2011. 1. 31

名古屋大学

中緯度短波レーダ研究会

対流パターンと沿磁力線電流の相関構造

田中高史

サブストーム（全ての磁気圏）モデルに必要な4条件

- 電流系が力バランスを満たすこと

$$(\mathbf{J}\times\mathbf{B})=\left(\rho\frac{d\mathbf{V}}{dt}+\nabla P\right)$$

- $J_{\parallel}$ にシアー流が付随すること

$$\frac{\mathbf{v}}{C_A}=\pm\frac{\mathbf{b}}{B_0}$$

- エネルギー供給→ダイナモが形成されること

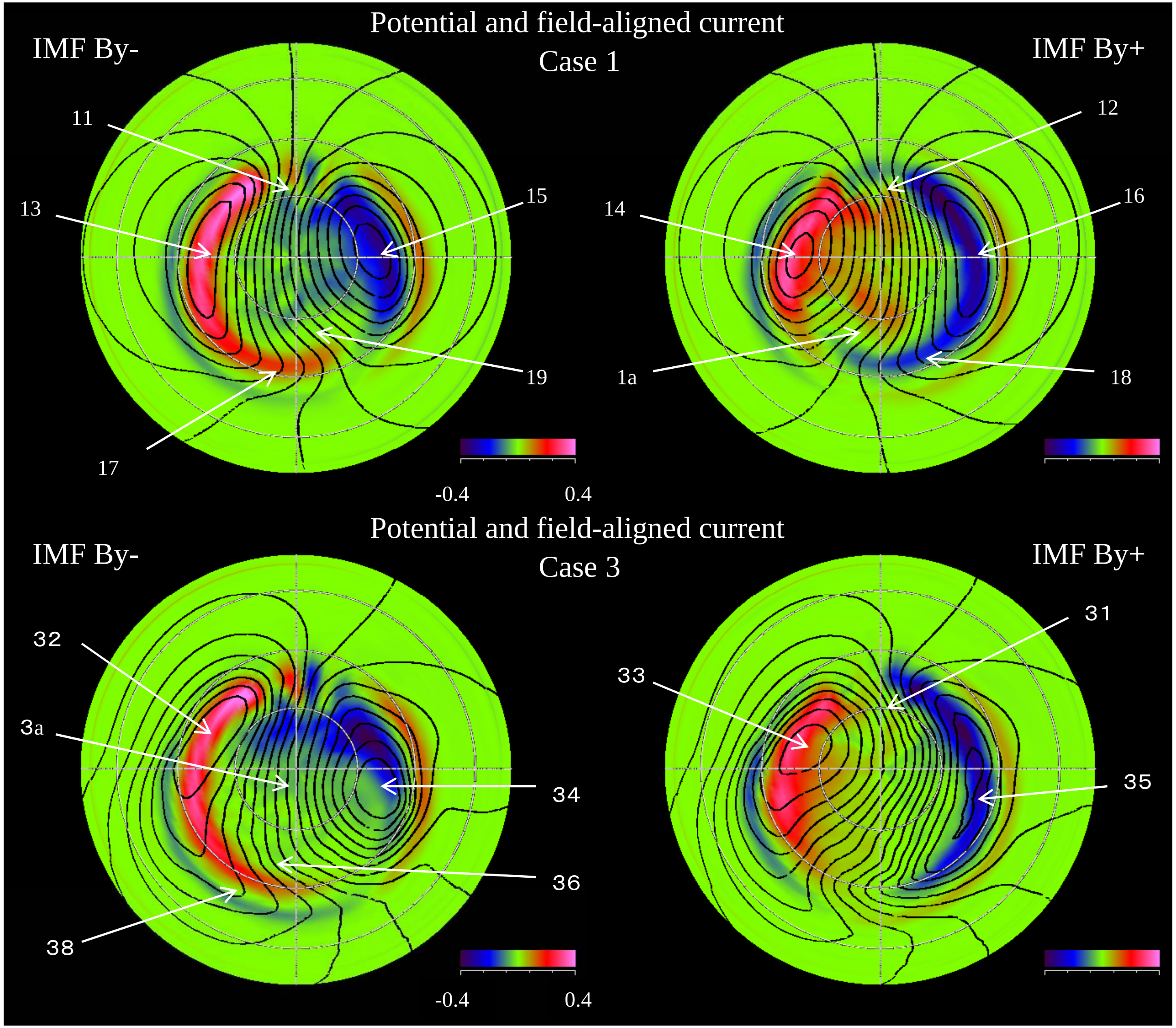
$$\mathbf{J}\cdot\mathbf{E}<\mathbf{0}$$

- 電離圏closureが成立すること

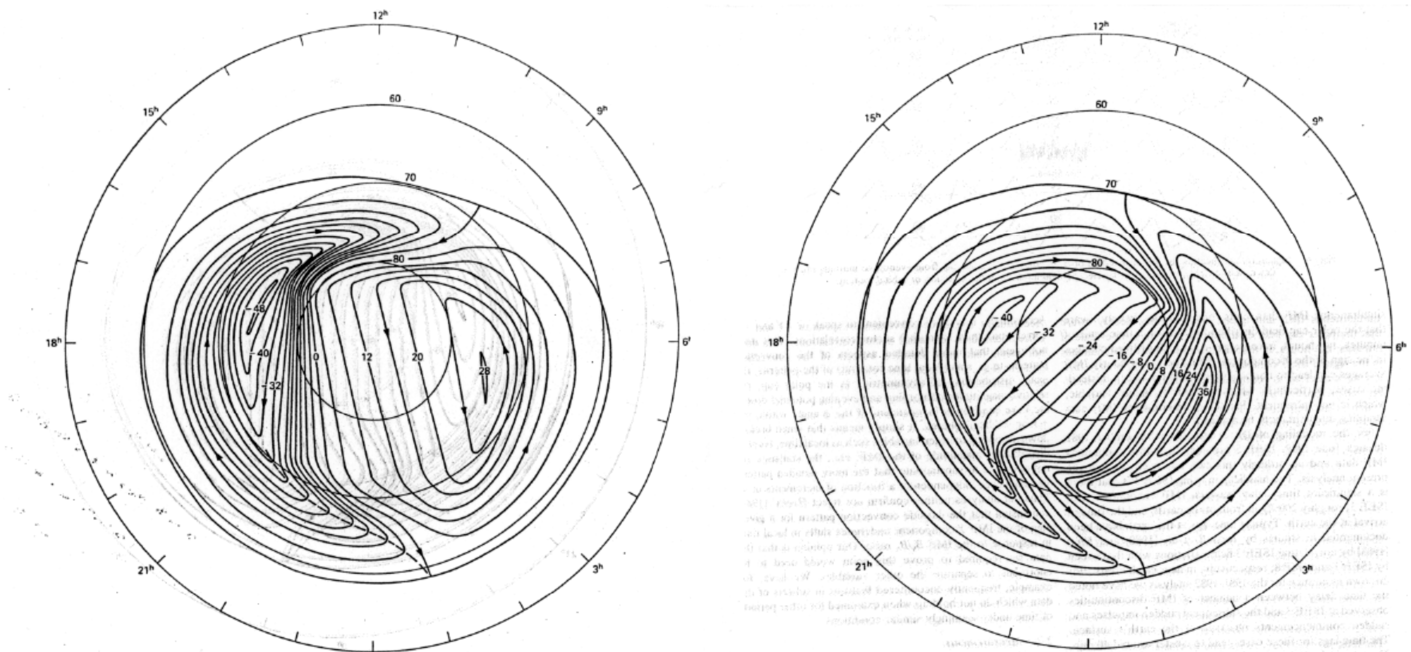
$$\nabla\bullet\sum\nabla\varphi=J_{\parallel}$$

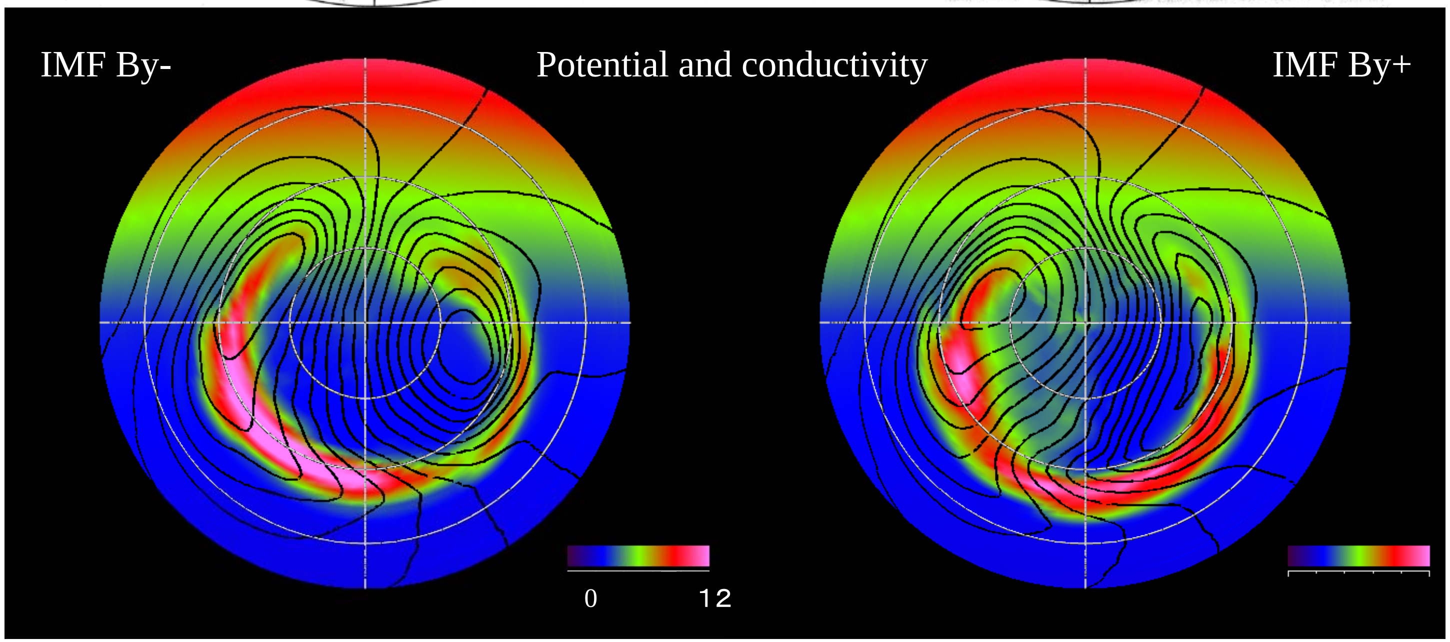
$\mathbf{v},\mathbf{E},\varphi$ → 同一物理量

Convection pattern and FAC (IMF By dependence)



