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Radio and Space Plasma Physics Group

FTE motion: Comparison with the Cooling model

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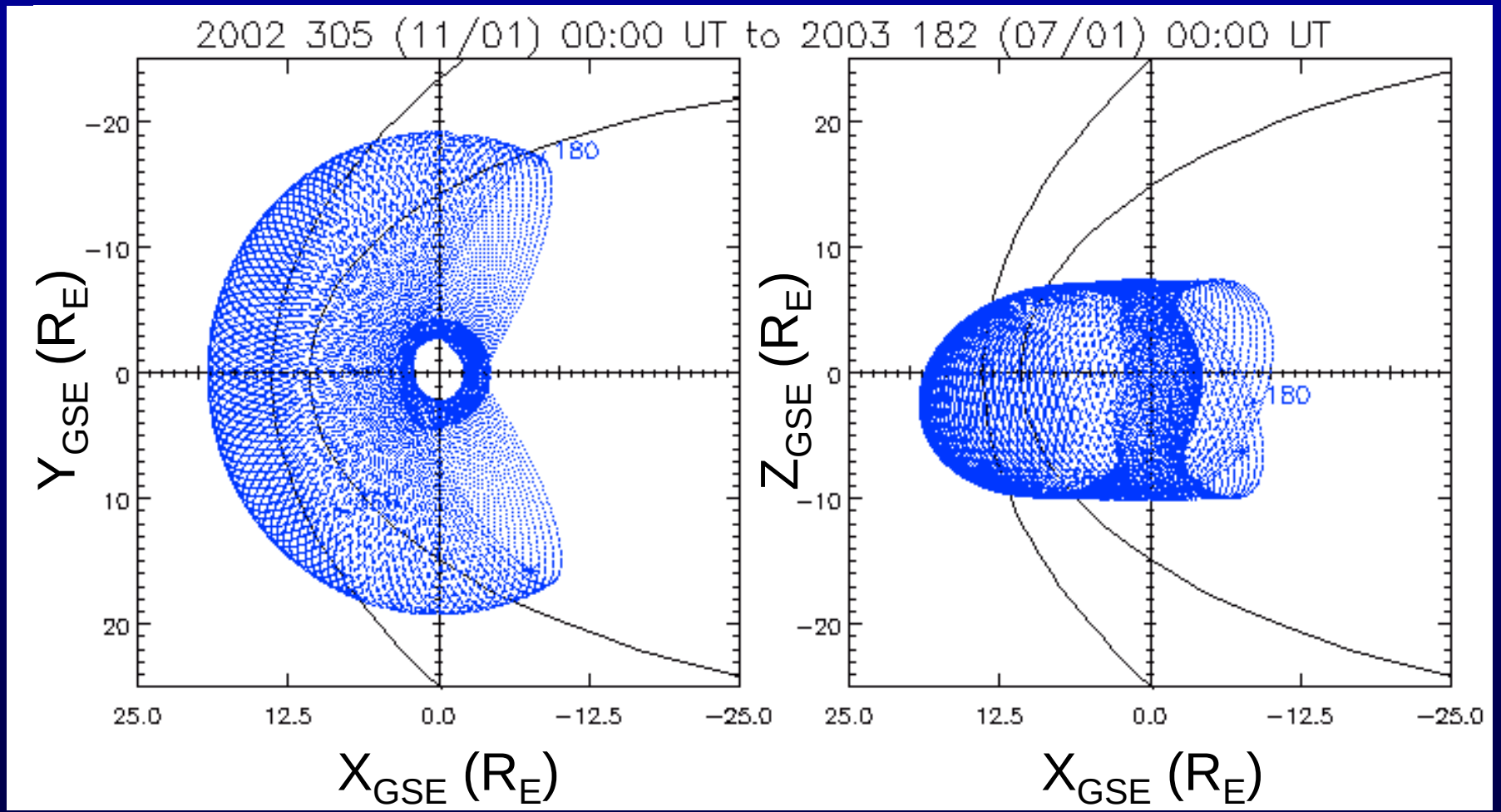
Fear *et al.* (2005), Geophys. Res. Lett.

Cooling *et al.* (2001), J. Geophys. Res.

