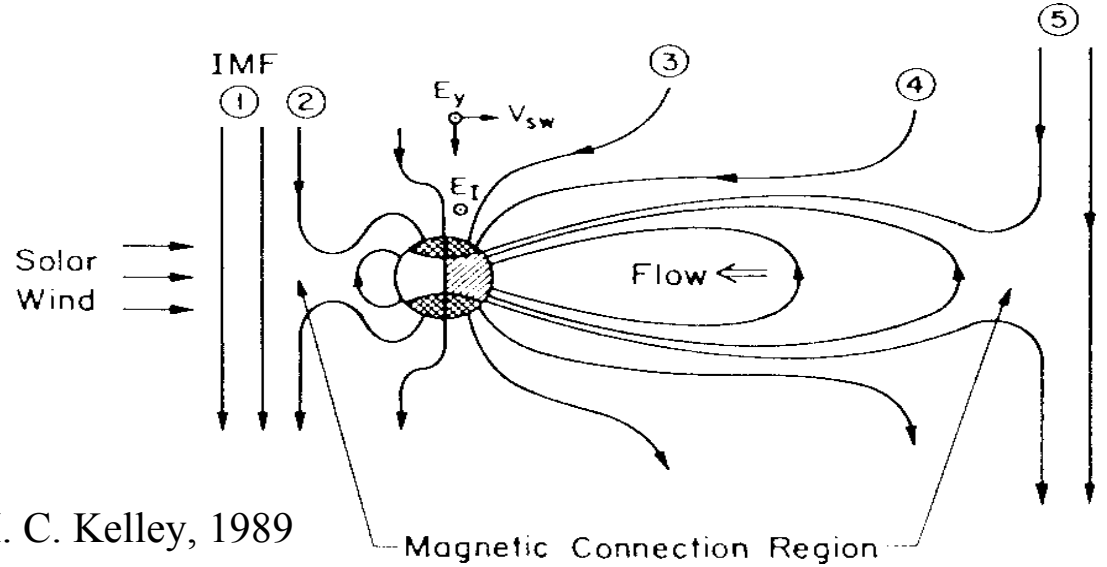
"Simultaneous measurements of convection changes in the high-latitude day- and night-side ionosphere with the Halley and TIGER HF backscatter radars - early results"

M. L. Parkinson[1], M. Pinnock[2], P. L. Dyson[1],
J. C. Devlin[3], and P. R. Smith[3]

(1) Department of Physics, La Trobe University, Melbourne, Victoria 3083, Australia
(2) British Antarctic Survey, Natural Environment Research Council, High Cross, Madingley Road, Cambridge, CB3 0ET, UK
(3) Department of Electronic Engineering, La Trobe University, Melbourne, Victoria 3083, Australia

Acknowledgements: Anthony Breed, Mark Gentile, Jin Li Huang, Bruce Lobb, Steven Merrifield, Ray Morris, Norman F. Ness, Steven Wang, Jim Whittington.

Some Recent Work:



[1] Siscoe, G. L., and T. S. Huang, *J. Geophys. Res.*, 90, 543–547, 1985.

[2] Cowley, S. W. H., and M. Lockwood, *Ann. Geophysicae,* 10, 103–, 1992.

[3] D. Neudegg, et al., ANARE Research Notes, 95, 152–167, 1995.

[4] Ridley, A. J., L. Gang, C. R. Clauer, and V. O. Papitashvili, *J. Geophys. Res.*, 103, 4,023–4,039, 1998.

[5] Ruohoniemi, J. M., and R. A. Greenwald, *Geophys. Res. Lett.*, 25, 2,913–2,916, 1998.

[6] Shepherd, S. G., R. A. Greenwald, and J. M. Rhuohoniemi, *Geophys. Res. Lett.*, In Press, 1999.

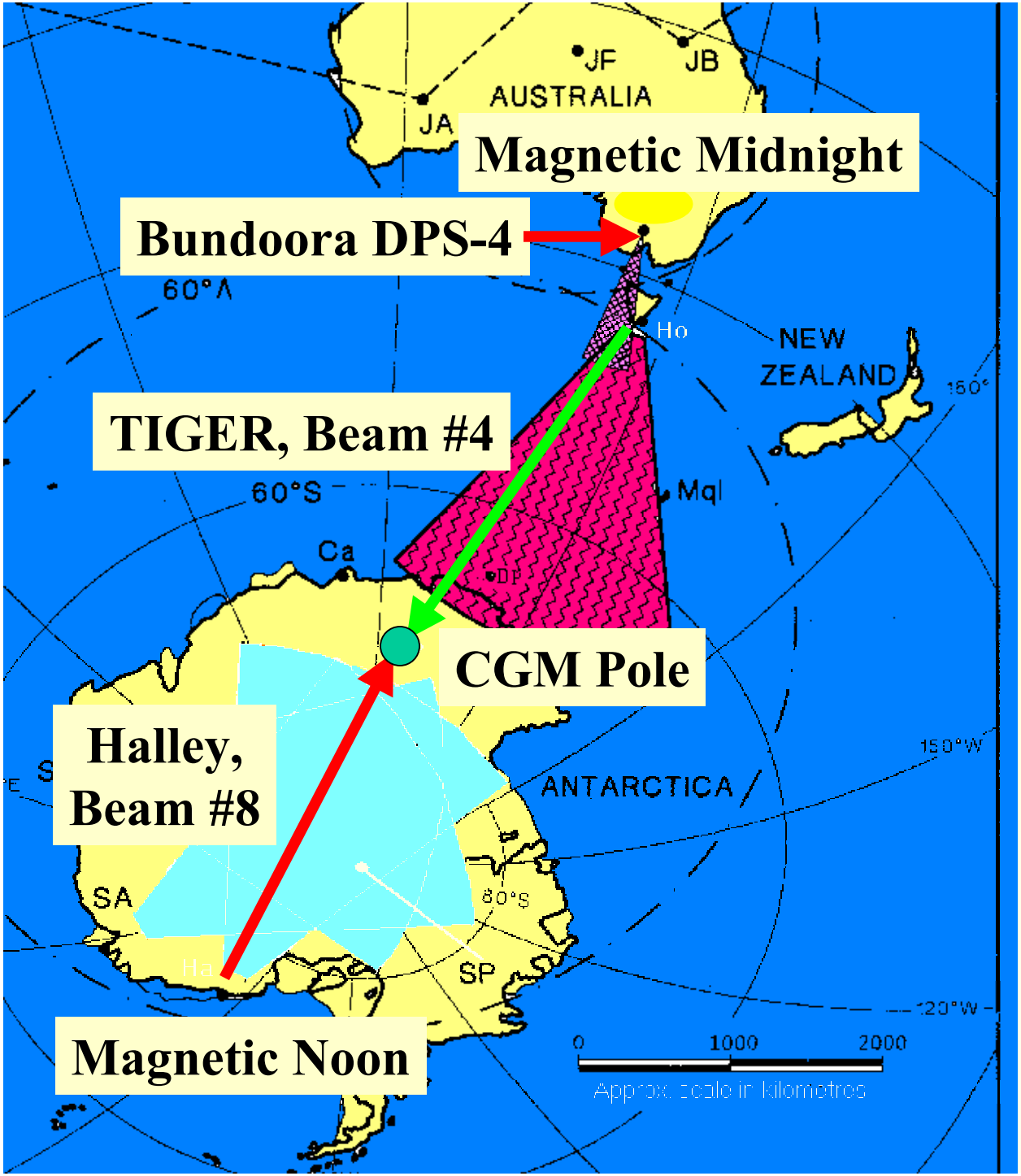
The Fundamental Question(s):

- **Do convection changes initiated on the dayside appear on the nightside after the magnetospheric field lines have been swept over the polar cap (~100 km s^{-1} at the magnetopause; ~5-10 km s^{-1} at their ionospheric footprint), or via a fast-mode Alfven wave propagating through the ionosphere at ~450 km s^{-1} ?**

- **That is, do convection changes manifest on the nightside after 10 to 30 mins, or "simultaneously" (≤ 2 mins)?**

- **Do both mechanisms play a role in communicating large-scale convection changes, and to what extent and under what conditions?**