Heppner-Maynard convection pattern

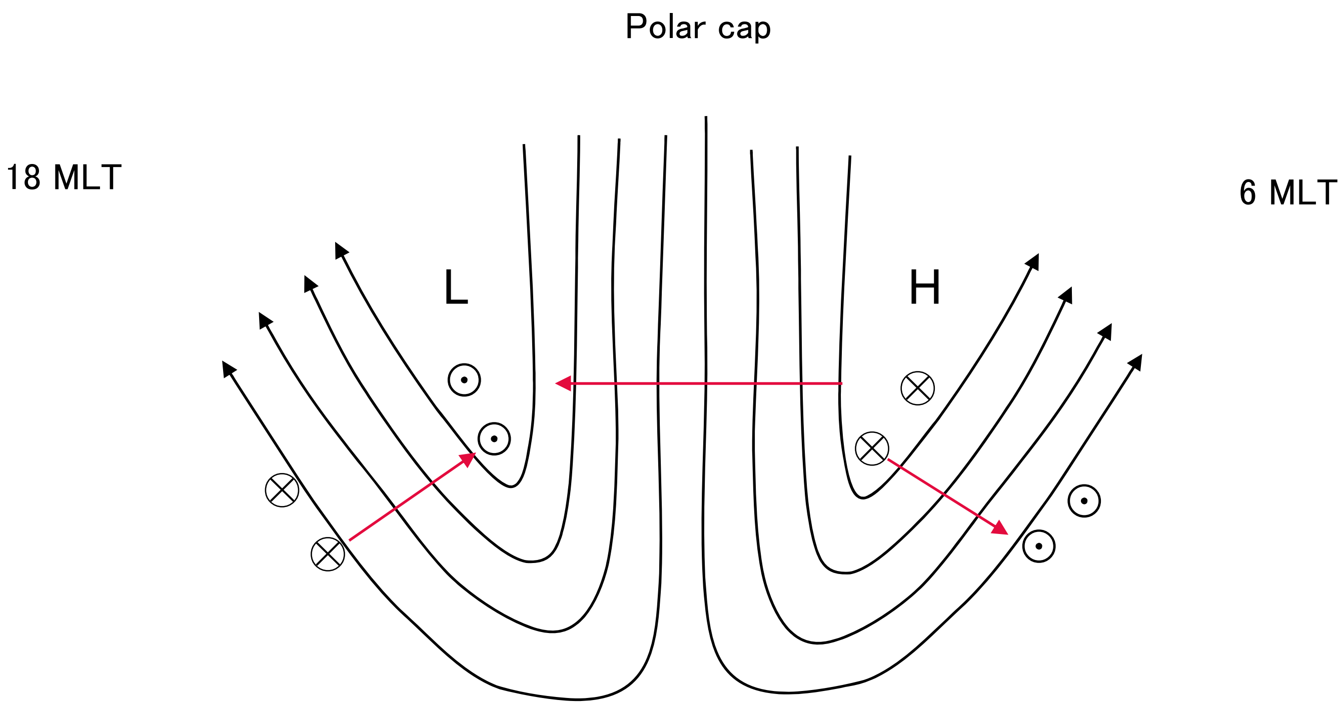




Convection pattern and FAC

Ionospheric closure with uniform Σ

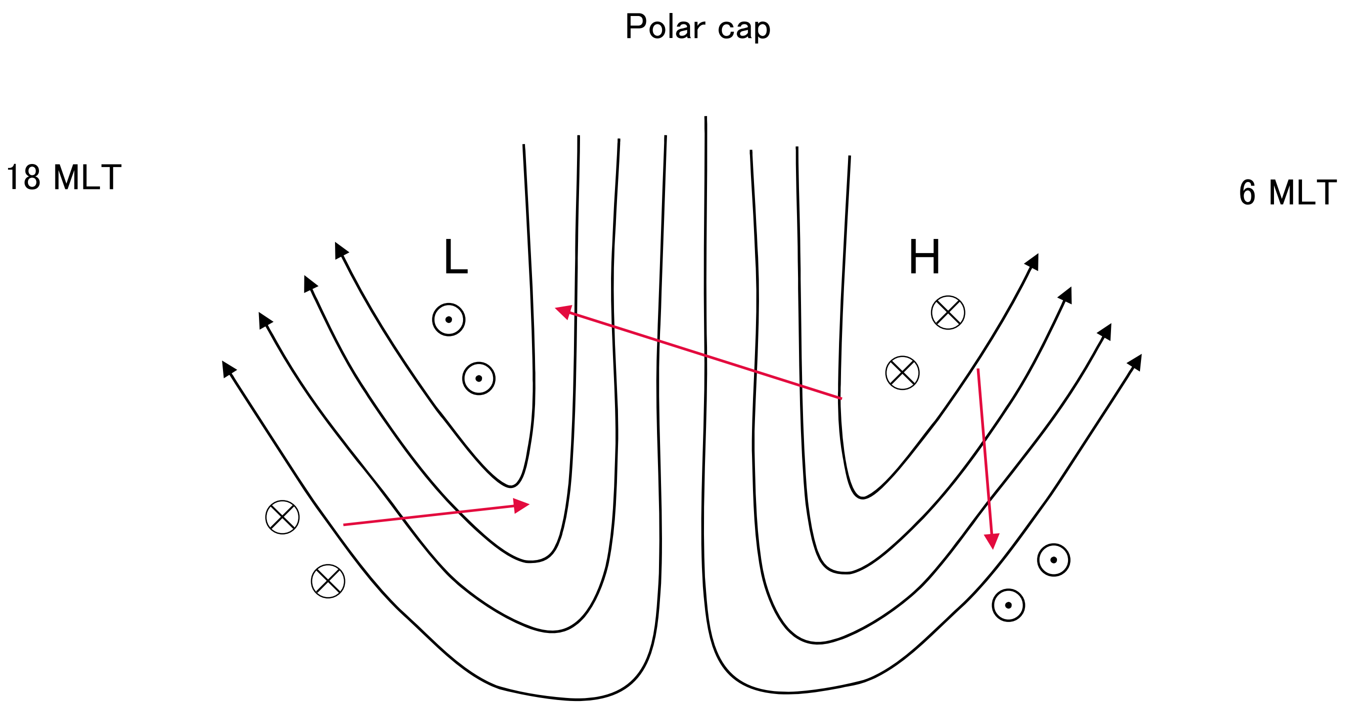
H: high potential, L: low potential



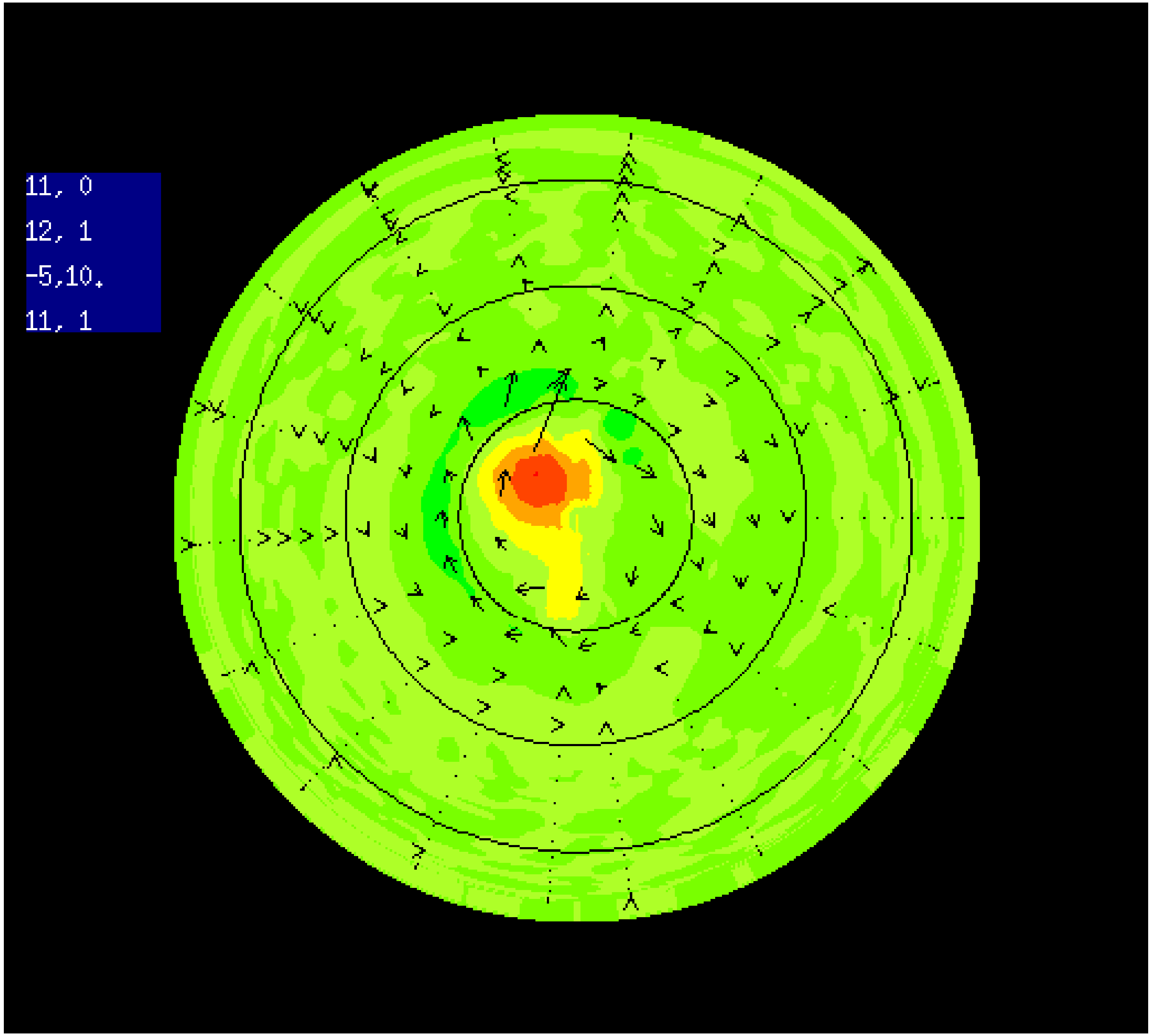
Convection pattern and FAC

Ionospheric closure with non-uniform Σ

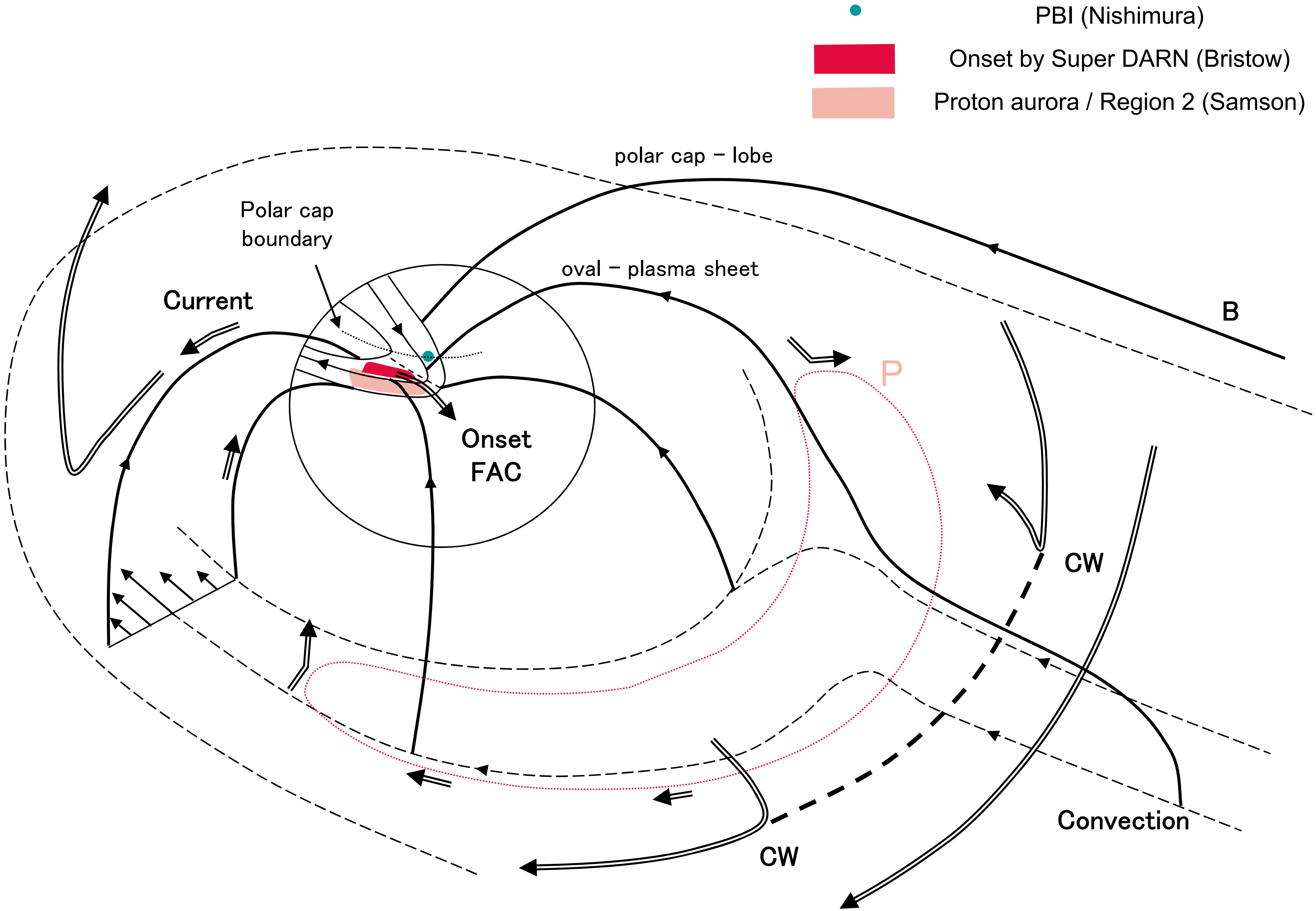
H: high potential, L: low potential



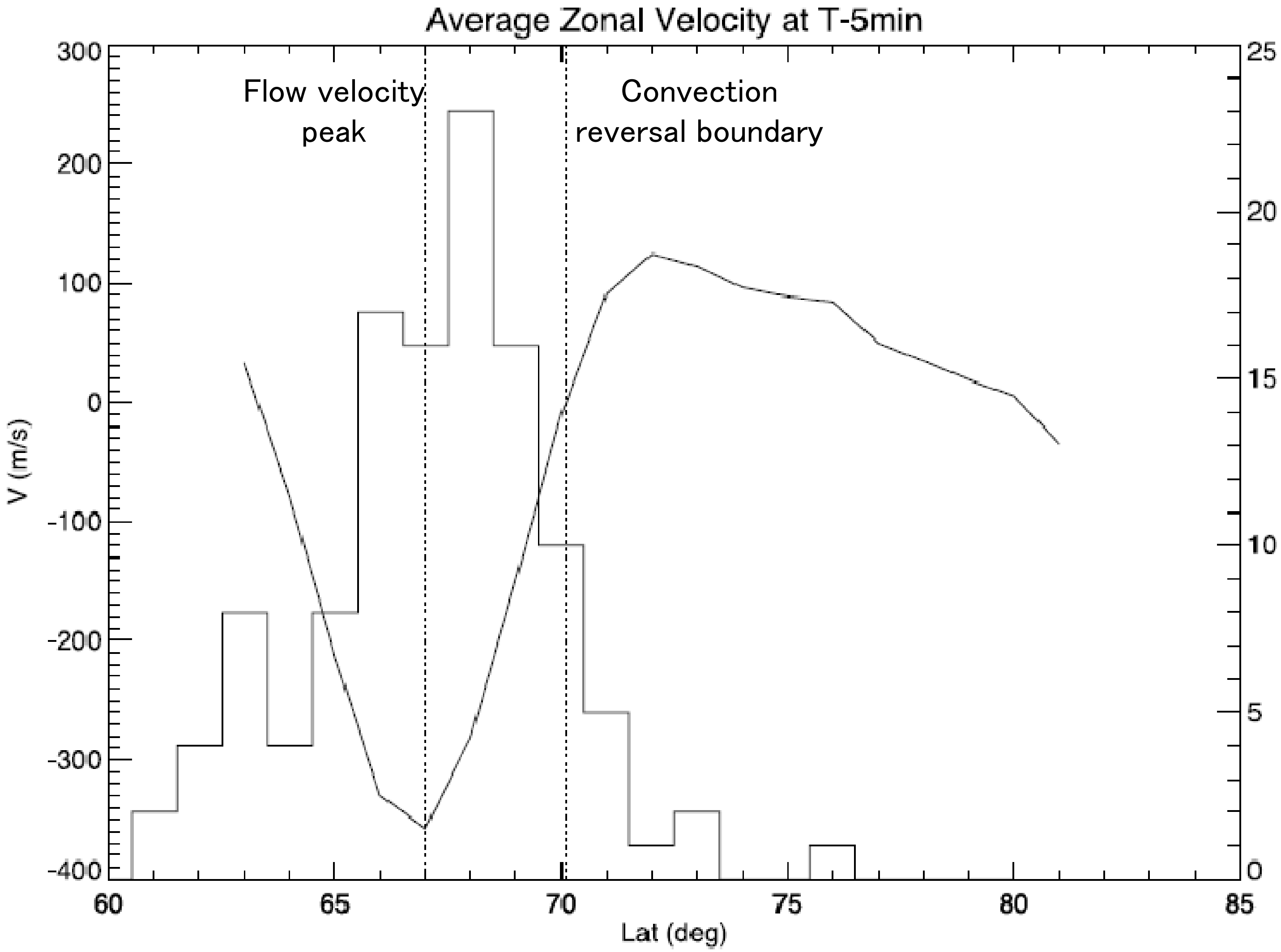
Substorm currents system (color FAC)



Substorm current system and convection

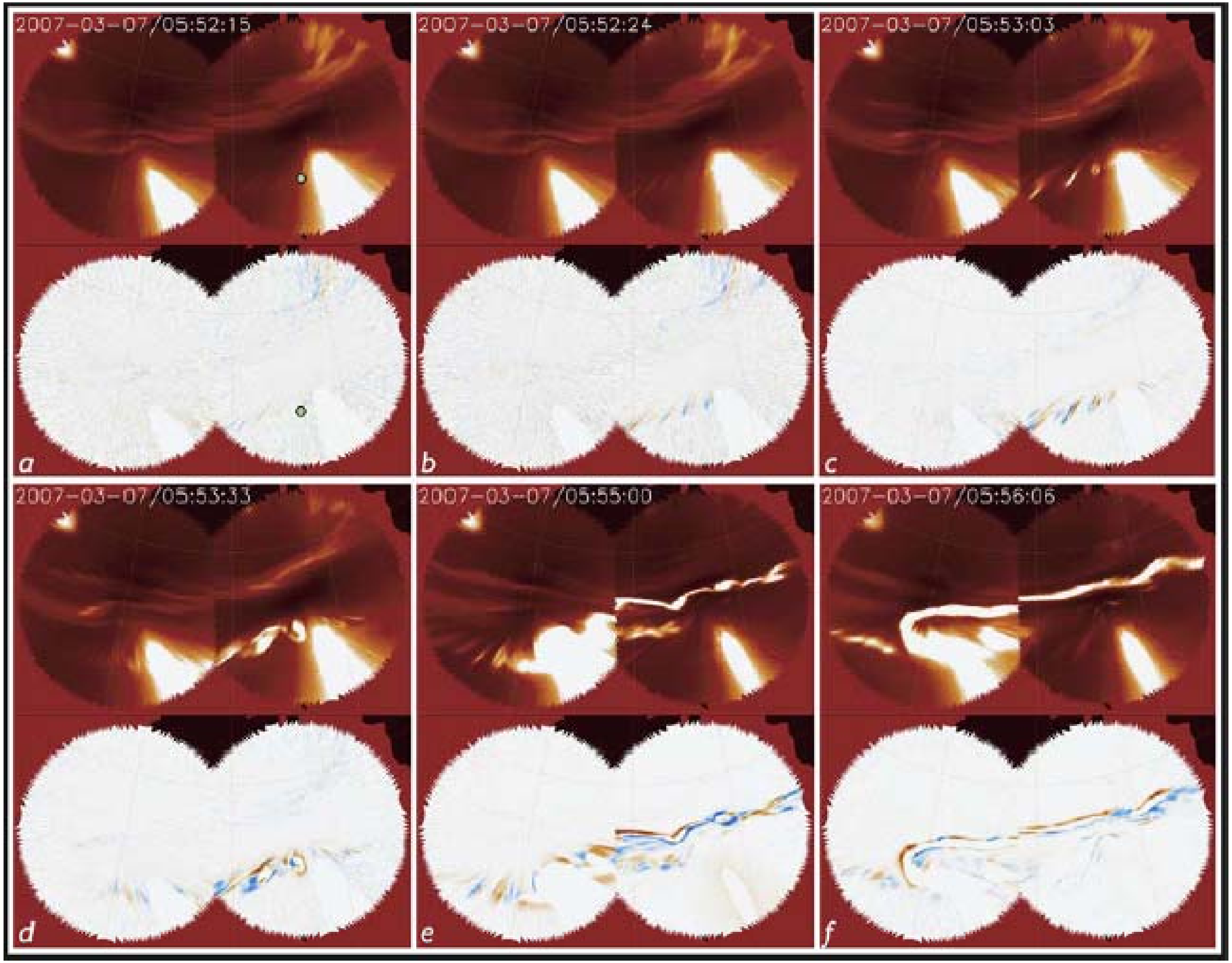


Substorm onset location (Super DARN)



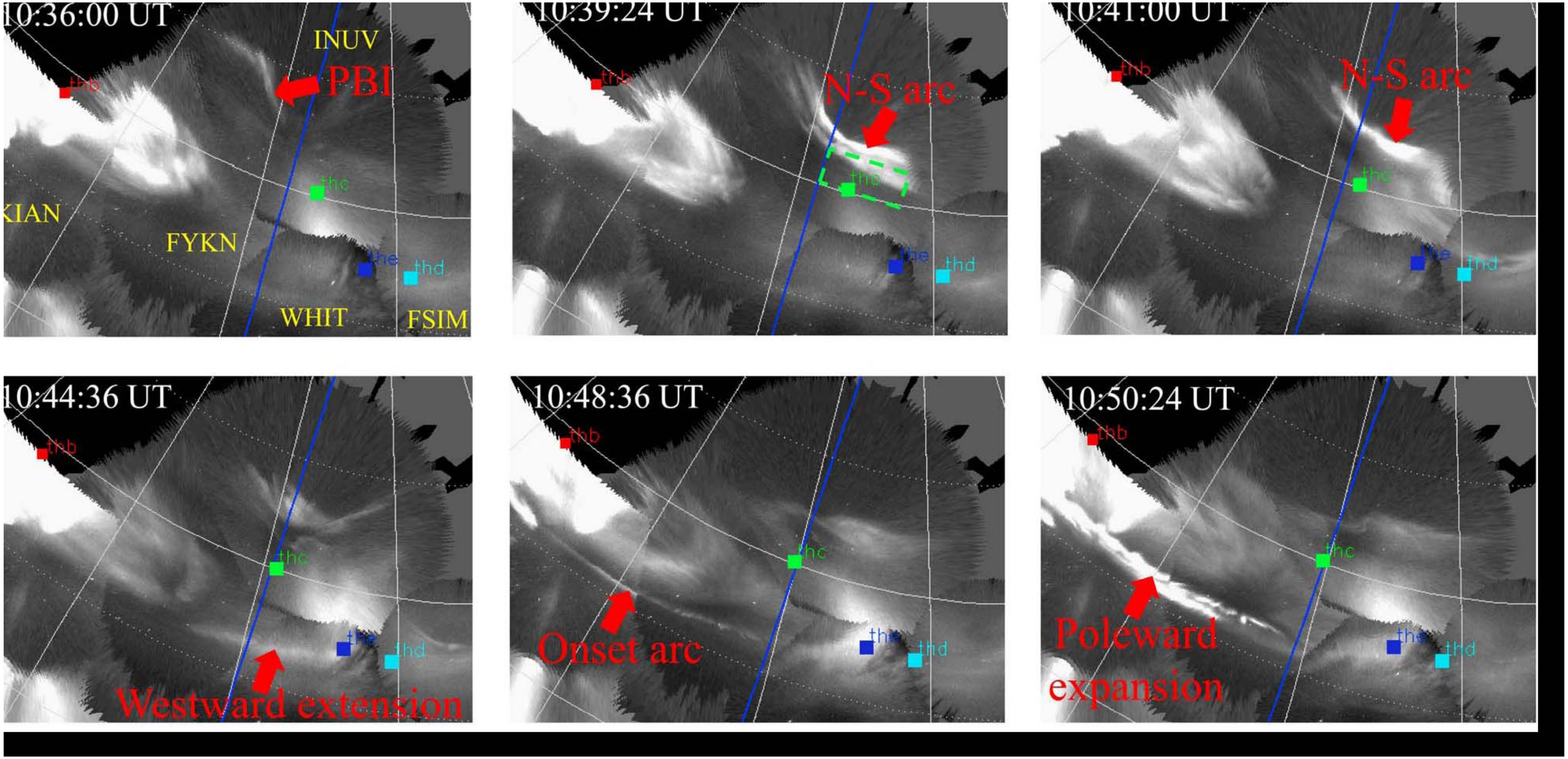
(Bristow, 2009)

Onset arc problem (upper poleward)



(Rae et al., 2009)

N-S arc and substorm onset



(Xing et al., 2010)

Region 2 current driven model of the substorm

Reconnection (NENL)

