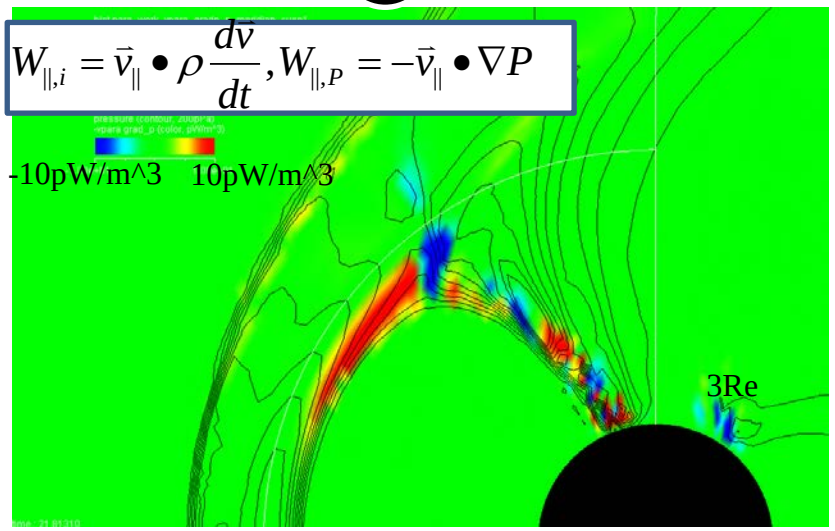
$$W_{\perp,P} = -\vec{v}_{\perp} \bullet \nabla P$$



$$W_{\perp,L} = \vec{v}_{\perp}(\vec{J} \times \vec{B})$$

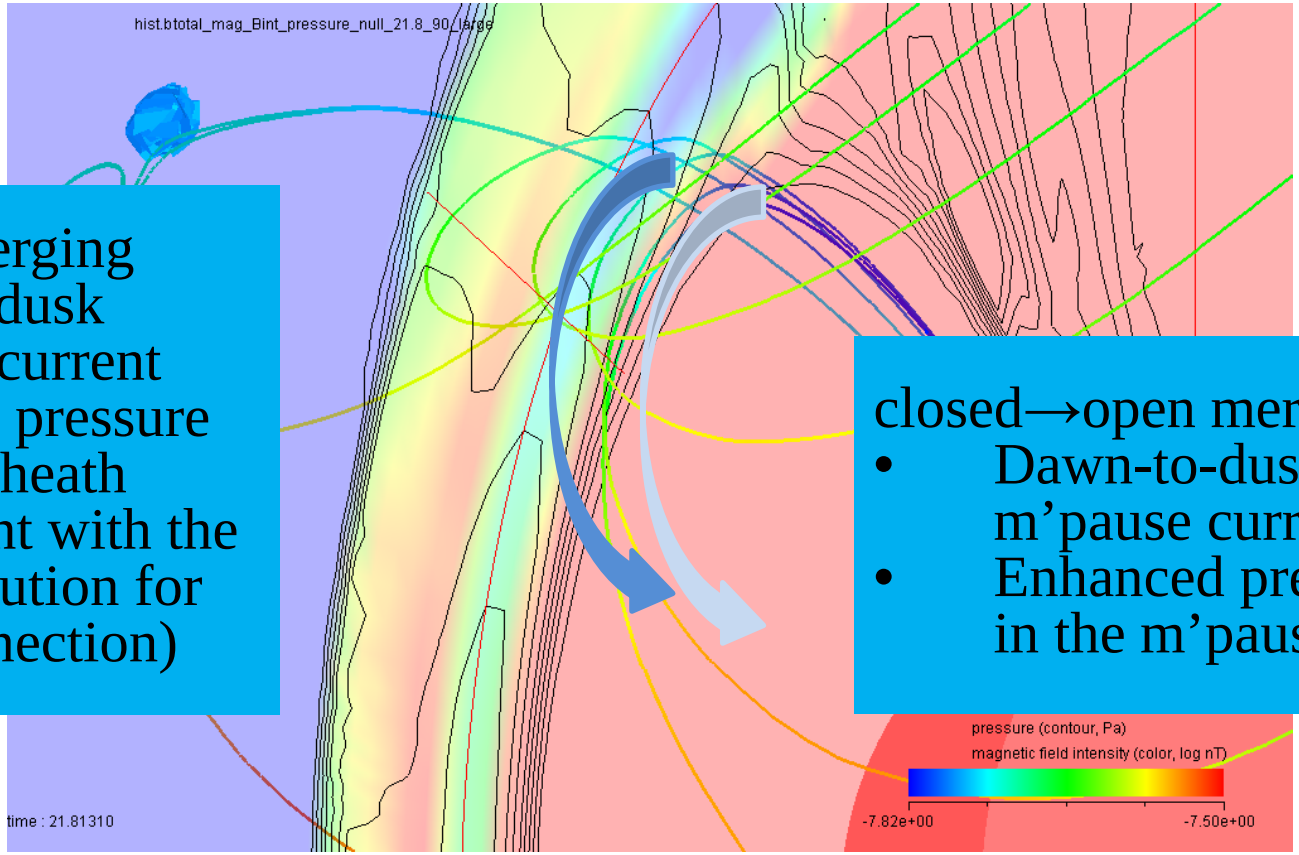


$$W_{\|,i} = \vec{v}_{\|} \bullet \rho \frac{d\vec{v}}{dt}, W_{\|,P} = -\vec{v}_{\|} \bullet \nabla P$$