- **Do convection changes occur on the dayside after changes occur on the nightside (i.e., when dayside merging relaxes, and reconnection in the tail dominates)?**



RCP: "Z_Tiger_99" (Written by "Kevin," Halley Base)

Halley Beam Sequence:
0, 8, 1, 8, 2, 8, 3, 8, 4, …

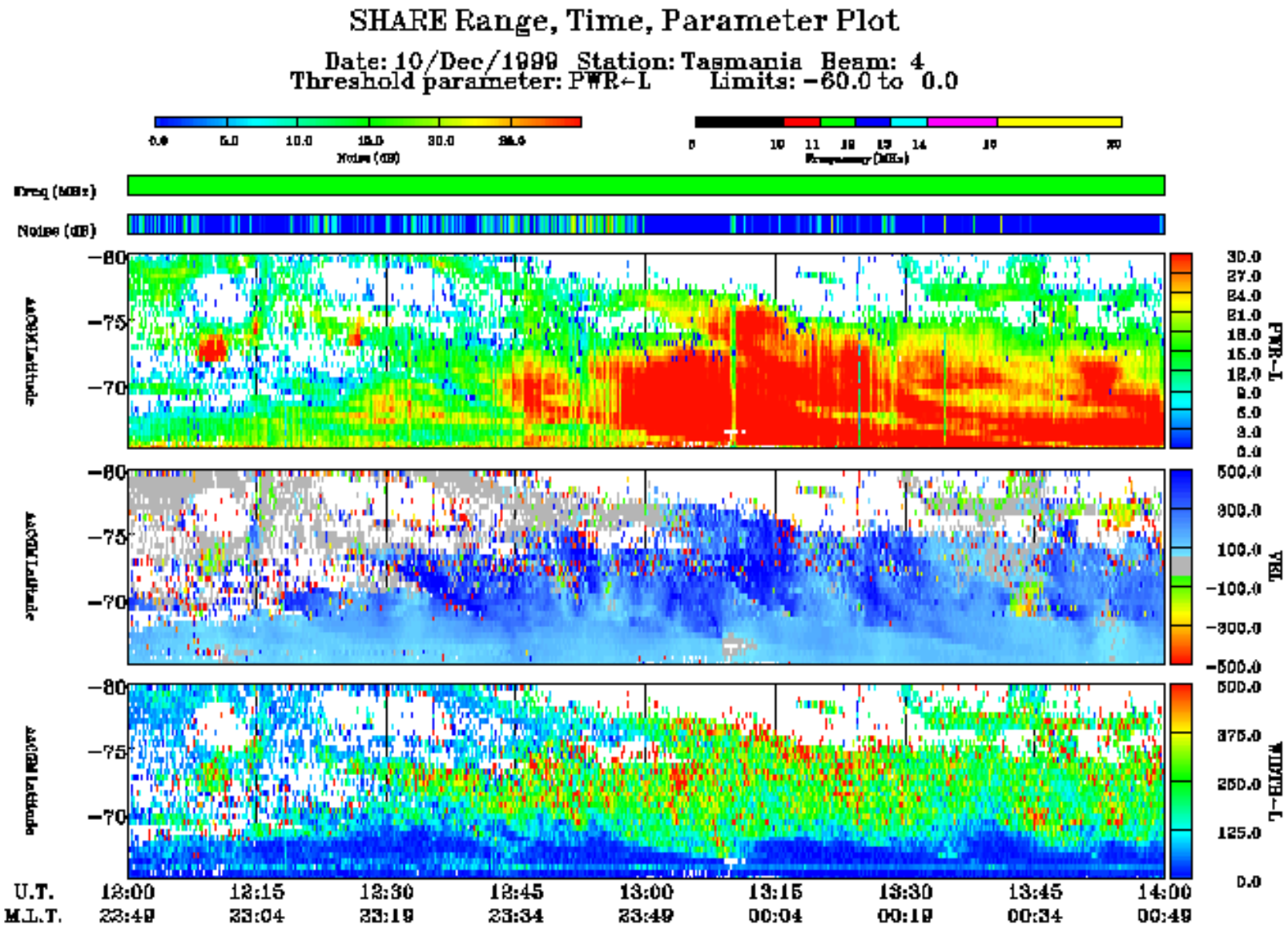
TIGER Beam Sequence:
15, 4, 14, 4, 13 , 4, 12, …