middle magnetosphere

↓

Plasma sheet collapse

↓

Magnetic tension①

positive J・E

↓

Thermal energy②

inner magnetosphere

↓

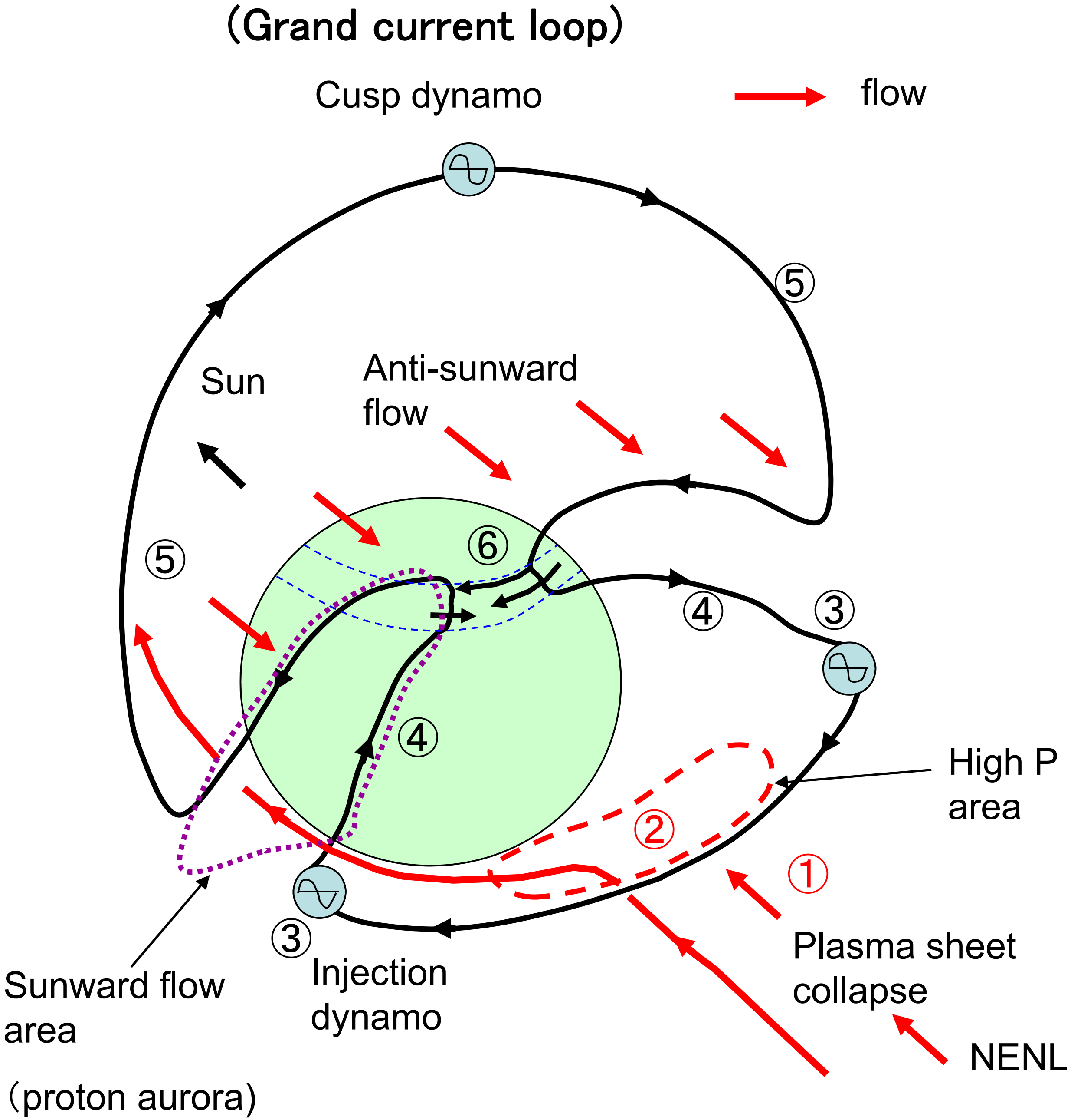
Dynamo③

region 2 current ④

↓

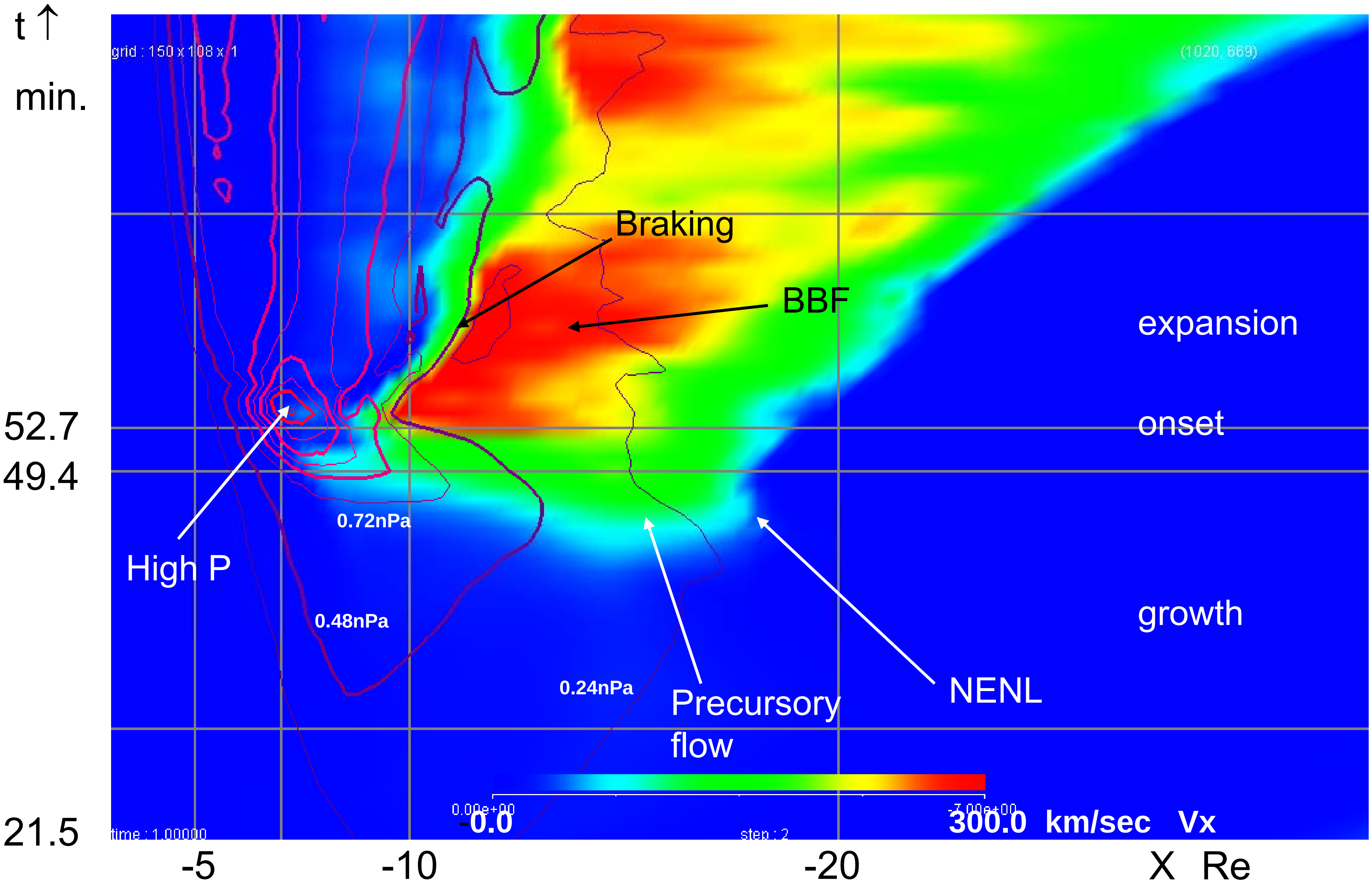
Region 1 current ⑤

WEJ⑥

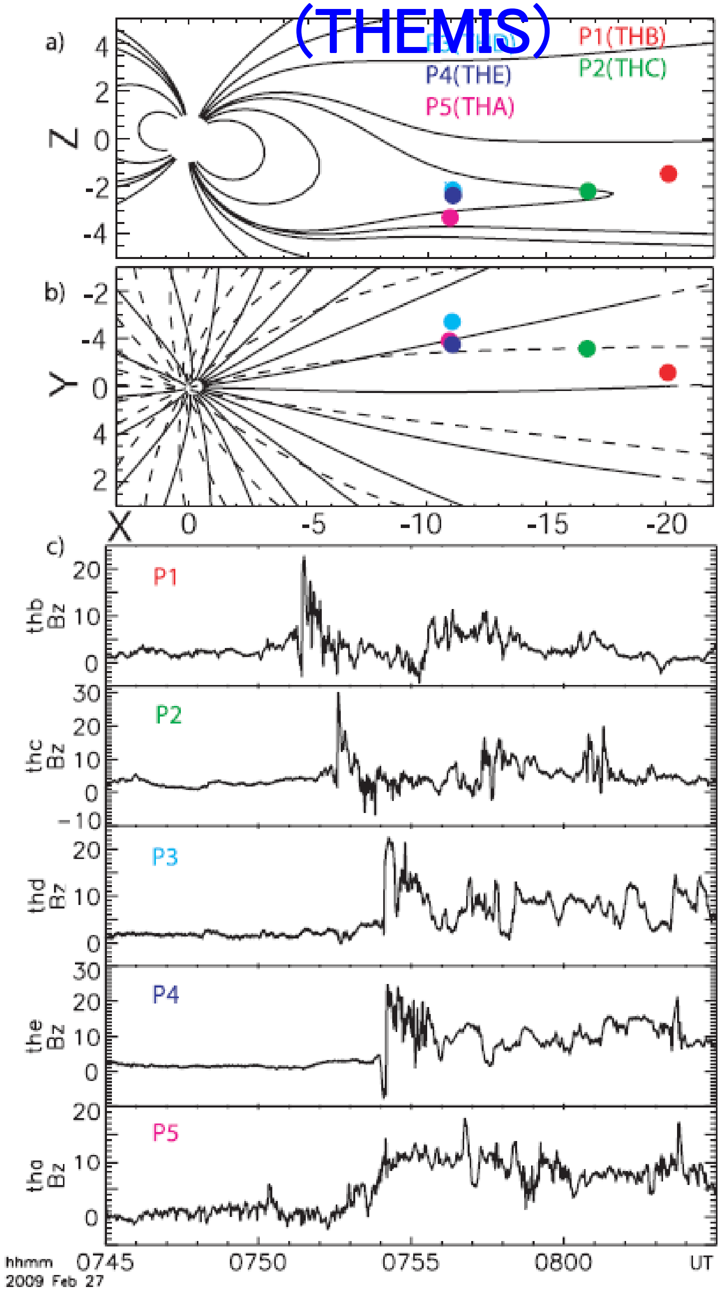


Developments of precursory flow and pressure

(Color:Vx at y=z=0, Contour:P at y=z=0 interval 240 pPa)



Earthward propagating dipolarization front (THEMIS)

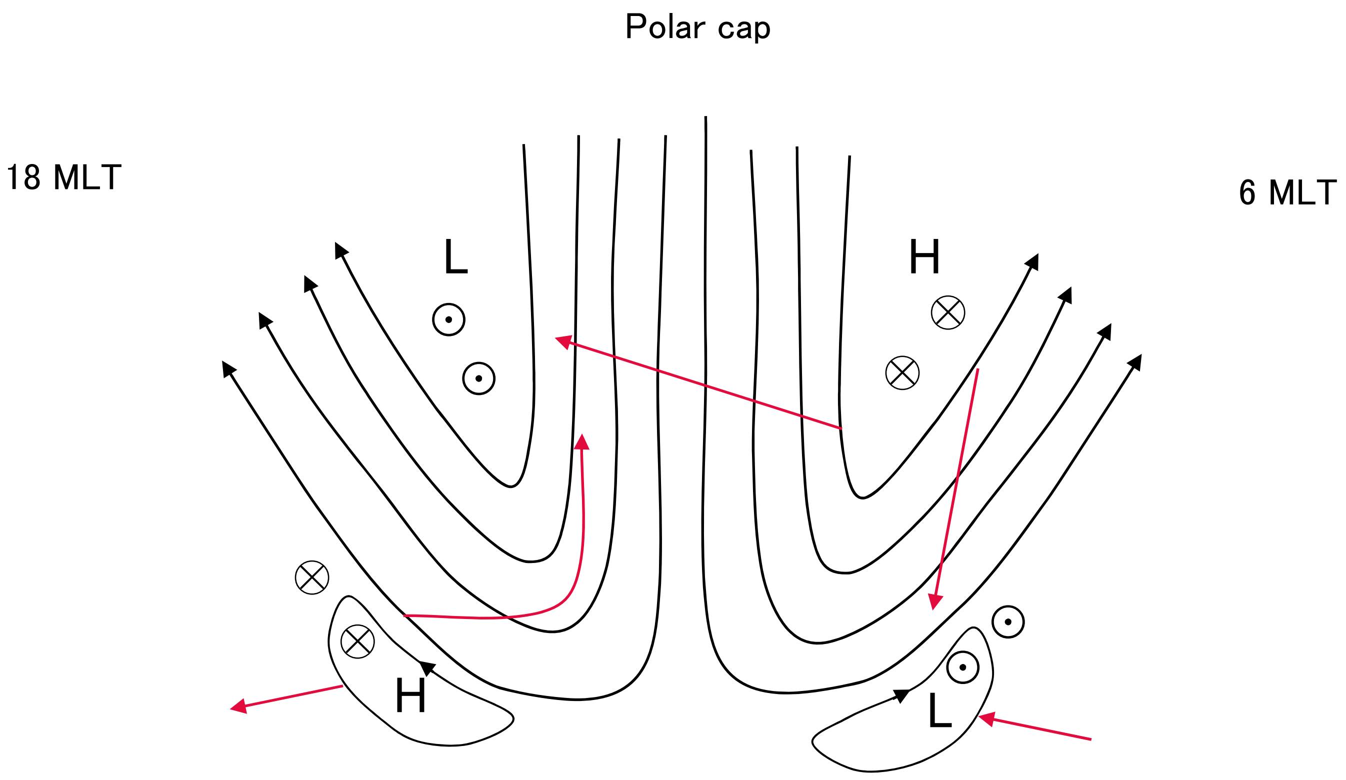


(Runov et al., 2009)

Convection pattern and substorm FAC

Onset → SAPS → CEJ

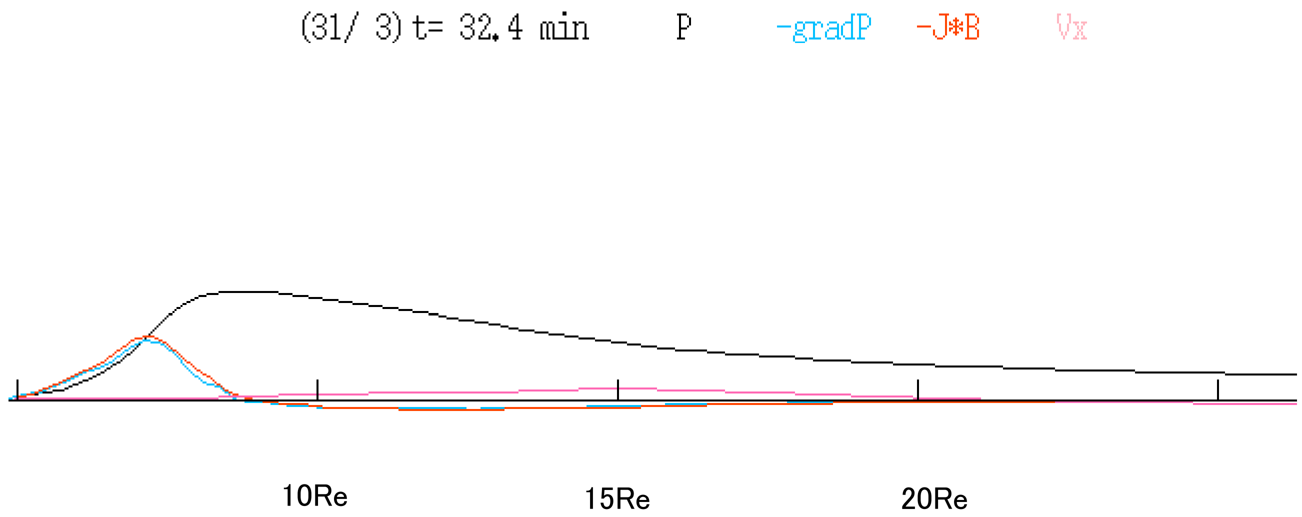
H: high potential, L: low potential



Force balance（34）

Force balance and state transition

onset t=52 min



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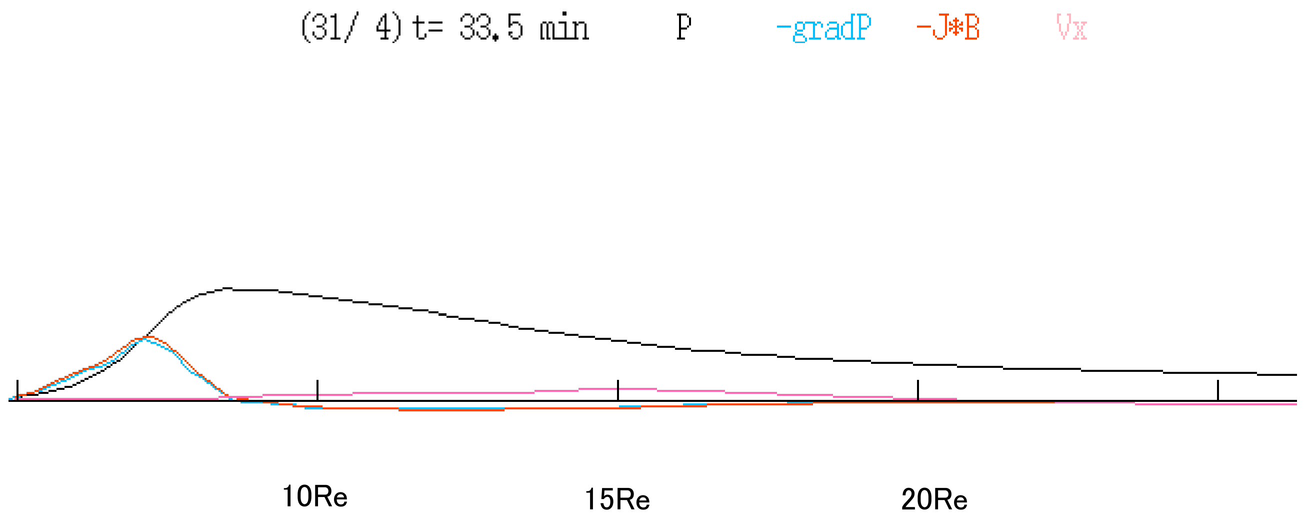

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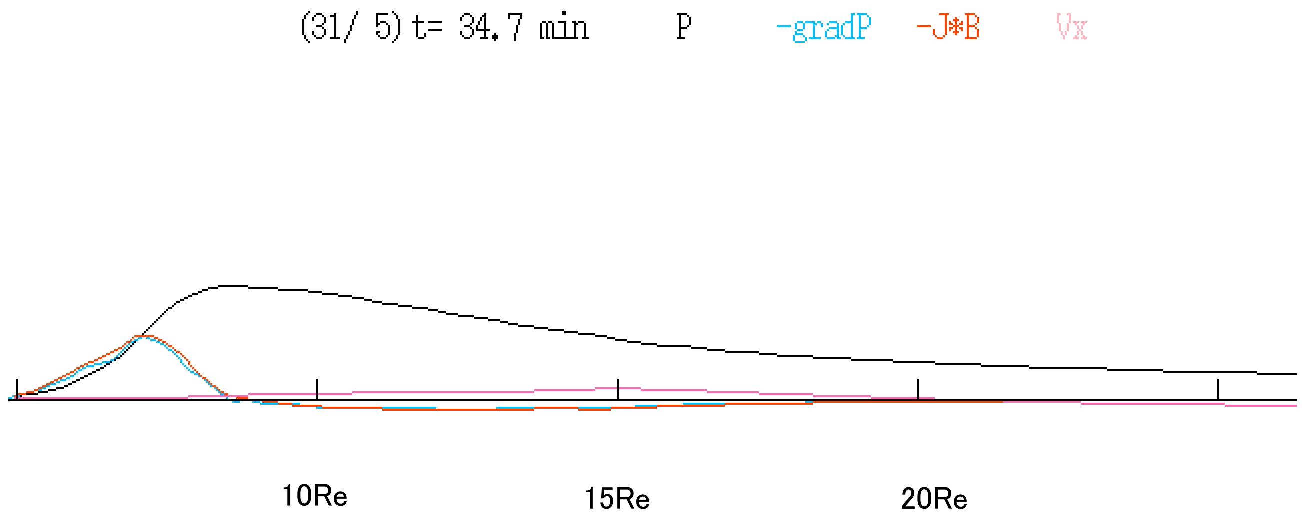

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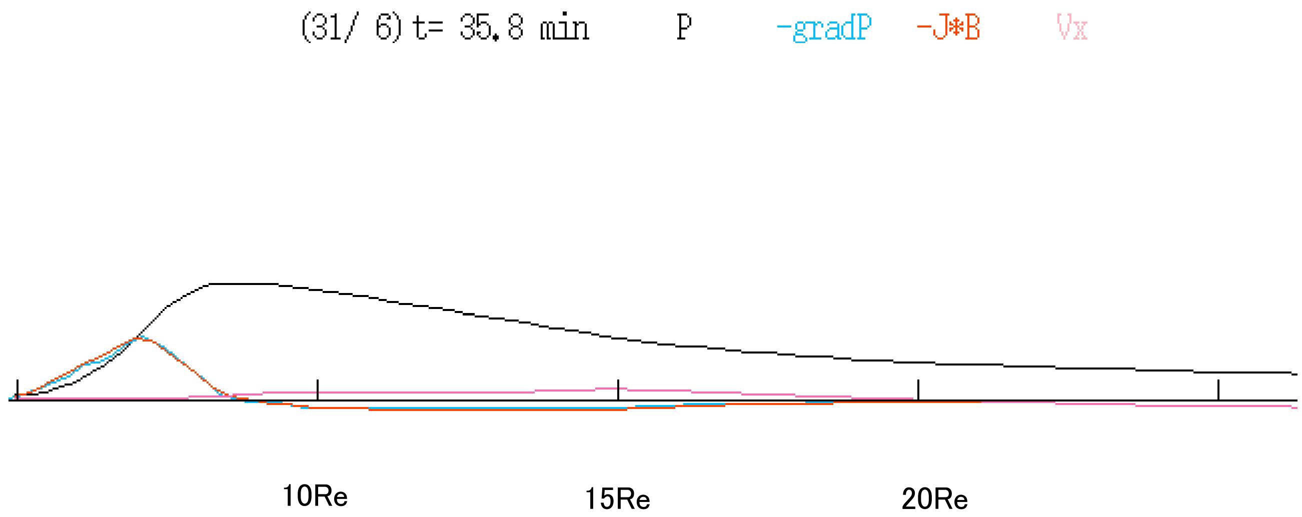

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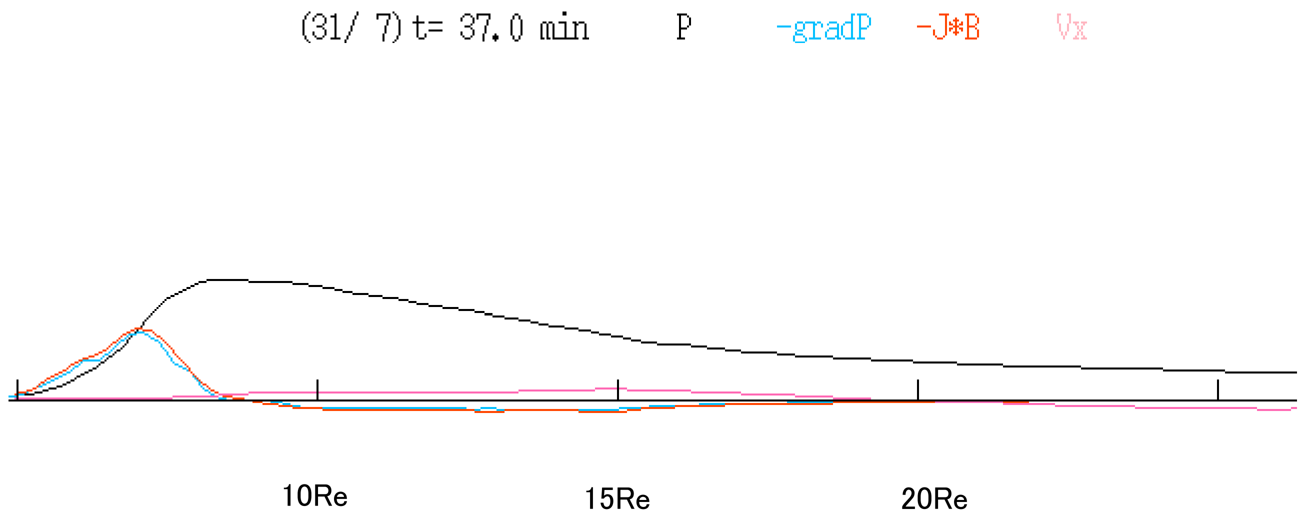

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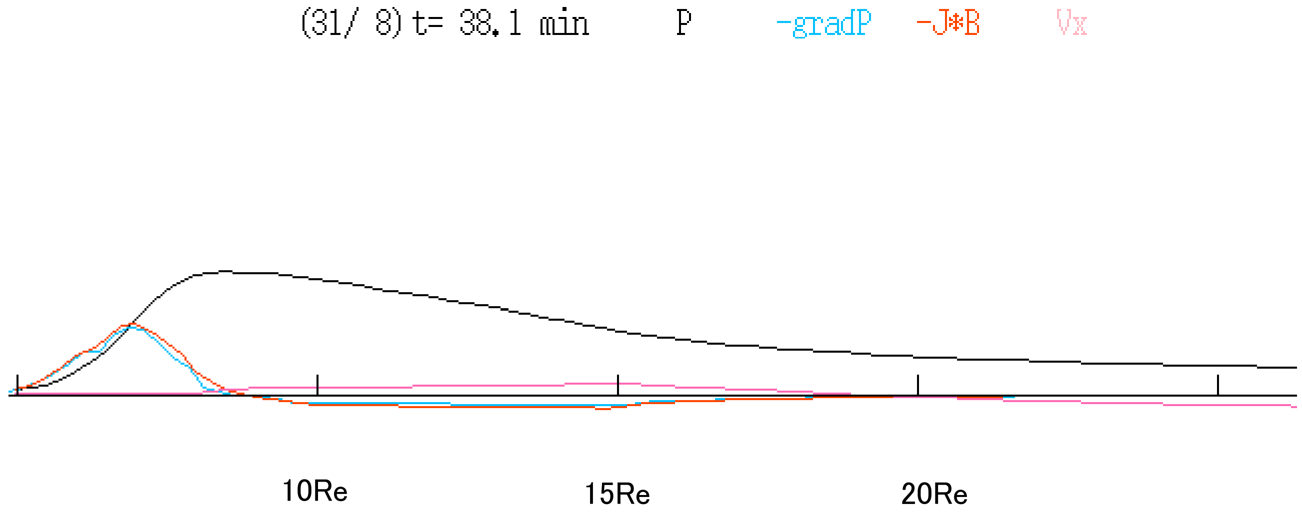

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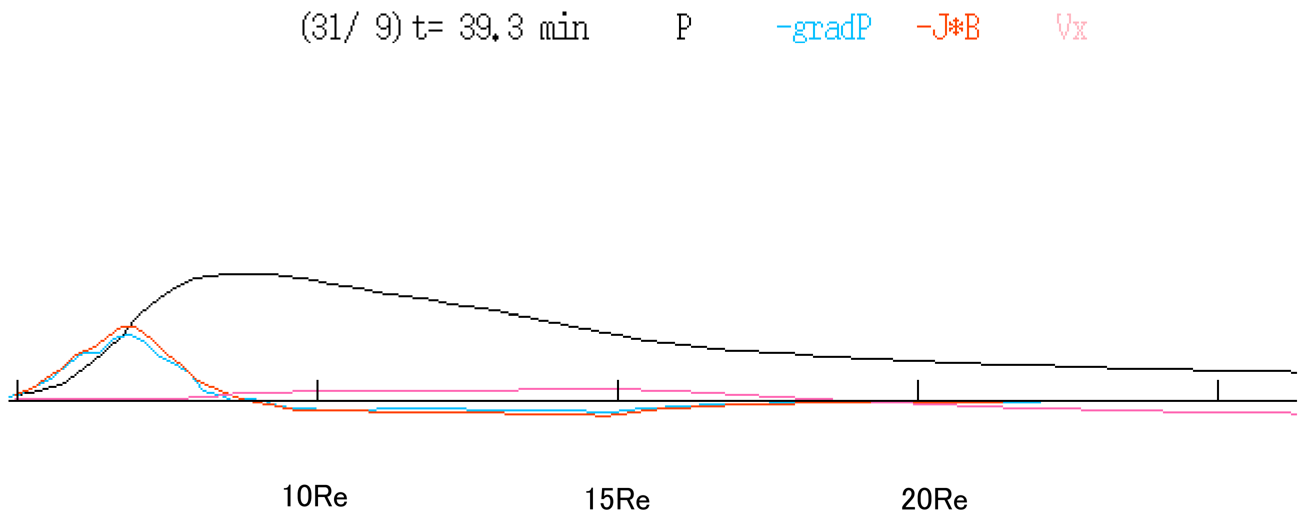

