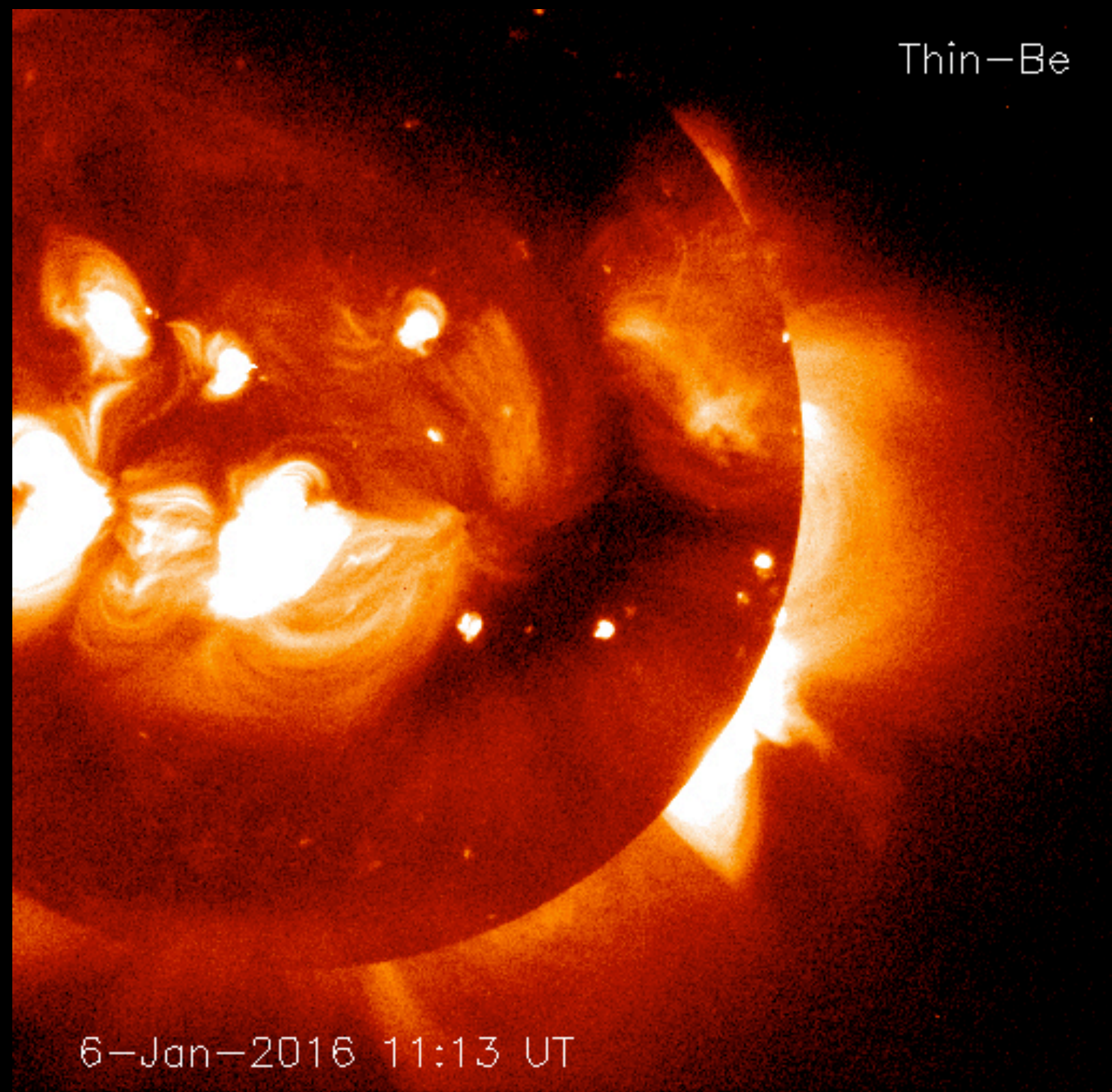
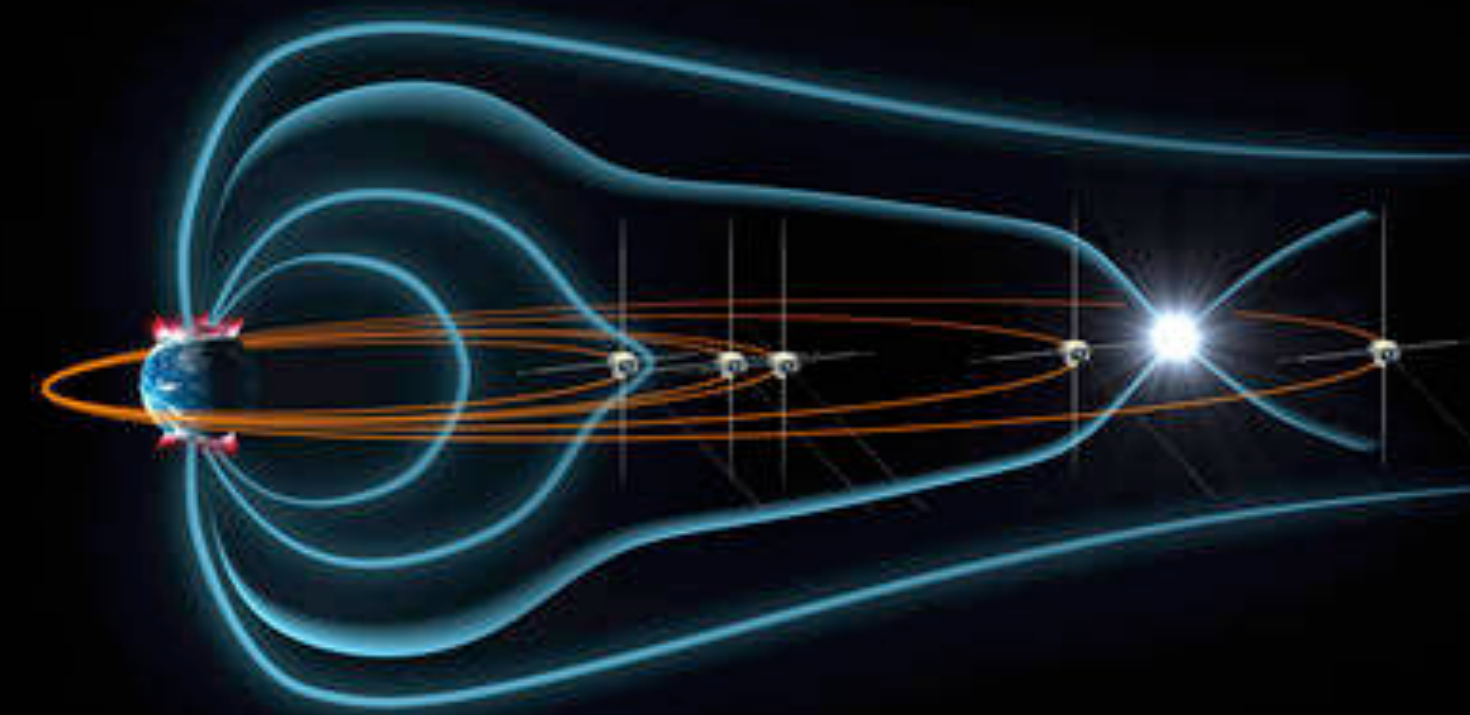


Supra Arcade Downflows in the Earth's Magnetotail



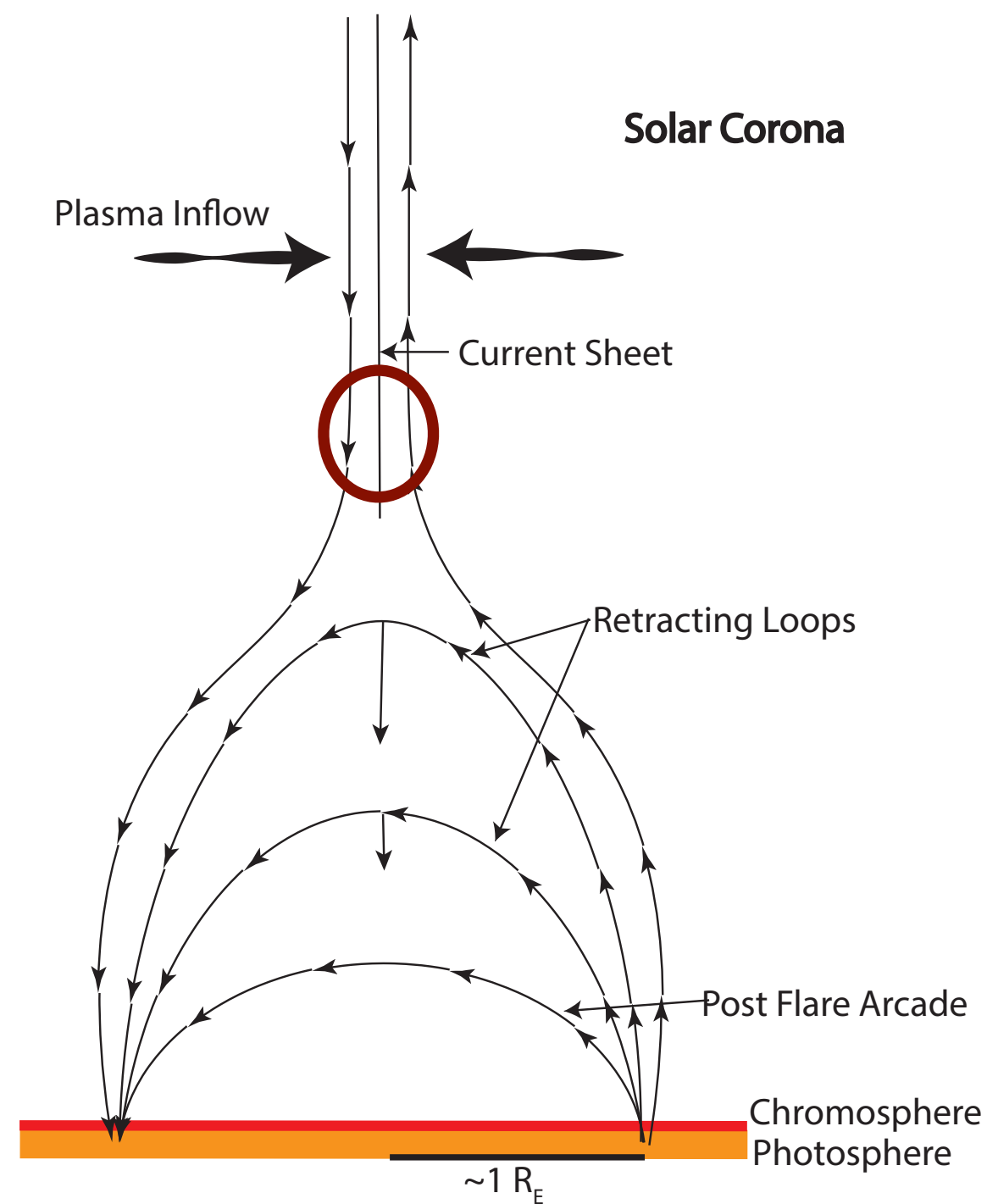
Adam R. Kobelski (UAH)
Sabrina L. Savage (MSFC)
David M. Malaspina (LASP)



Overview

- Comparison of Coronal and Magnetotail Reconnection
- Supra Arcade Downflows (SADs)
- Magnetotail Reconnection and Observations
- Dipolarization Fronts (DPFs)
- DPFs and SADs

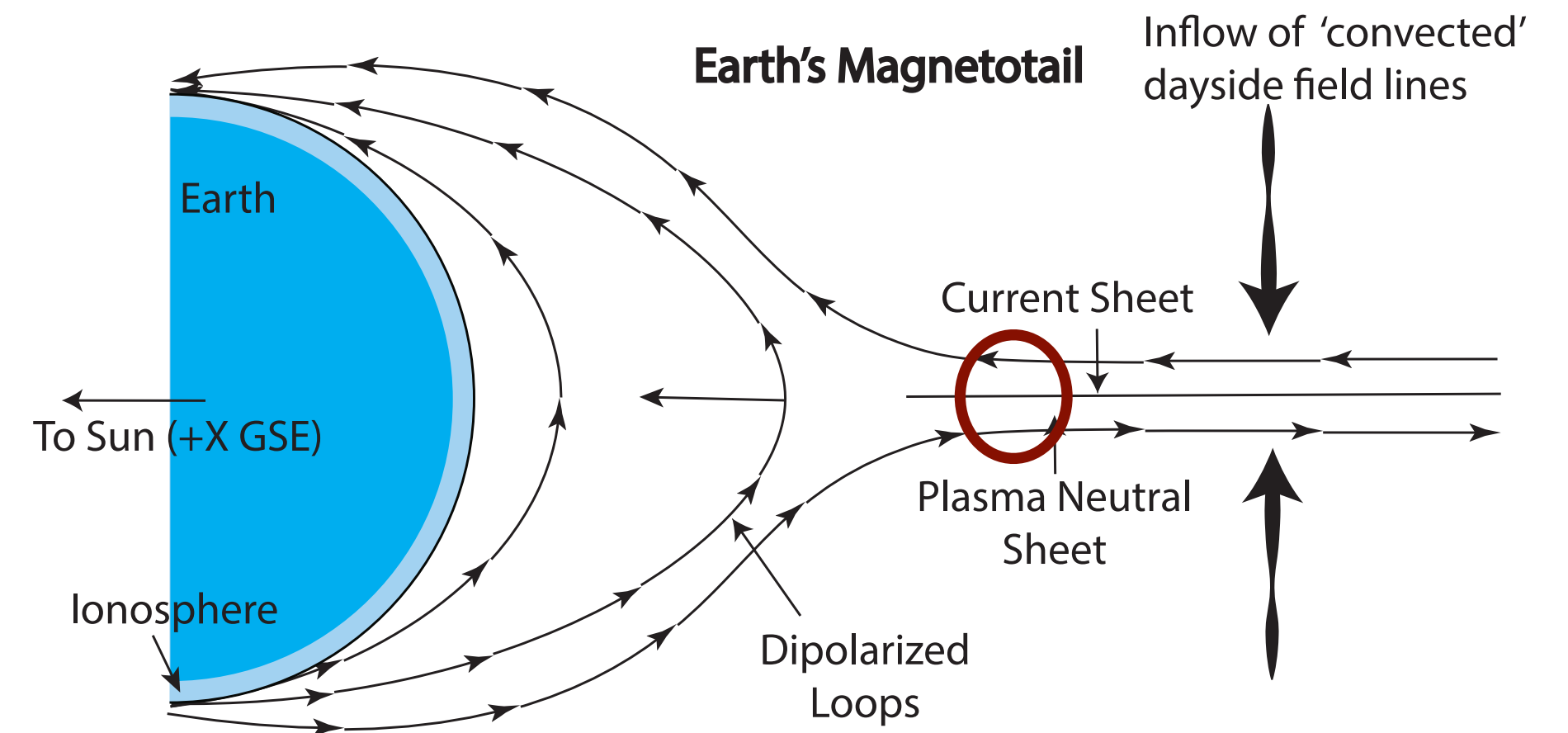
Reconnection in the Corona vs The Magnetotail



