Sudden appearance of sub-keV structured ions in the inner magnetosphere within one hour: drift simulation

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Yamauchi, et al. (2014), Ann.Geo., doi:10.5194/angeo-32-83-2014.

B1011@ST2.3 (EGU2014-3730) Wednesday2014-04-30

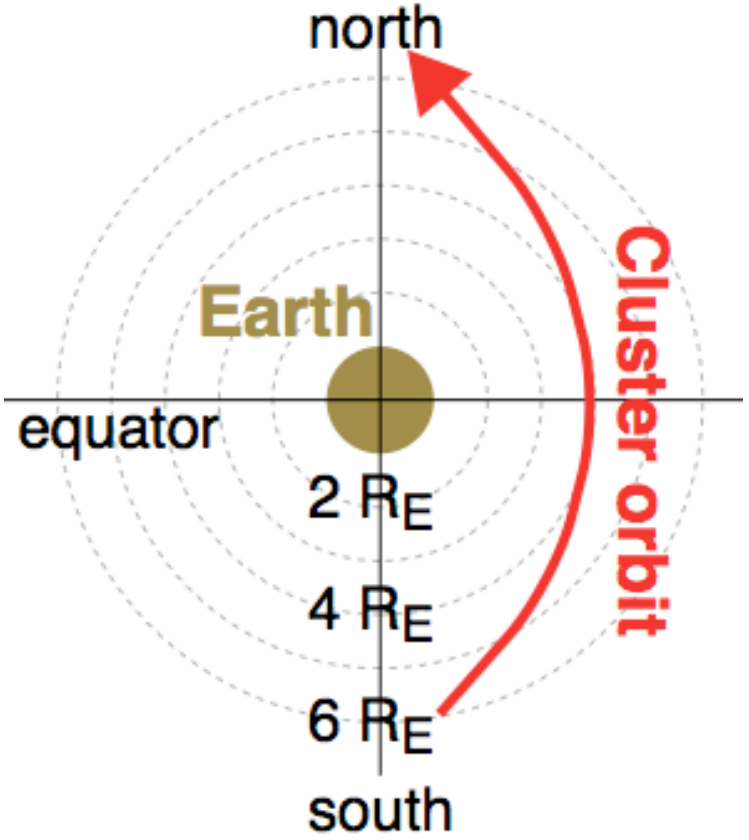
What to simulate?

Where? Inner Magnetosphere at 4~6 R_E (**Cluster perigee**)

Species? H^+ of 10 eV ~ 10 keV (CIS/CODIF energy range)

Distribution? Wedge-like energy-latitude dispersed bouncing ions.

Why simulation? 6-years statistics show significant 1-2 hour scale evolution in the dayside, where drift of sub-keV ions stagnates. We need to know if drift can explain or we need new source in the dayside.



* North-South symmetric
* Quick scan of all latitude
* North-south bouncing symmetry of trapped ions

