

Magnetospheric solitary structure maintained by 3000 km/s ions as a cause of westward moving auroral bulge at 19 MLT

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(a) Sunward propagation (10 km/s) of Solitary DC field

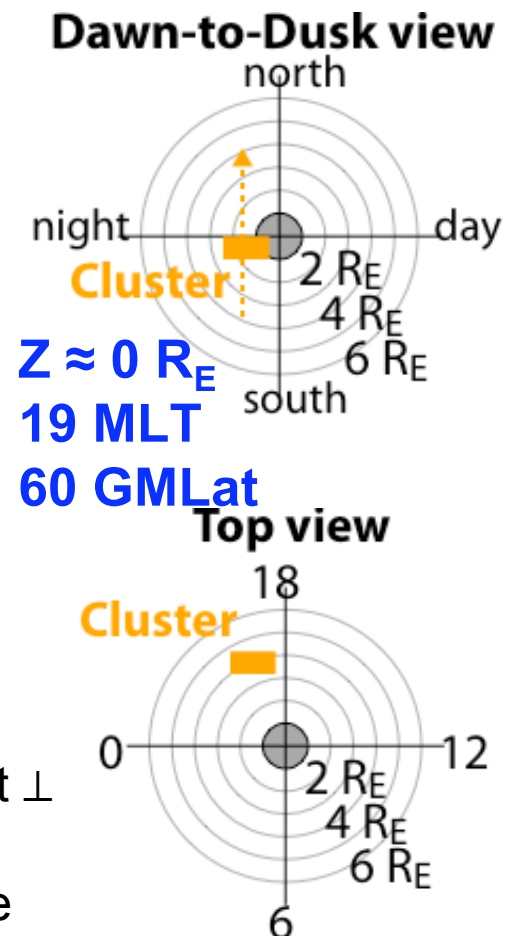
- Fig 2 * polarization $E \approx -E_x$ of up to 8~9 mV/m
- Fig 2 * depletion of $|B| \approx B_z$ up to 25% (more structured than E)
- Fig 2 * $E \times B$ convection (up to 50 km/s) of cold He+
- Fig 2 * timing of ΔE (& $E \times B$): SC-3 $\neq$ SC-2 ~ SC-4 ~ SC-1
 $\Rightarrow$ speed = 10 km, and size = 2000 km

(b) Solitary structure is maintained by 3000 km/s ions

- Fig 3 * net flux increase of 50 keV H+, 200 keV He, 700 keV O
- * $\Delta P_{3000\text{km/s}} = 3 \text{ nPa} = -\Delta P_B$
- * magnetic drift velocity is faster than propagation velocity

(c) The auroral bulge is caused by this solitary structure

- Fig 4 * simultaneous appearance of 7 keV ions in +// and -// but not $\perp$
- Fig 4 * energy-time dispersion matches ionospheric distance
- Fig 4 * size, speed, and potential structure agree with auroral bulge