Halley Beam #8:
MLT ≈ UT – 02 h 46 m

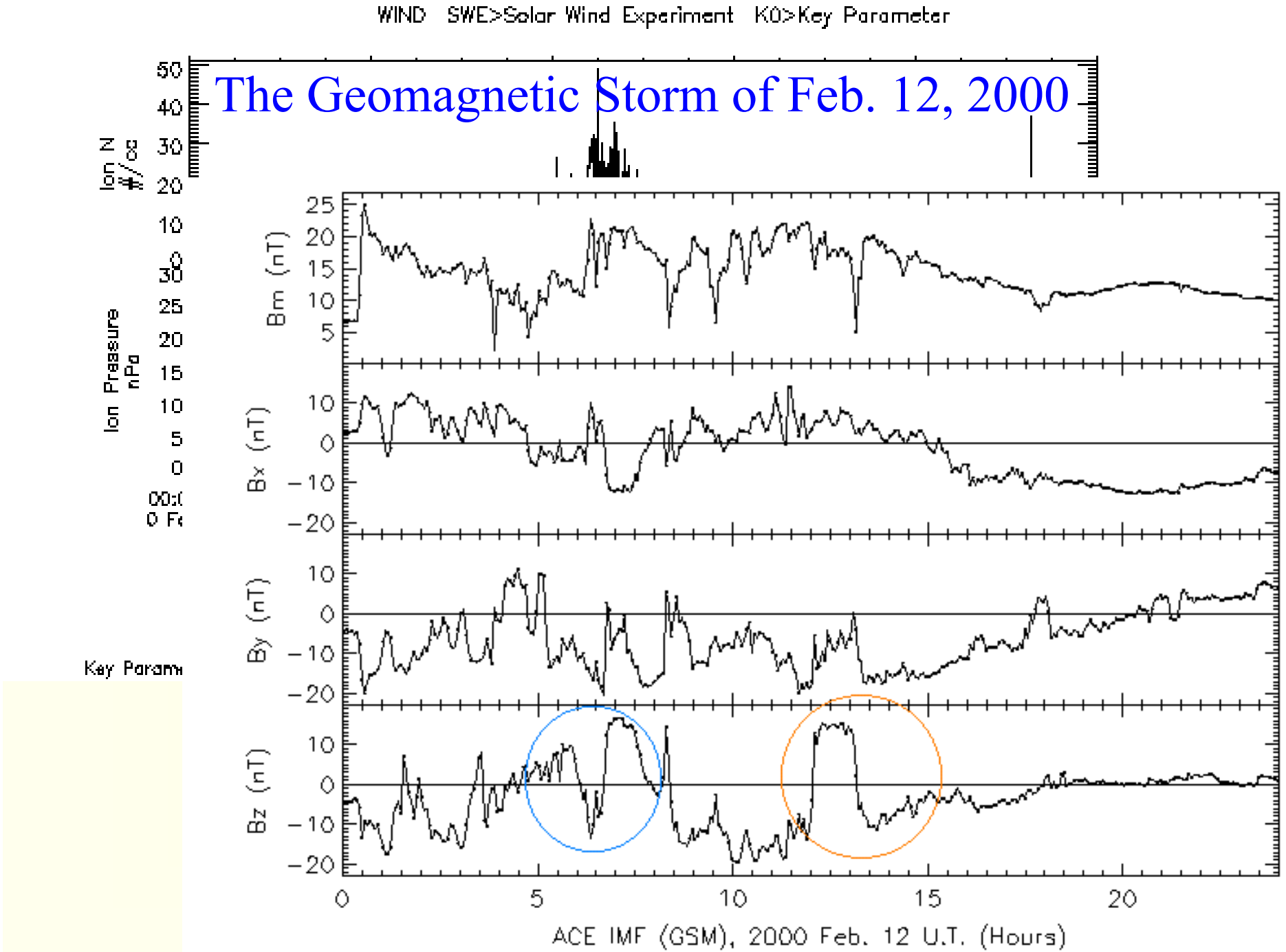
TIGER Beam #4:
MLT ≈ UT + 10 h 25 m

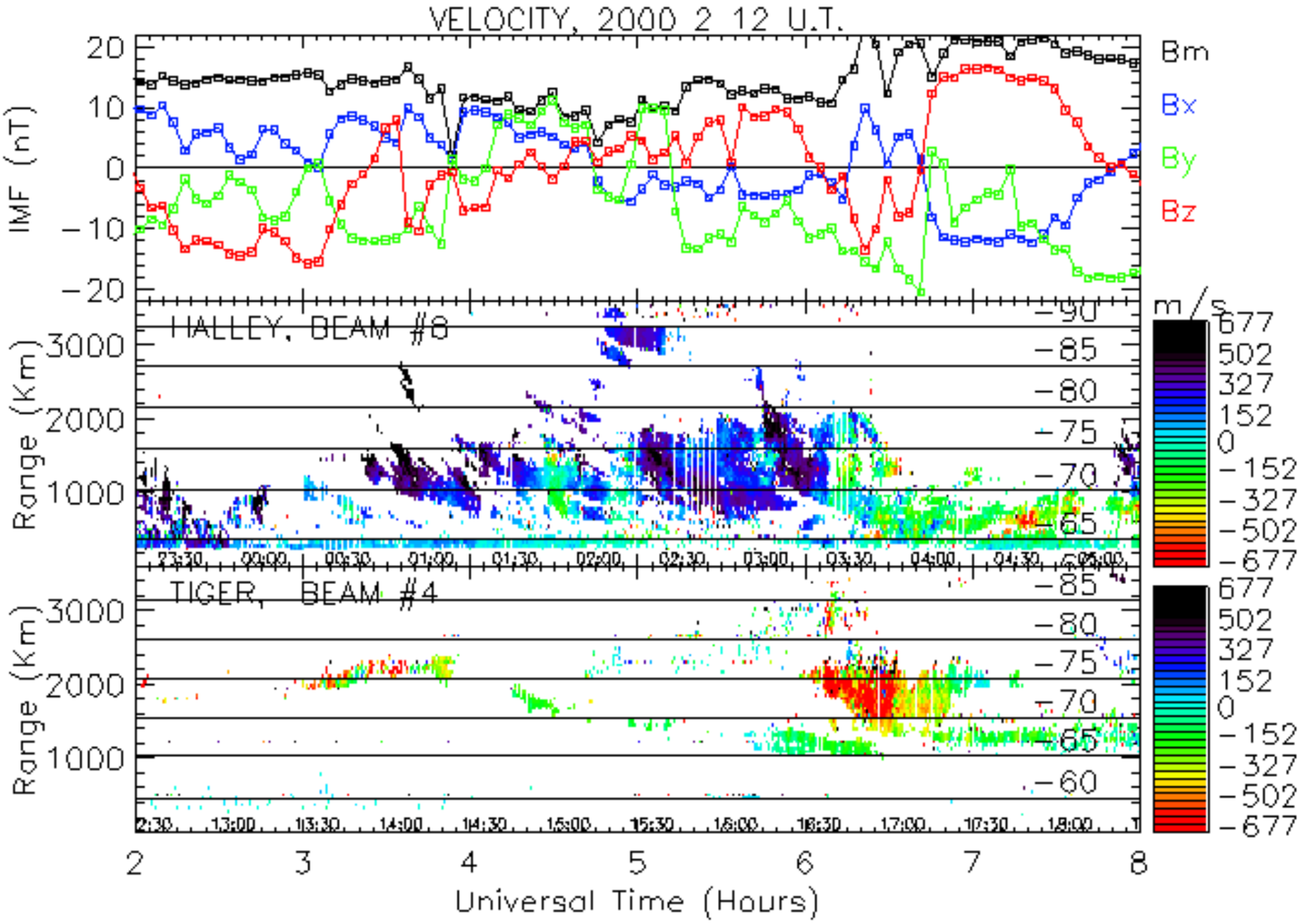
Bundoora DPS-4:
MLT ≈ UT + 10 h 18 m

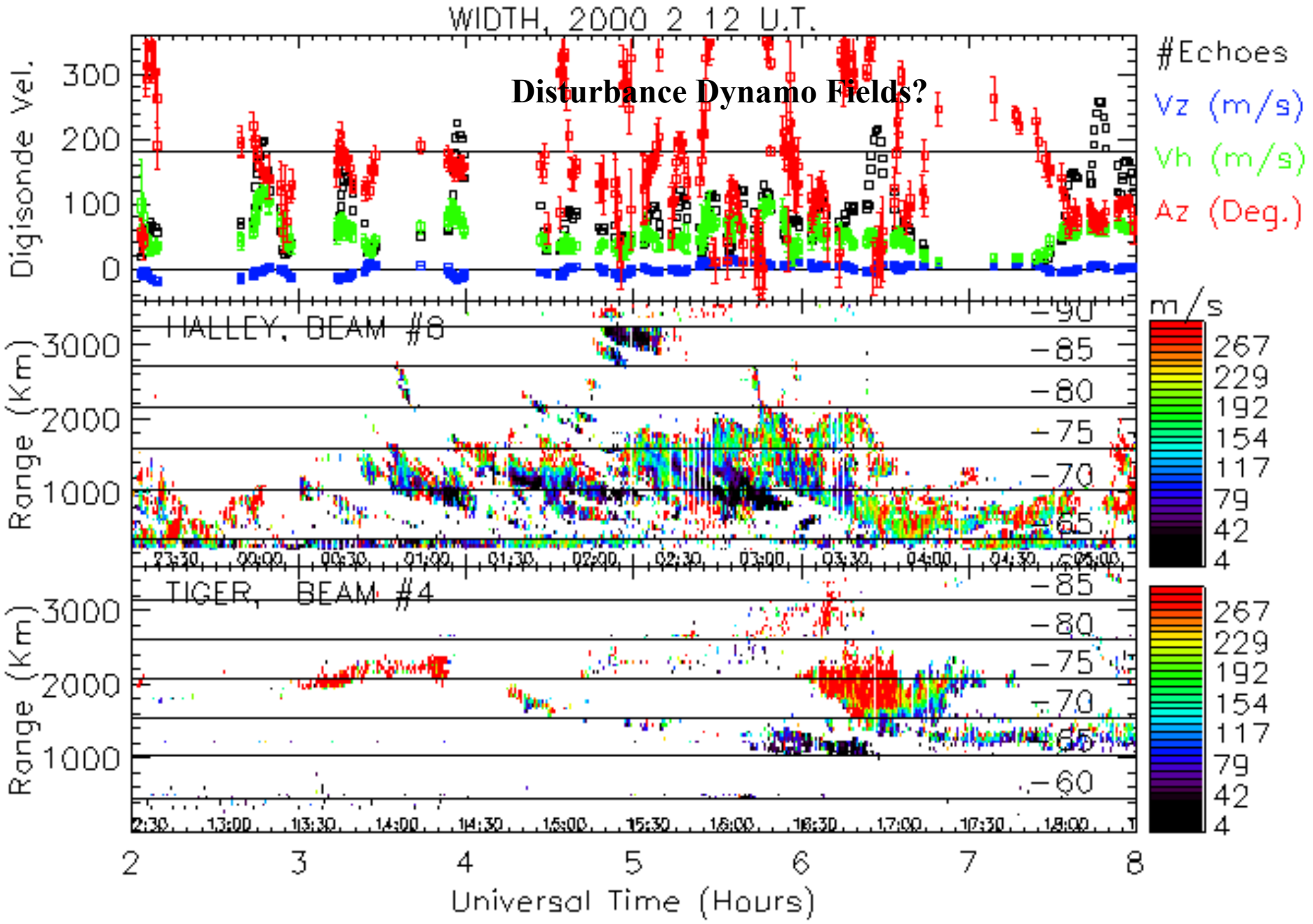
Ideally, what do we hope to see?