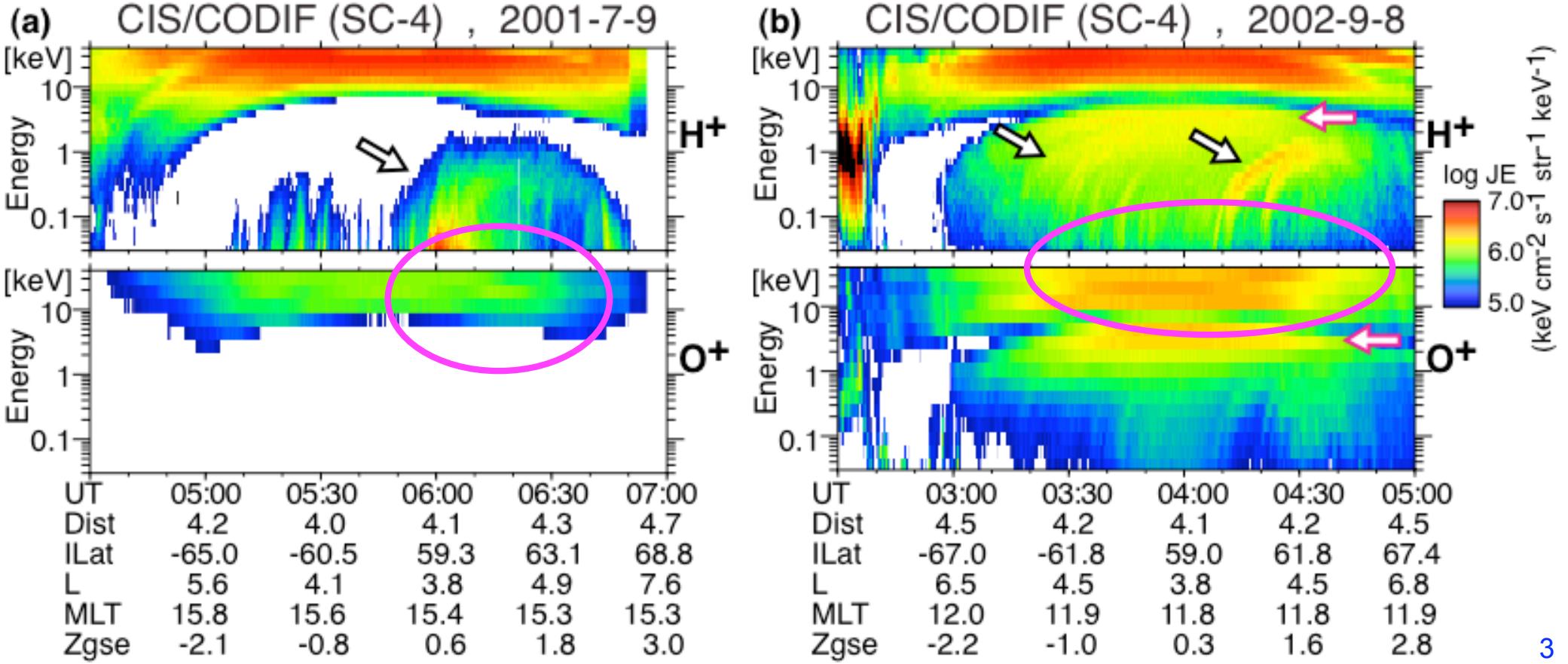
⇓

Distribution must be north-south symmetric

The examined ion signatures

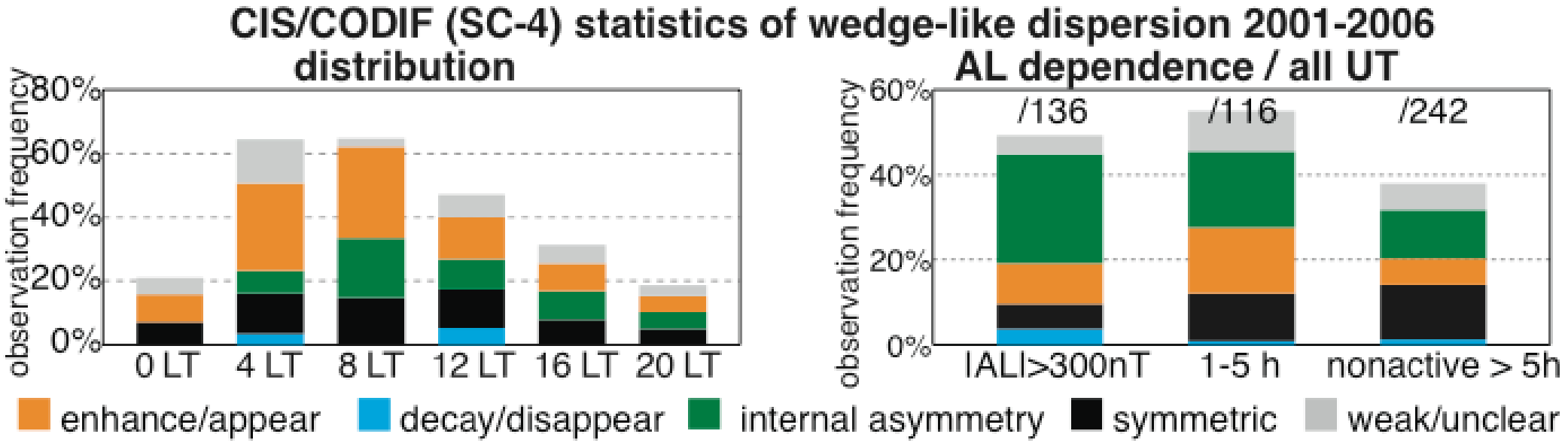
(a) Wedge-like energy-latitude dispersed ions at sub-keV range: predominantly found in the morning sector some hours after a substorm. The source population is much colder than the plasma sheet.