Cluster's Orbit: Nov 2002 to June 2003



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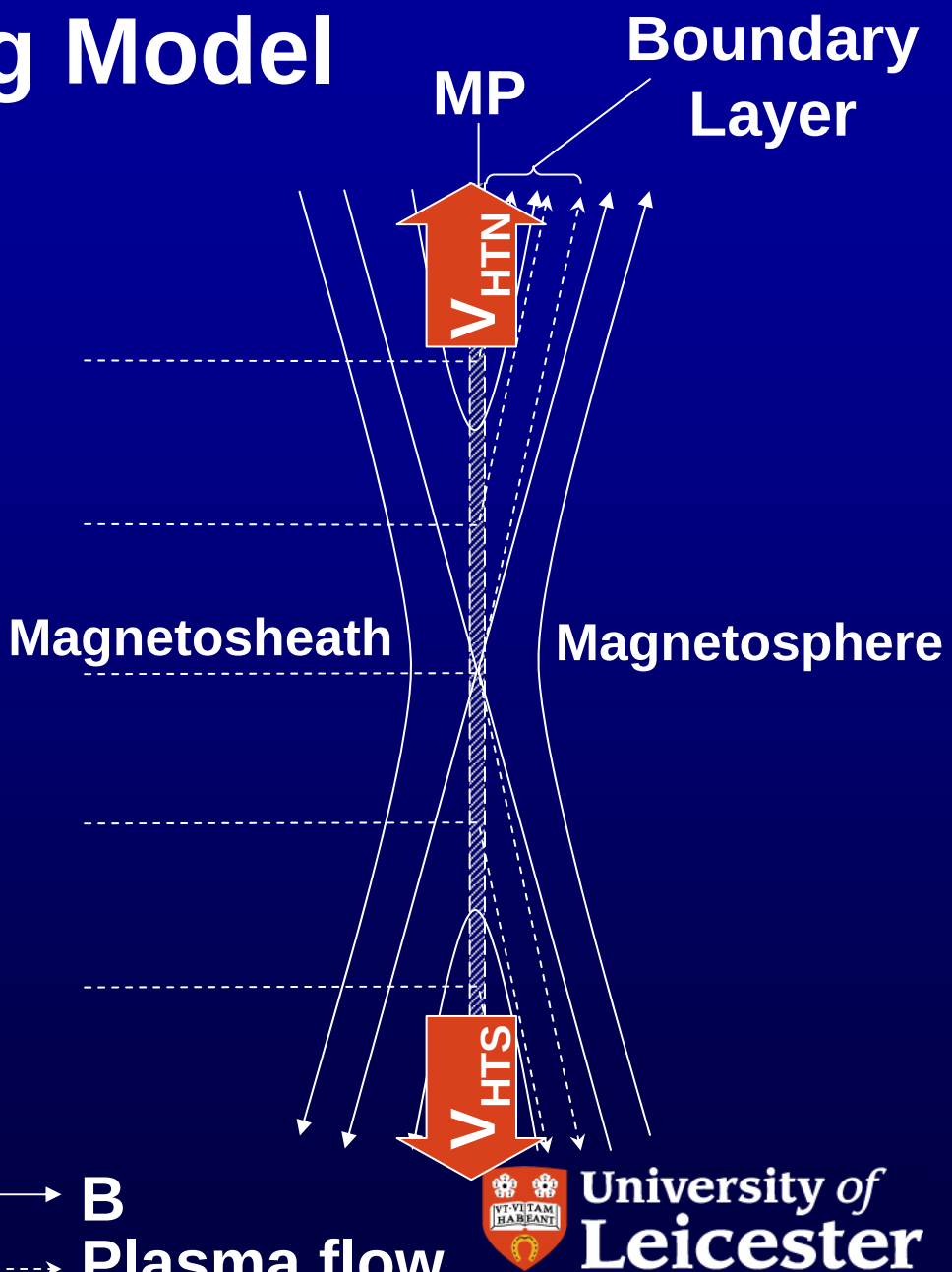
Cooling Model

- Cowley and Owen (1989):