$$n \approx 3 \times 10^9 \text{ cm}^{-3}$$

$$T \approx 13 \times 10^6 \text{ K}$$

$$B \approx 6 - 16 \times 10^5 \text{ nT} = 6 - 16 \text{ G}$$



$$n \approx 1 \text{ cm}^{-3}$$

$$T \approx 12 \times 10^6 \text{ K}$$

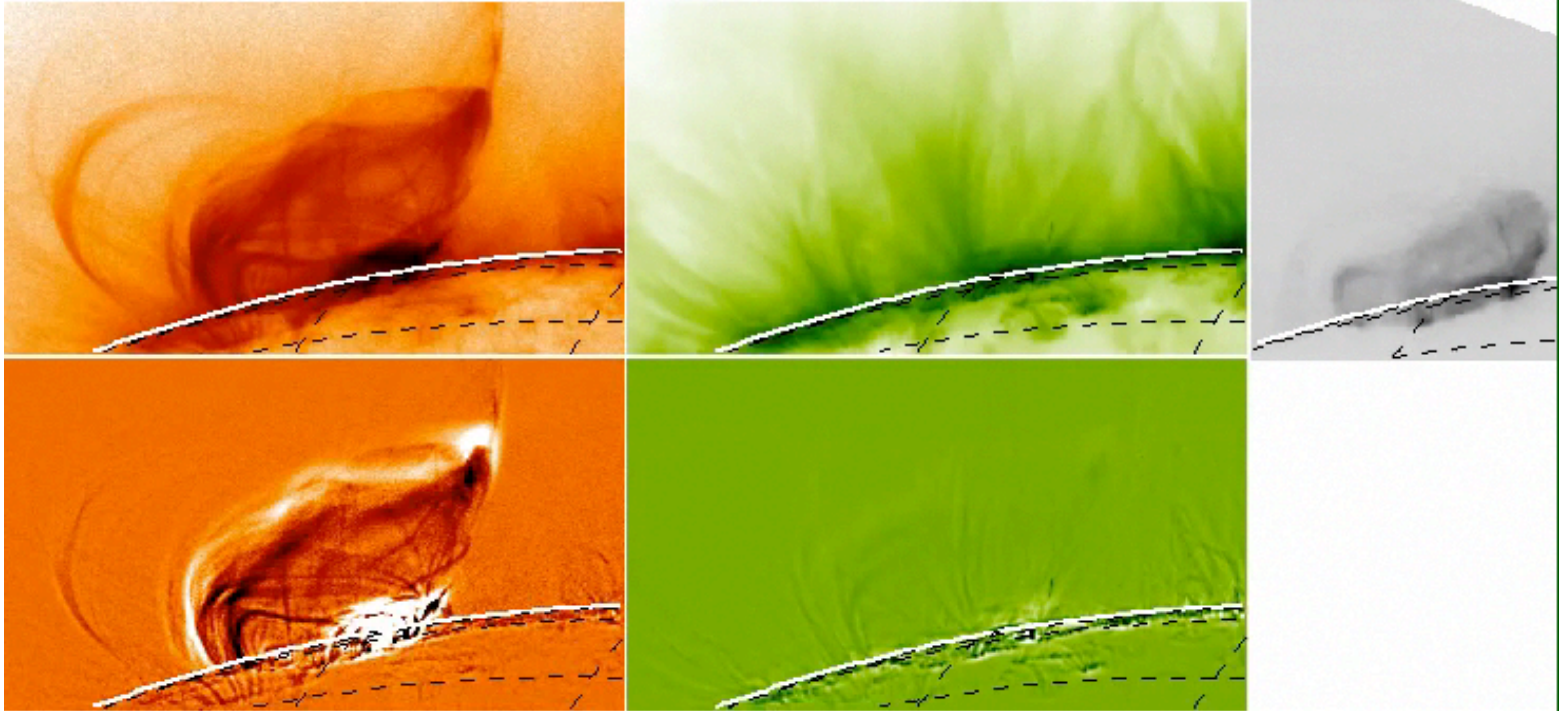
$$B \approx 10 \text{ nT} = 10^{-4} \text{ G}$$

$$\beta = \frac{p}{(B^2/8\pi)} \approx 8$$

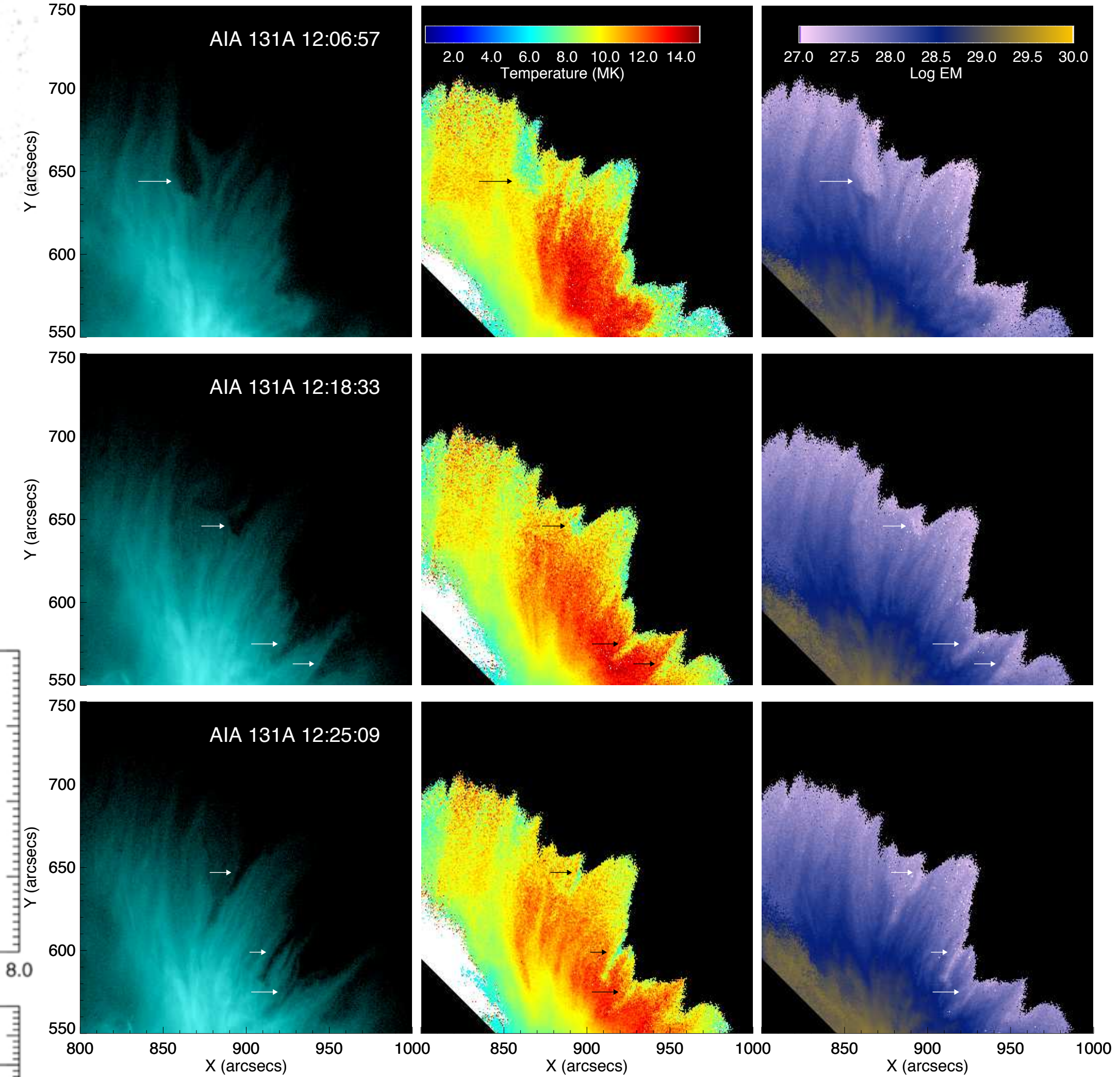
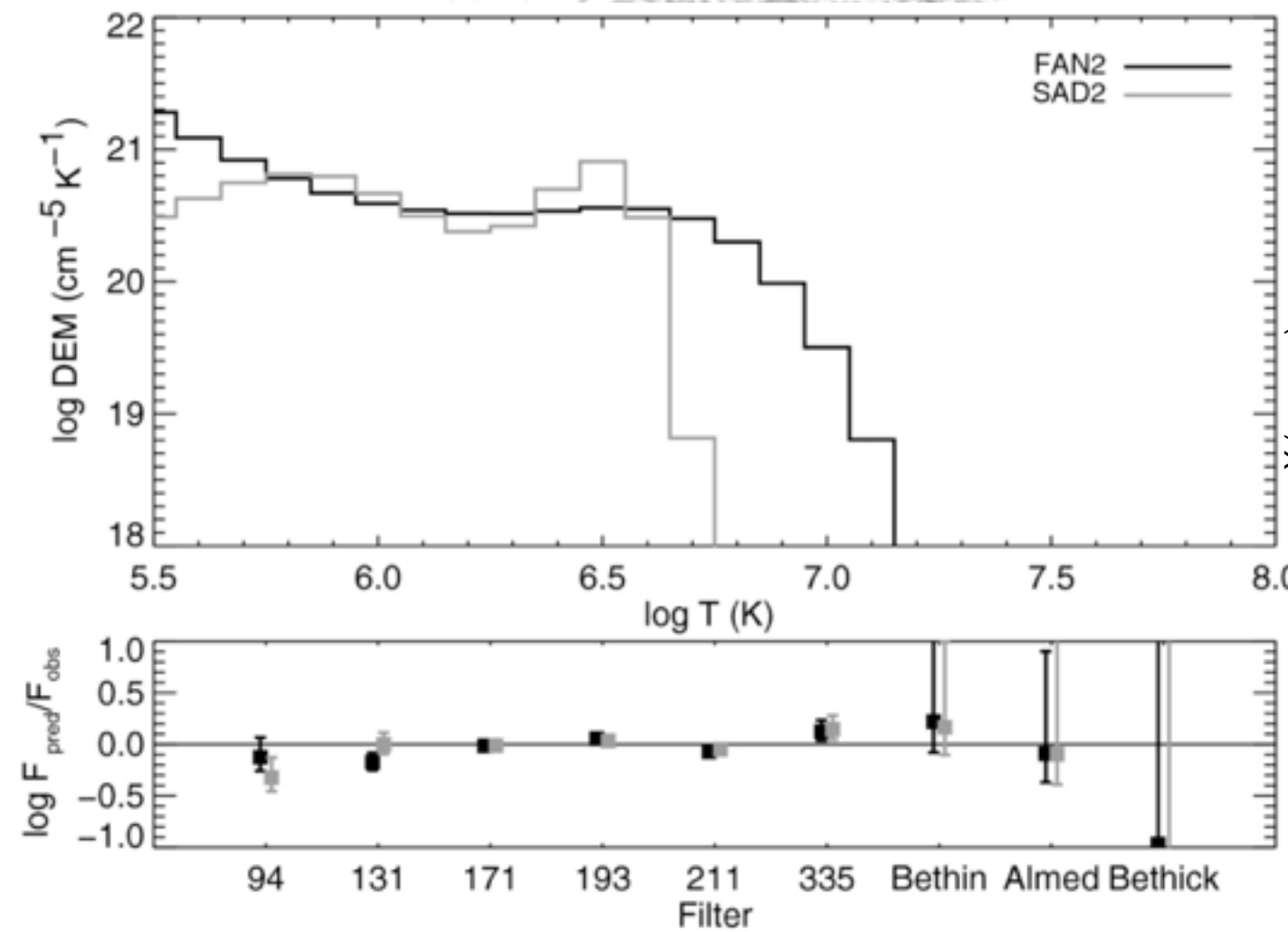
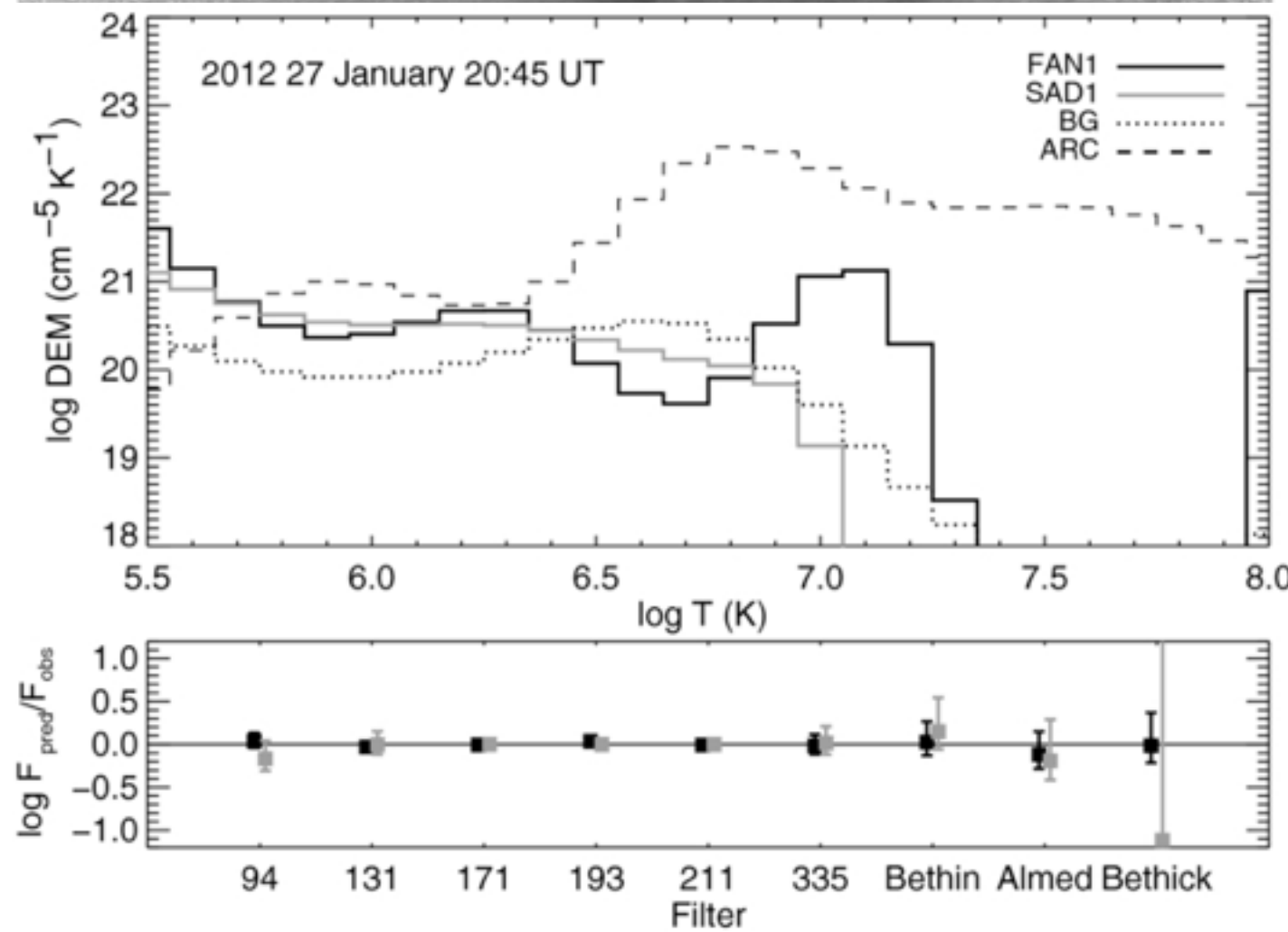
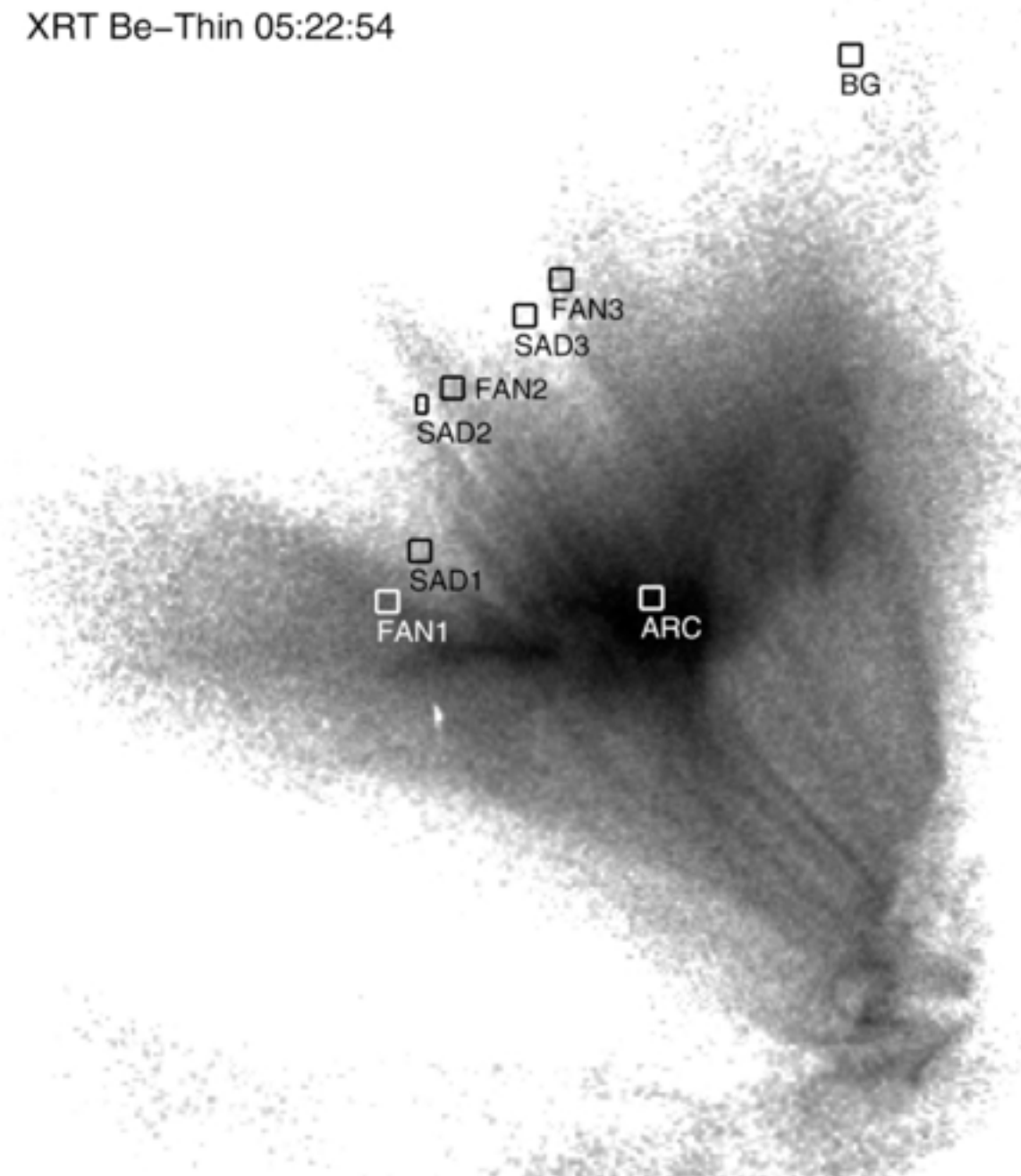
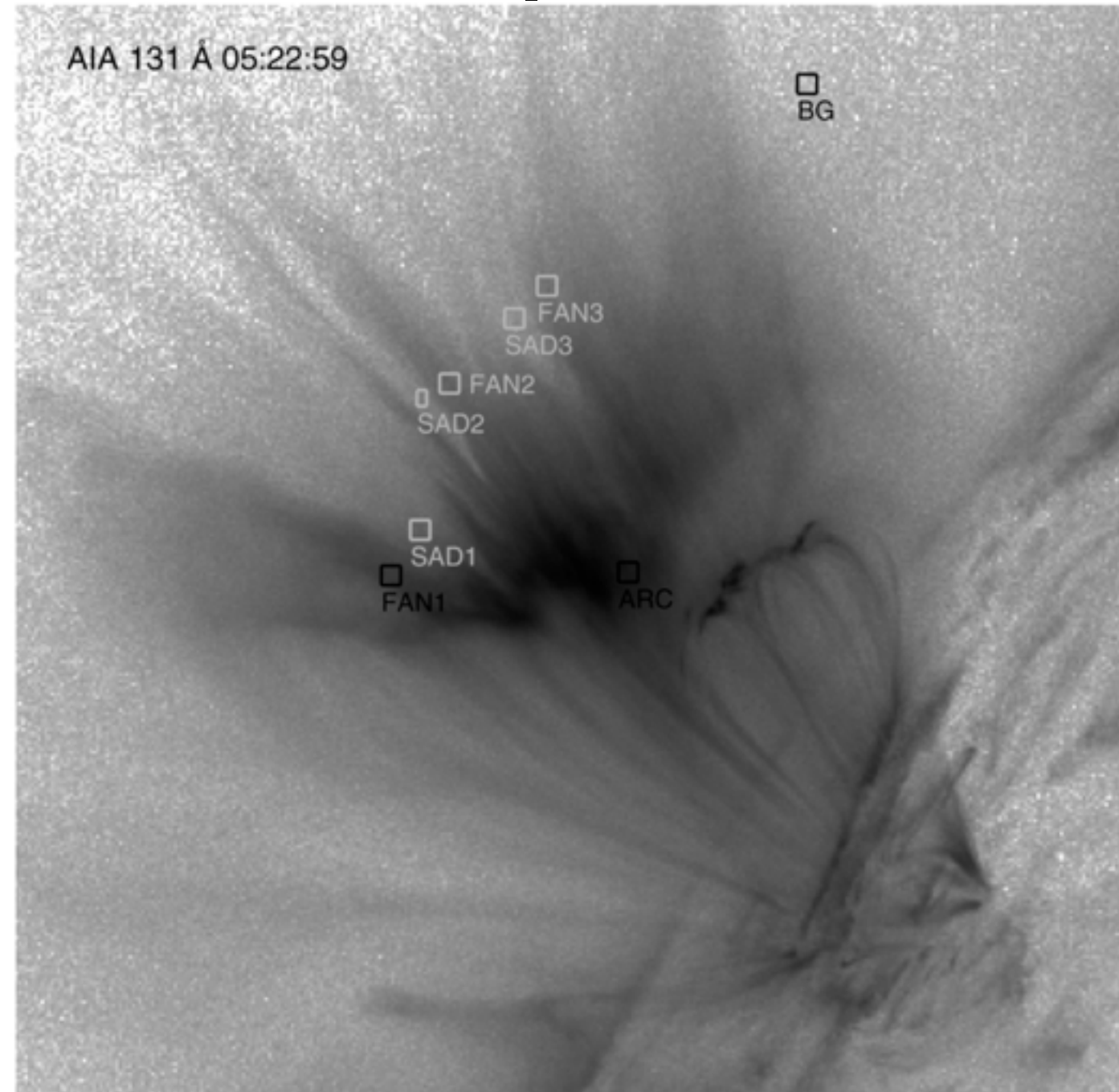
$$\nu_A = \frac{B}{\sqrt{4\pi n_p m_p}} \approx 2 \times 10^7 \text{ cm s}^{-1}$$