(b) Internal asymmetry of (a)



Significant changes within 1-2 hours

- asymmetric cases (large inbound-outbound difference) are found more often than symmetric cases at almost all LT.

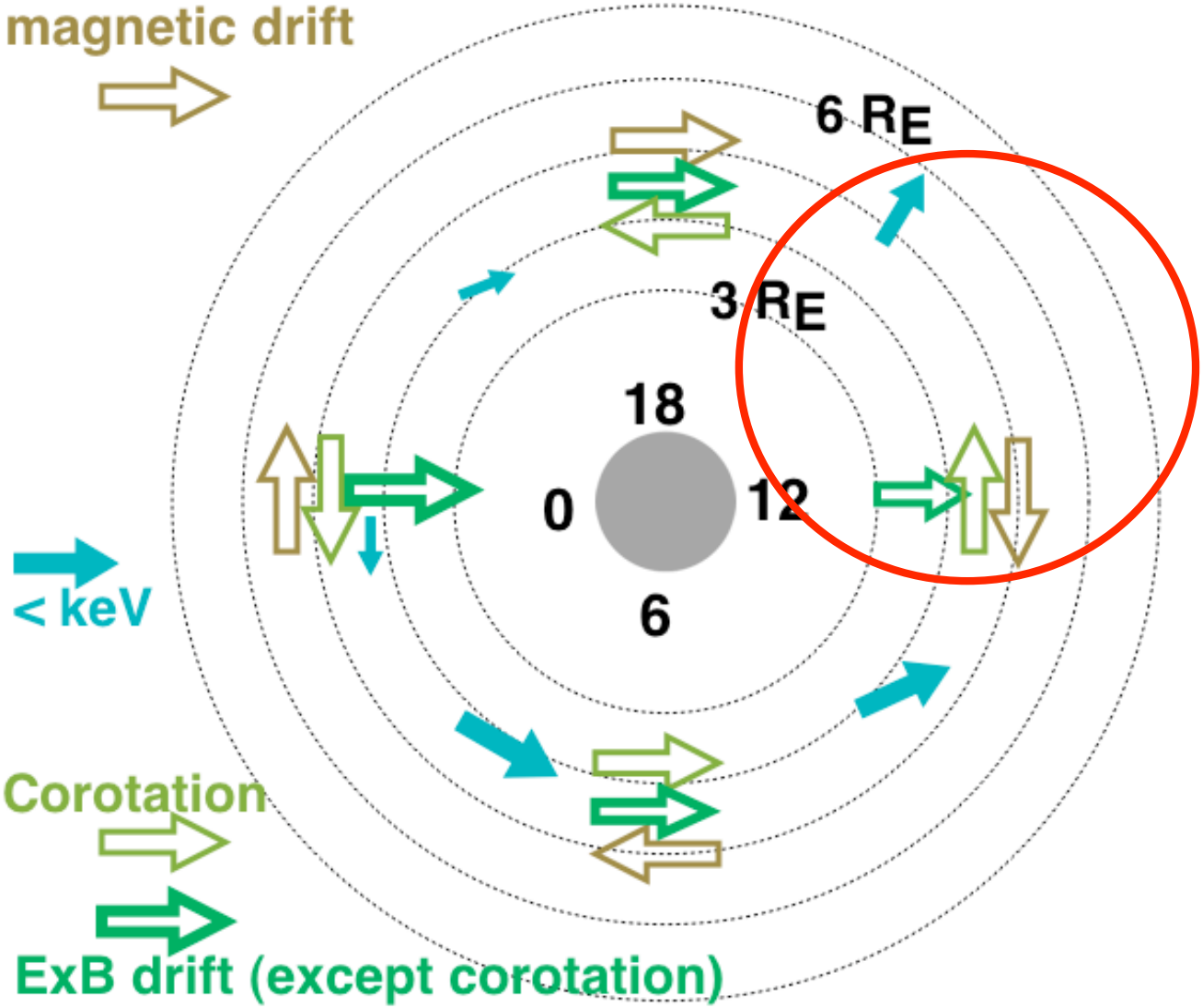


* Same result as Viking (morning~0h, afternoon>5h)