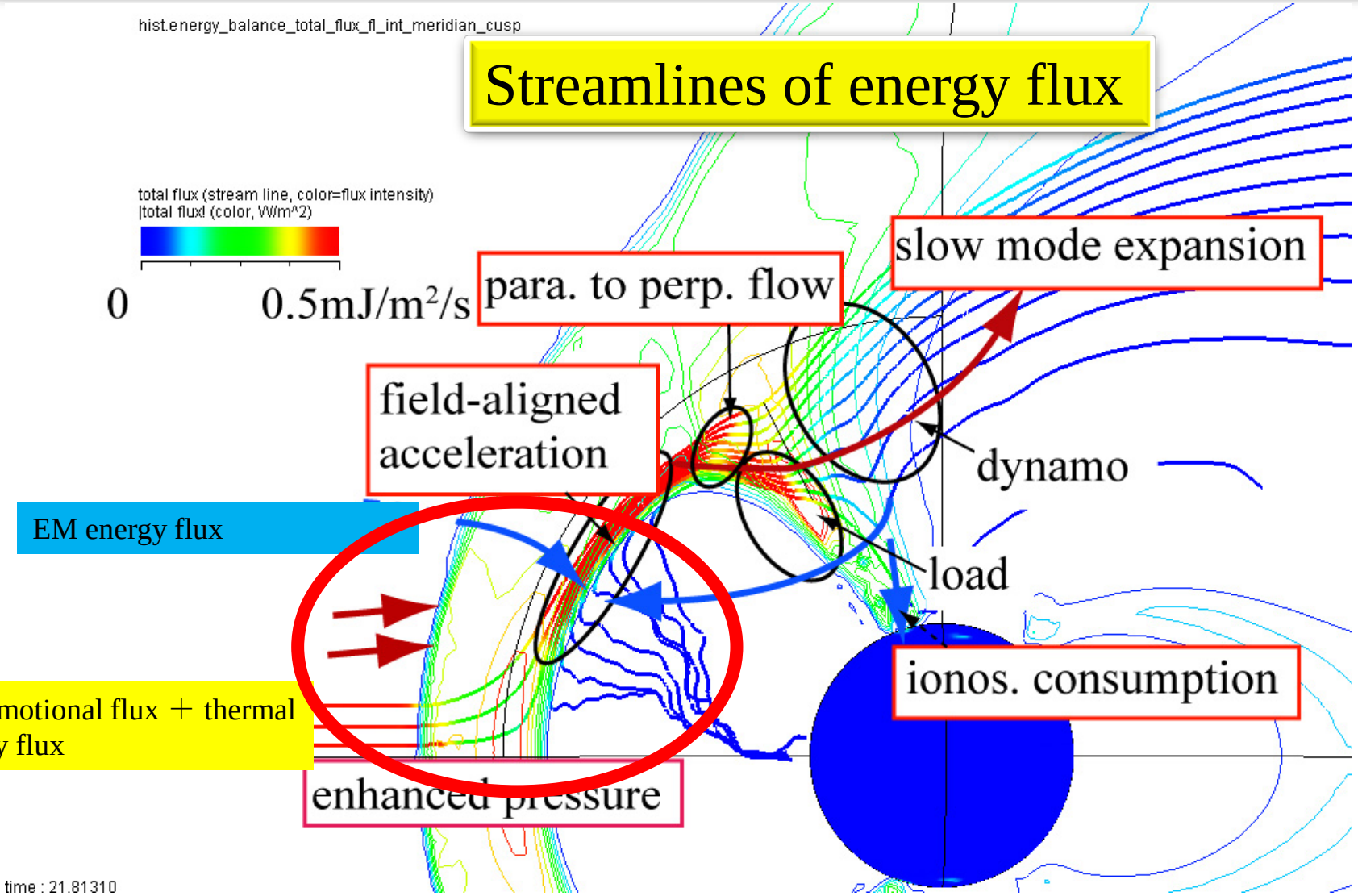
plasma and current properties in the separator reconnection

IMF→open merging
- Dawn-to-dusk m'sheath current
- Enhanced pressure in the m'sheath (equivalent with the Harris solution for 2D reconnection)



closed→open merging
- Dawn-to-dusk m'pause current
- Enhanced pressure in the m'pause

A driving mechanism of the convection



Summary

- The separator reconnection process is elucidated in the simulation results for the first time.
  - The null point structure does not invoke effective conversion from the EM energy to other energies
  - Bending field lines peeled from the separator line invoke the Lorentz force.
  - The magnetosheath current is associated with the merging from IMF to the open field
  - The magnetopause current is associated with the merging from the closed field to the open one.
  - Plasma pressure profile is naturally consistent with the merging process.

- Perpendicular flow acceleration in the magnetosheath is caused by the merging from IMF to the open field
- Stationary EM energy supply in the magnetopause region is caused by the merging from the closed field to the open one.

end