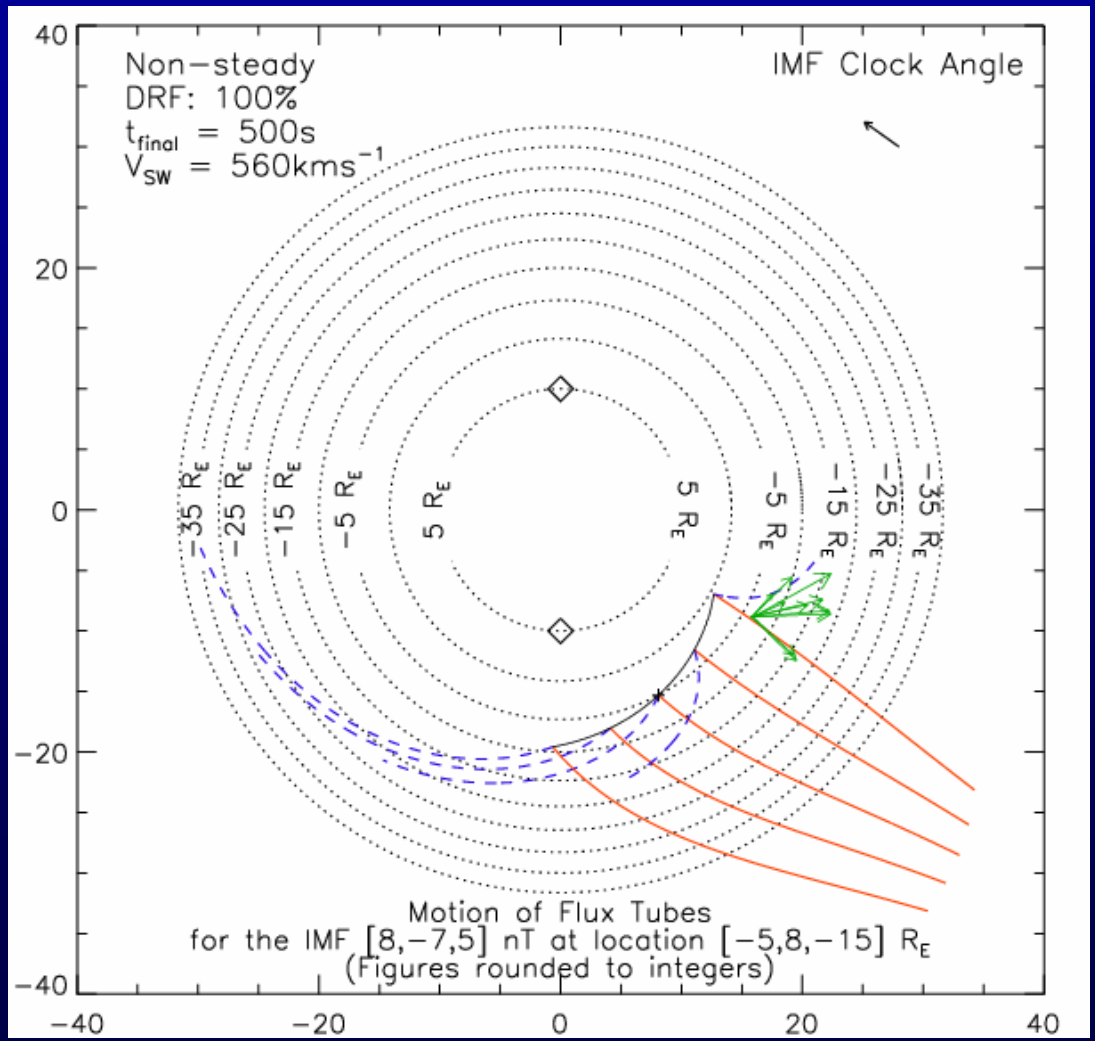
$$\mathbf{V}_{HTN} = \mathbf{V}_{Sheath} - V_A \hat{\mathbf{B}}_{Sheath}$$

$$\mathbf{V}_{HTS} = \mathbf{V}_{Sheath} + V_A \hat{\mathbf{B}}_{Sheath}$$

- Cooling *et al.* (2001) calculates and integrates these vectors using models for:
  - B_{Sheath} (Köbel and Flückiger, 1994)
  - Sheath velocity and density (Spreiter *et al.*, 1966)



Strongly Northward IMF Events



40 R_E

Z_{GSM}

- 40 R_E

- 40 R_E Y_{GSM} 40 R_E

- Equatorward-moving events observed in magnetosheath
- Parallel-streaming accelerated electrons: consistent with southern hemisphere connection (blue path)
- Paths connected to southern hemisphere swept tailward and equatorward by super-Alfvénic magnetosheath flow
- Fear *et al.* (2005), Geophys. Res. Lett.