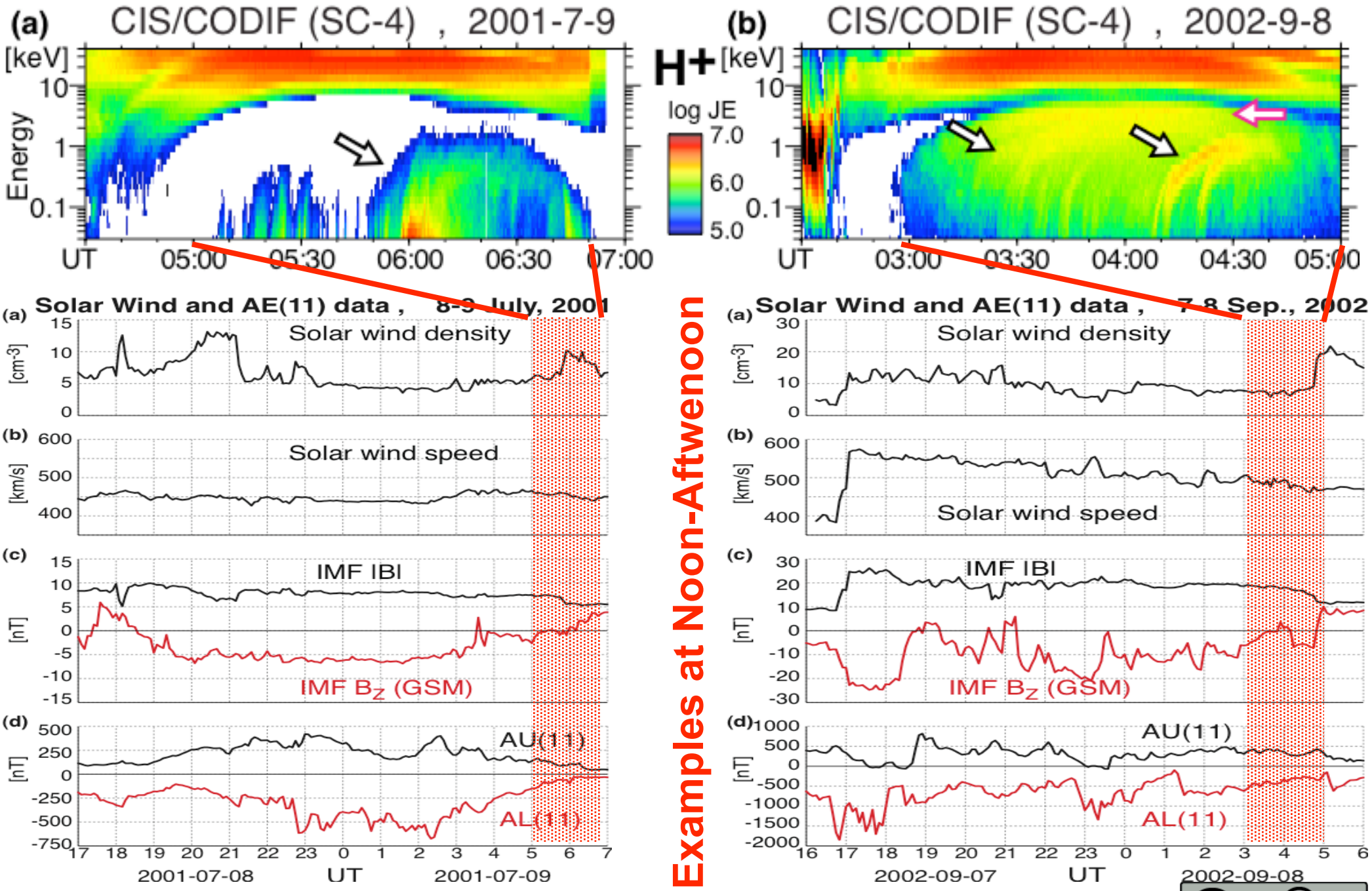
* Less enhancement with elapsed time ⇒ **stagnation**