Supra Arcade Downflows (SADs)

0 AIA & XRT 20120127 - 131, 193, Ti-Poly 18:04:09.620



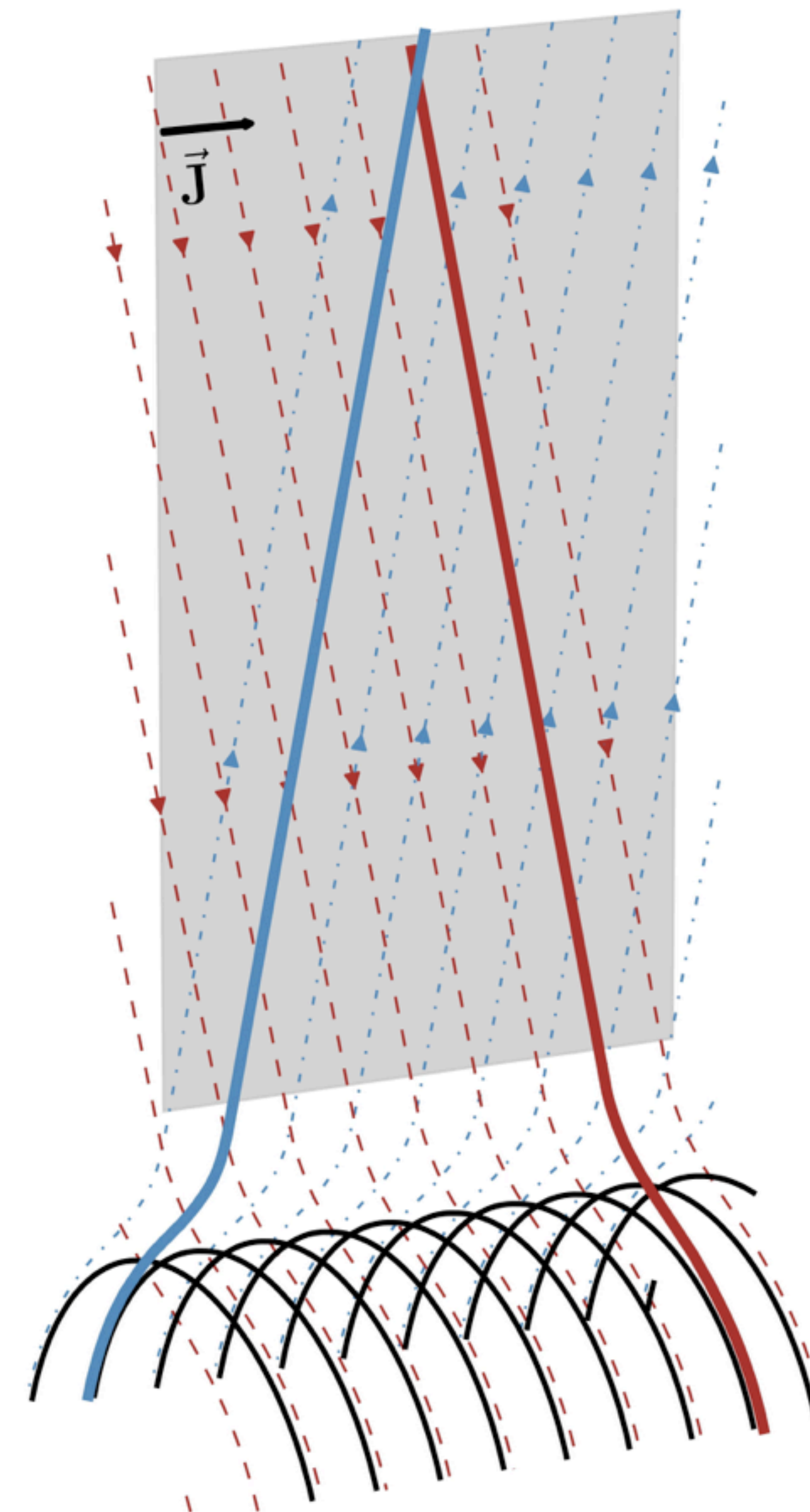
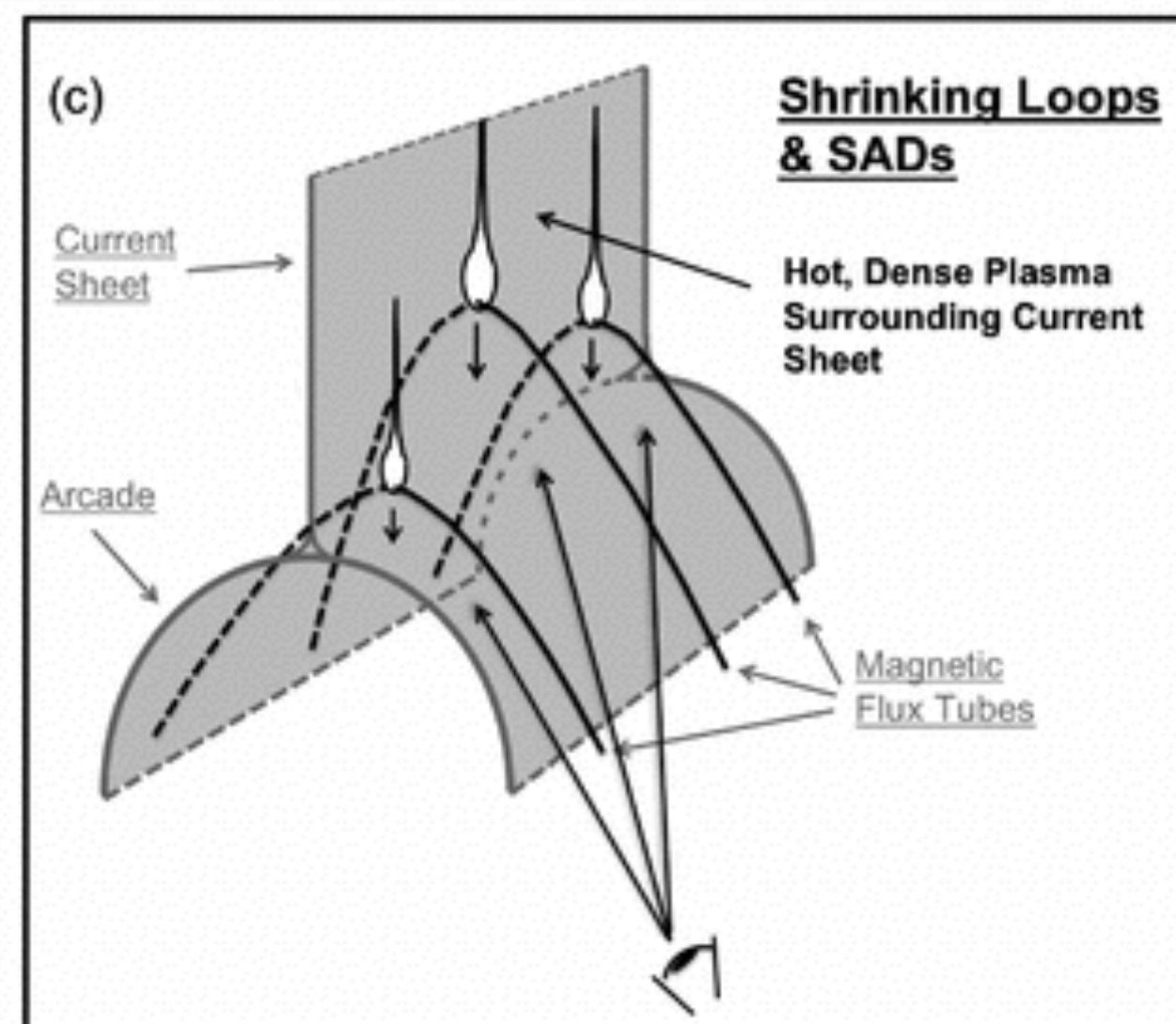
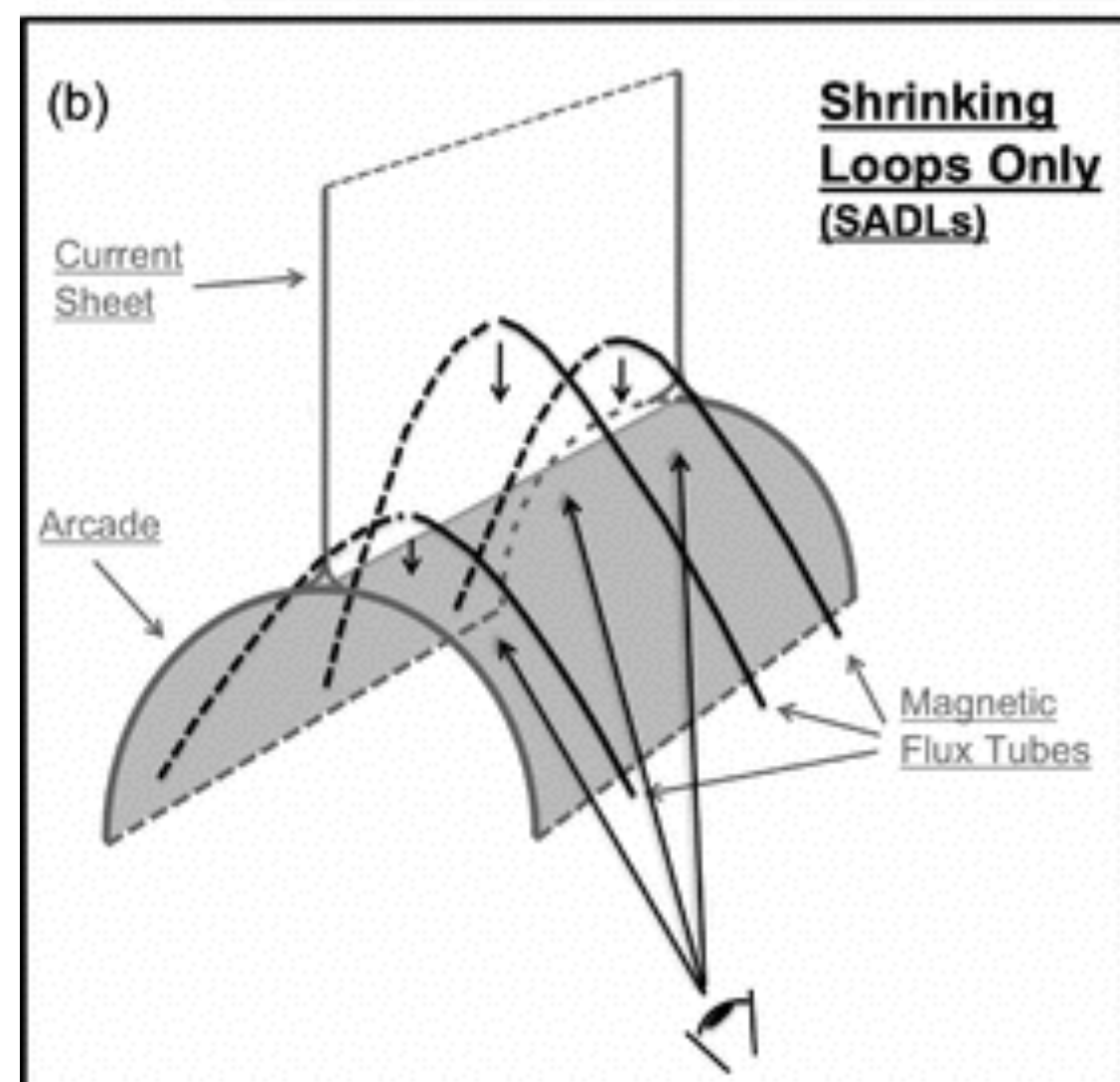
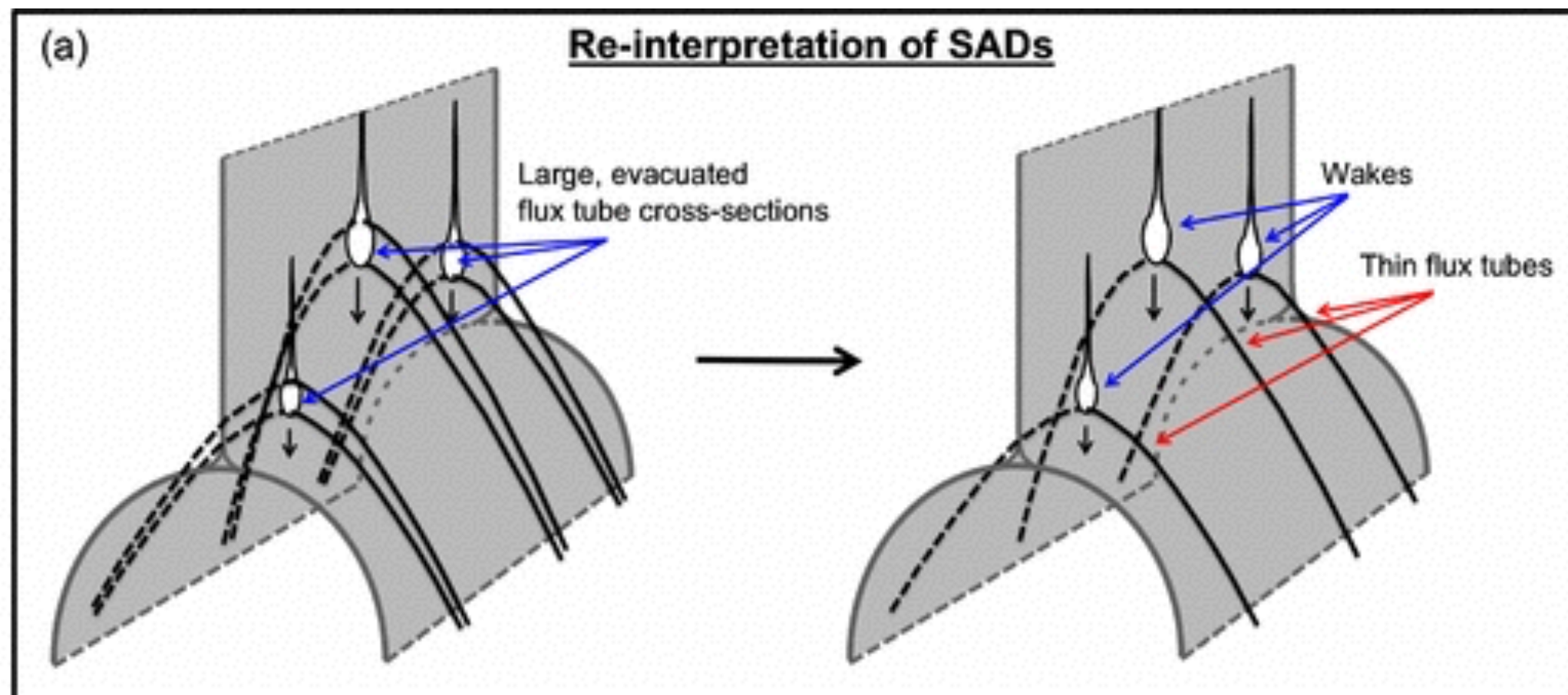
Temperature and Density Estimates of SADs