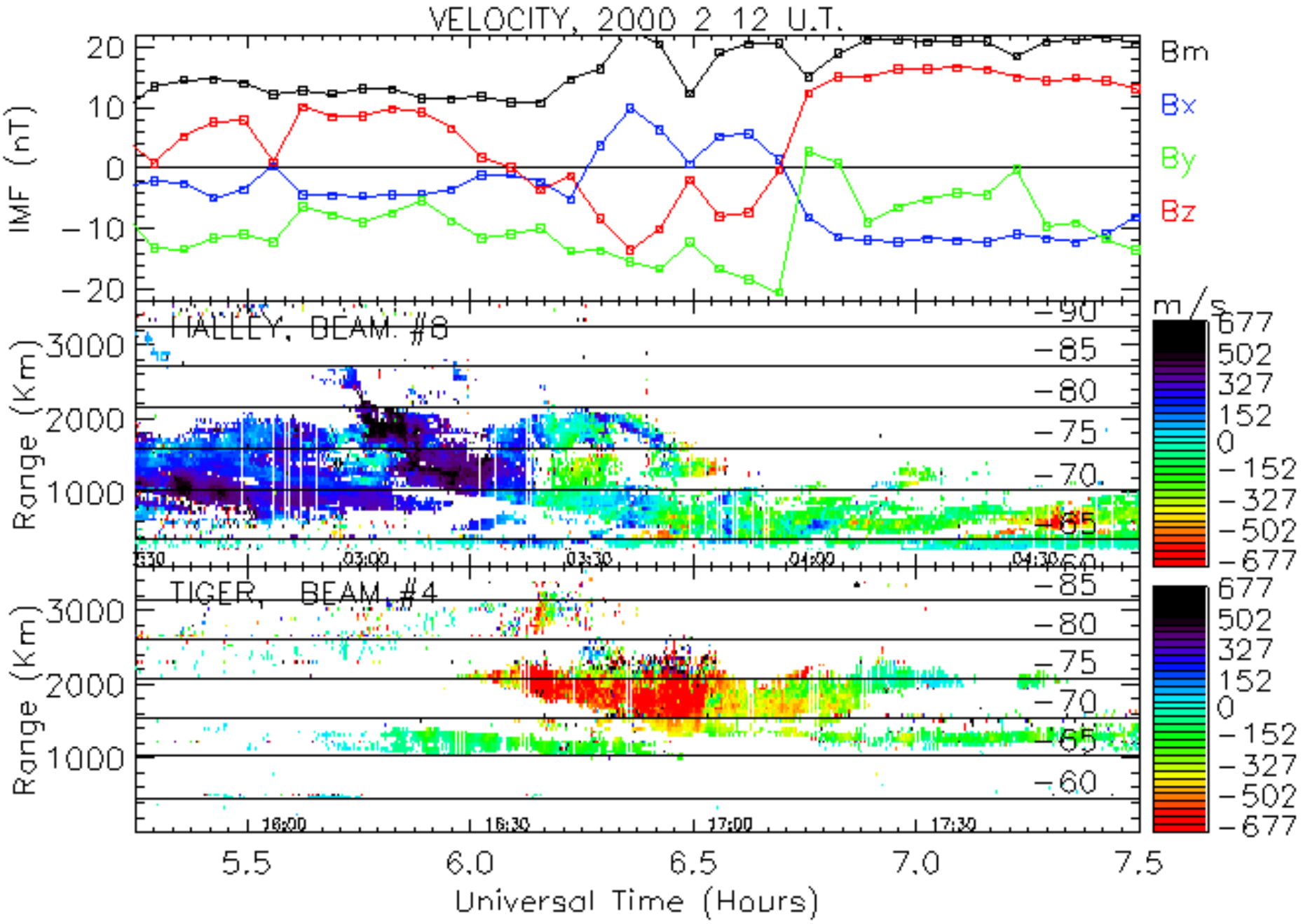


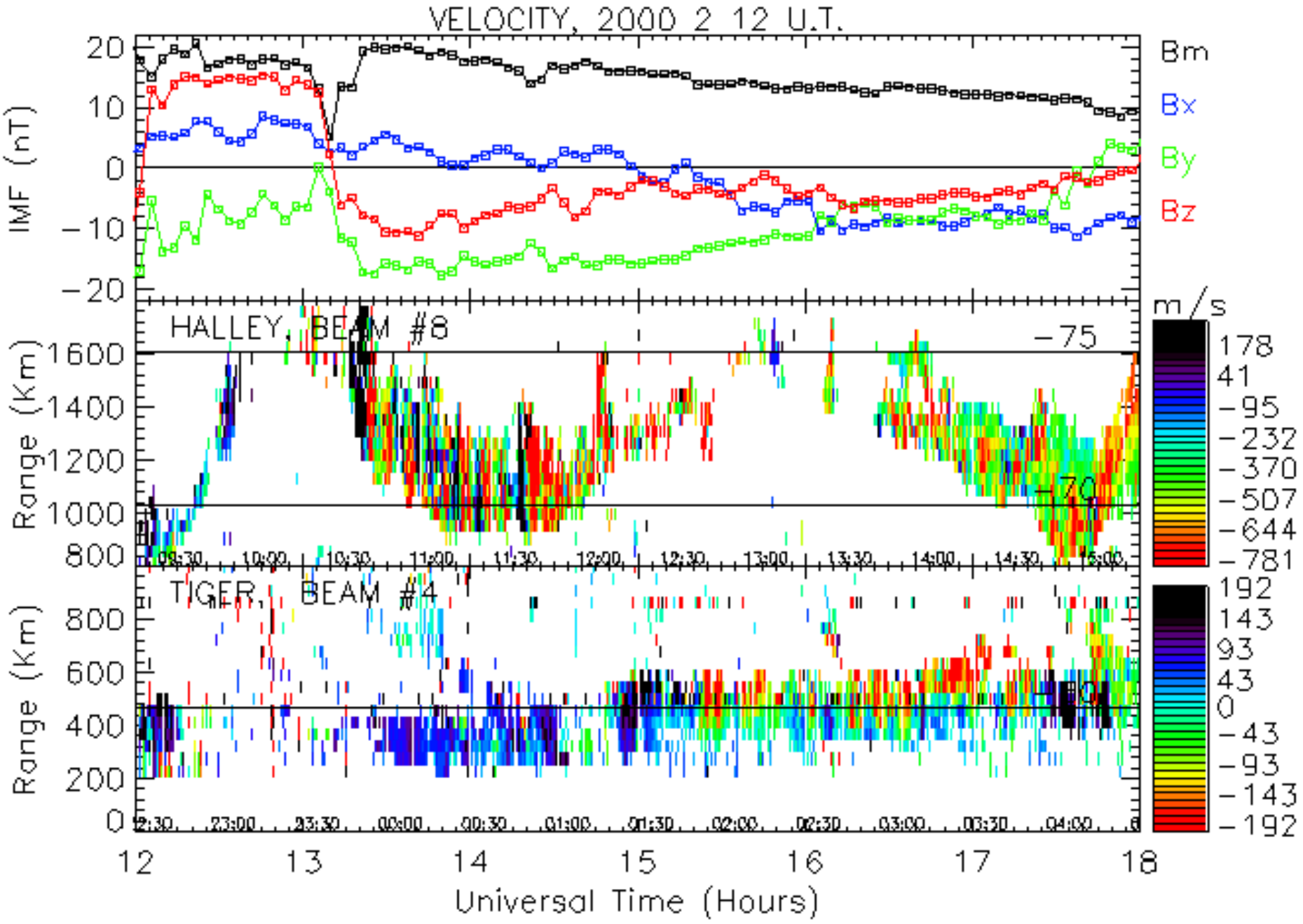
Mike Pinnock, BAS

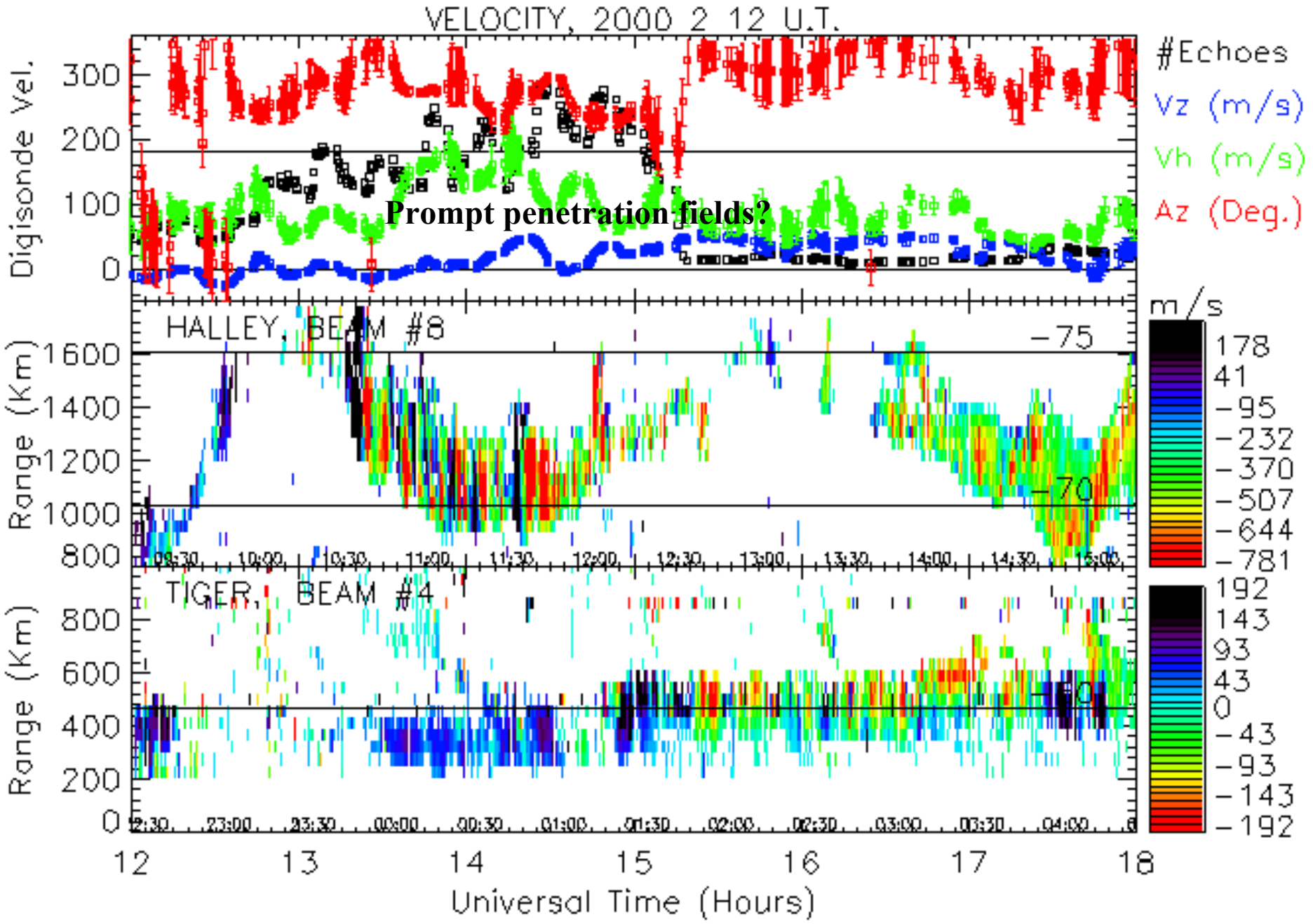

WIND SWE>Solar Wind Experiment K0>Key Parameter
The Geomagnetic Storm of Feb. 12, 2000
Ion N #/cc
Ion Pressure nPa
Bm (nT)
Bx (nT)
By (nT)
Bz (nT)
ACE IMF (GSM), 2000 Feb. 12 U.T. (Hours)

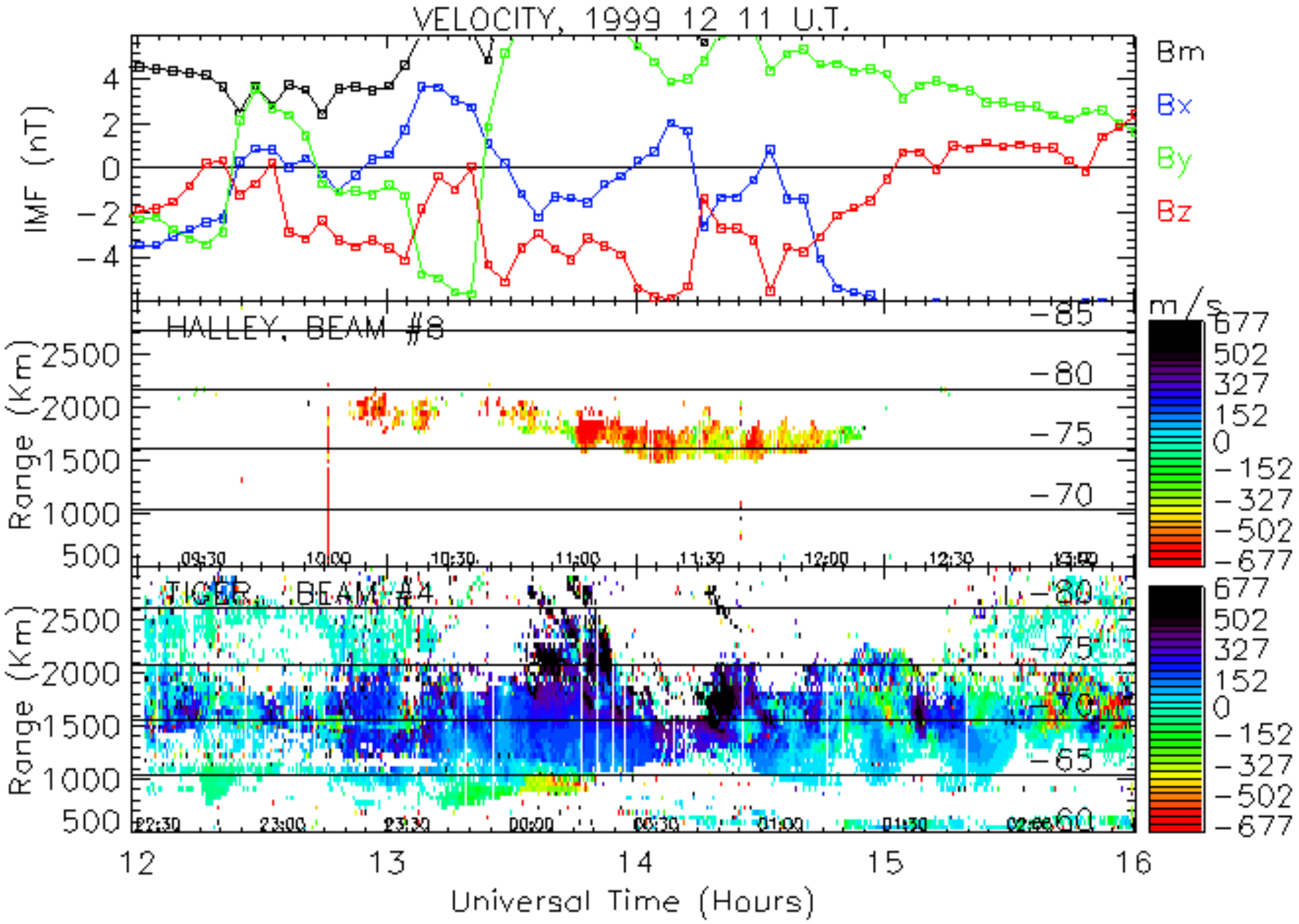

VELOCITY, 2000 2 12 U.T.
IMF (nT)
20
10
0
-10
-20
Bm
Bx
By
Bz
HALLEY, BEAM #8
TIGER, BEAM #4
Range (Km)
3000
2000
1000
m/s
677
502
327
152
0
-152
-327
-502
-677
-90
-85
-80
-75
-70
-65
-60
23:30
00:00
00:30
01:00
01:30
02:00
02:30
03:00
03:30
04:00
04:30
05:00
12:30
13:00
13:30
14:00
14:30
15:00
15:30
16:00
16:30
17:00
17:30
18:00
2
3
4
5
6
7
8
Universal Time (Hours)