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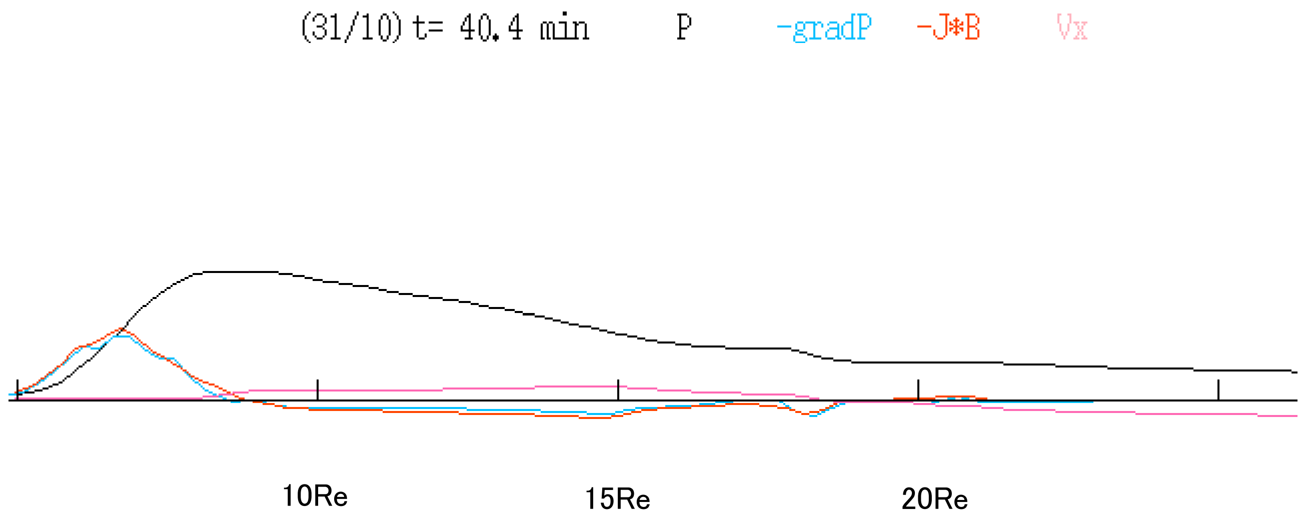

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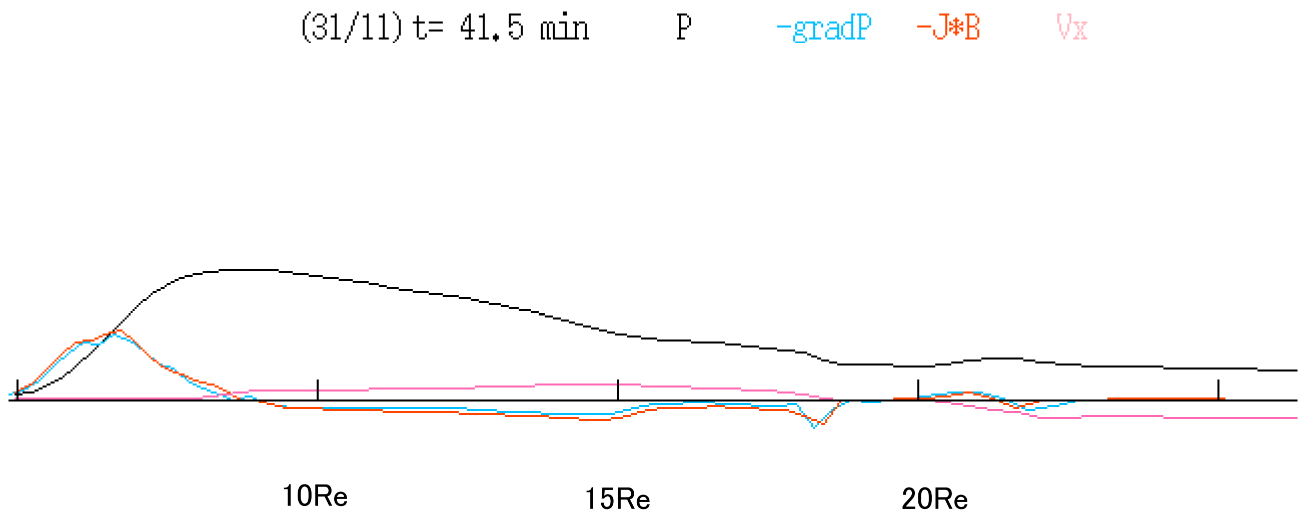

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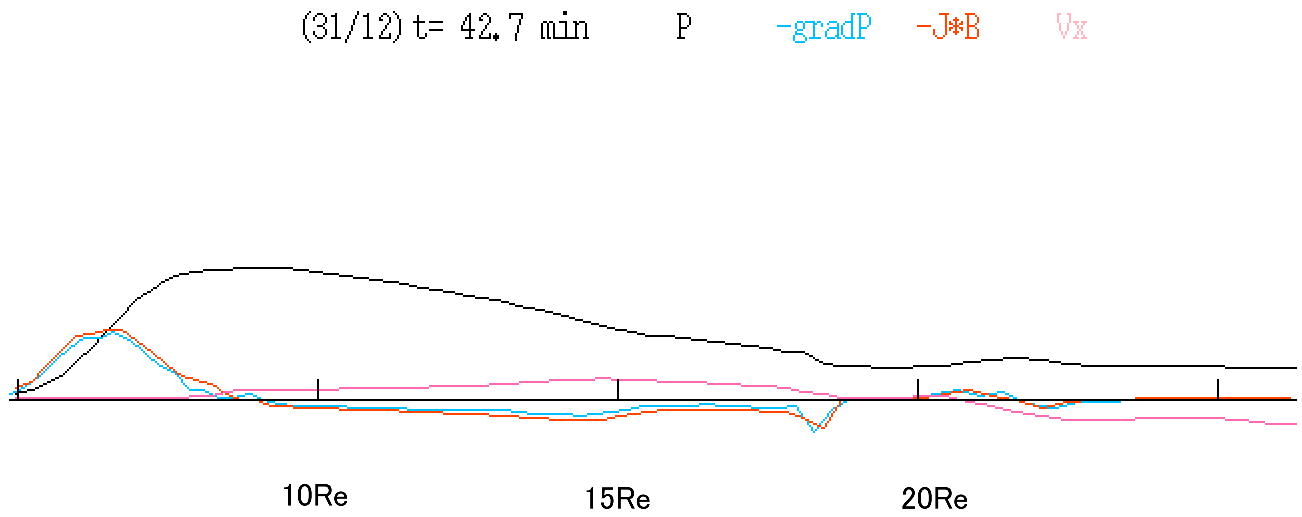

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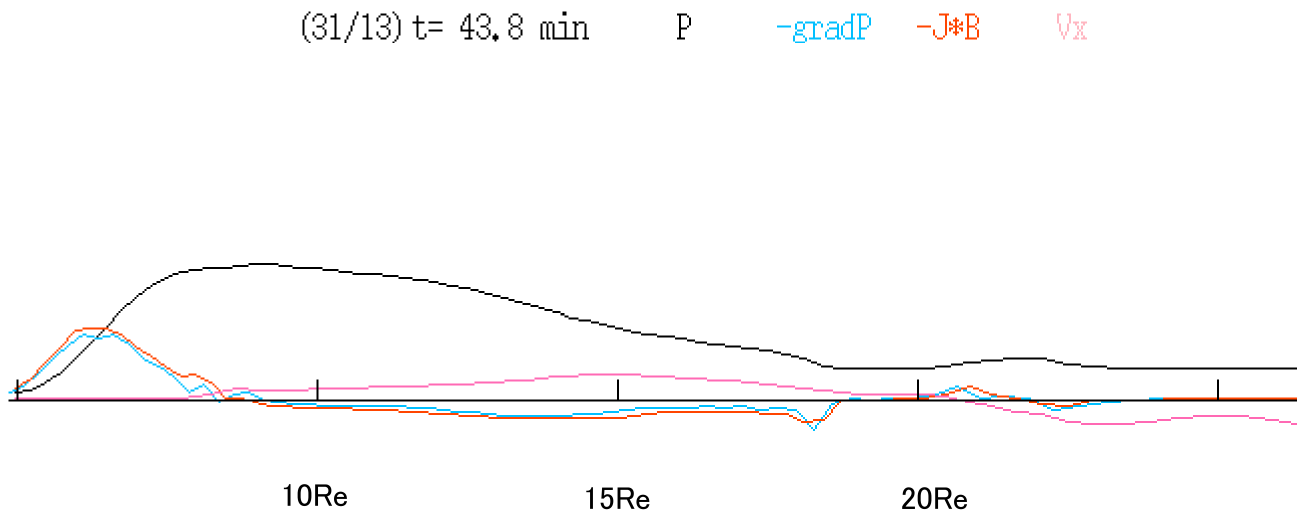

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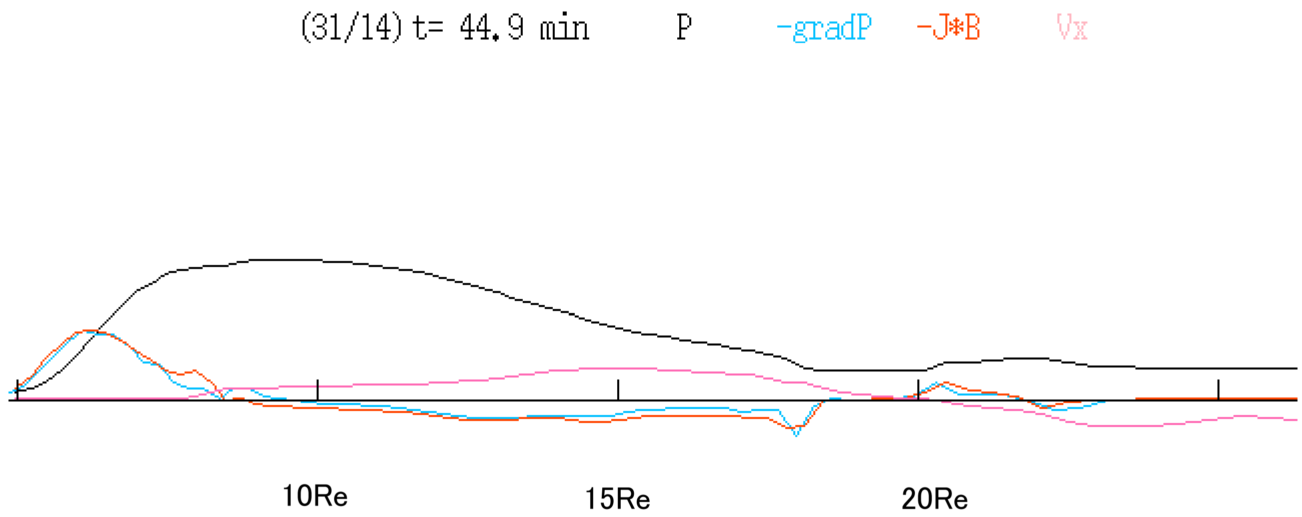

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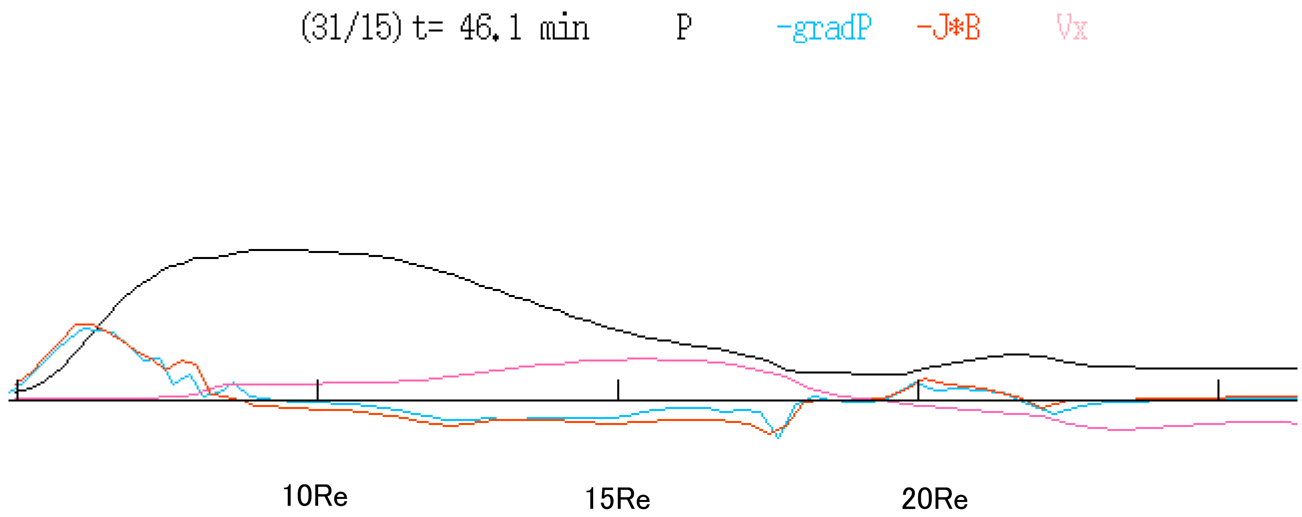

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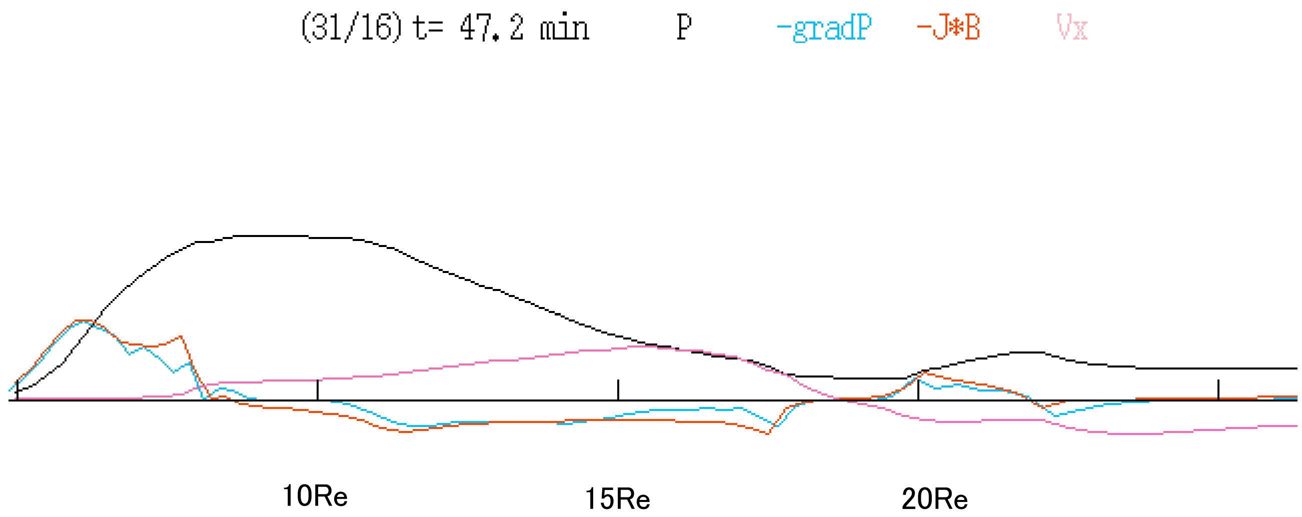

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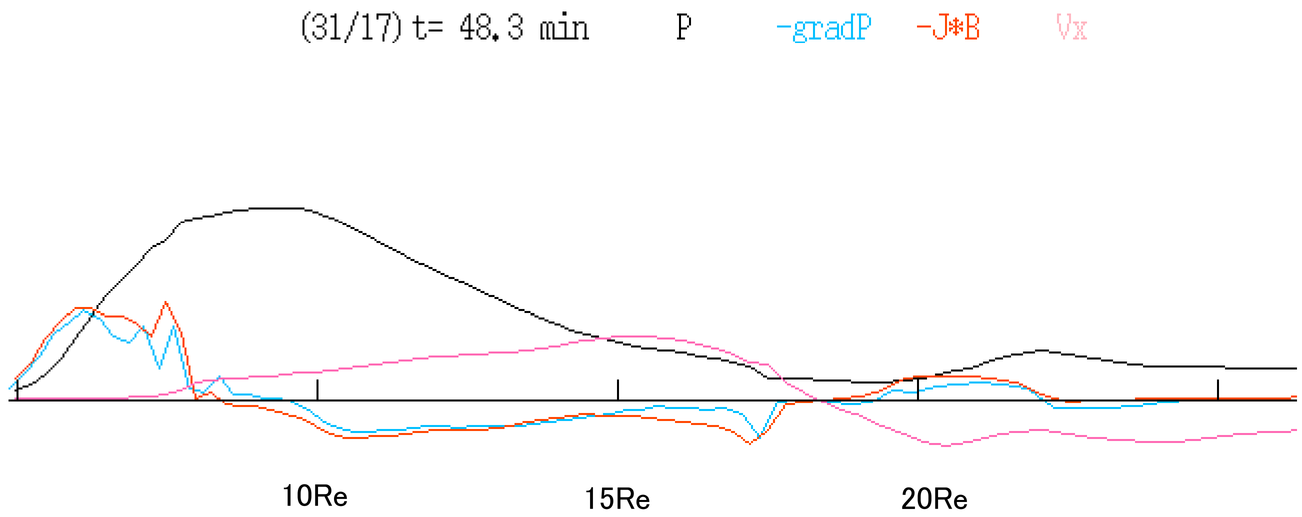

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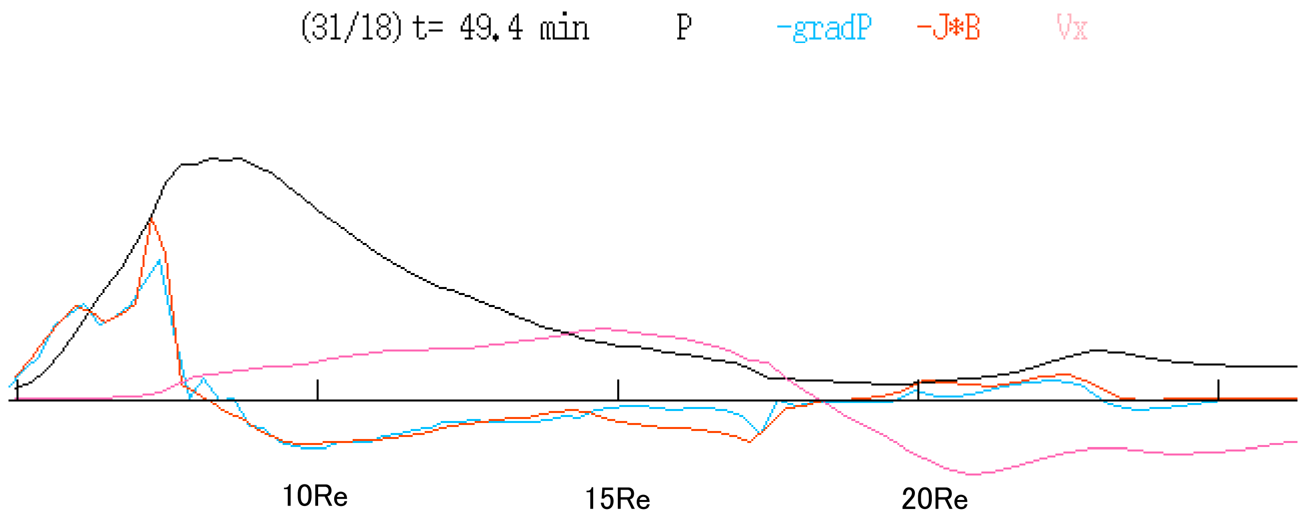