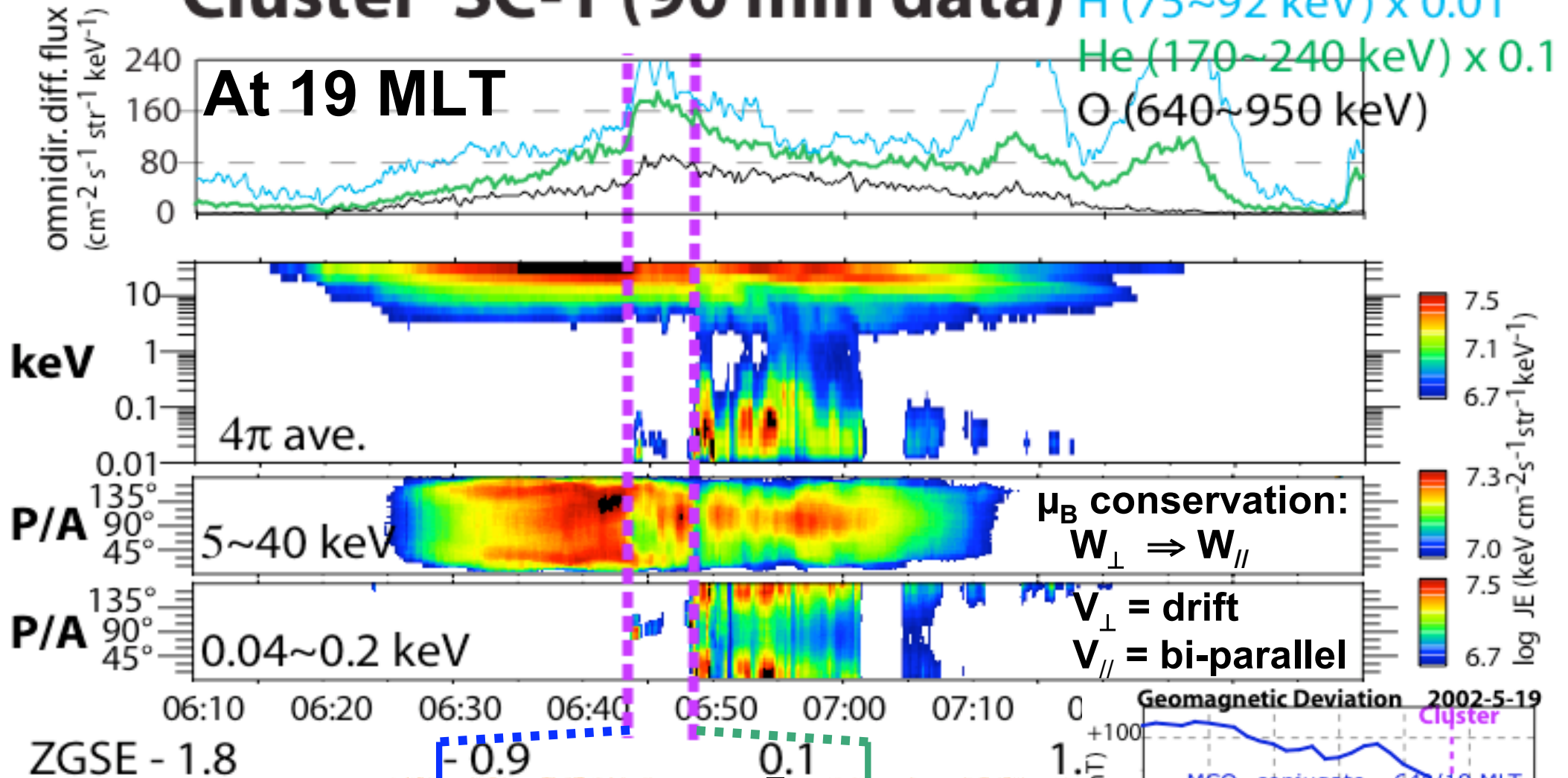
Cluster SC-1 (90 min data)

At 19 MLT

H (75~92 keV) x 0.01

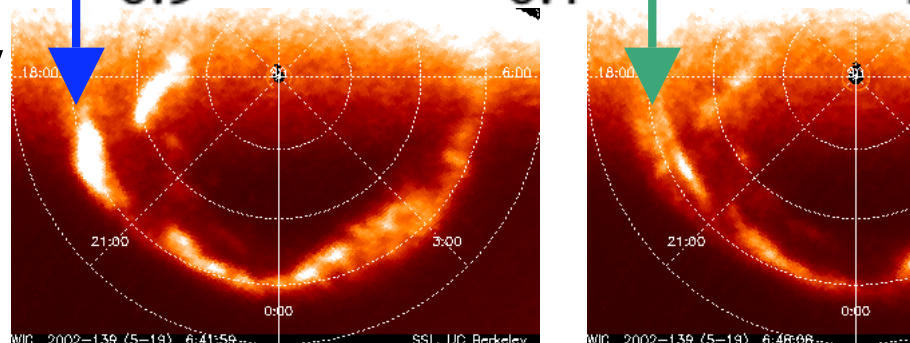
He (170~240 keV) x 0.1

O (640~950 keV)