* **Yet, enhancements after 5h & afternoon ⇒ ???**

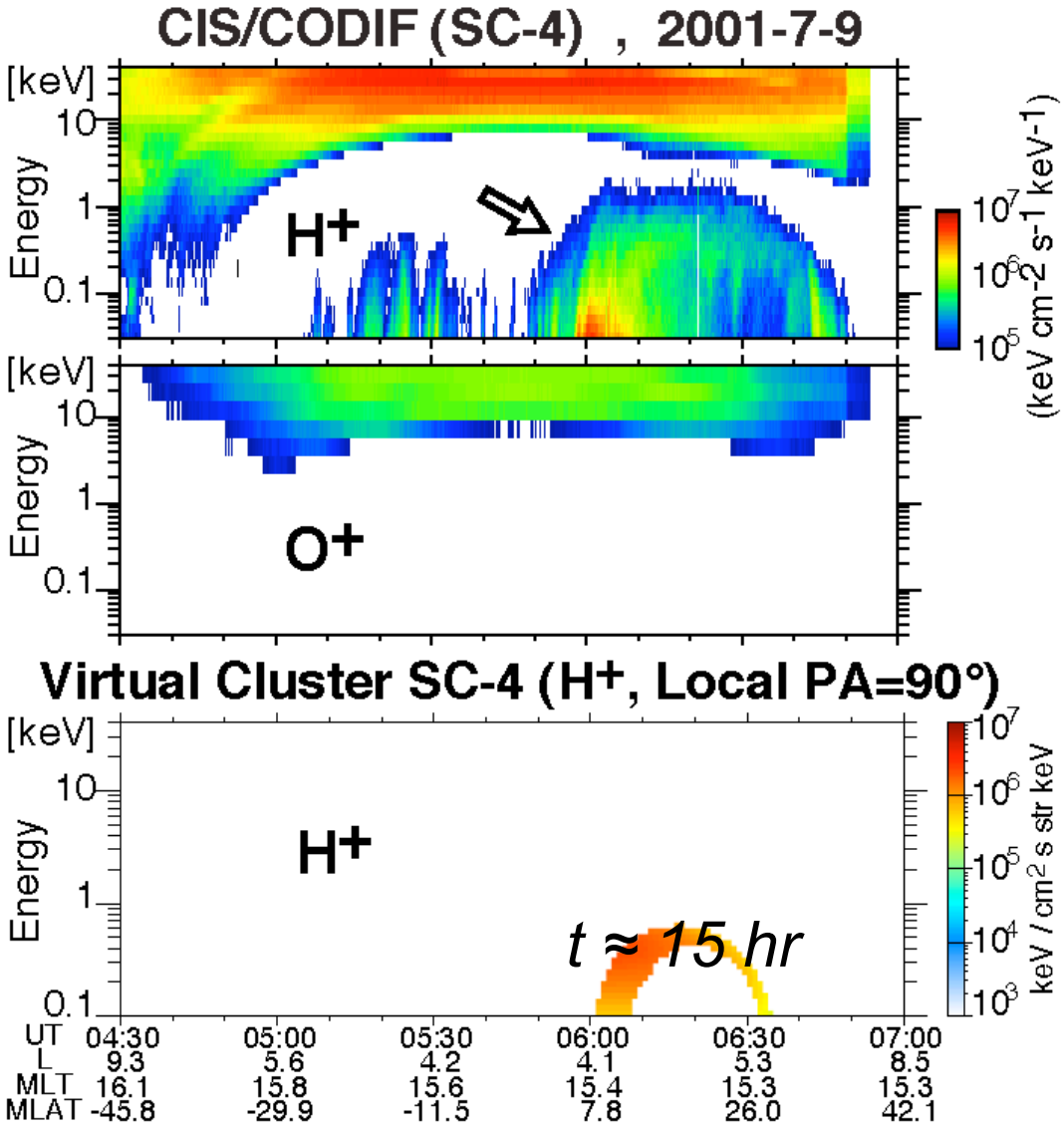
Unexpected "enhancement" because the signature should stagnate at Noon-Afternoon