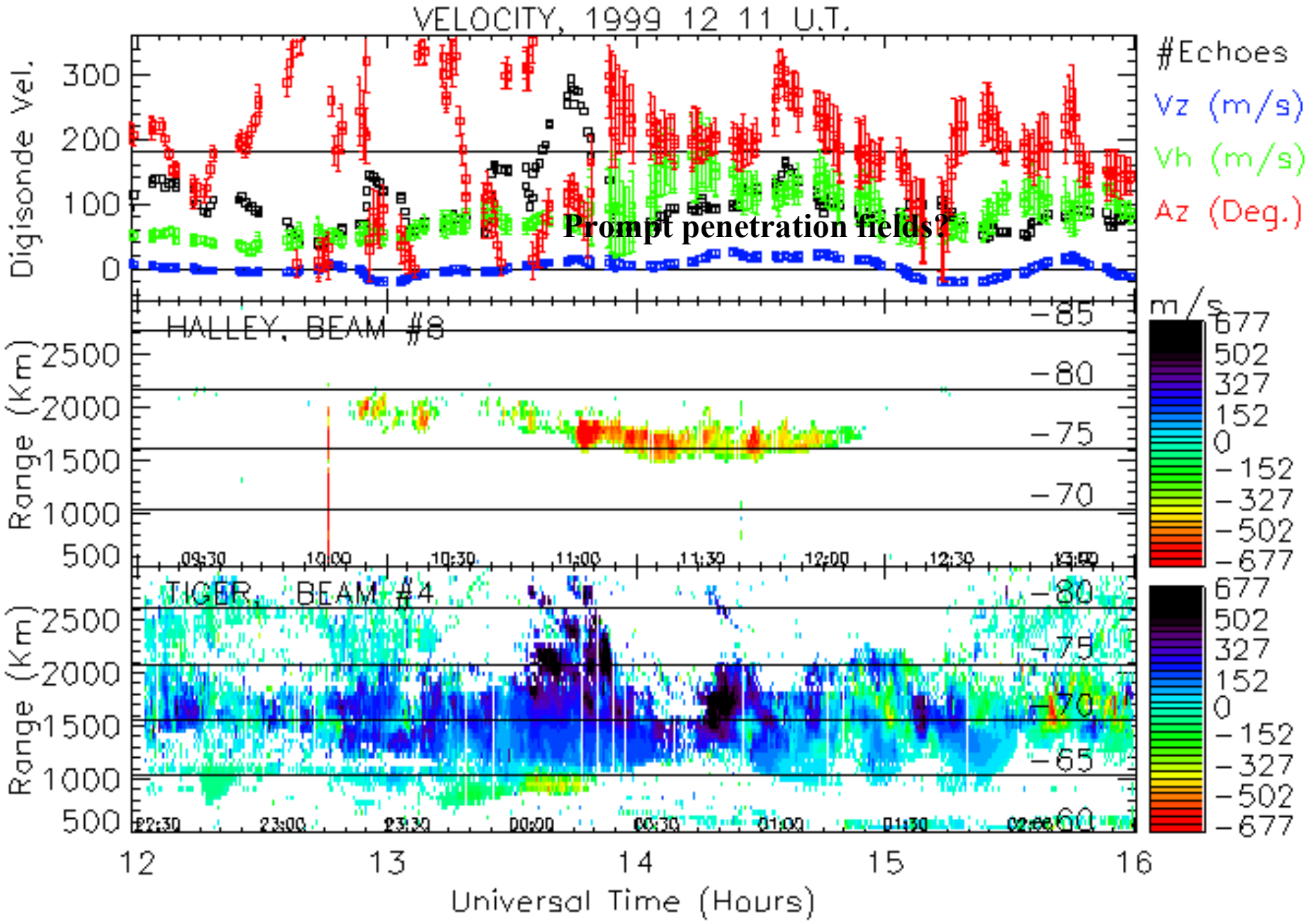

WIDTH, 2000 2 12 U.T.
Disturbance Dynamo Fields?
Digisonde Vel.
300
200
100
0
#Echoes
Vz (m/s)
Vh (m/s)
Az (Deg.)
m/s
267
229
192
154
117
79
42
4
HALLEY, BEAM #8
Range (Km)
3000
2000
1000
-90
-85
-80
-75
-70
-65
23:30
00:00
00:30
01:00
01:30
02:00
02:30
03:00
03:30
04:00
04:30
TIGER, BEAM #4
-60
12:30
13:00
13:30
14:00
14:30
15:00
15:30
16:00
16:30
17:00
17:30
18:00
2
3
4
5
6
7
8
Universal Time (Hours)


VELOCITY, 2000 2 12 U.T.
IMF (nT)
20
10
0
-10
-20
Bm
Bx
By
Bz
HALLEY, BEAM #8
Range (Km)
3000
2000
1000
03:00
03:30
04:00
04:30
TIGER, BEAM #4
16:00
16:30
17:00
17:30
-90
-85
-80
-75
-70
-65
-60
m/s
677
502
327
152
0
-152
-327
-502
-677
5.5
6.0
6.5
7.0
7.5
Universal Time (Hours)


VELOCITY, 2000 2 12 U.T.
IMF (nT)
Bm
Bx
By
Bz
HALLEY, BEAM #8
Range (Km)
TIGER, BEAM #4
m/s
Universal Time (Hours)