From Hanneman and Reeves 2014

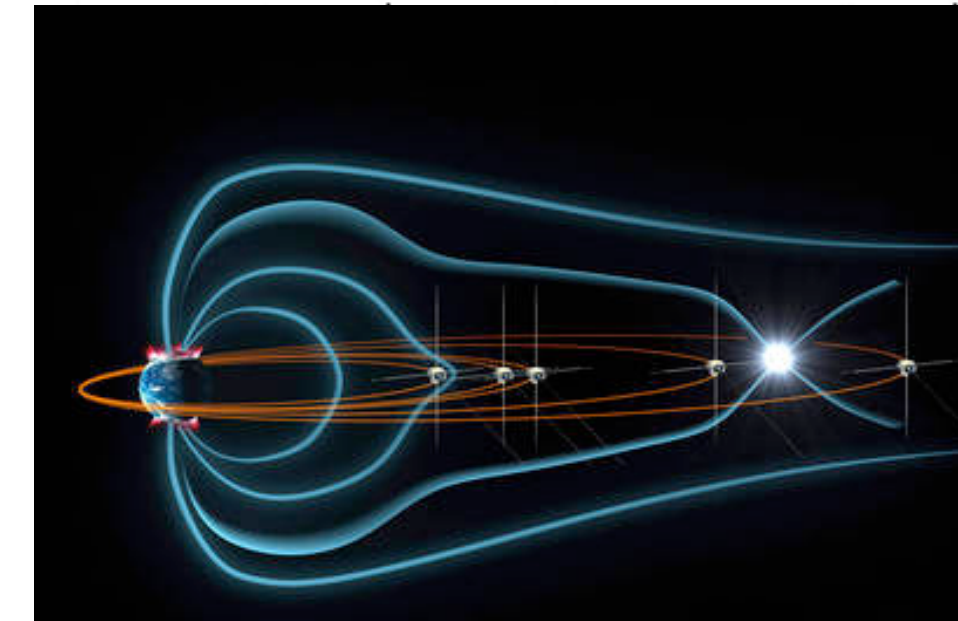
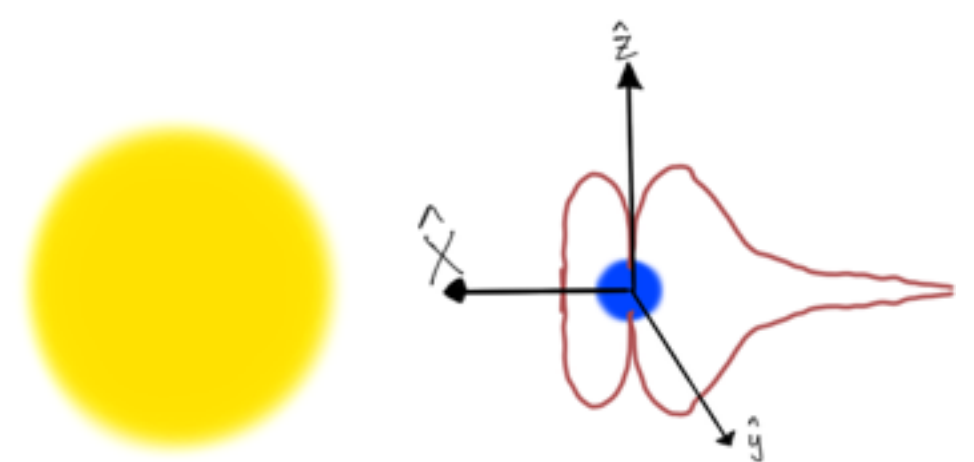
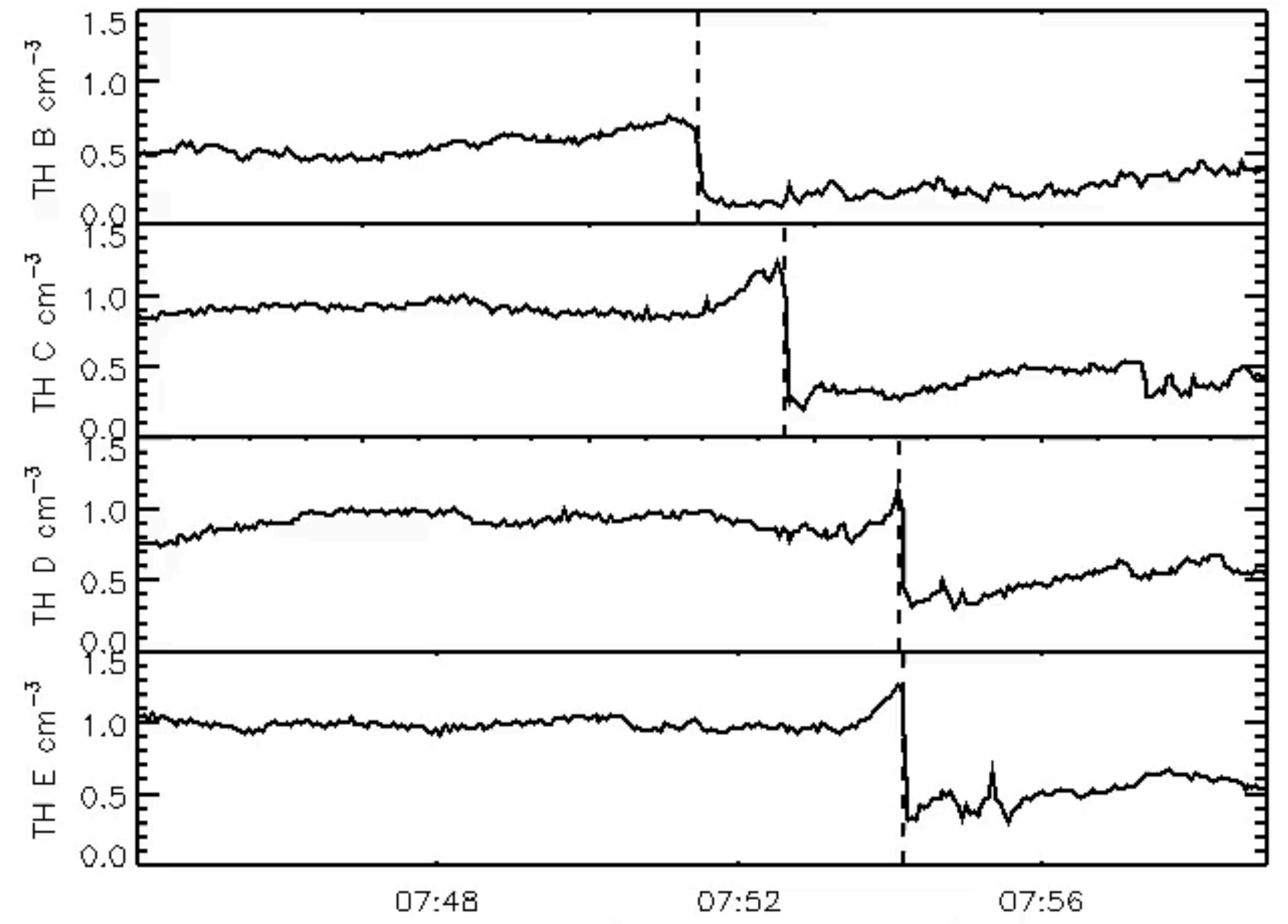
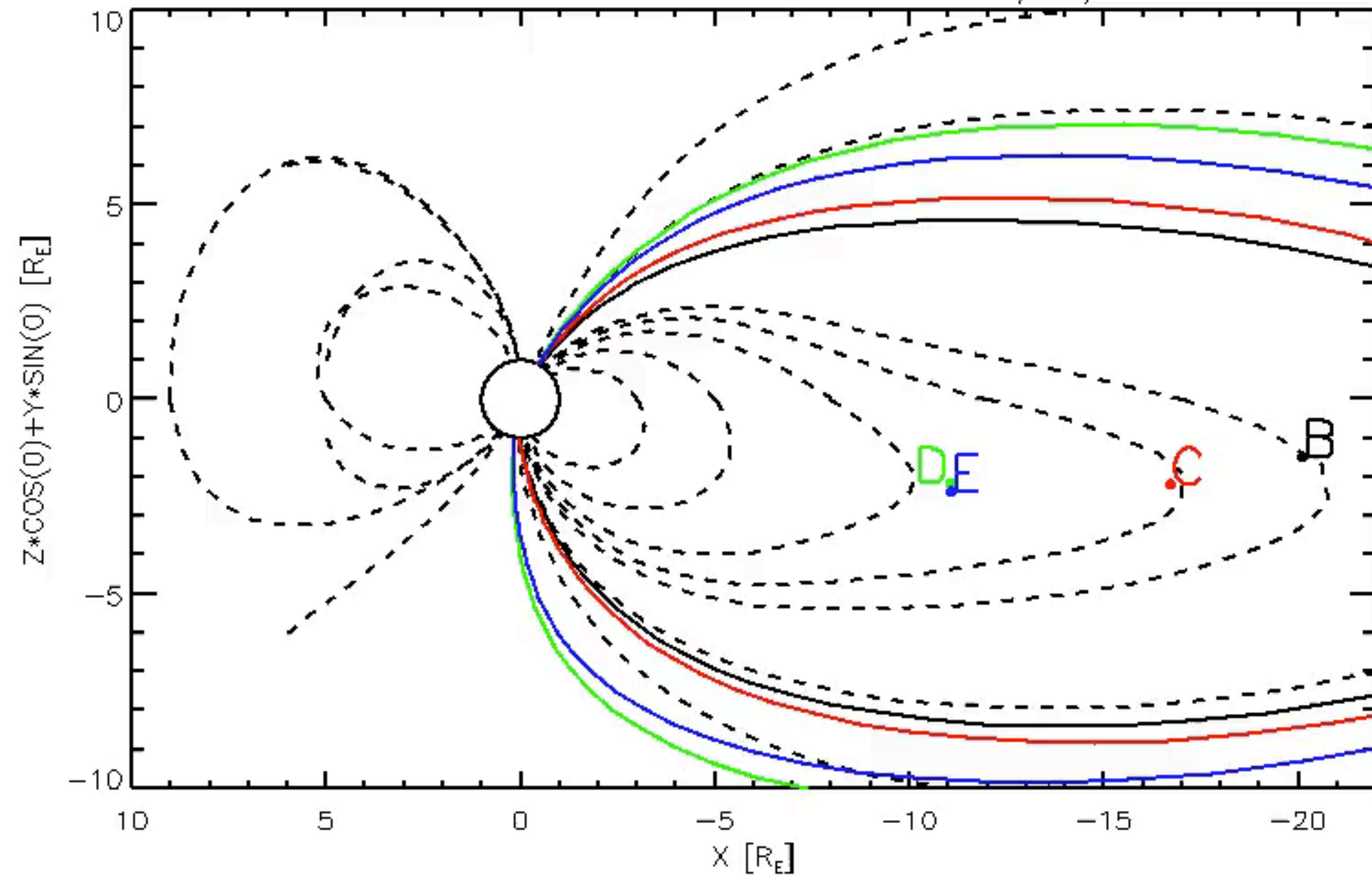
From Reeves et al 2017