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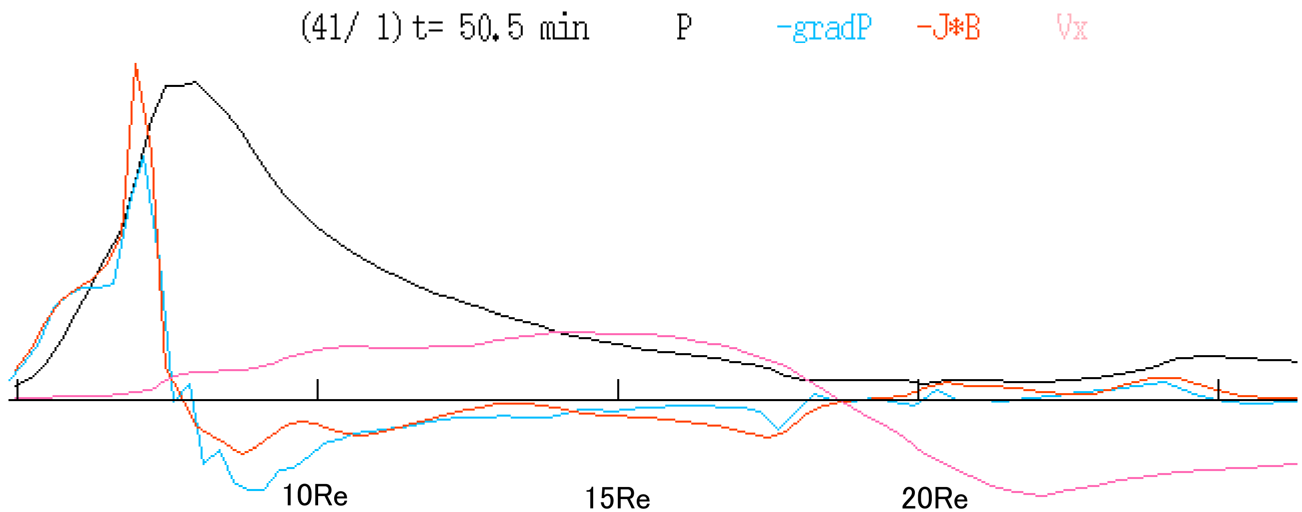

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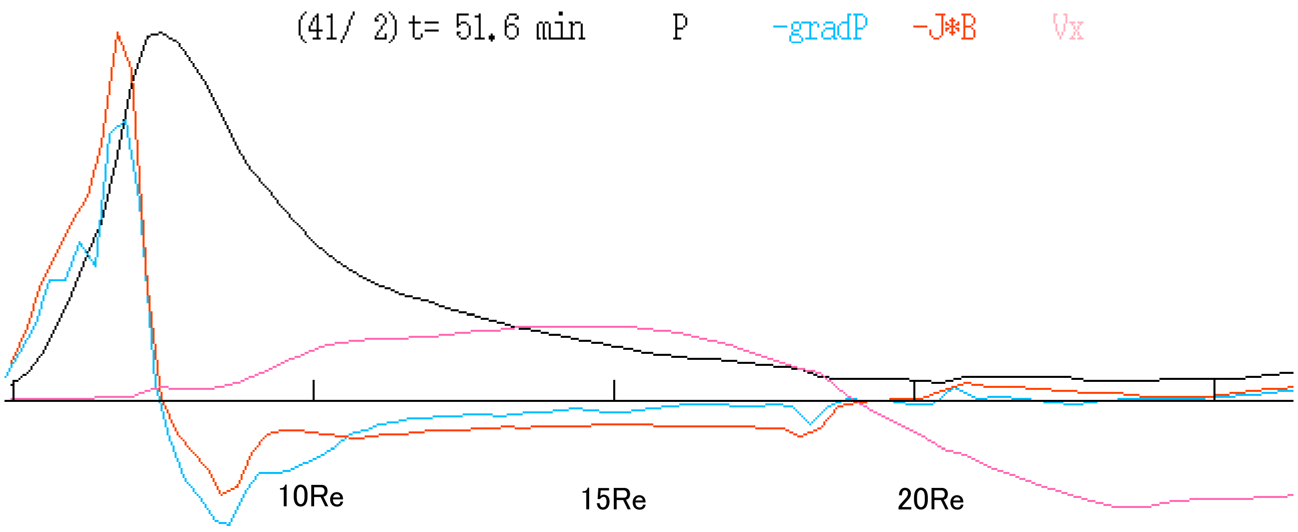

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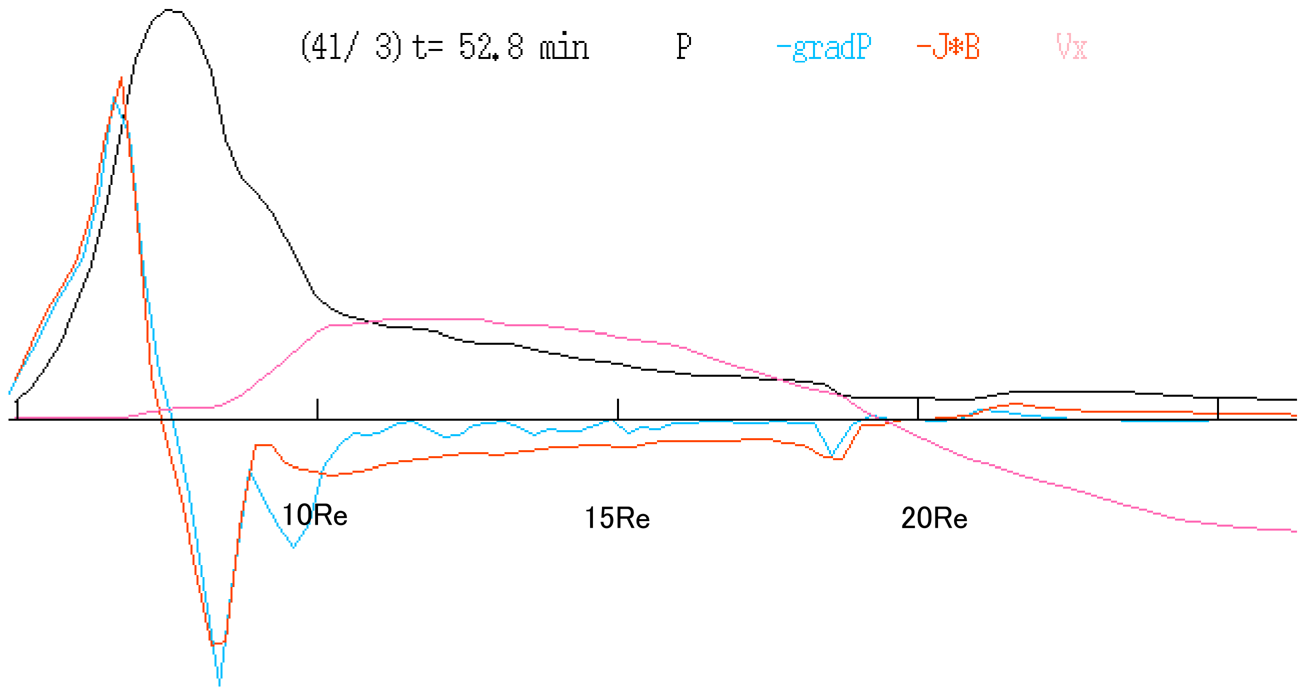

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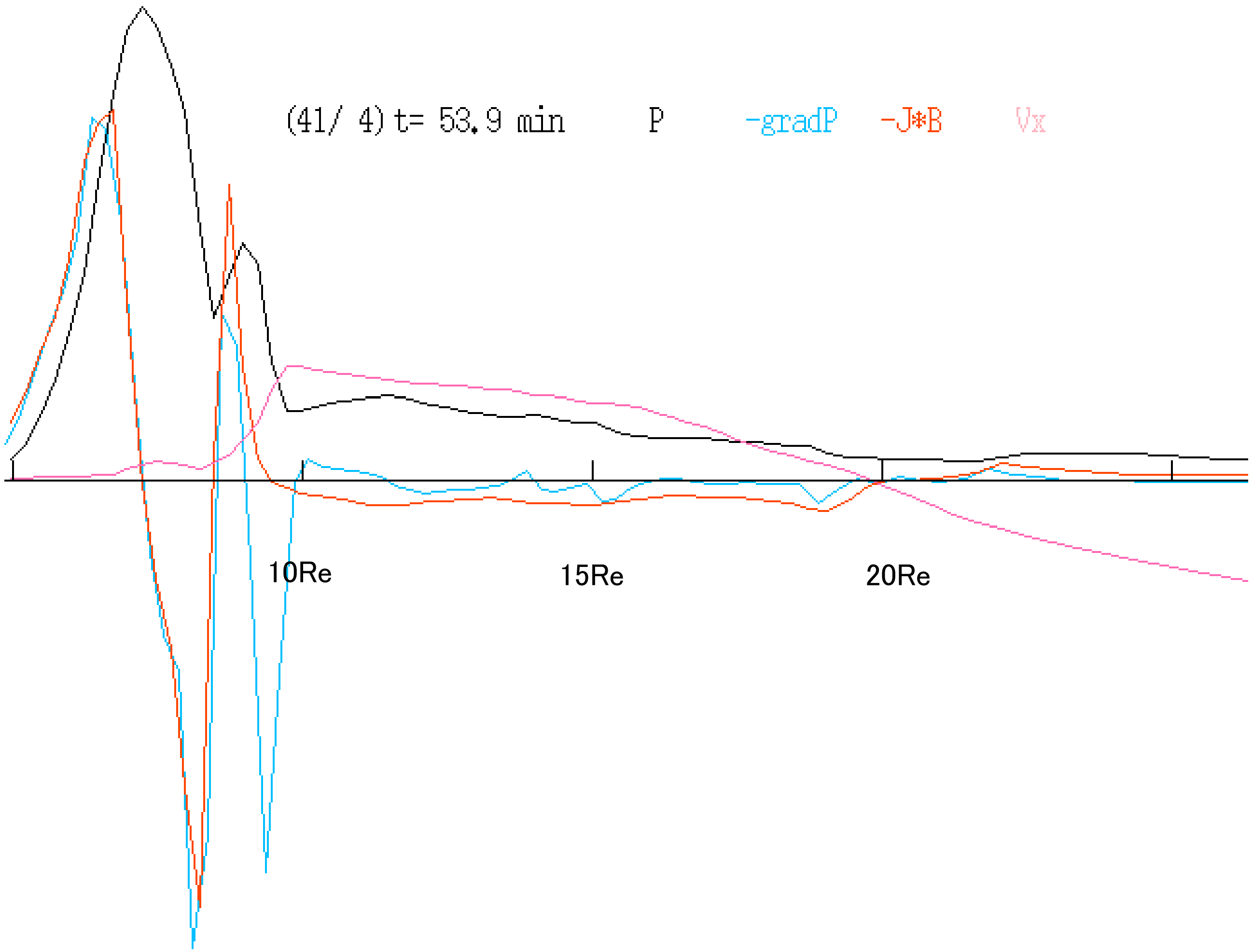

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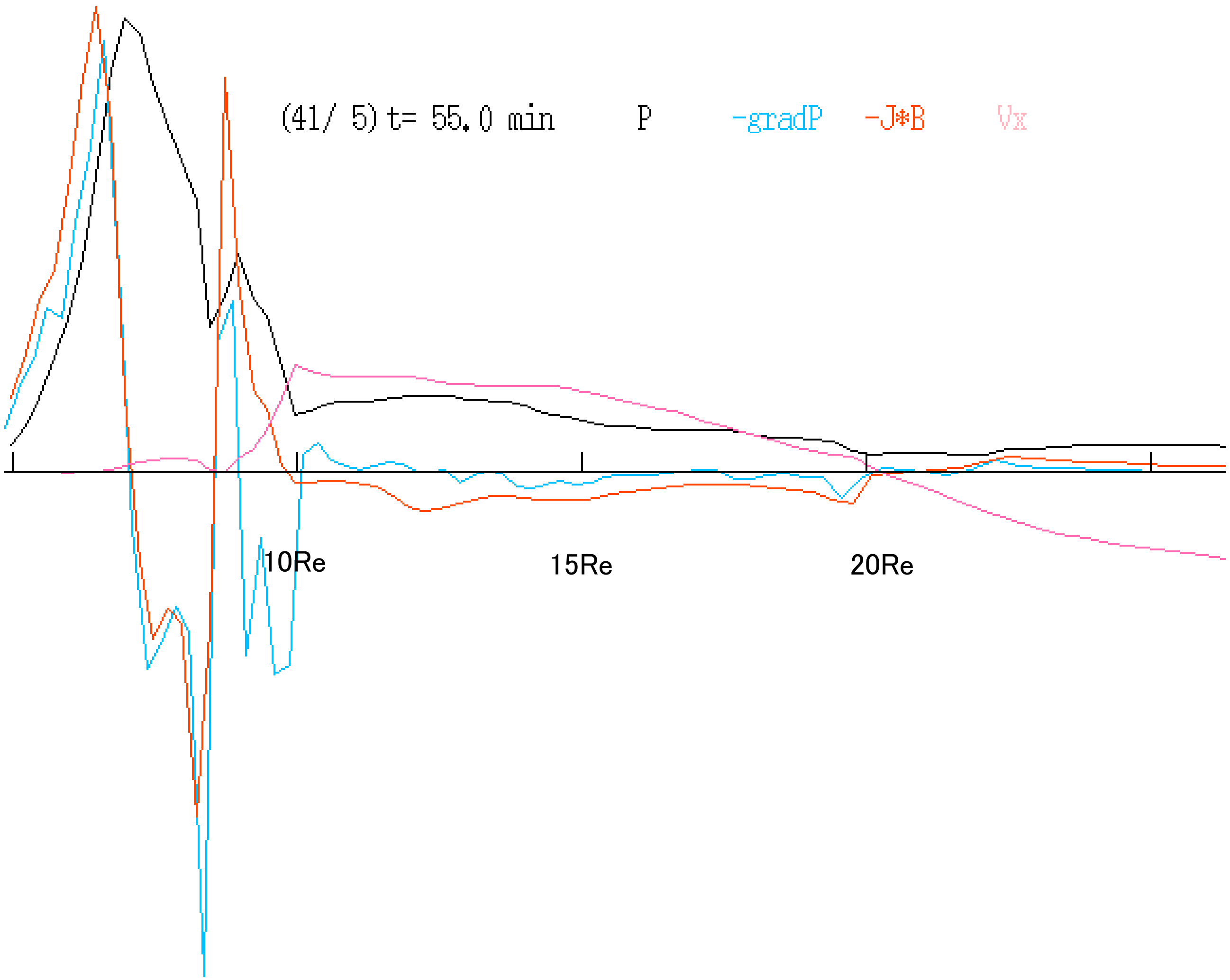

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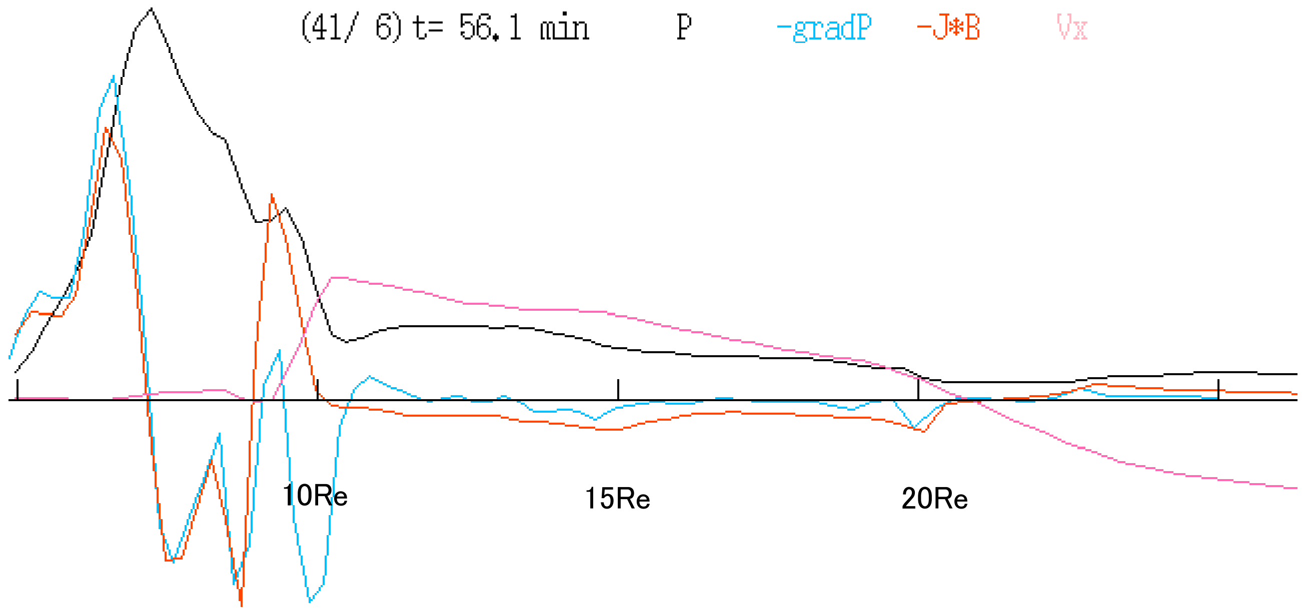

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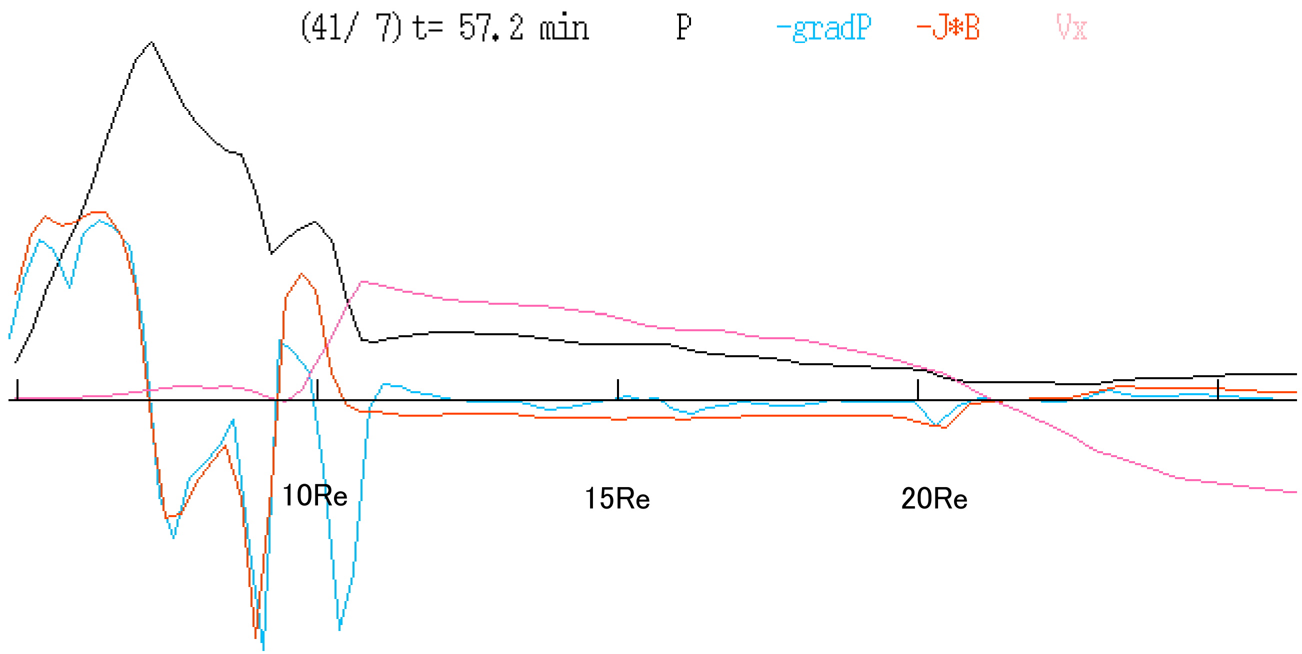

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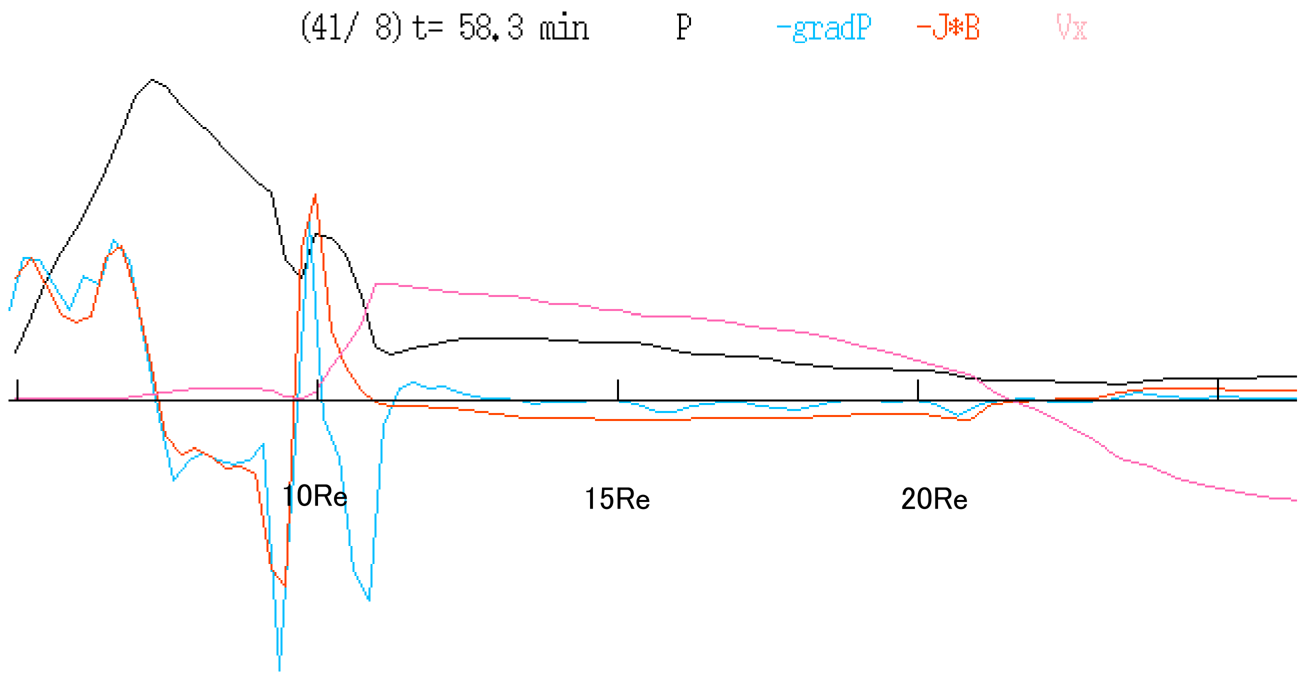