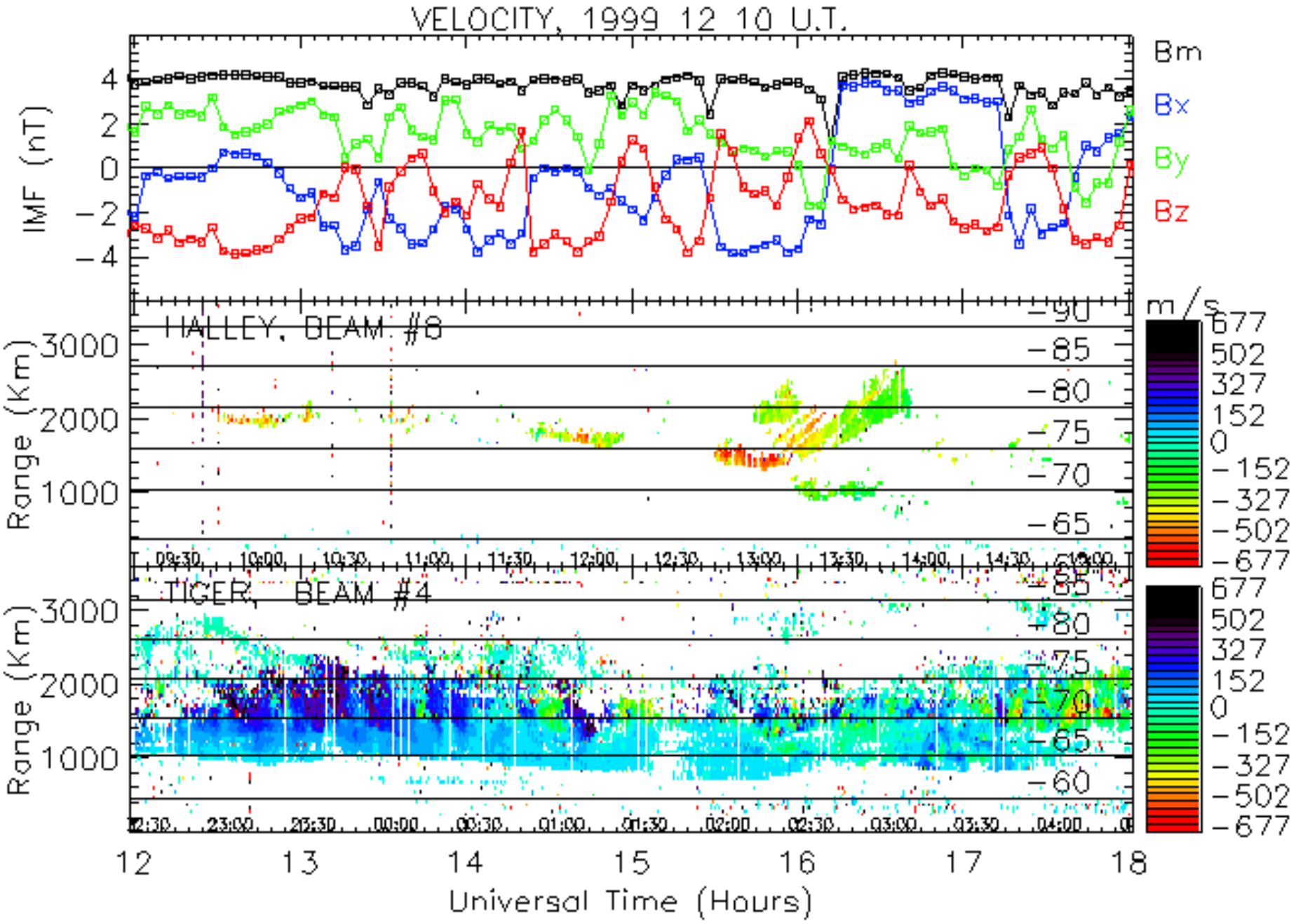

VELOCITY, 2000 2 12 U.T.
Digisonde Vel.
300
200
100
0
#Echoes
Vz (m/s)
Vh (m/s)
Az (Deg.)
Prompt penetration fields?
HALLEY, BEAM #8
Range (Km)
1600
1400
1200
1000
800
-75
-70
m/s
178
41
-95
-232
-370
-507
-644
-781
TIGER, BEAM #4
Range (Km)
800
600
400
200
0
-70
192
143
93
43
0
-43
-93
-143
-192
12
13
14
15
16
17
18
Universal Time (Hours)

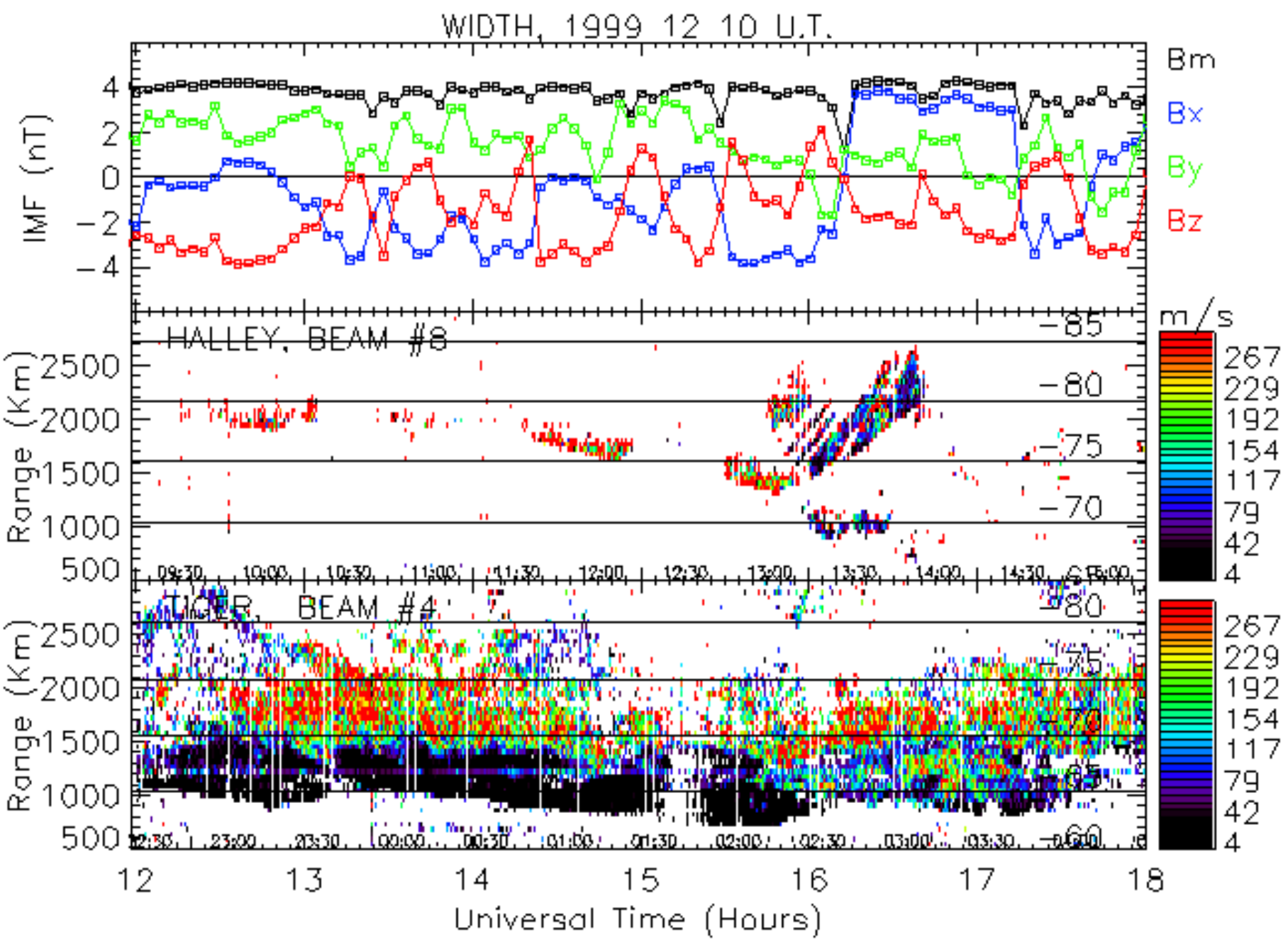

VELOCITY, 1999 12 11 U.T.
IMF (nT)
4
2
0
−2
−4
Bm
Bx
By
Bz
HALLEY, BEAM #8
Range (Km)
2500
2000
1500
1000
500
−85
−80
−75
−70
09:30
10:00
10:30
11:00
11:30
12:00
12:30
13:00
TIGER, BEAM #4
Range (Km)
2500
2000
1500
1000
500
−80
−75
−70
−65
−60
22:30
23:00
23:30
00:00
00:30
01:00
01:30
02:00
m/s
677
502
327
152
0
−152
−327
−502
−677
12
13
14
15
16
Universal Time (Hours)