Supra Arcade Downflows

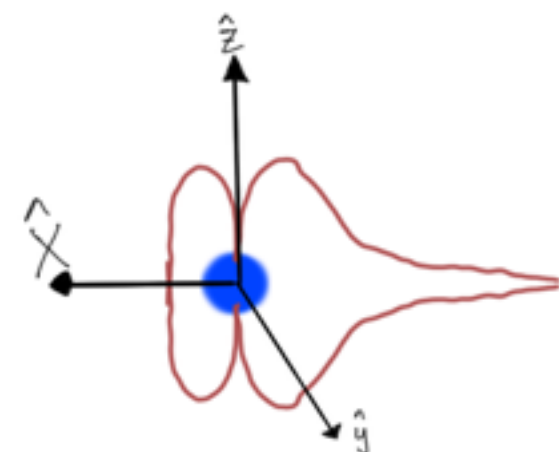
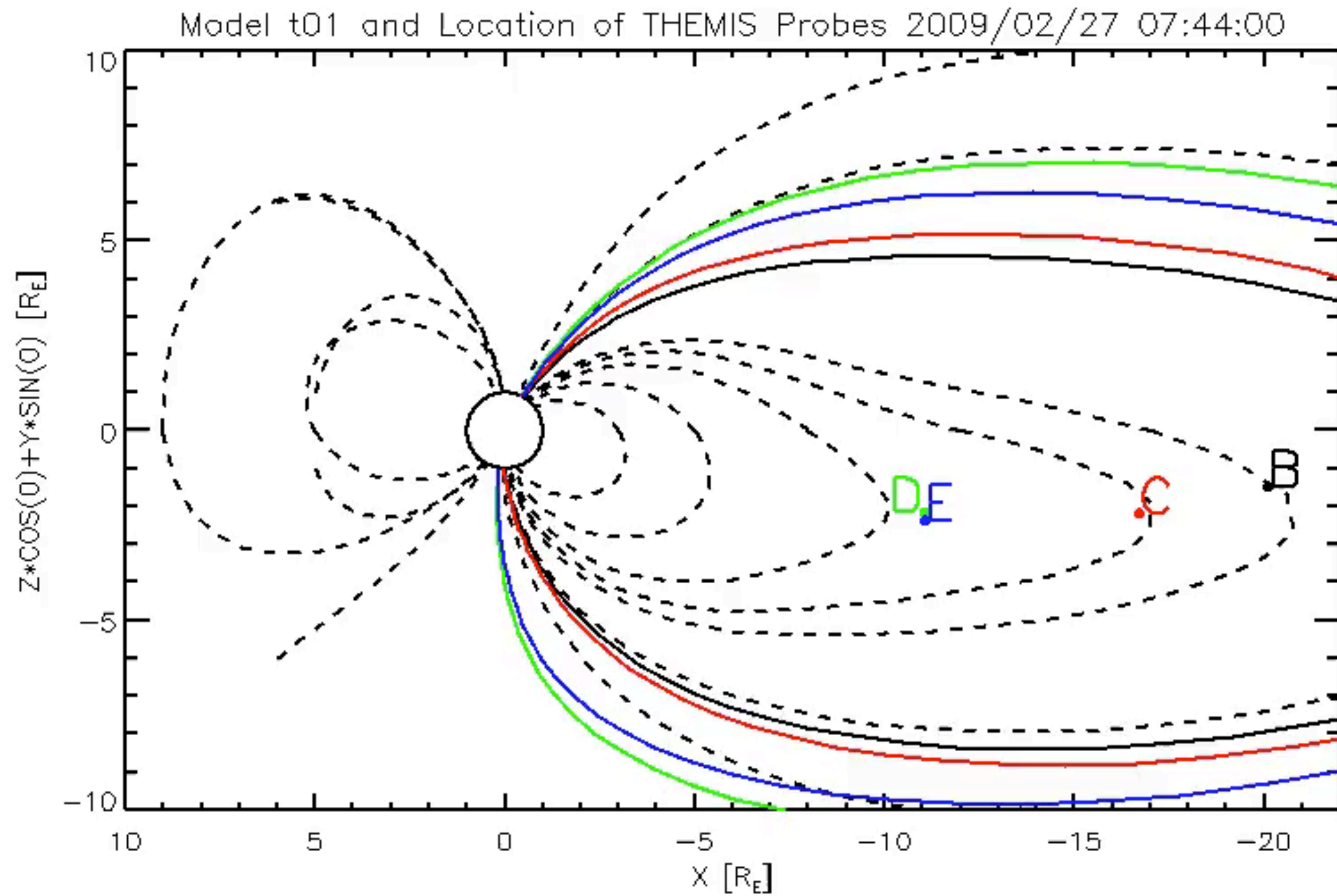


Time History of Events and Macroscopic Interactions during Substorms (THEMIS)

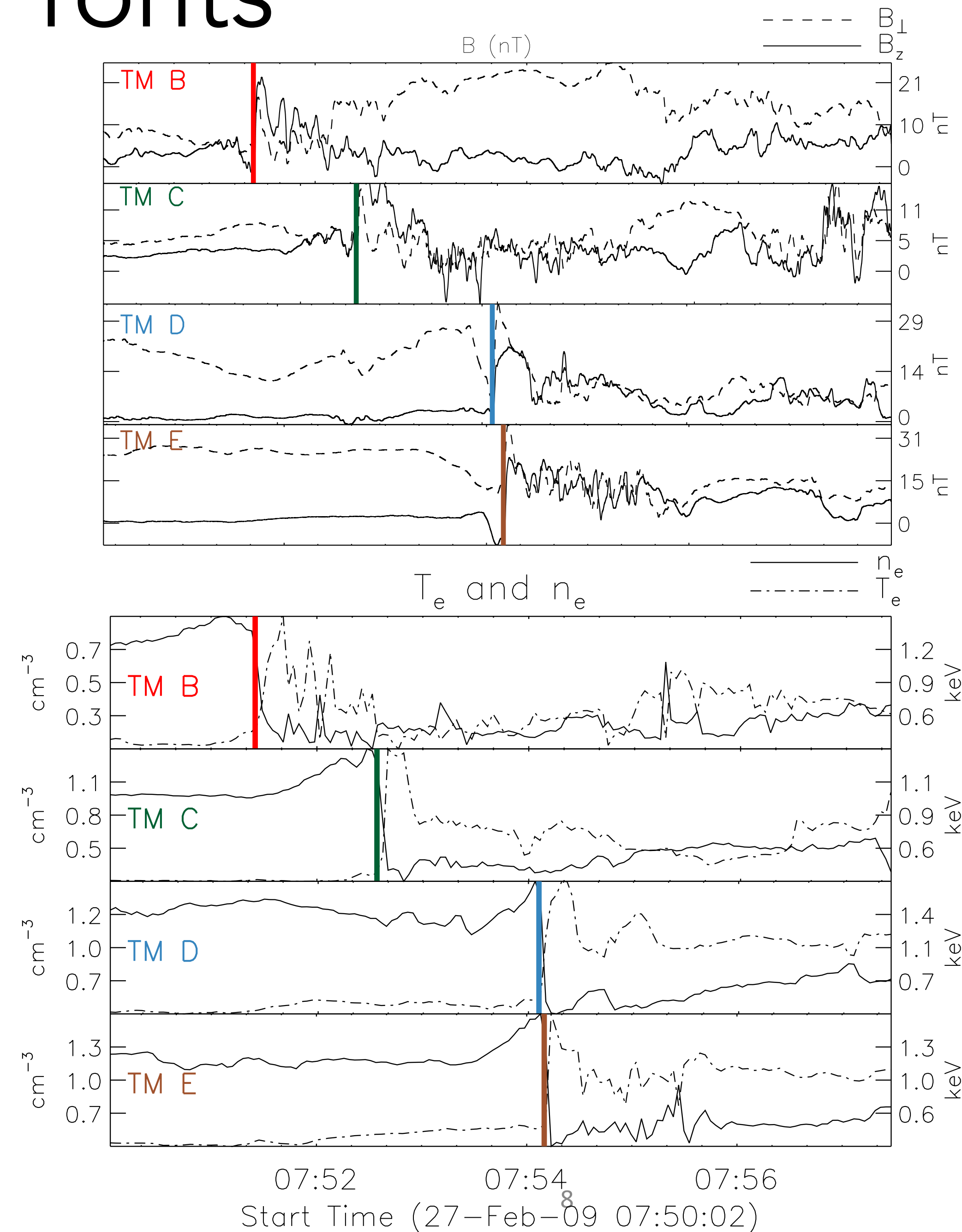
Model t01 and Location of THEMIS Probes 2009/02/27 07:44:00



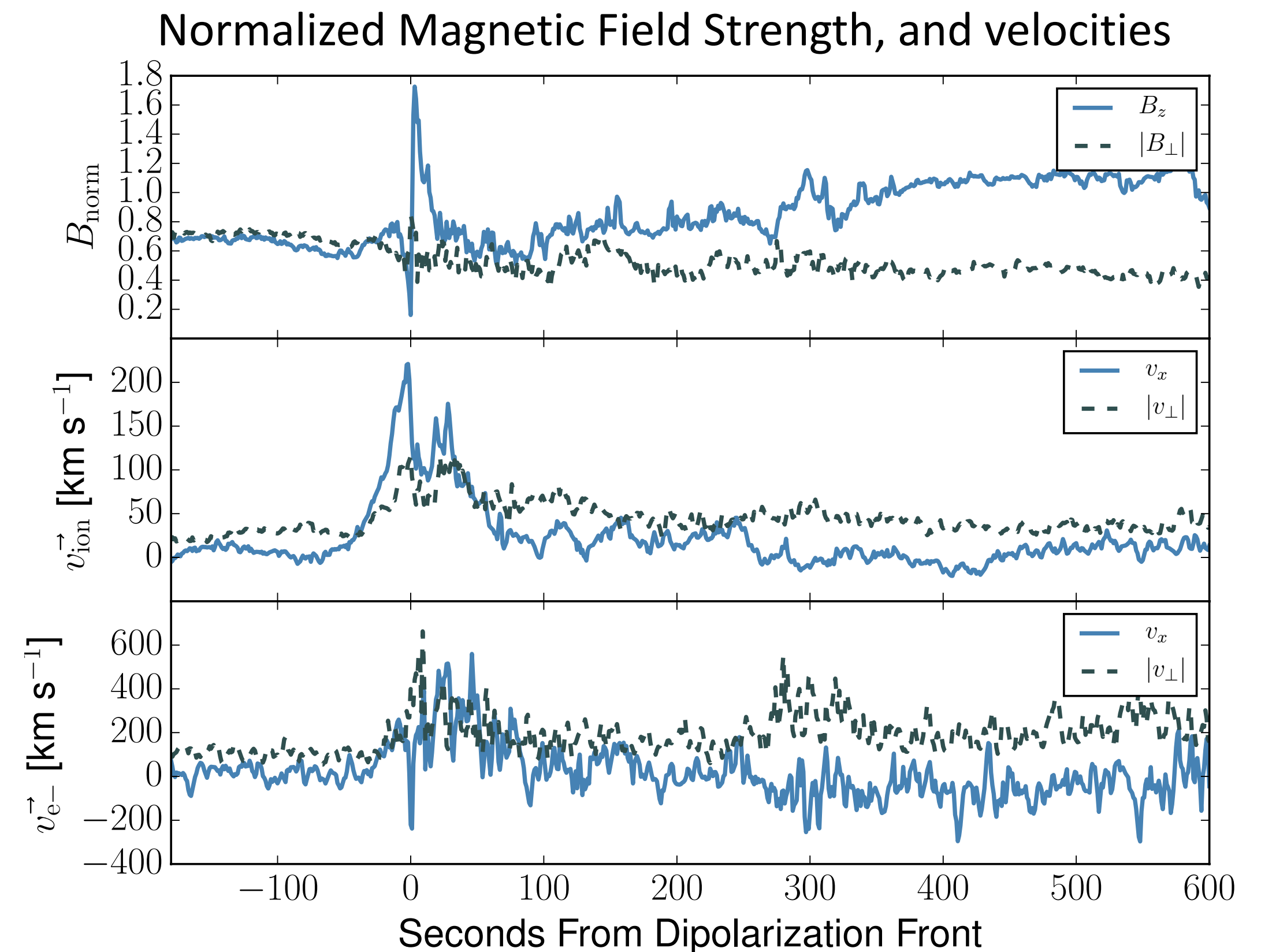
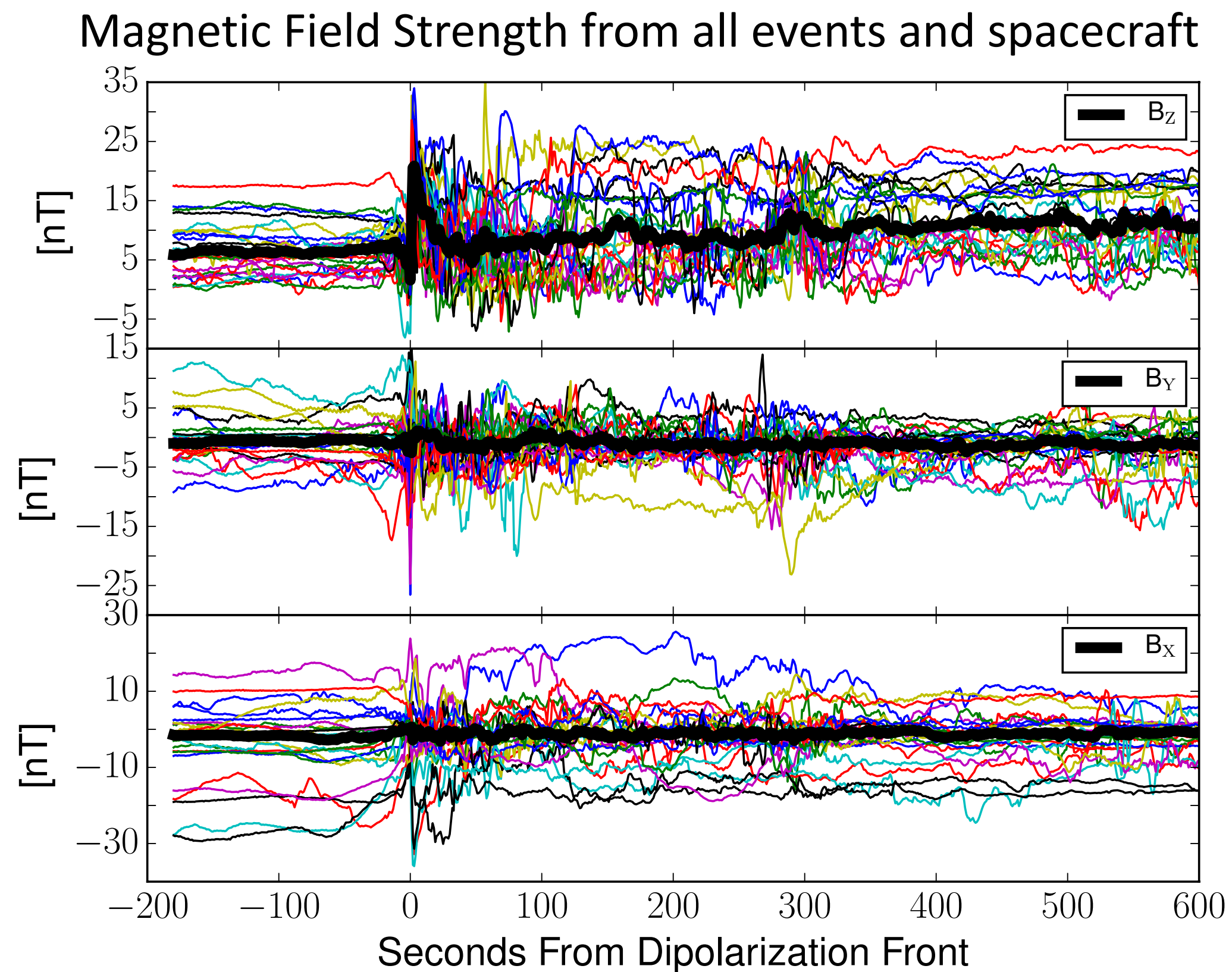
Dipolarization Fronts