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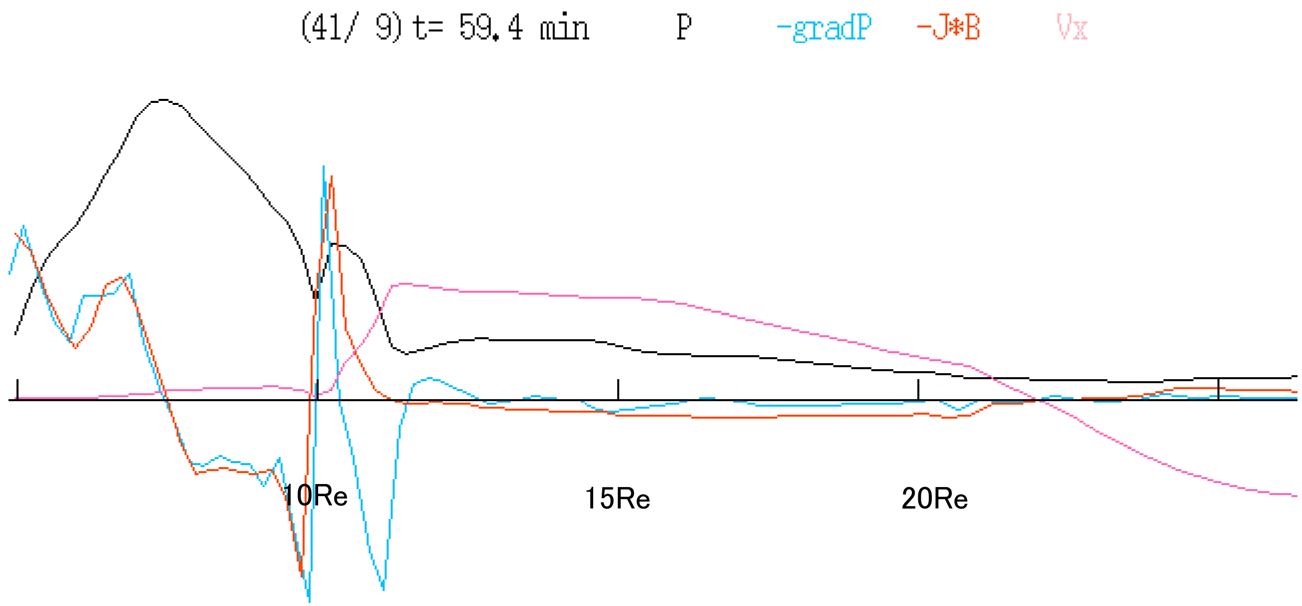

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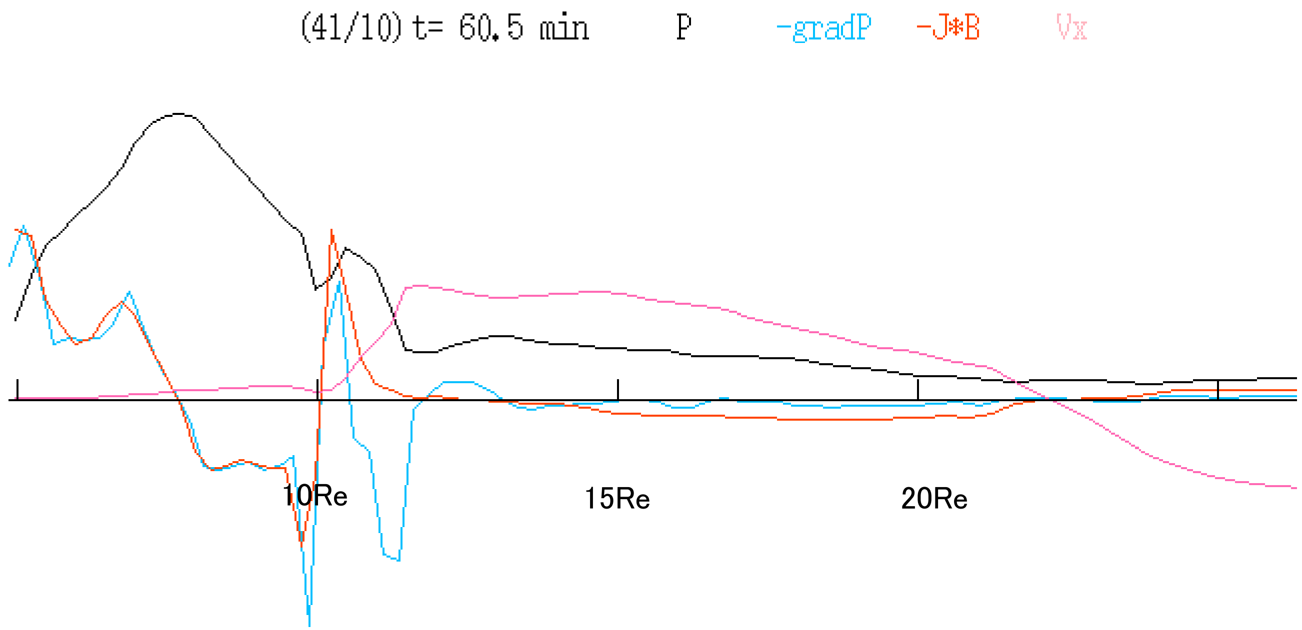

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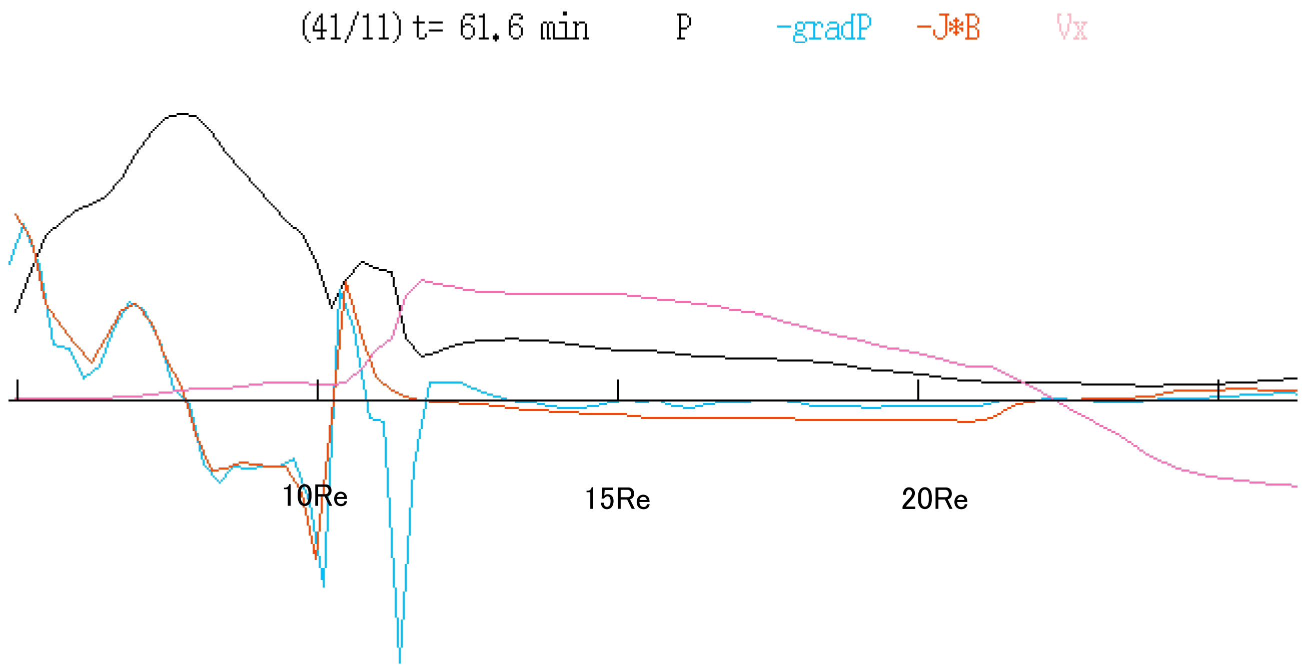

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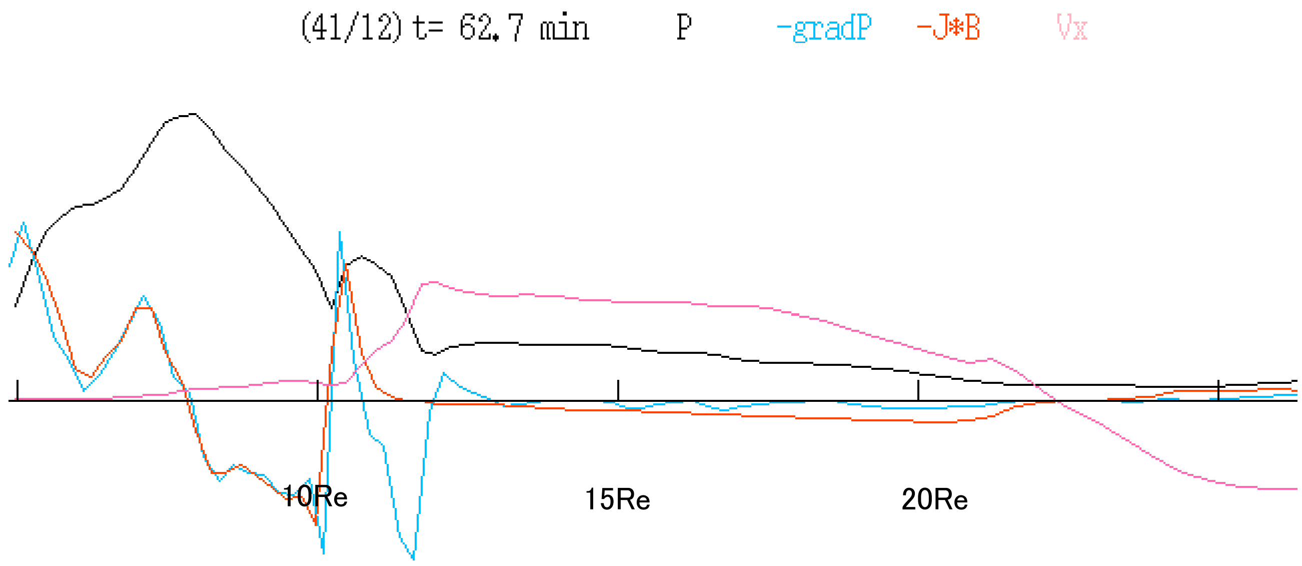

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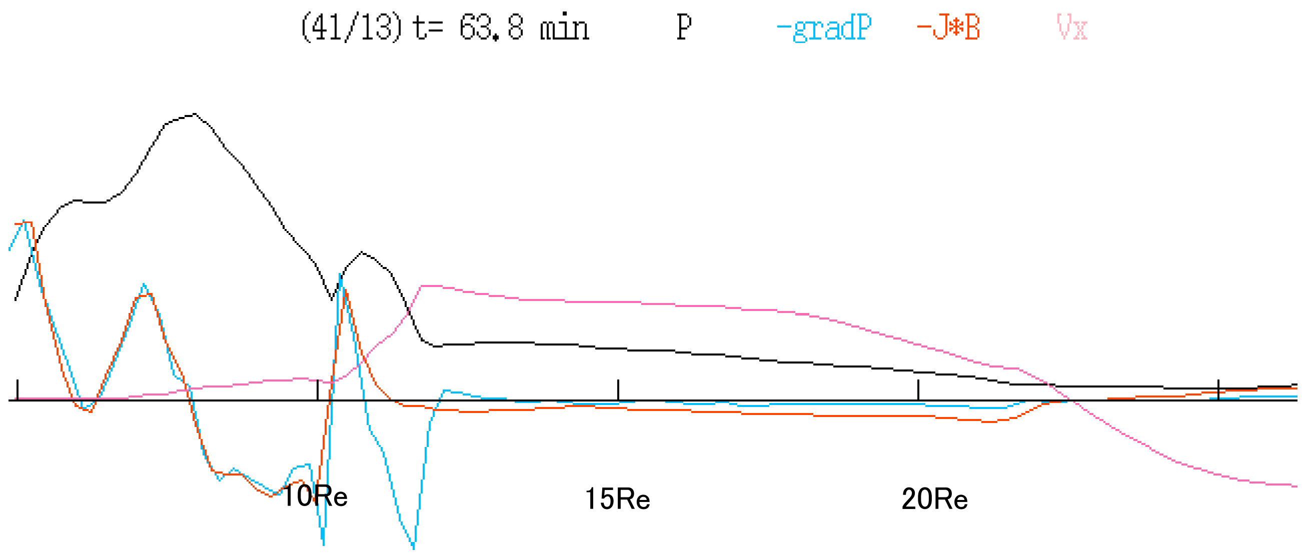

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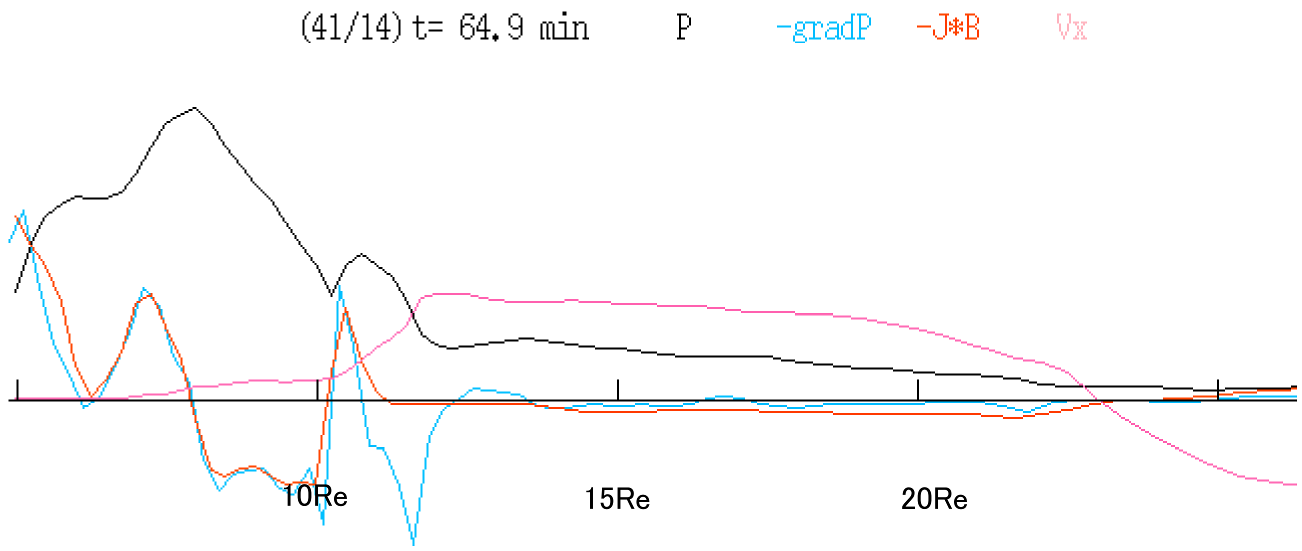

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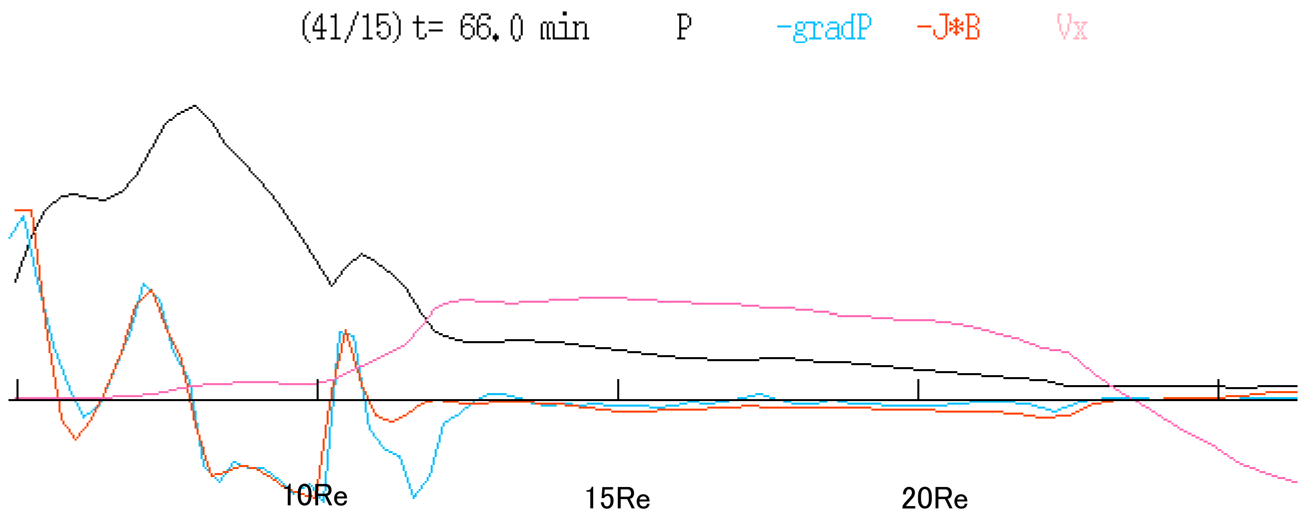

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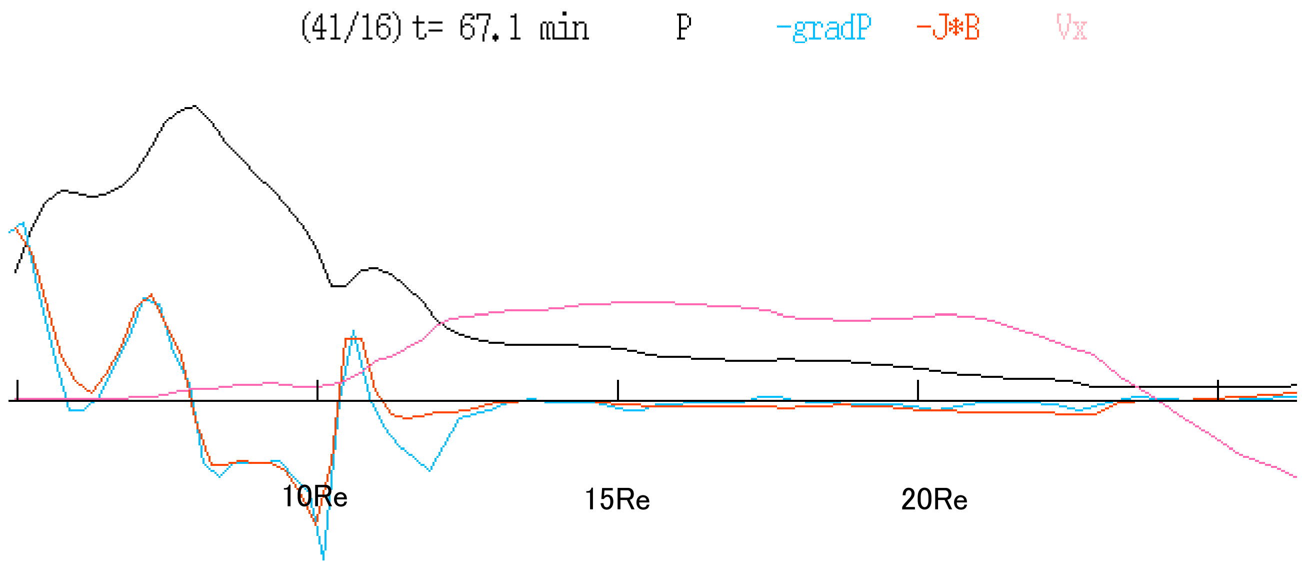

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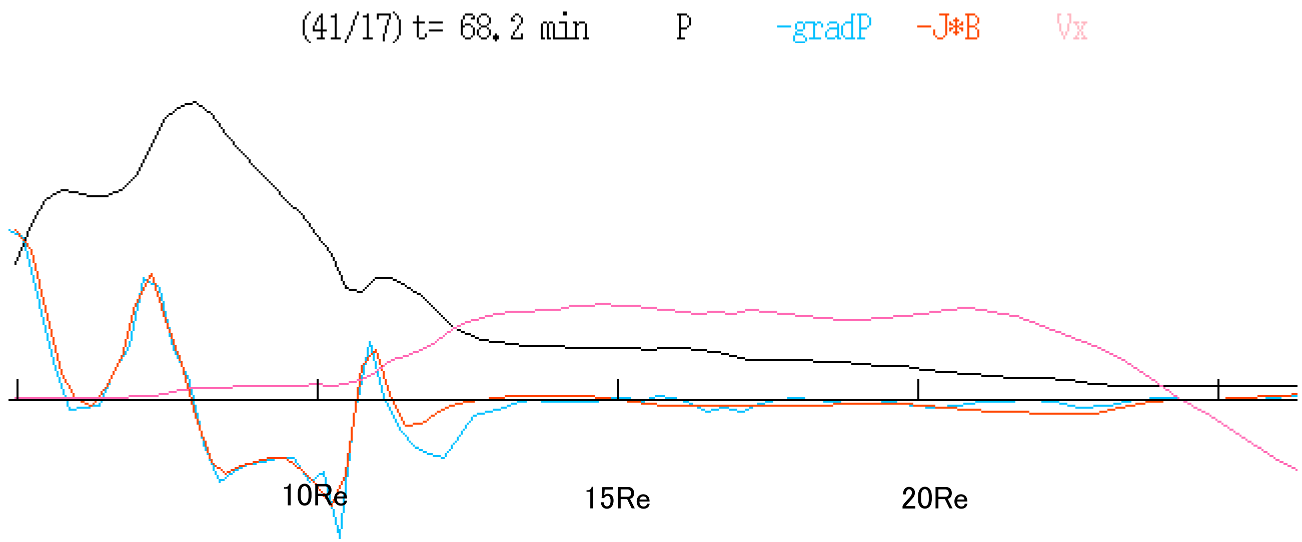