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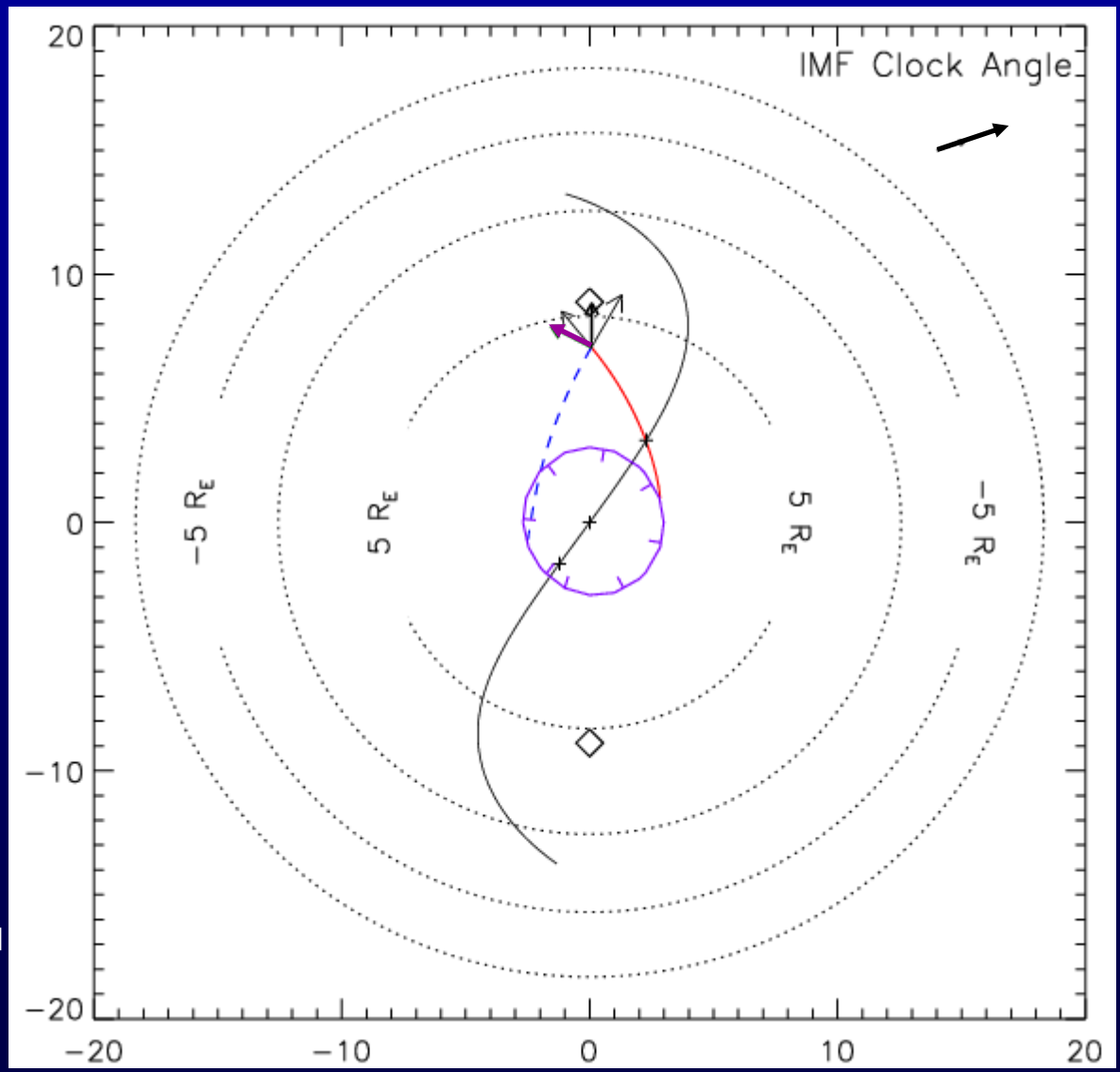
Example: 22nd Feb 2003, 01:23 UT



20 R_E

Z_{GSM}

-20 R_E

-20 R_E Y_{GSM} 20 R_E

- V_{FTE} to MP: 4°
- V_{Plane} to V_{HTN}: 24°
- Model V_{HTN} path can be traced back to subsolar component X-line
- Antiparallel-streaming electrons observed in magnetosheath
  - Consistent with northern hemisphere connection (red path)
- Maximum model shear is 83°; C3 observed northward/tailward magnetospheric magnetic field