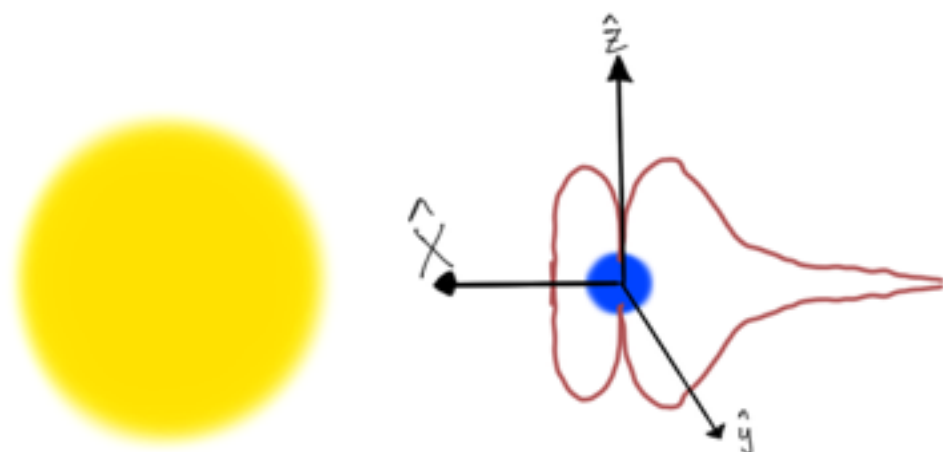
2017 May 30 - Kobelski - Hinode 11



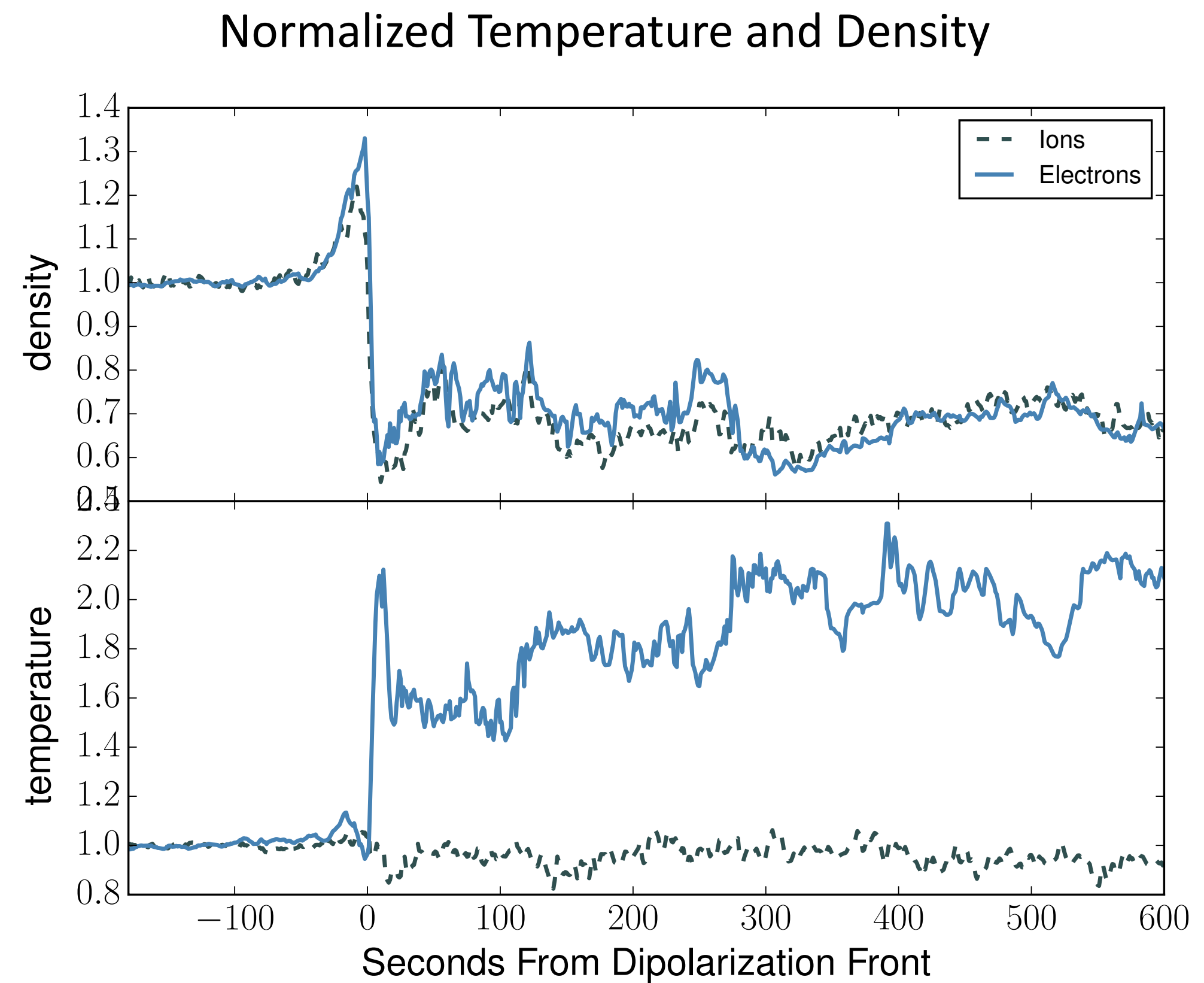
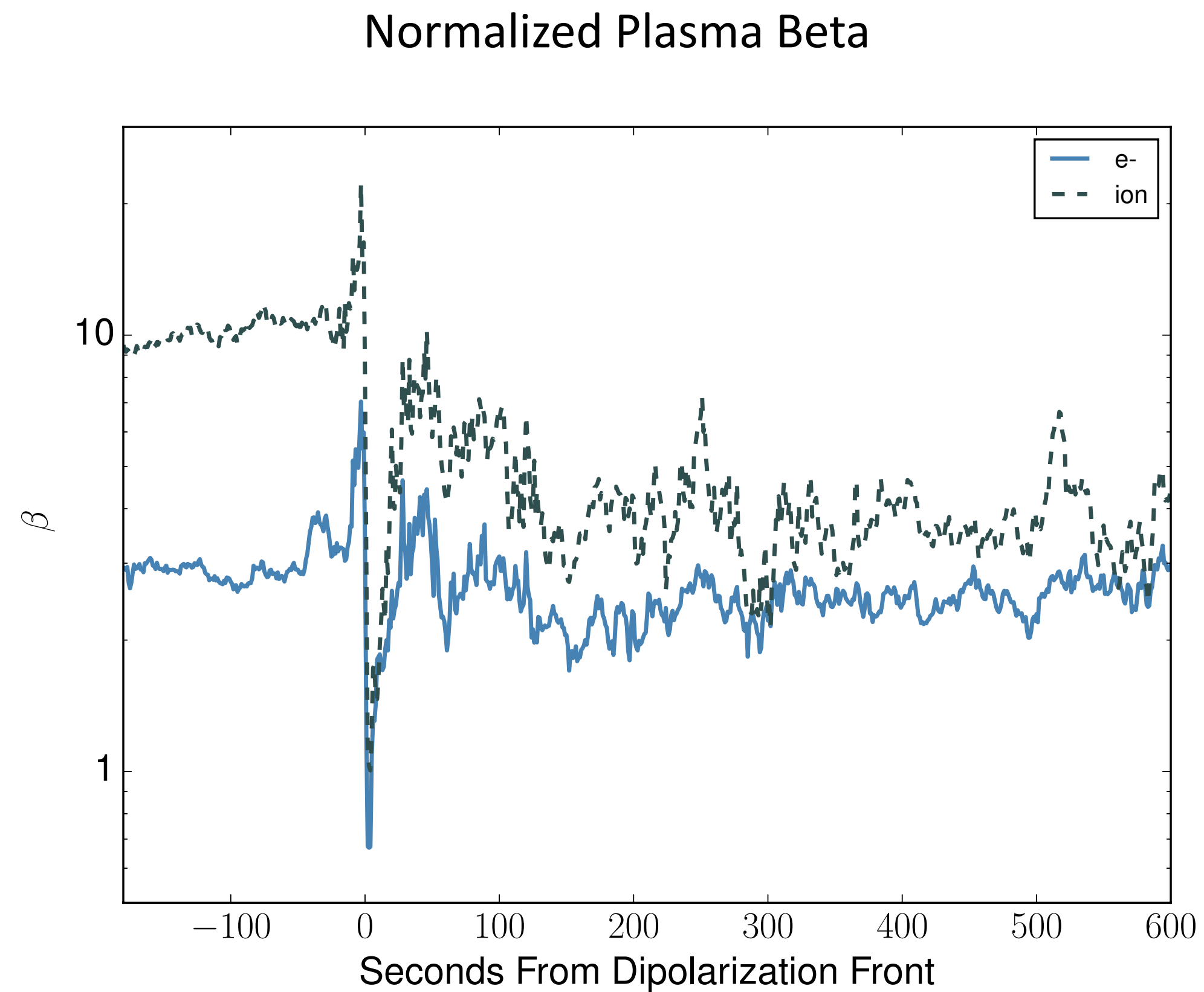
Generalizing Dipolarization Fronts



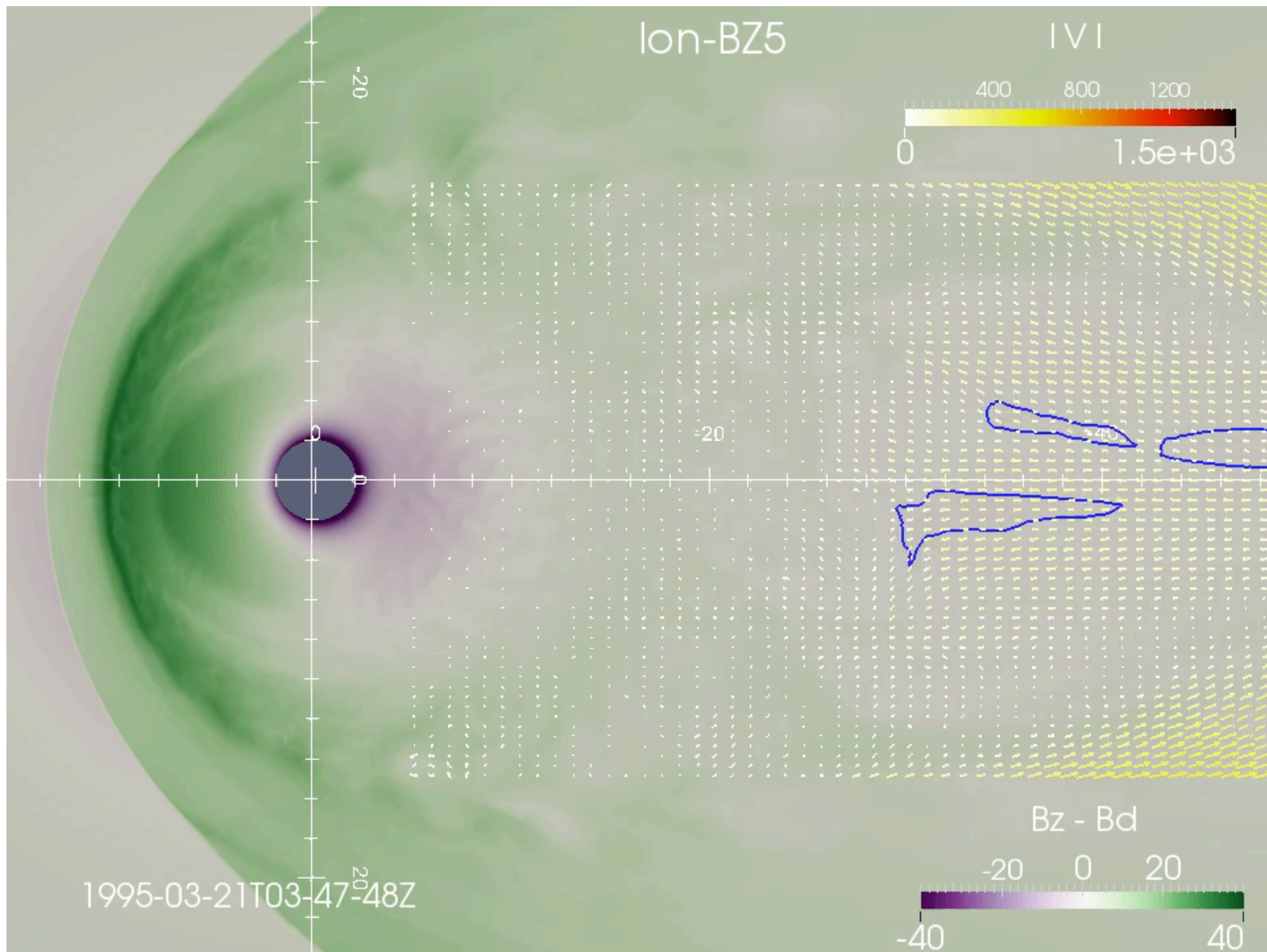
Dataset of 6 events each observed by up to 5 THEMIS spacecraft
(as listed in Runov et al. 2011)