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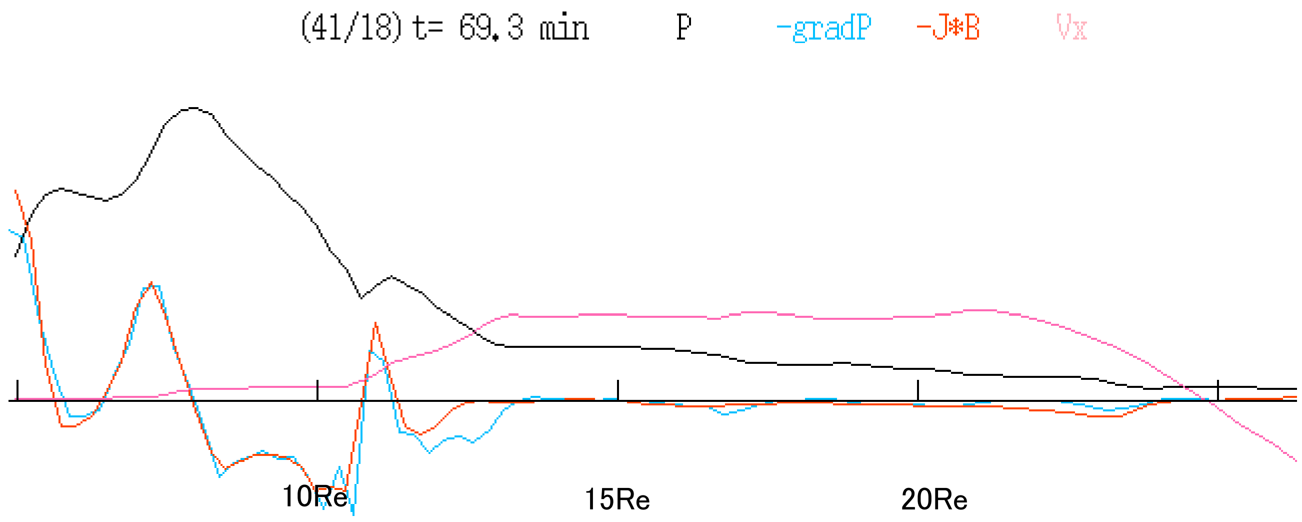
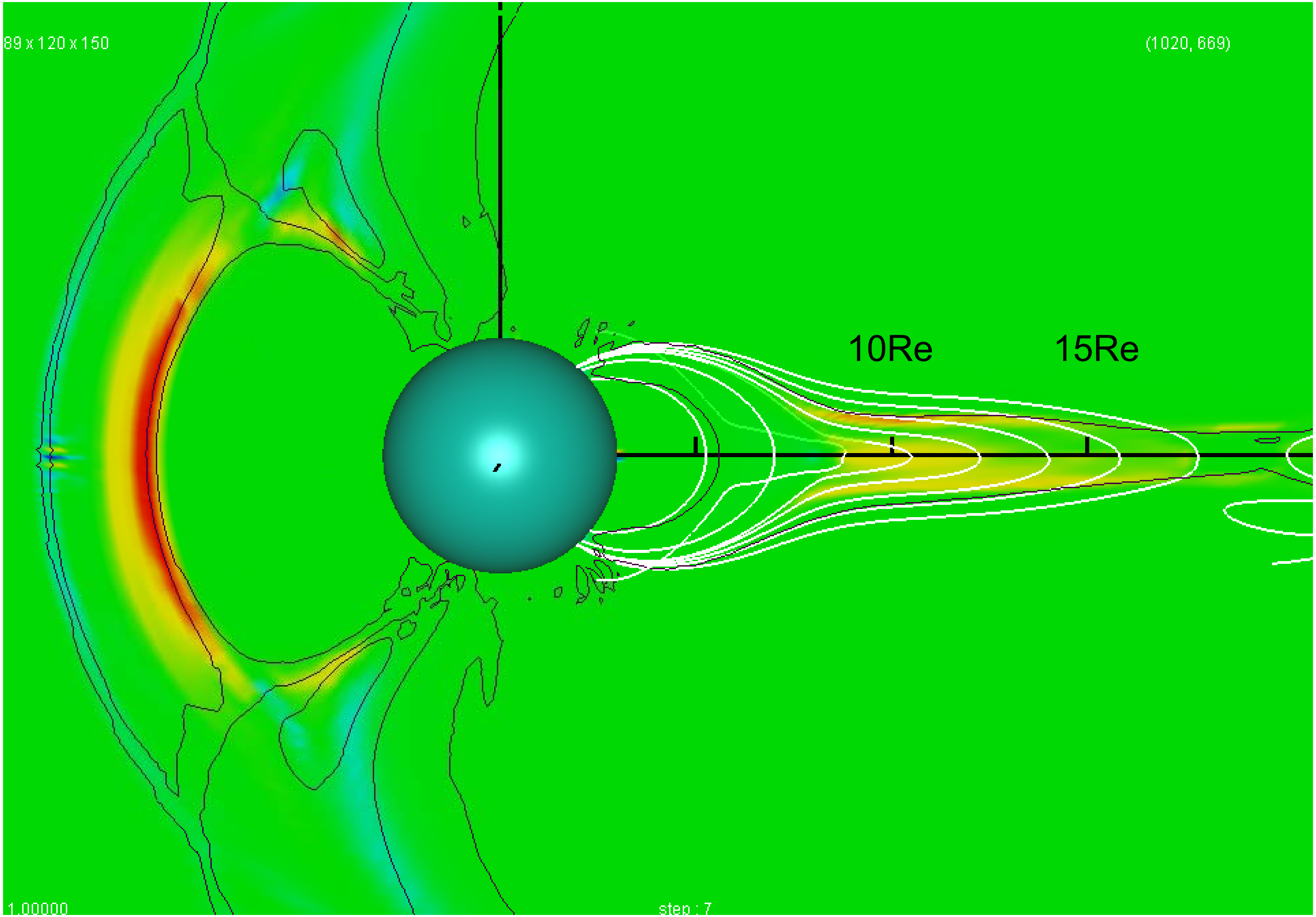
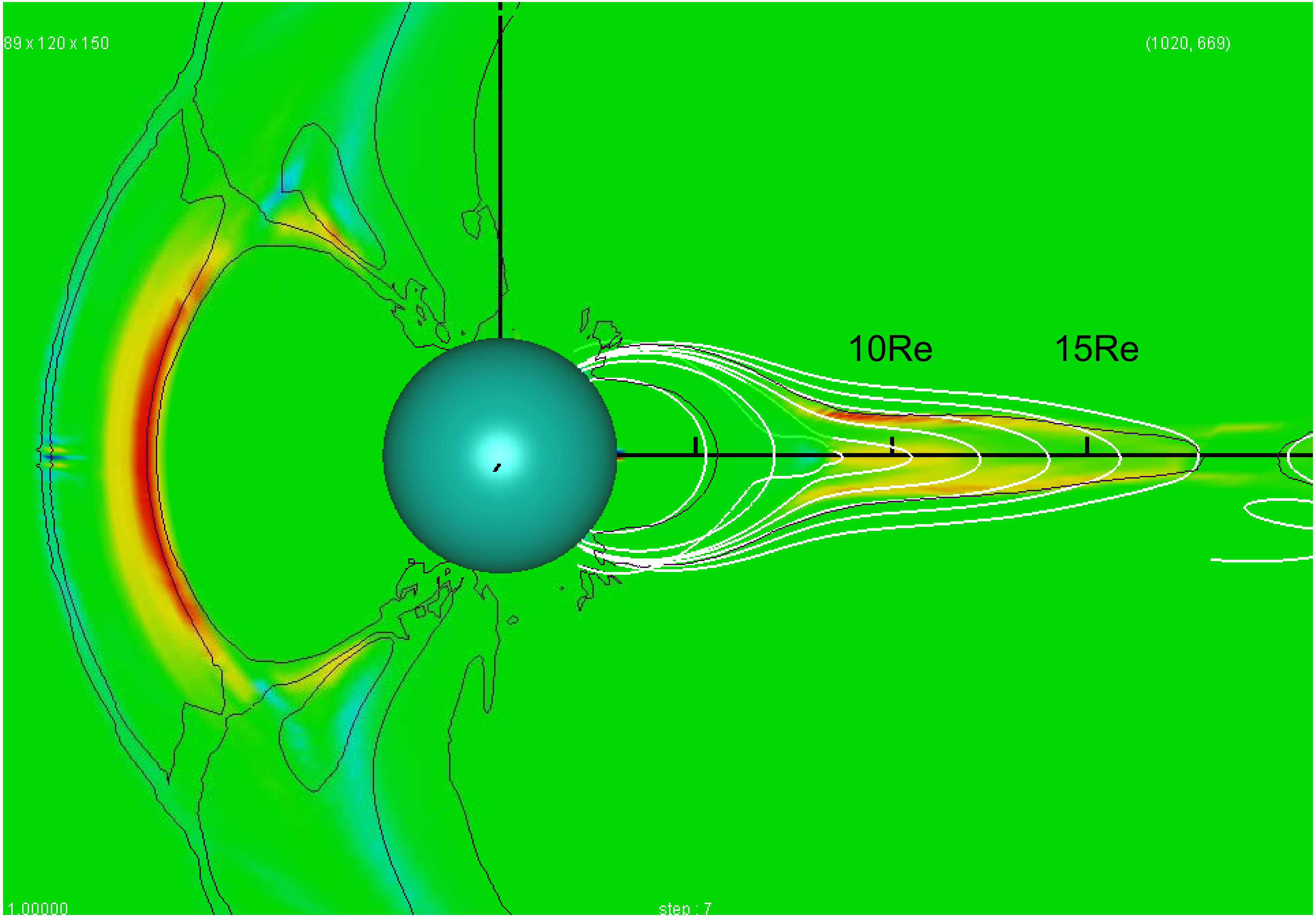


Force balance end（34）

Jy（10）



89 x 120 x 150
(1020, 669)
10Re
15Re
1.00000
step : 7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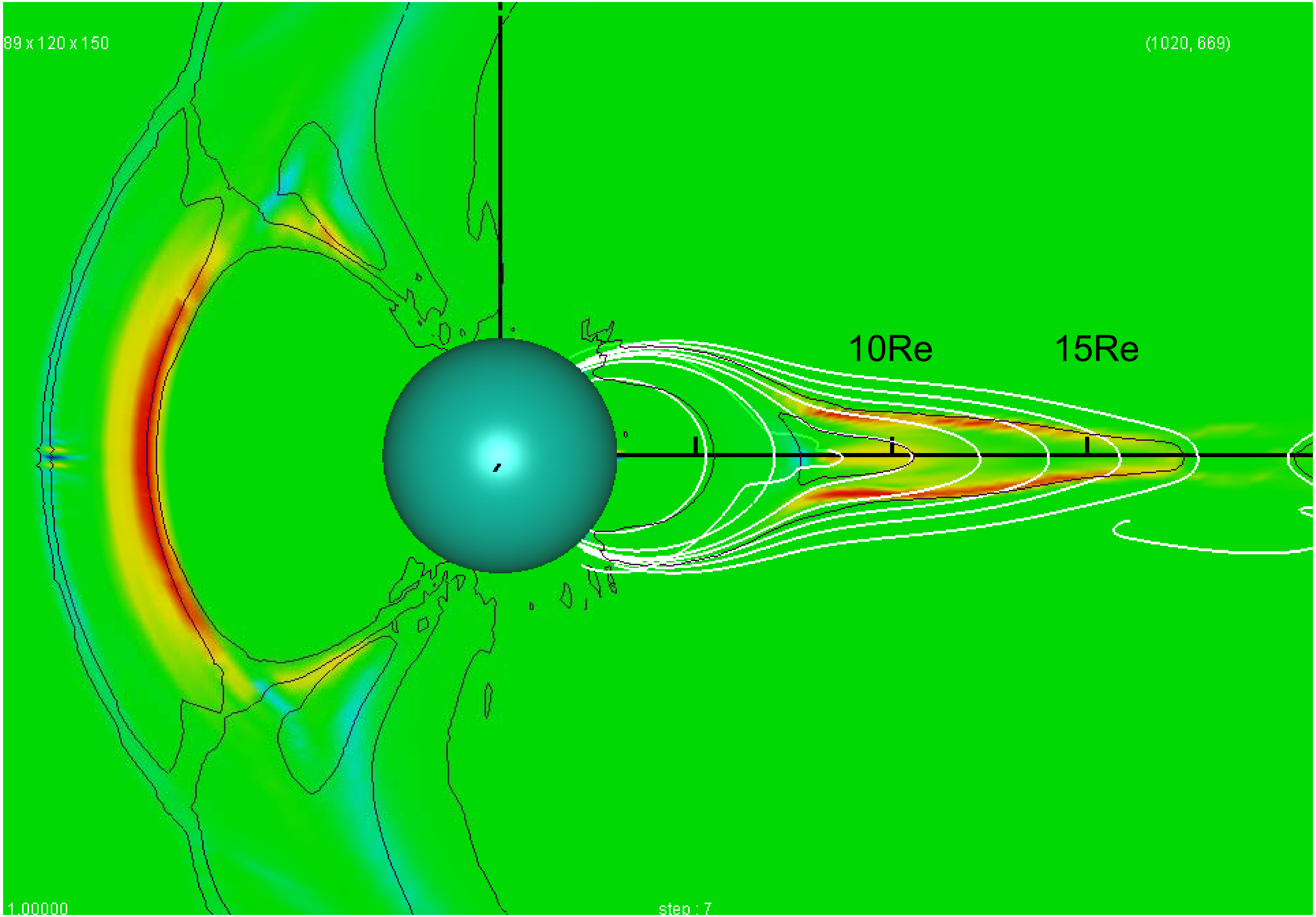
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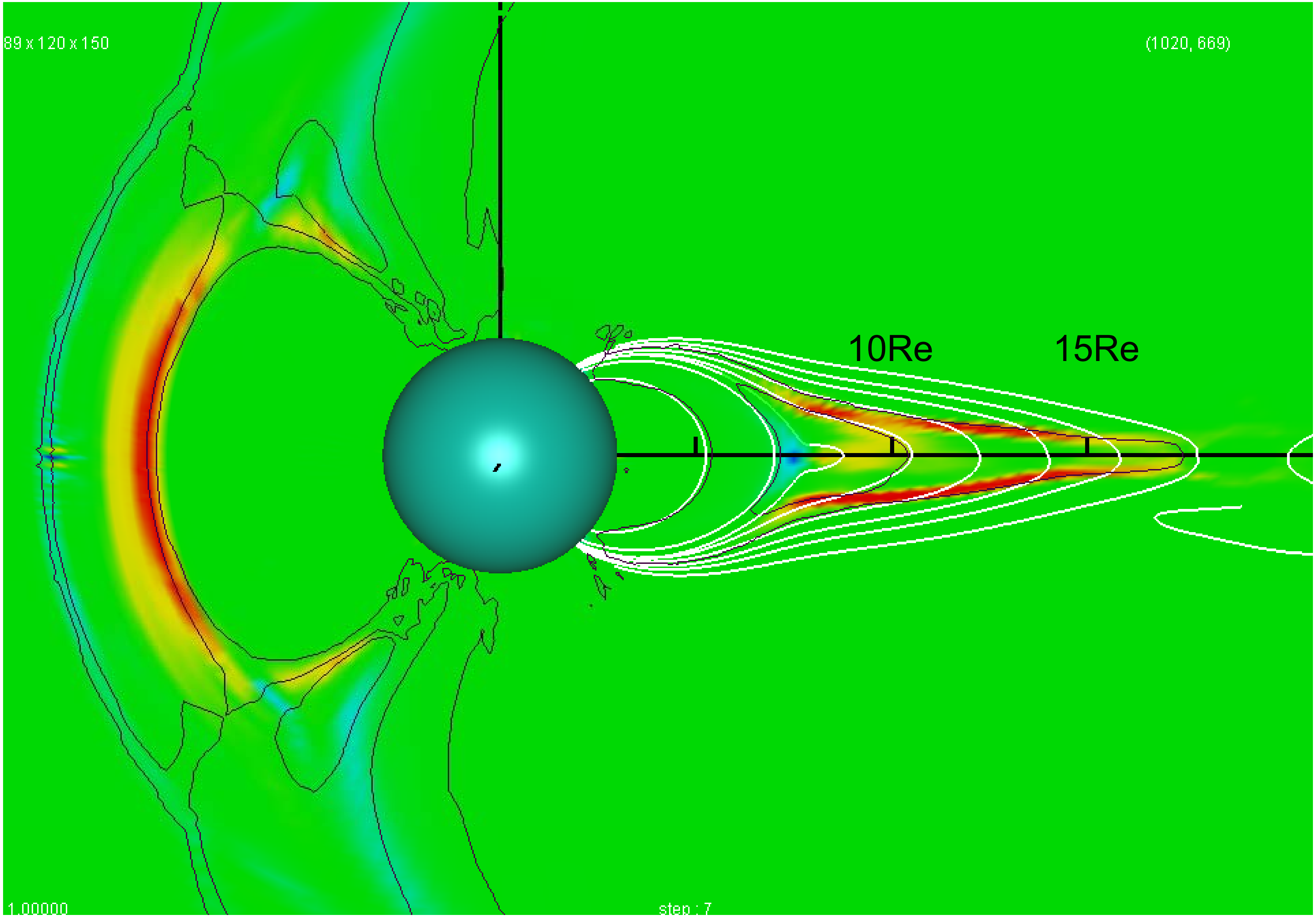
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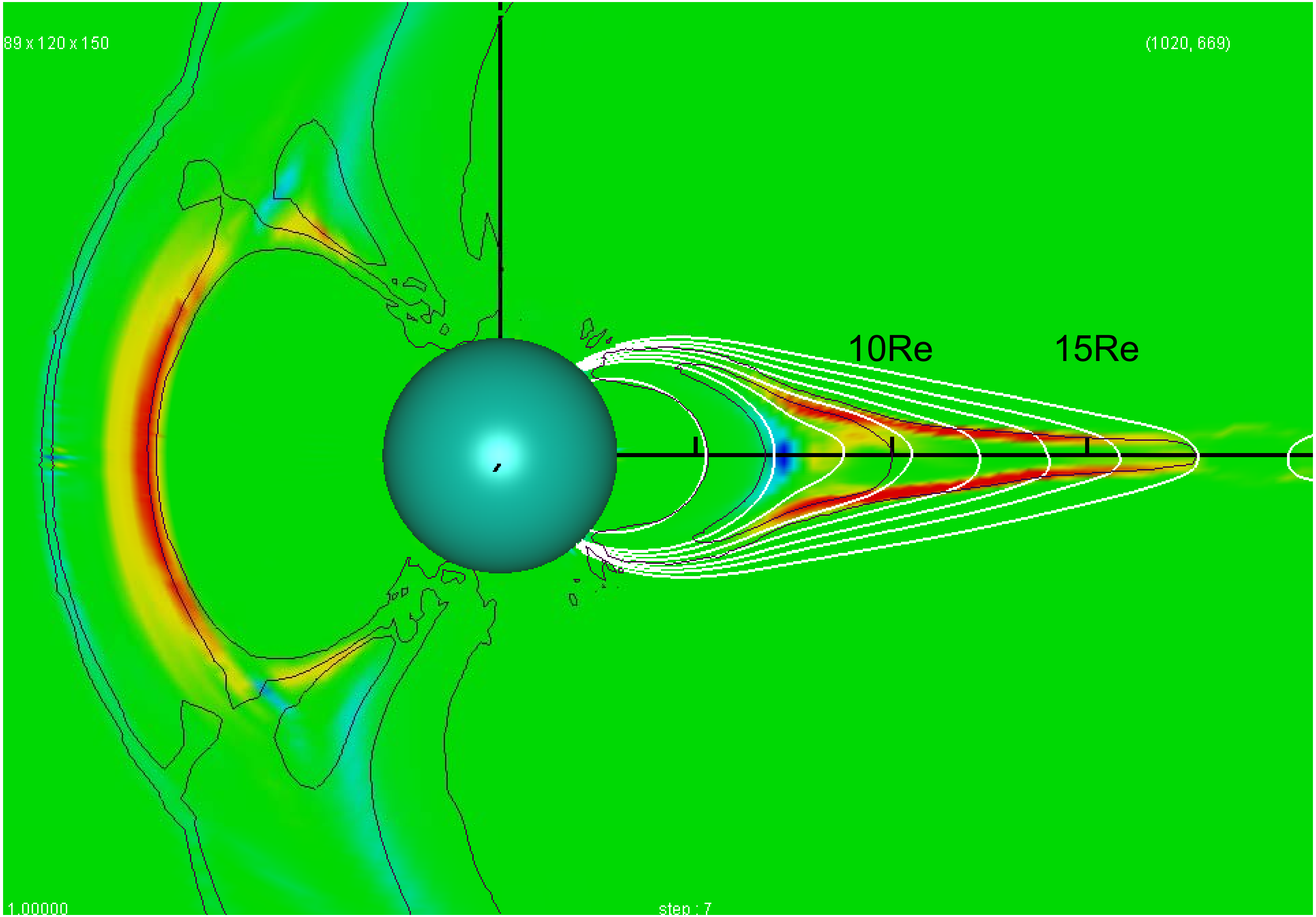