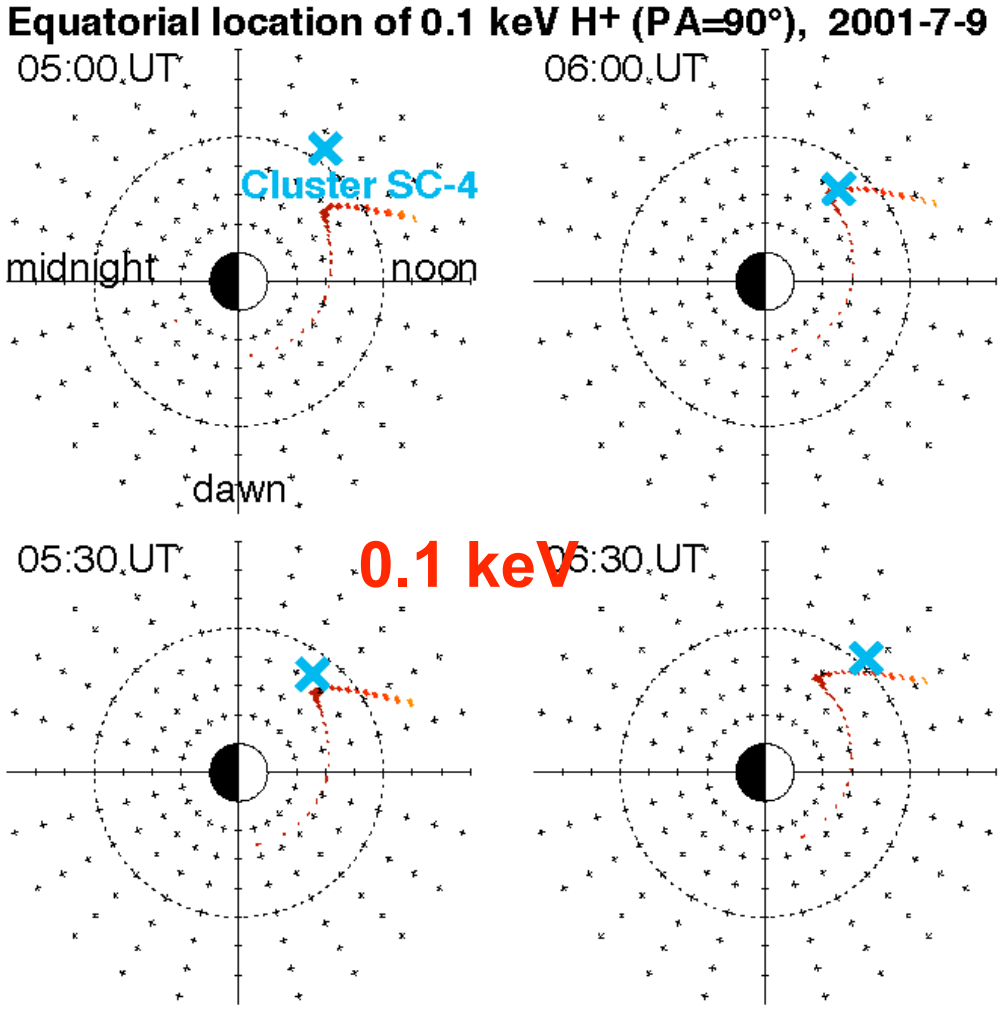


⇒ We examine using ion drift simulation

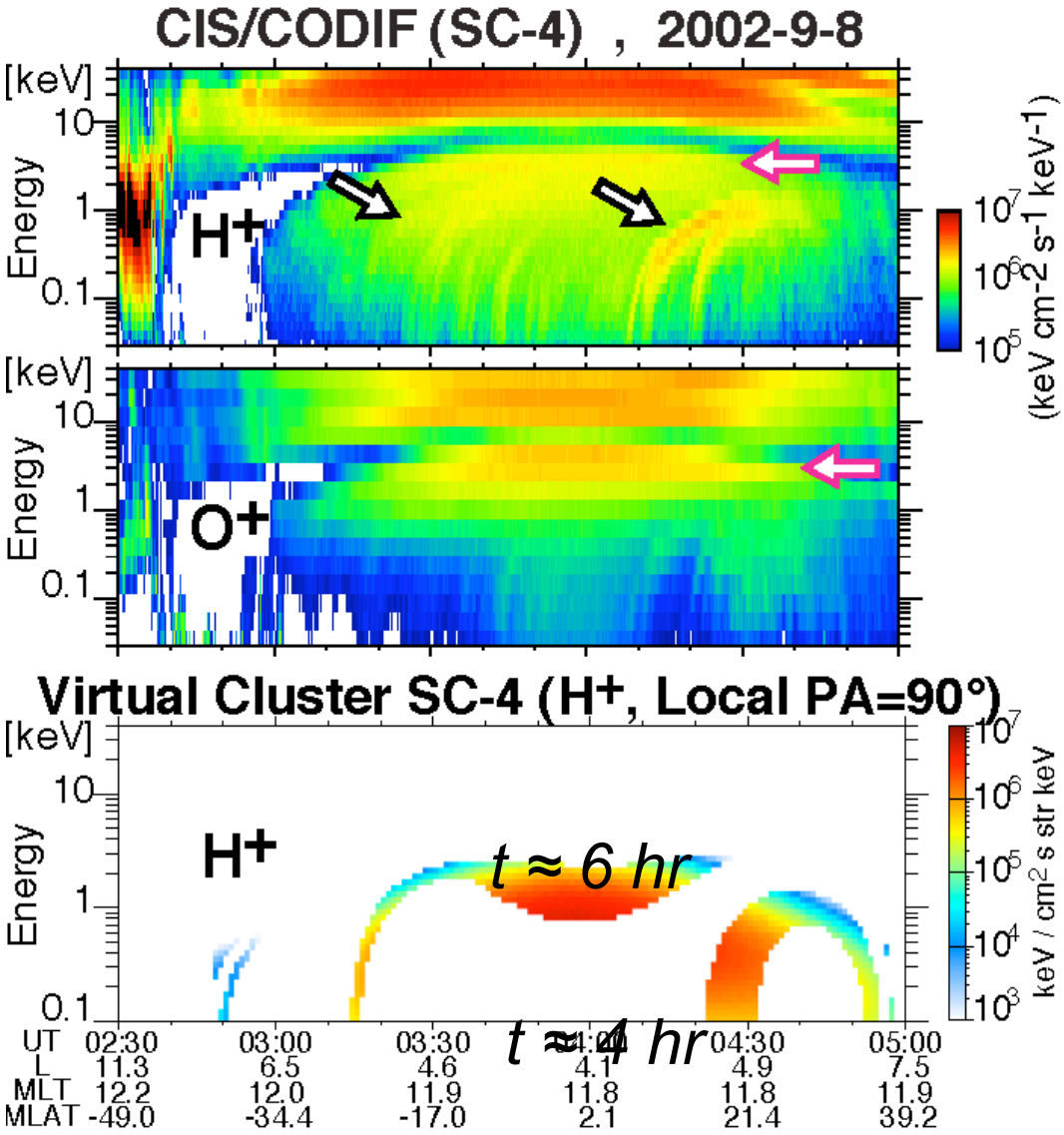

(a) CIS/CODIF (SC-4) , 2001-7-9
[keV]
Energy
10
1
0.1
UT
05:00
05:30
06:00
06:30
07:00
H+
log JE
7.0
6.0
5.0
(b) CIS/CODIF (SC-4) , 2002-9-8
[keV]
10
1
0.1
UT
03:00
03:30
04:00
04:30
05:00
Solar Wind and AE(11) data , 8-9 July, 2001
(a)
Solar wind density
[cm-3]
(b)
Solar wind speed
[km/s]
(c)
IMF IBI
IMF B_Z (GSM)
[nT]
(d)
AU(11)
AL(11)
[nT]
17 18 19 20 21 22 23 0 1 2 3 4 5 6 7
2001-07-08
UT
2001-07-09
Solar Wind and AE(11) data , 7-8 Sep., 2002
(a)
Solar wind density
[cm-3]
(b)
Solar wind speed
[km/s]
(c)
IMF IBI
IMF B_Z (GSM)
[nT]
(d)
AU(11)
AL(11)
[nT]
16 17 18 19 20 21 22 23 0 1 2 3 4 5 6
2002-09-07
UT
2002-09-08
Examples at Noon-Afternoon