Generalizing Dipolarization Fronts

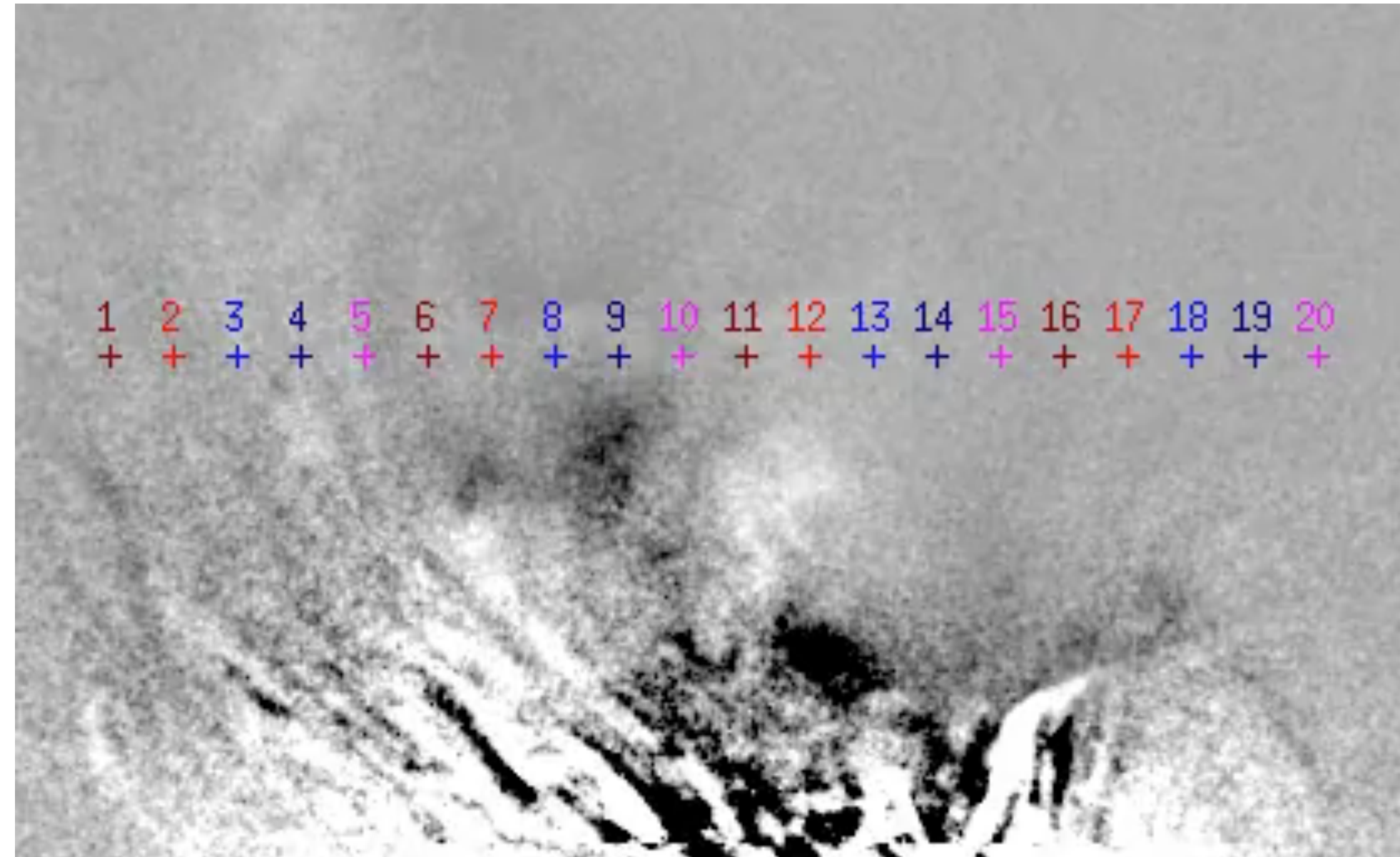


Dataset of 6 events each observed by up to 5 THEMIS spacecraft
(as listed in Runov et al. 2011)



. SIMULATION from Wiltberger, M., V. Merkin, J. G. Lyon, and S. Ohtani (2015), High-resolution global magnetohydrodynamic simulation of bursty bulk flows, *J. Geophys. Res. Space Physics*, 120, 4555–4566, doi:10.1002/2015JA021080.