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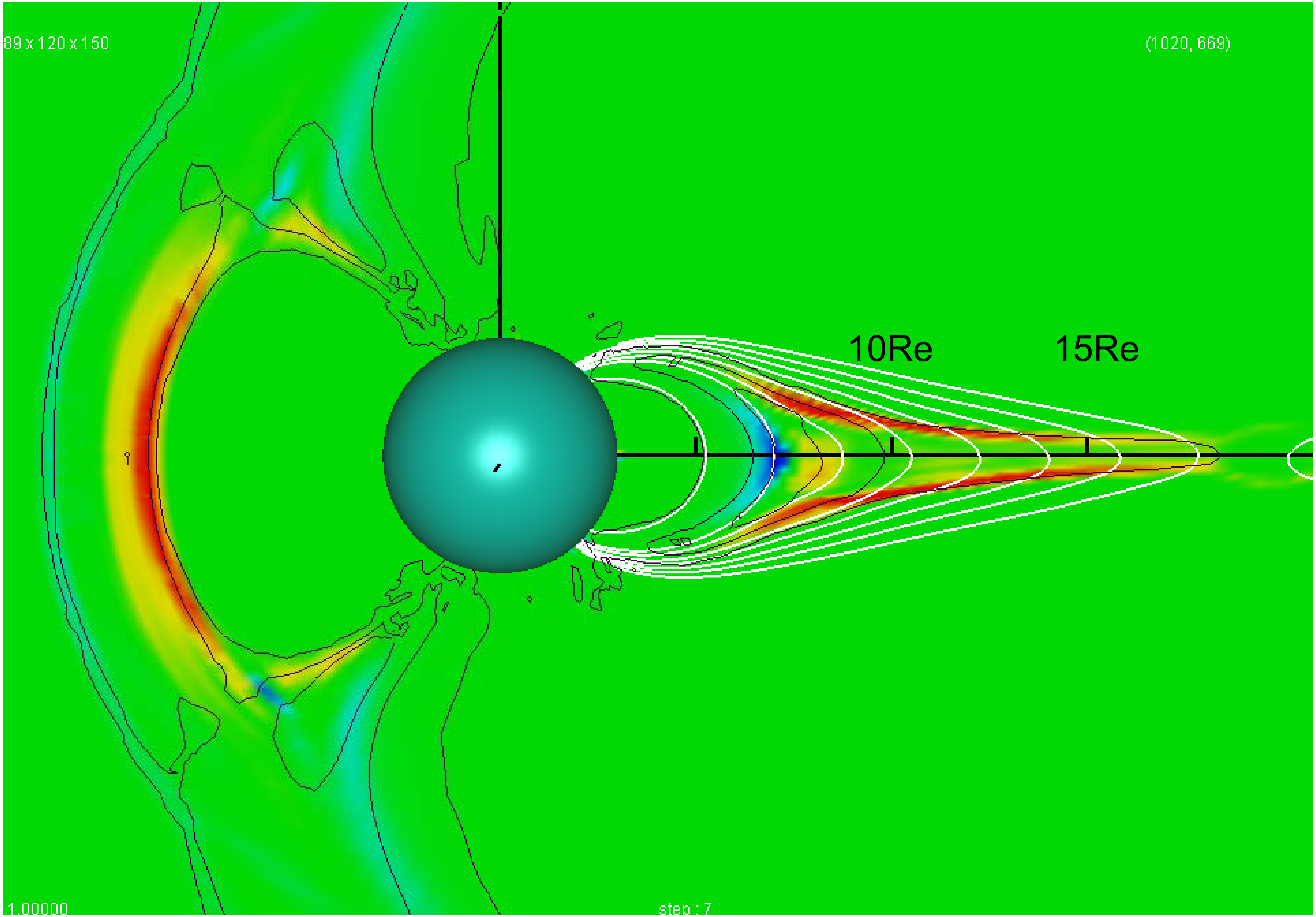

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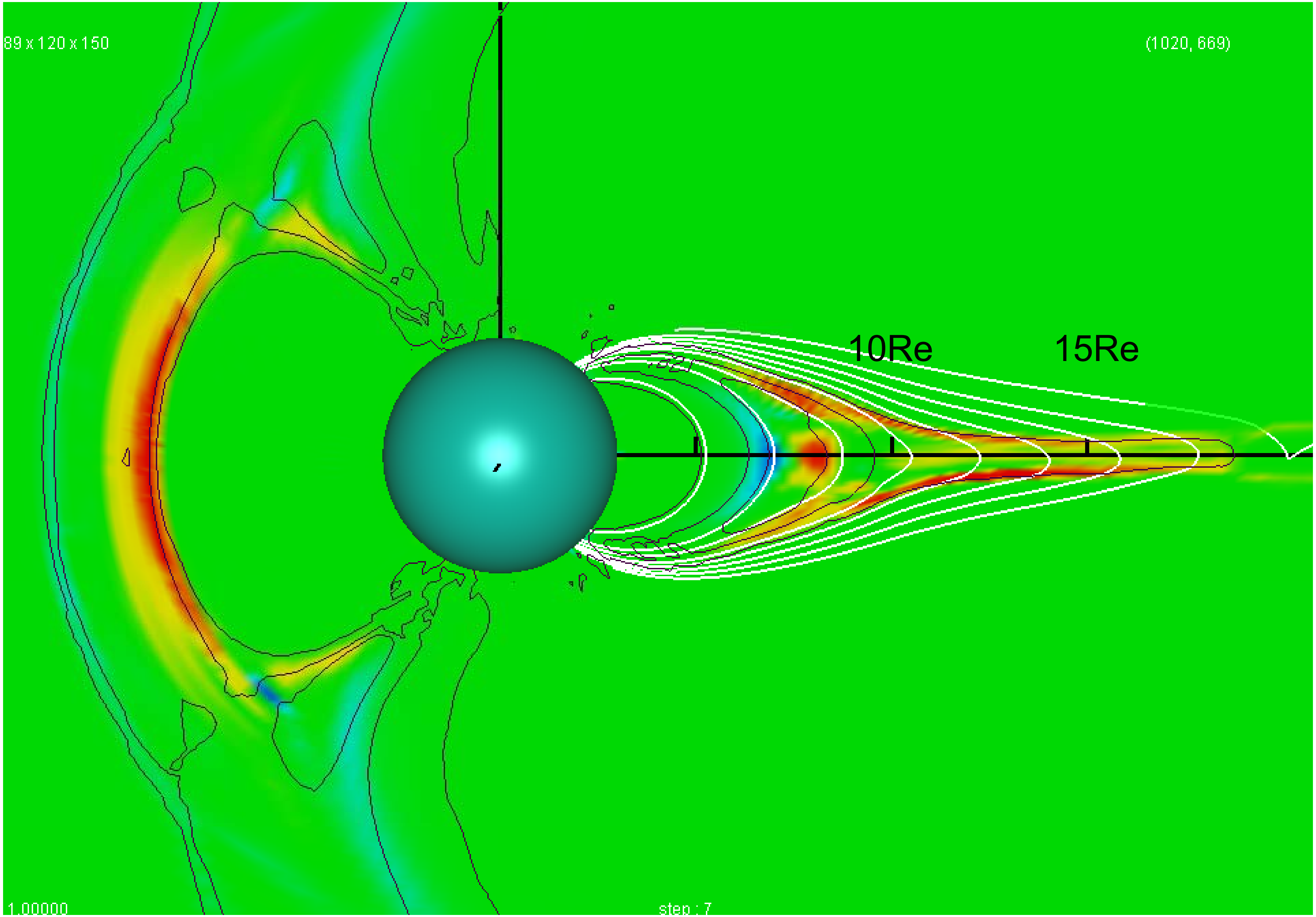
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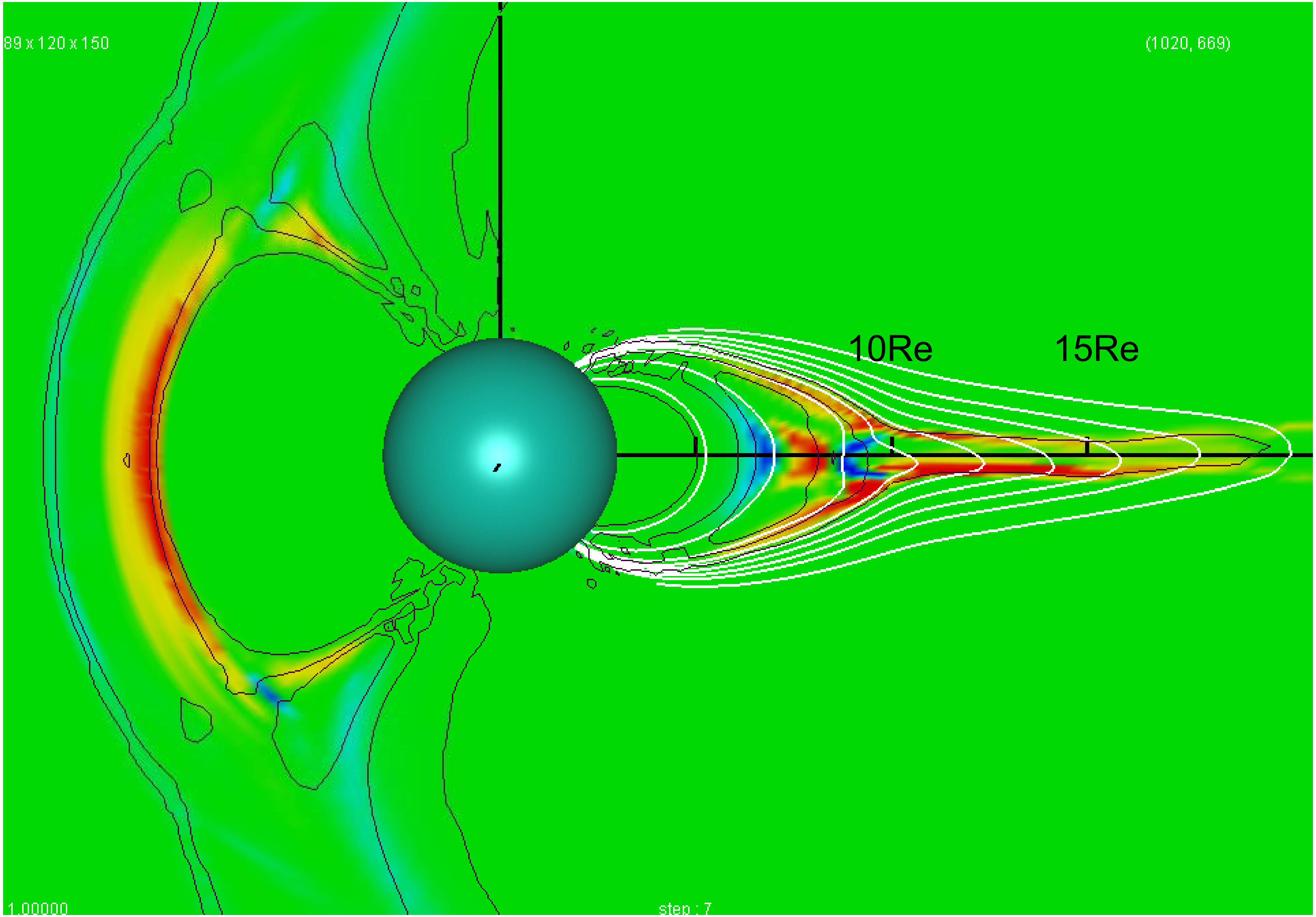

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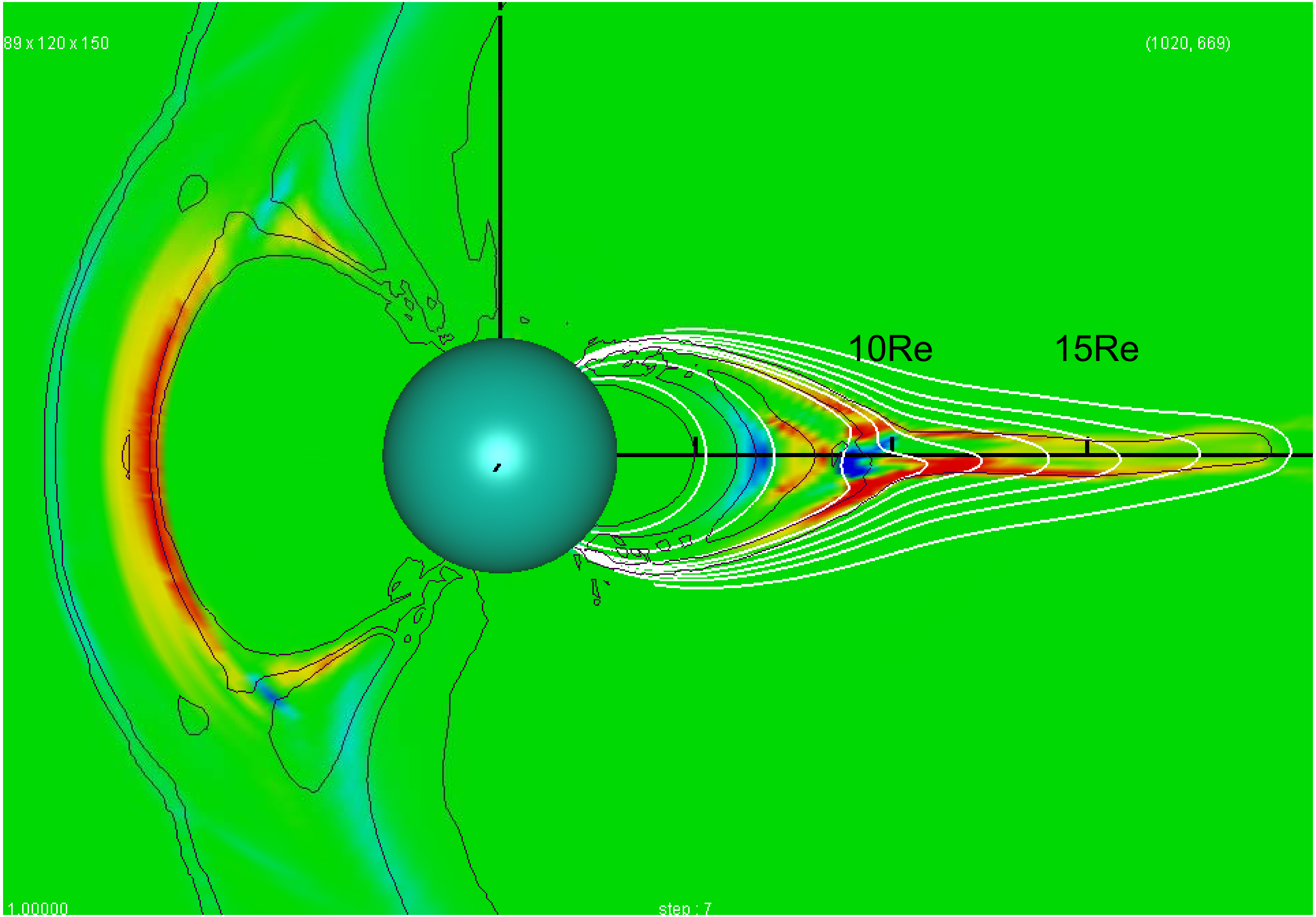
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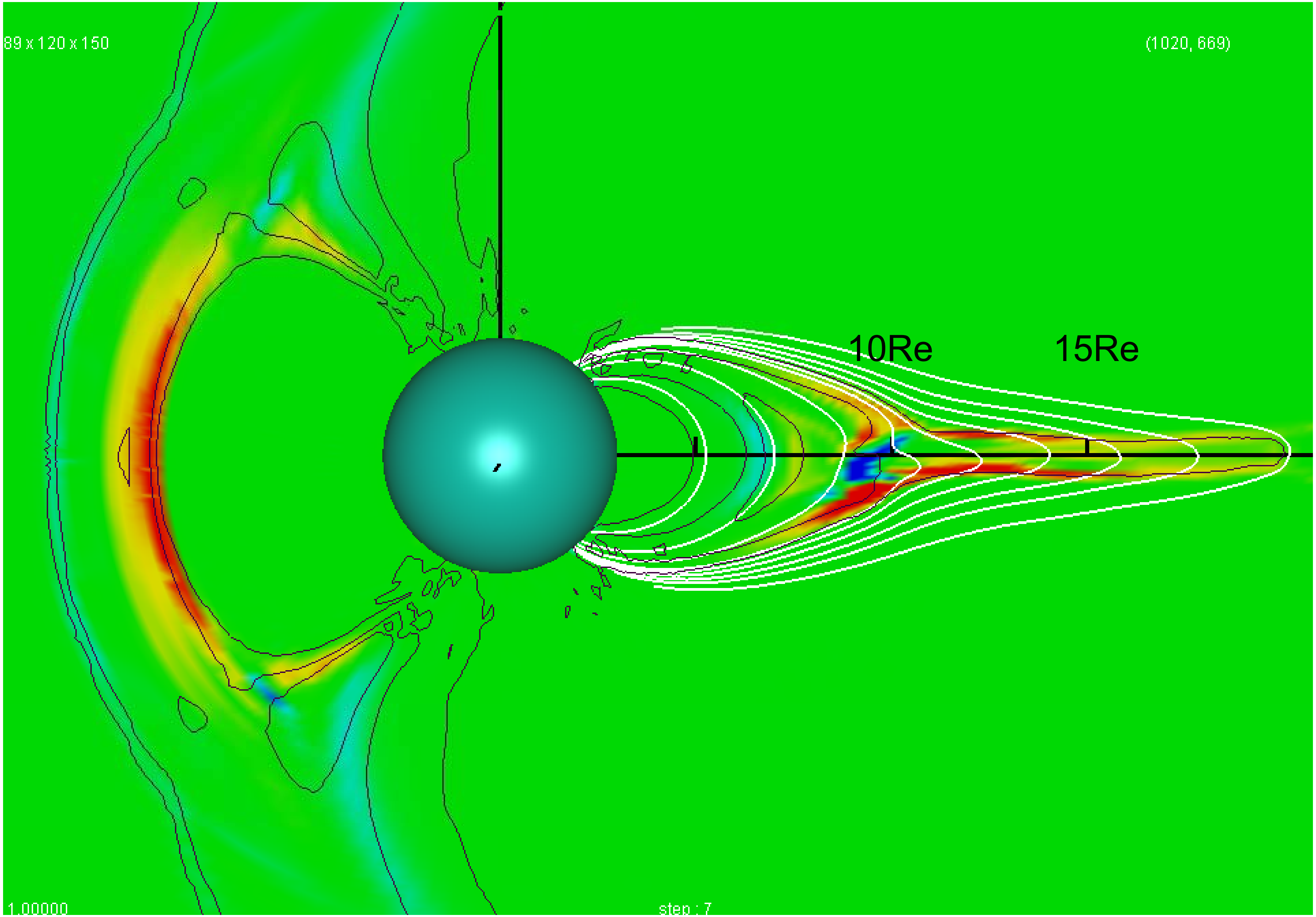
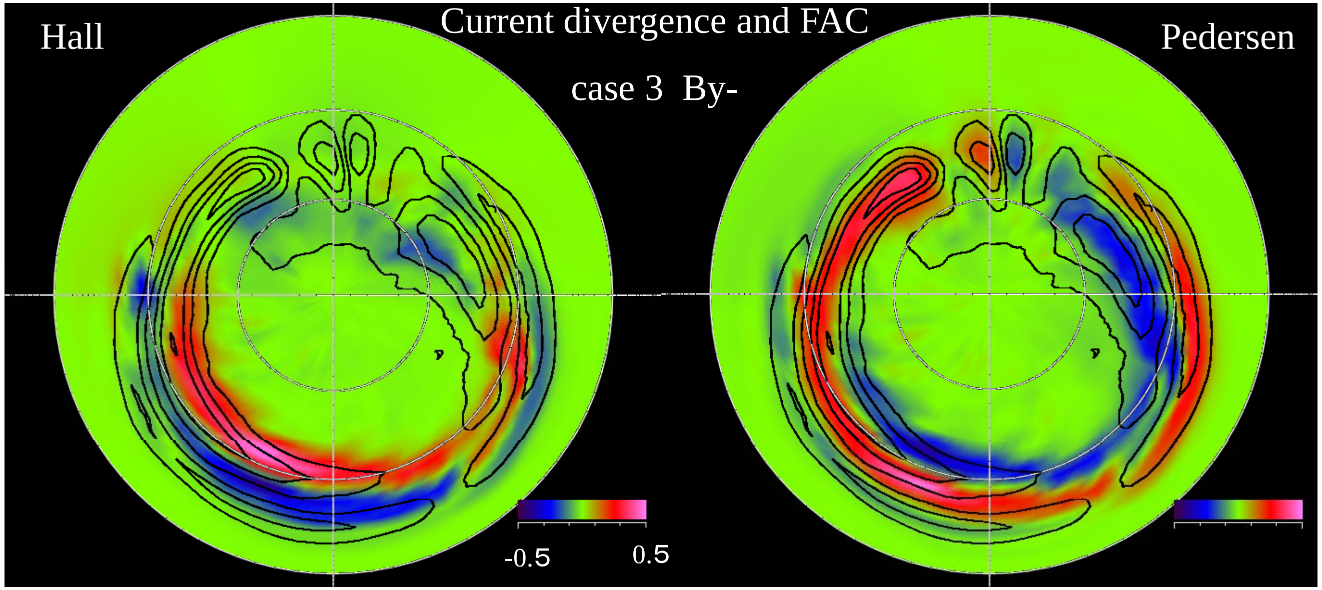

89 x 120 x 150
(1020, 669)
10Re
15Re
1.00000
step : 7

Jy end（10）

end

Cowling channel



$$\mathrm{div}\,(J_{Hall}) + \mathrm{div}\,(J_{Pedersen}) = J_{\parallel}$$

left right contour