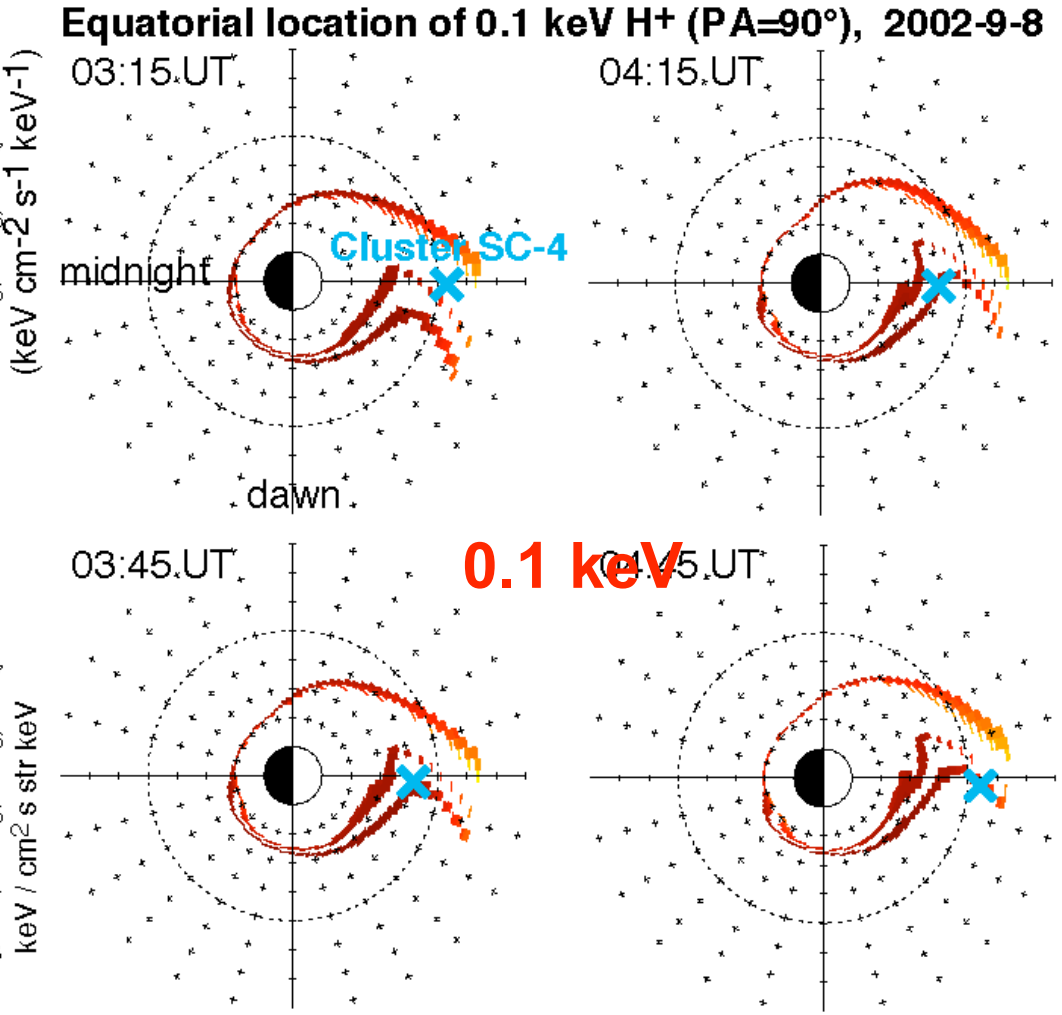
The ion drift alone can re-produce significant inbound-outbound difference !





Another example: sub-keV (dispersion asymmetry) and a few keV (ion band)





Summary

The sudden appearance the inner magnetospheric “wedge-like energy-latitude dispersed sub-keV ions" within only 1-2 hours in the noon-afternoon sector can be explained by the drift motion only.

Even the internal energy-time dispersive structure can also be explained by the drift motion.

The source ion energy is low (< 0.1 keV) but not cold.

The simulation dose not exclude the direct ionospheric sources that also has short time scale. (some signature are more likely ionospheric origin)

The eastward azimuthal ion drift is fast enough to make significant changes in the inner magnetospheric sub-keV ion population within 1-2 hours even at noon-afternoon.