**SM41A-1996**
Magnetospheric Response to Transient Solar Wind Features III Posters

# Auroral Response to Hot Flow Anomalies

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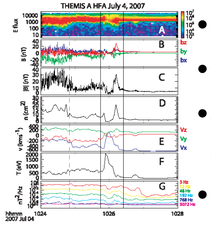
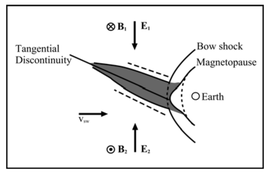
## Introduction and Previous Work

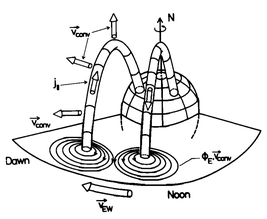
- Hot flow anomalies (HFAs) are disruptions in the normal solar wind flow characterized by
  - increased plasma temperature,
  - deflected solar wind velocity,
  - and decreased plasma density and magnetic field strength
  - (from *Eastwood et al.* [2008])

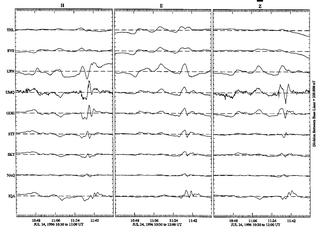



- The dynamic pressure decrease causes the magnetopause to deform ("bulge out") → bulge propagates anti-sunward

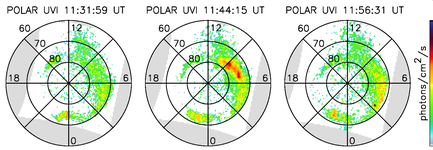



- Deformation of the magnetopause generates field-aligned currents (FACs) into the auroral ionosphere – FAC signatures are measured on the ground as magnetic impulse events (MIEs) or traveling convection vortices (TVCs) [*Glassmeier et al.*, 1989; *Sitar et al.*, 1998]



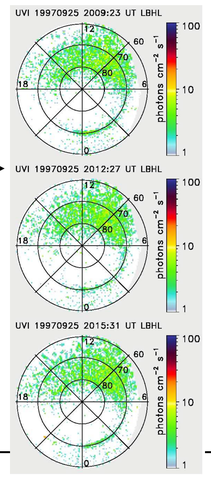
- *Sometimes*, brightening of dayside aurora is observed coincident with HFA/TCV signatures

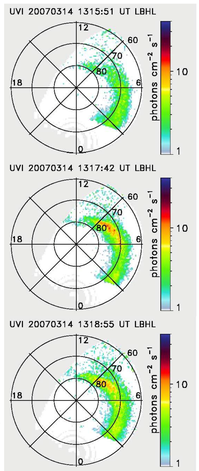



## Current Work

- To date, there has been no systematic study of the *auroral* response to HFAs
- **Is auroral emission a common feature of HFA-magnetosphere interaction?**
- To answer this question, we examine global auroral images from Polar UVI and IMAGE FUV for increases in auroral brightness following HFA observations – we use previously compiled lists of HFA/MIE/TVC events from 1996 to 2007
- Events from over 20 references were tabulated (and the list continues to grow):
  e.g., *Šafránková et al.*, 2002
  *Kataoka et al.*, 2003
  *Lam and Rodger*, 2004
  *Koval et al.*, 2005
  *Facskó et al.*, 2009
  *Ebihara et al.*, 2010
  …
- From these references, approximately 180 events (!) were investigated
- Of these, 34 "usable" events were identified – that is, global auroral image data were available at the right place and at the right time – 2 examples below

| | YYYYMMDD | Time | UVI Availability | FUV Availability | Type |
|---|---|---|---|---|---|
| 1 | 19960522 | 13:11 | Y | N | HFA |
| 2 | 19960609 | 12:05 | Y | N | TCV |
| 3 | 19960724 | 11:38 | Y | N | MIE |
| 4 | 19970131 | 20:30 - 20:50 | Y | N | HFA |
| 5 | 19970308 | 19:17 | Y | N | HFA |
| 6 | 19970308 | 20:29 | Y | N | HFA |
| 7 | 19970403 | 12:00 | Y | N | TCV |
| 8 | 19970404 | 12:20 | Y | N | TCV |
| 9 | 19970606 | 15:55 - 16:25 | Y | N | MIE |
| 10 | 19970724 | 13:38 | Y | N | MIE |
| 11 | 19970925 | 19:47 | Y | N | MIE |
| 12 | 19971003 | 14:17 | Y | N | MIE |
| 13 | 19980121 | 11:25 | Y | N | TCV |
| 14 | 19980222 | 11:20 | Y | N | TCV |
| 15 | 19980502 | 13:10 | Y | N | TCV |
| 16 | 19980503 | 17:50 | Y | N | TCV |
| 17 | 19980527 | 16:10 | Y | N | HFA |
| 18 | 19990505 | 15:40 | Y | N | TCV |
| 19 | 19990615 | 13:10 | Y | N | TCV |
| 20 | 19990626 | 20:15 | Y | N | TCV |
| 21 | 20020402 | 03:20-04:10 | Y | Y | HFA |
| 22 | 20021219 | 10:00-11:40 | Y | Y | TCV |
| 23 | 20030217 | 09:59 | Y | N | HFA |
| 24 | 20030217 | 10:05 | Y | N | HFA |
| 25 | 20030217 | 10:07 | Y | N | HFA |
| 26 | 20030412 | 01:38 | Y | N | HFA |
| 27 | 20030412 | 01:42 | Y | N | HFA |
| 28 | 20030416 | 16:07 | Y | N | HFA |
| 29 | 20030416 | 16:23 | Y | N | HFA |
| 30 | 20070314 | 07:53 | Y | N | HFA |
| 31 | 20070314 | 12:51 | Y | N | HFA |
| 32 | 20070314 | 15:52 | Y | N | HFA |
| 33 | 20070316 | 18:13 | Y | N | HFA |
| 34 | 20070316 | 19:56 | Y | N | HFA |

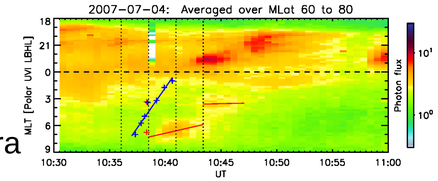



## Results

- **Not all events have an auroral signature**
- Of the events examined, only 60% show an increase in auroral brightness near the time of HFA/TCV observations (e.g., on 2007-03-14 shown below left in the right-most column)
- The remaining 40% do not show an obvious brightening of the aurora (e.g., on 1997-09-25 shown below left in the left image column)
- For those events with clear auroral signatures, the regions of auroral emission are either stationary or slow-moving – much slower than the expected MIE/TCV propagation velocity
- In an example shown by *Fillingim et al.* [2011], the ionospheric current system (TCV) traveled 6 X faster than the region of auroral emission

blue line: speed of TCV
red lines: speed of aurora




### Open Questions:

- Is there a threshold HFA intensity, magnetopause deformation, and/or ionospheric current intensity for generating dayside auroral emission?
- What is the source of the auroral emission?
- Observed velocity difference implies a decoupling between FAC and aurora
- Dayside magnetospheric instability region?