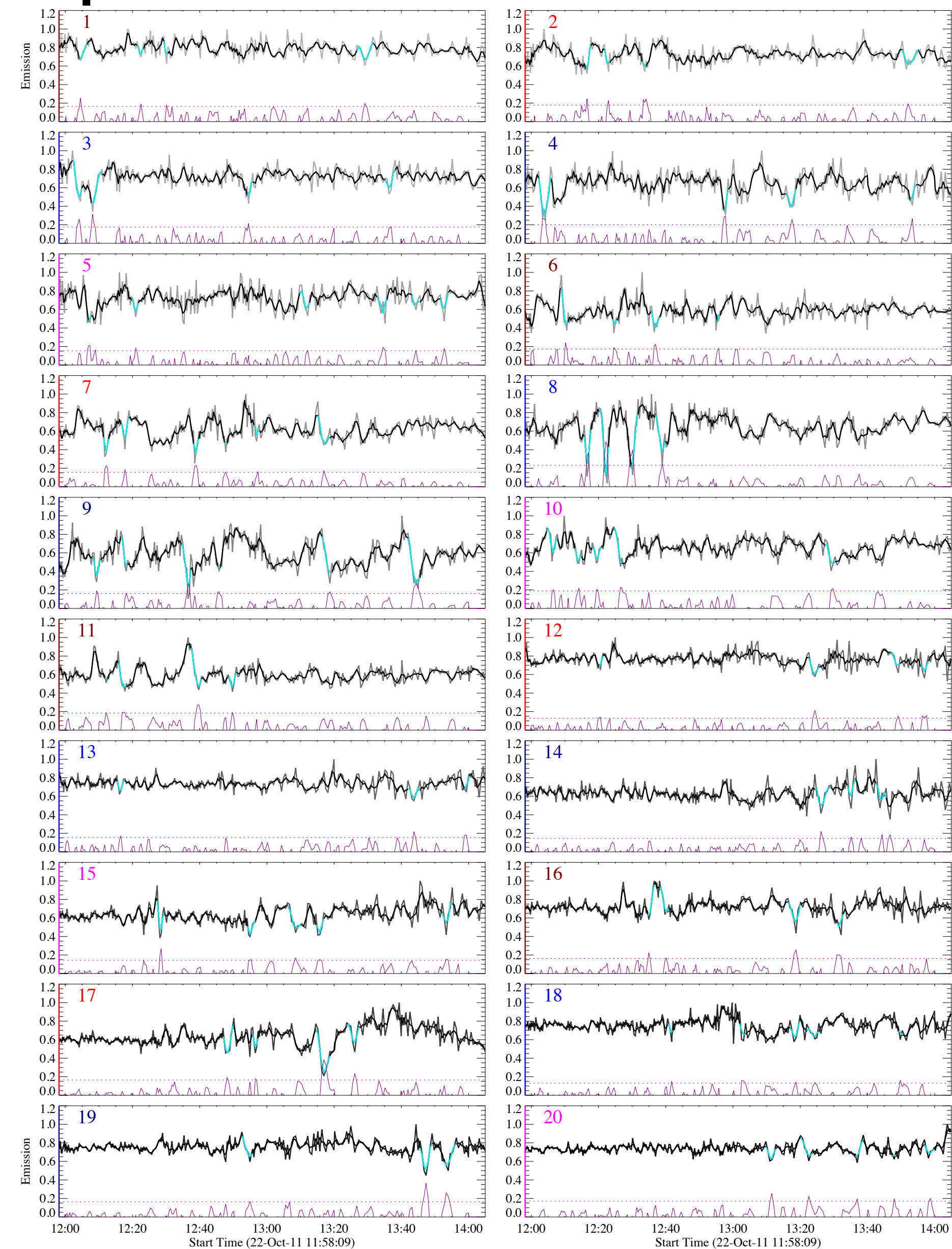
Observing SADs as Dipolarization Fronts



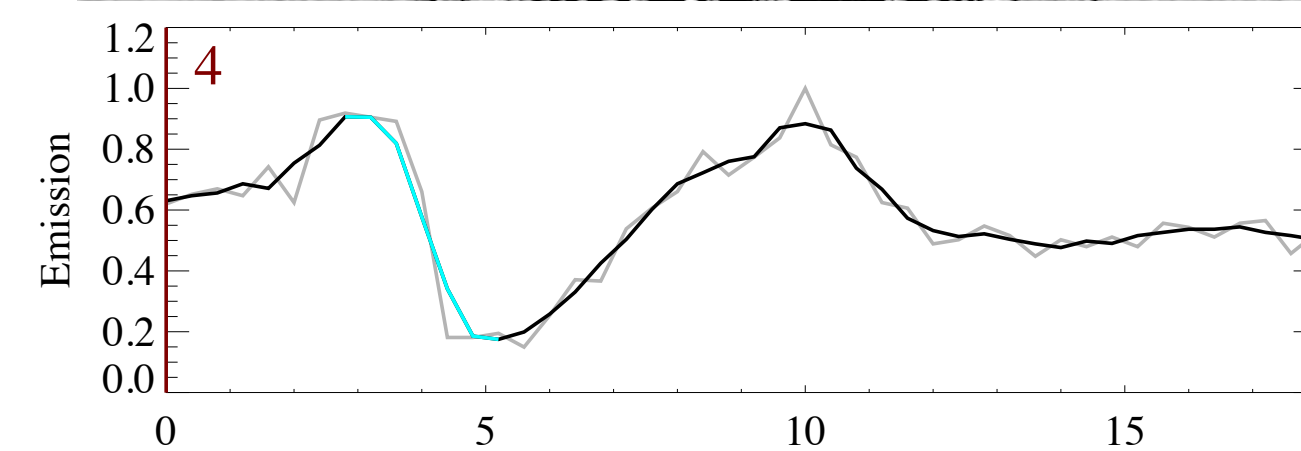
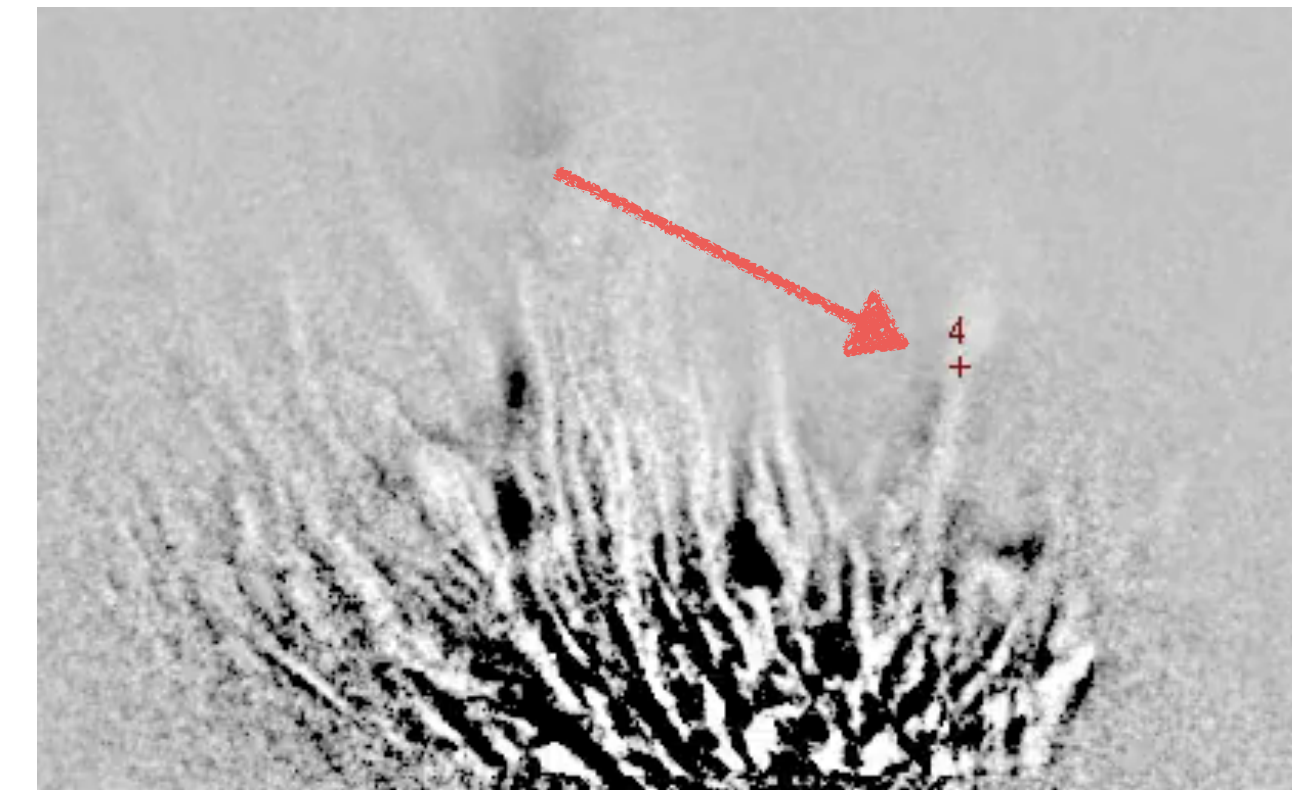
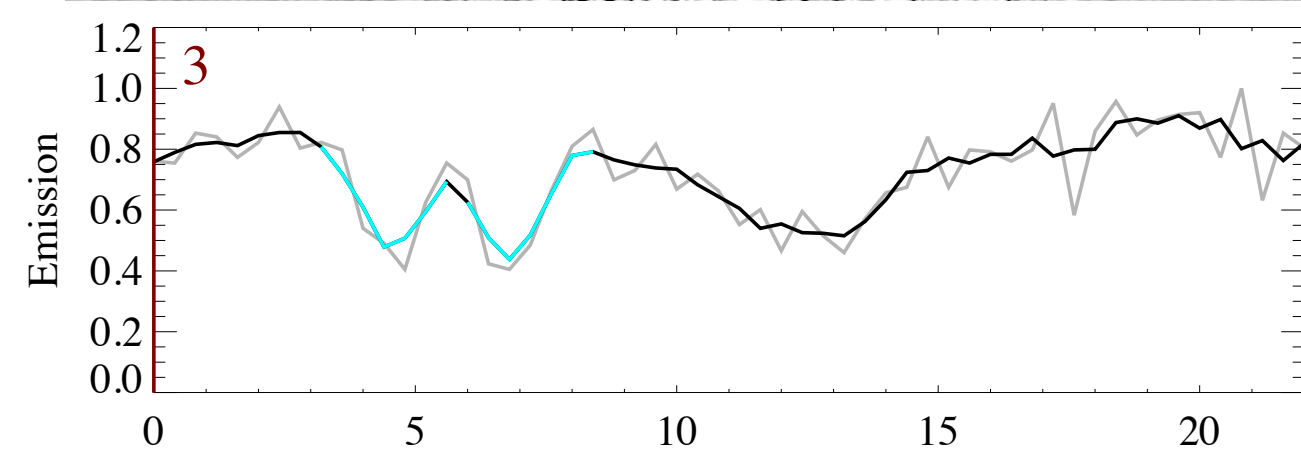
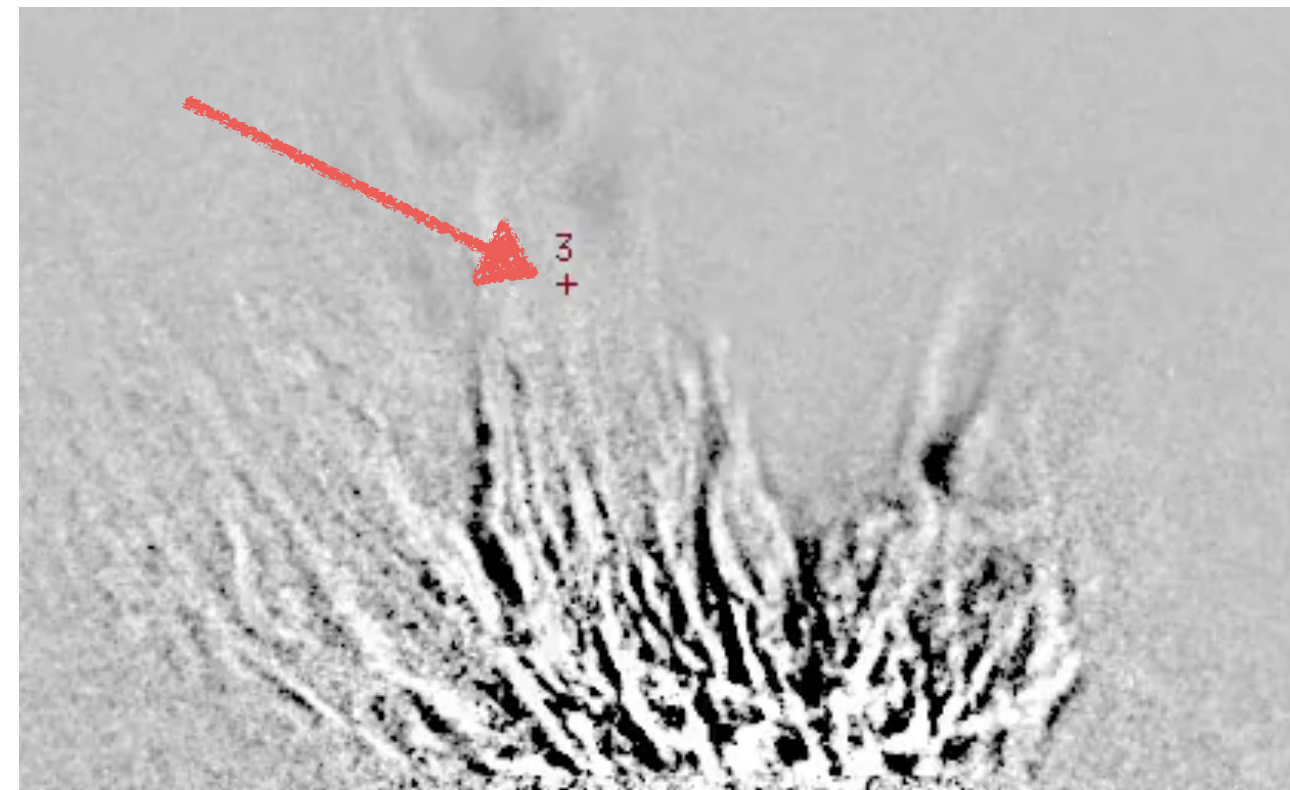
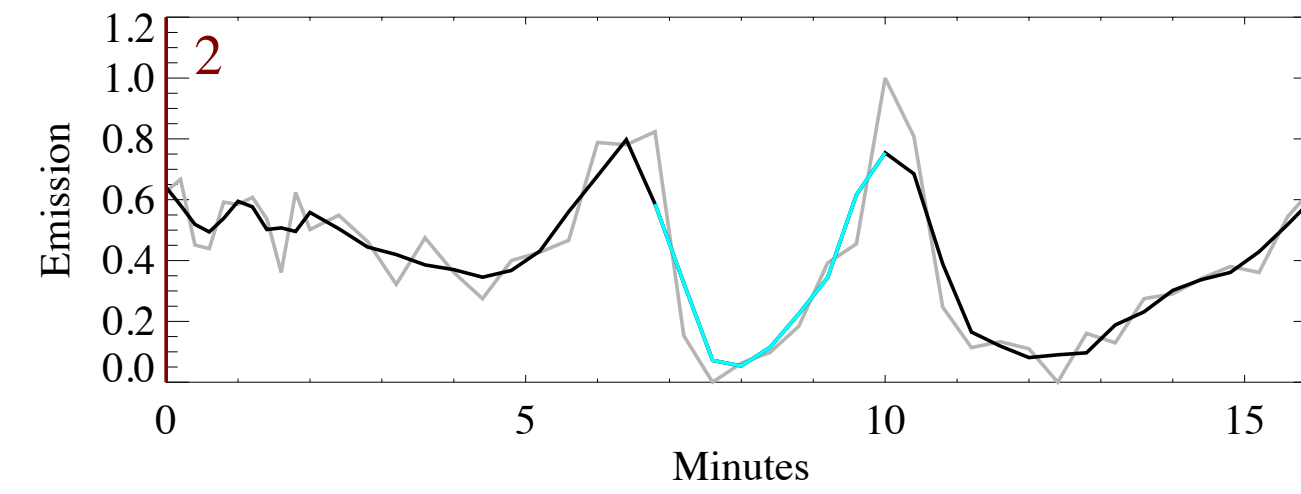
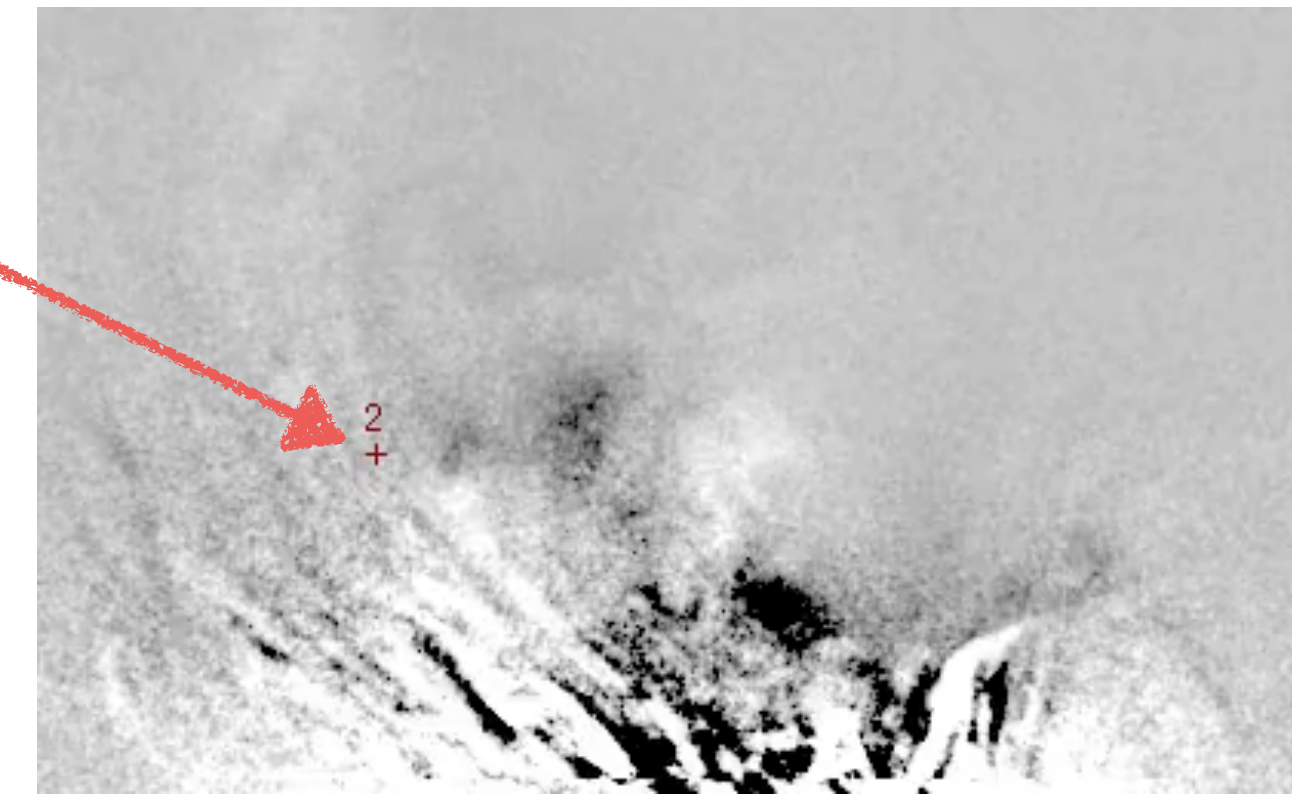
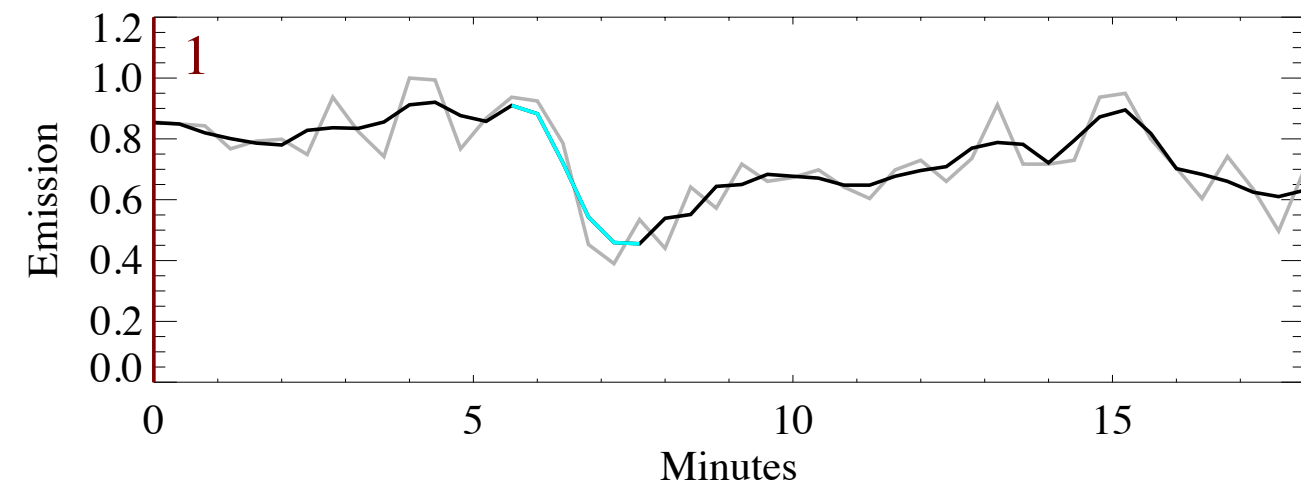
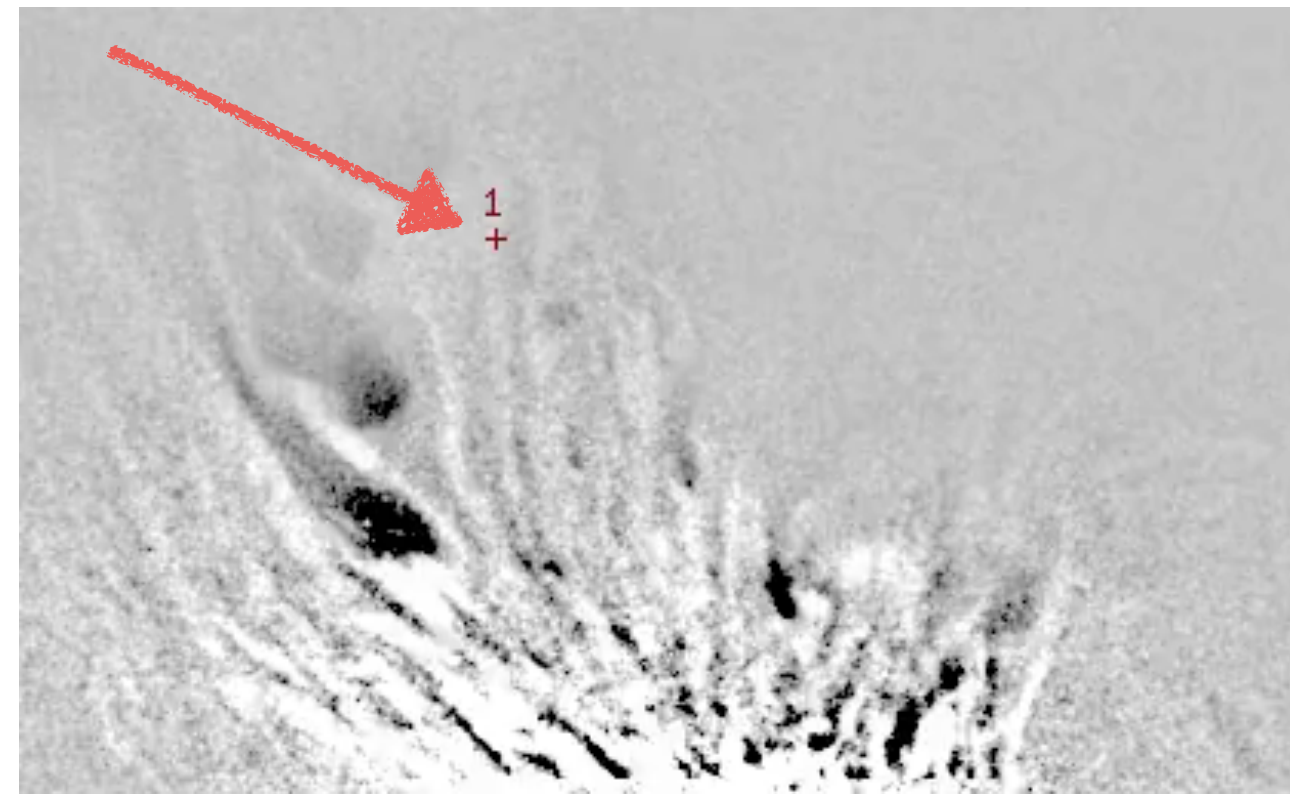
AR 11314 (GOES M1.3) between ~9:30 and 10:00 UT

SOL2011-10-22

AIA 131 running difference.



Observing SADs as Dipolarization Fronts



Summary

- Dipolarization fronts clearly show wakes behind collapsing/retracting loops in the magnetosphere during/after substorms
- Dipolarization fronts should have coronal counterparts in solar flares
- SADs are low density sunward moving regions observed above solar flares
- Observations of SADs show similar features to Dipolarization Fronts
- Some SADs are the wakes behind collapsing loops, like dipolarization fronts.
- The velocity, density, temperature and magnetic field behaviors of observed Dipolarization Fronts provide useful checks for models of SADs
- Will continue to analyze SADs as DPFs to better understand these events.