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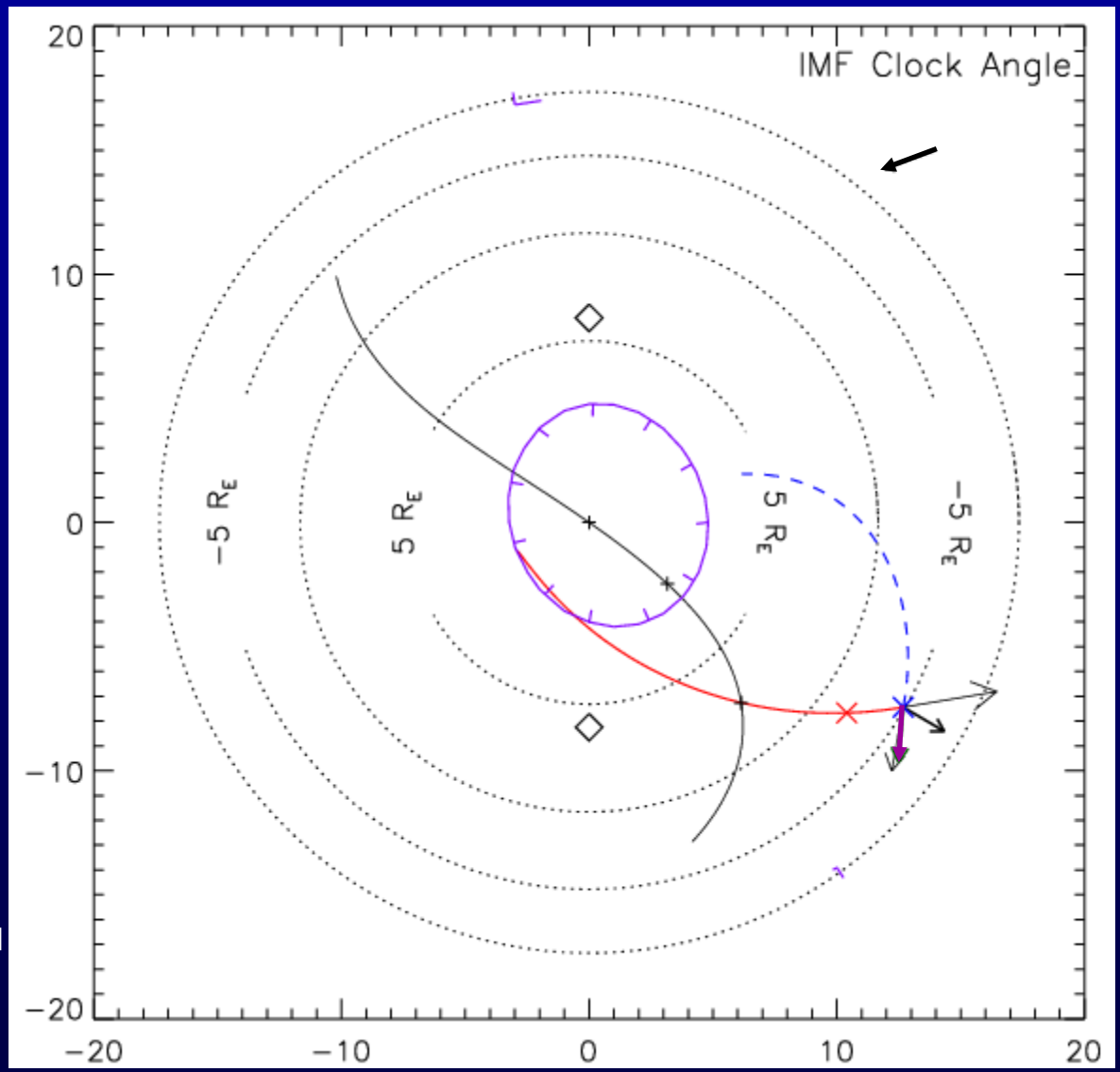
Example: 13th Nov 2002, 00:08 UT



20 R_E

Z_{GSM}

-20 R_E

-20 R_E Y_{GSM} 20 R_E

- V_{FTE} to MP: 17°
- V_{Plane} to V_{HTS}: 7°
- No PEACE data
- Model V_{HTS} path cannot be traced back to subsolar component X-line unless X-line is shifted significantly
- FTE is observed where model magnetic shear is 172°
- (Almost) antiparallel reconnection

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Conclusions

- Flux transfer events during strongly northward IMF events (clock angle less than 70°) were commonly observed on the post-terminator magnetopause
  - Location, polarity and velocity consistent with a high-latitude X-line, but component reconnection required
  - Observed equatorward motion is due to reconnection in super-Alfvénic flow region

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Conclusions

- Cooling model generally describes FTE motion reasonably well

- Many southward/B_Y-dominated IMF events consistent with a subsolar component X-line, but some more consistent with a high-latitude antiparallel site

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