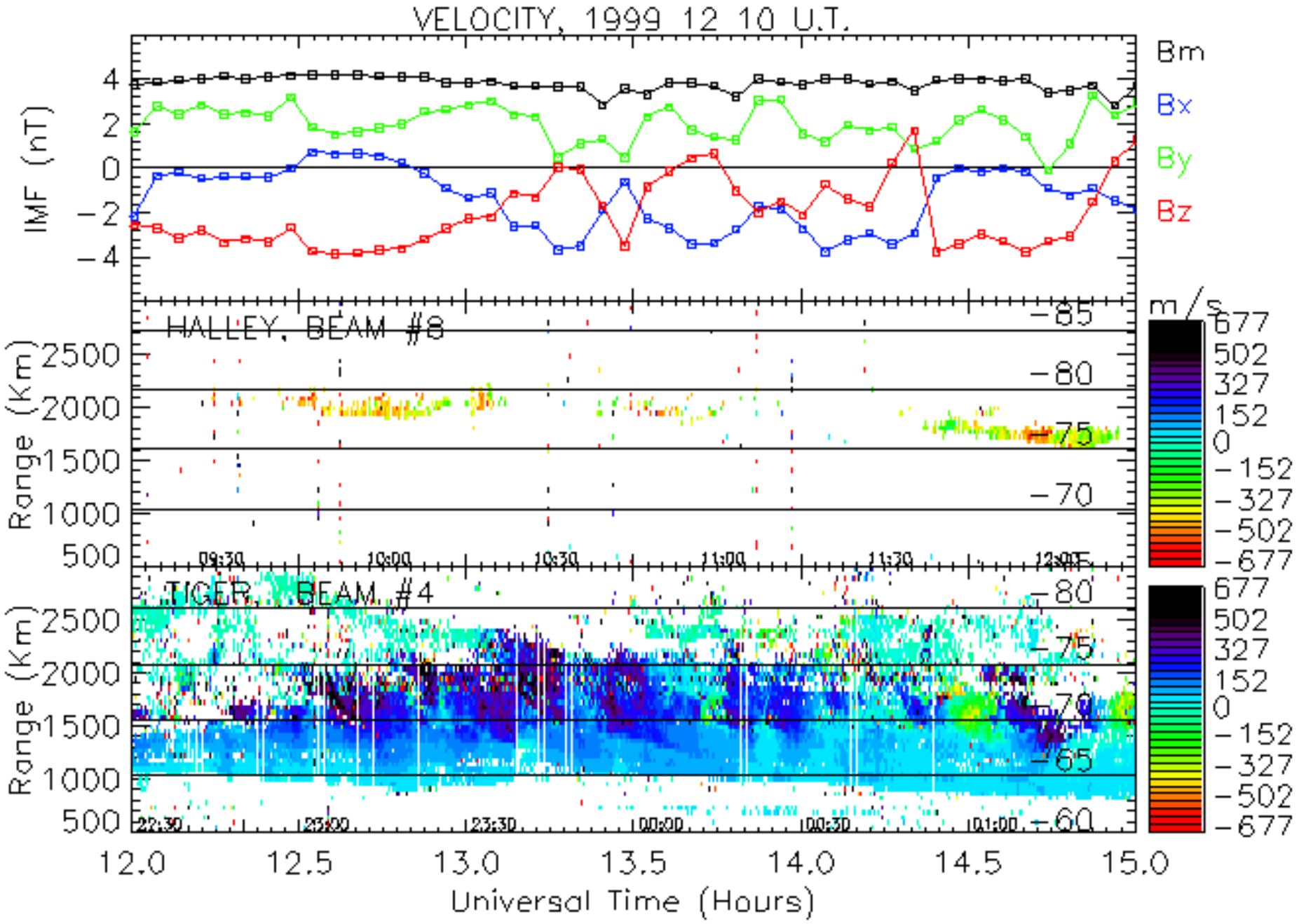

VELOCITY, 1999 12 11 U.T.
Digisonde Vel.
300
200
100
0
#Echoes
Vz (m/s)
Vh (m/s)
Az (Deg.)
Prompt penetration fields?
HALLEY, BEAM #8
Range (Km)
2500
2000
1500
1000
500
-85
-80
-75
-70
09:30
10:00
10:30
11:00
11:30
12:00
12:30
m/s
677
502
327
152
0
-152
-327
-502
-677
TIGER, BEAM #4
-80
-75
-70
-65
-60
22:30
23:00
23:30
00:00
00:30
01:00
01:30
12
13
14
15
16
Universal Time (Hours)

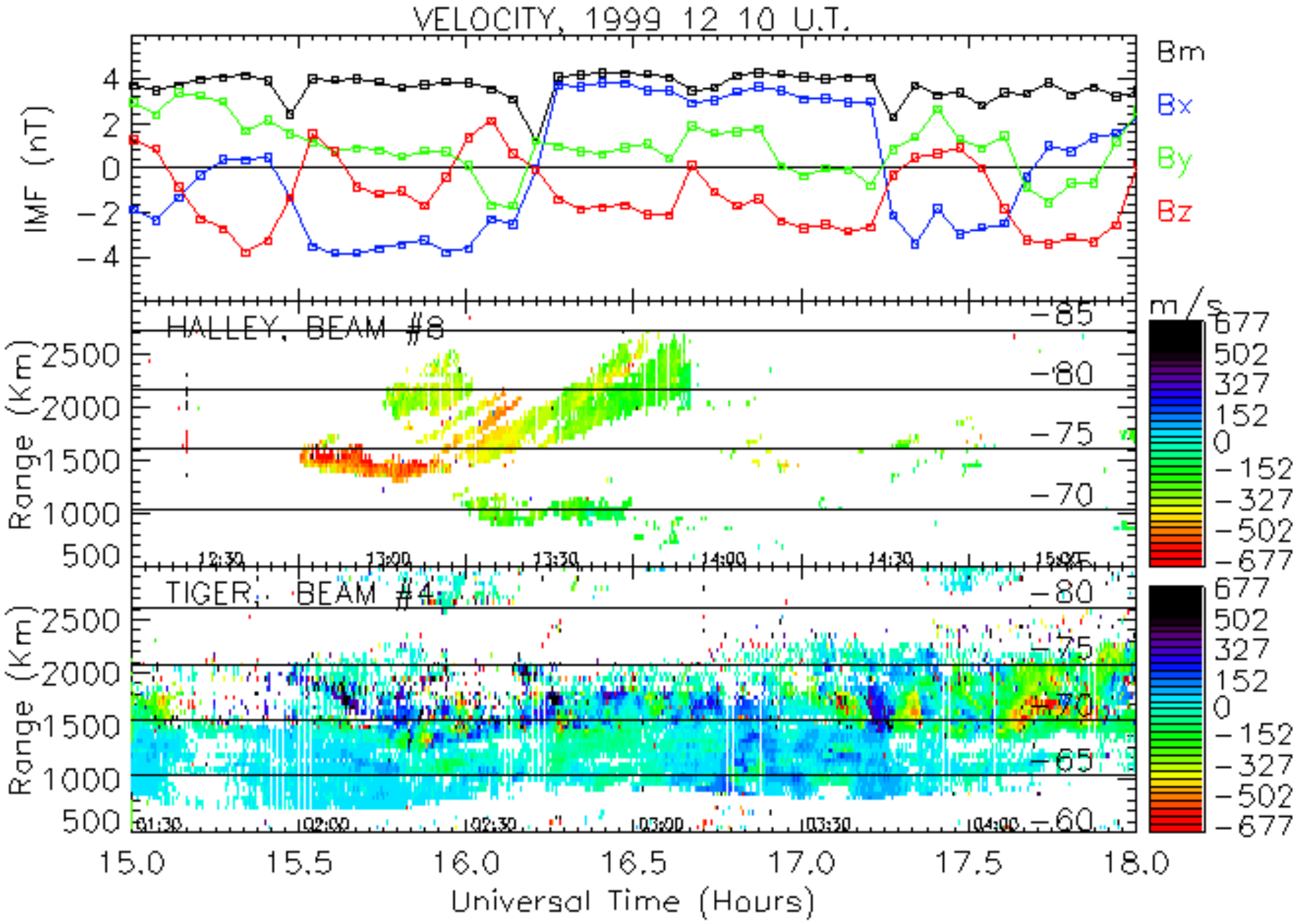
Closing Remarks

- **Identifying the different arrival times of convection changes observed by two SuperDARN radars is a very subjective process. One has to be very careful here...**
- **So far, the evidence suggests that nightside convection changes occur about 10 minutes after changes on the dayside. However, this does not preclude the occurrence of "instantaneous" changes within the polar cap...**
- **There is evidence for prompt-penetration electric fields and disturbance dynamo fields in concurrent Digisonde observations of Doppler velocity. The time delays for these events, and their relationship to SAIDs, is being investigated...**


VELOCITY, 1999 12 10 U.T.
IMF (nT)
Bm
Bx
By
Bz
HALLEY, BEAM #8
TIGER, BEAM #4
Range (Km)
m/s
Universal Time (Hours)


WIDTH, 1999 12 10 U.T.
IMF (nT)
Bm
Bx
By
Bz
HALLEY, BEAM #8
TIXIE, BEAM #4
Range (Km)
m/s
Universal Time (Hours)


VELOCITY, 1999 12 10 U.T.
IMF (nT)
4
2
0
−2
−4
Bm
Bx
By
Bz
HALLEY, BEAM #8
Range (Km)
2500
2000
1500
1000
500
09:30
10:00
10:30
11:00
11:30
12:00
−85
−80
−75
−70
TIGER, BEAM #4
22:30
23:00
23:30
00:00
00:30
01:00
−80
−75
−70
−65
−60
m/s
677
502
327
152
0
−152
−327
−502
−677
12.0
12.5
13.0
13.5
14.0
14.5
15.0
Universal Time (Hours)


VELOCITY, 1999 12 10 U.T.
IMF (nT)
4
2
0
−2
−4
Bm
Bx
By
Bz
HALLEY, BEAM #8
Range (Km)
2500
2000
1500
1000
500
12:30
13:00
13:30
14:00
14:30
15:00
−85
−80
−75
−70
TIGER, BEAM #4
01:30
02:00
02:30
03:00
03:30
04:00
−80
−75
−70
−65
−60
m/s
677
502
327
152
0
−152
−327
−502
−677
15.0
15.5
16.0
16.5
17.0
17.5
18.0
Universal Time (Hours)