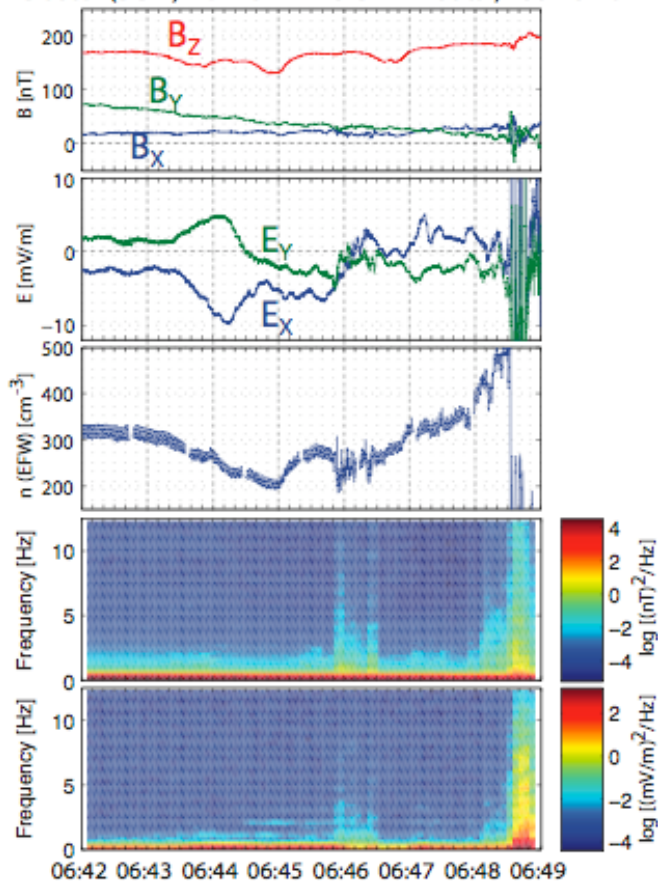


IMAGE/FUV

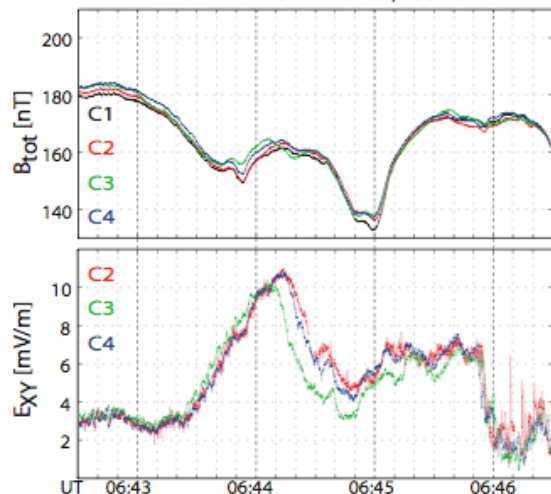
Fig 1:
overview



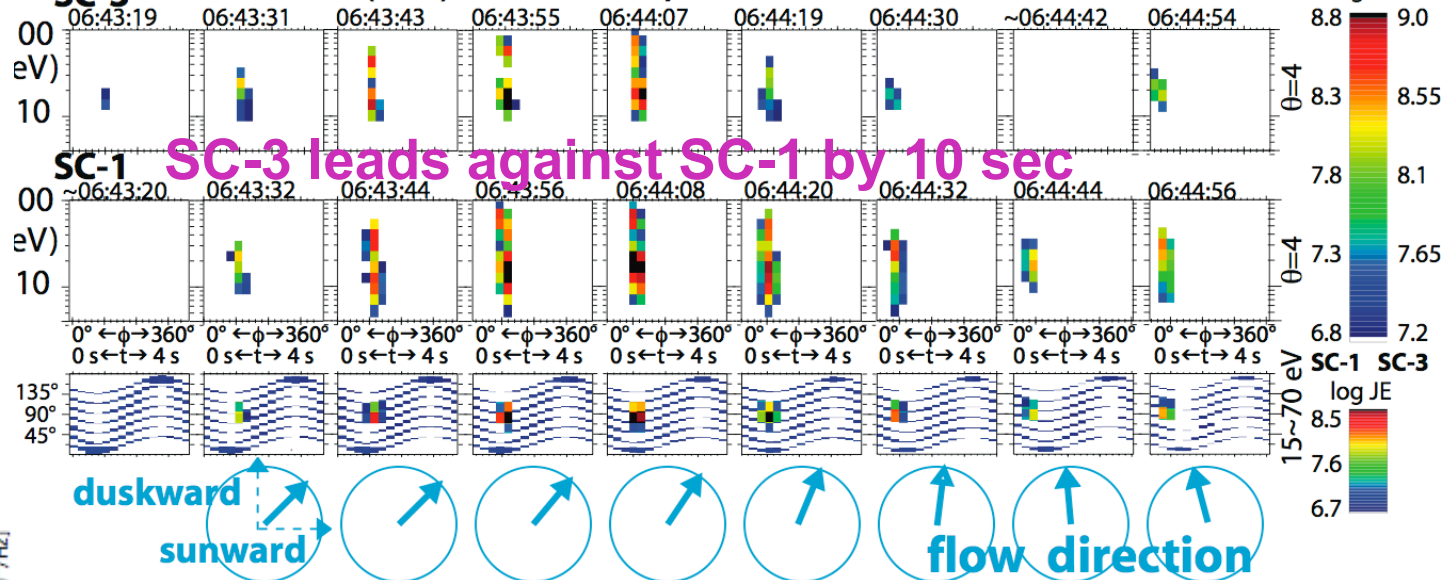
Cluster (SC-4) FGM & EFW & STAFF data , 2002-5-19



Cluster FGM & EFW data , 2002-5-19



SC-3 CIS/HIA (ions) 2002-5-19 , 06:43~06:45 UT



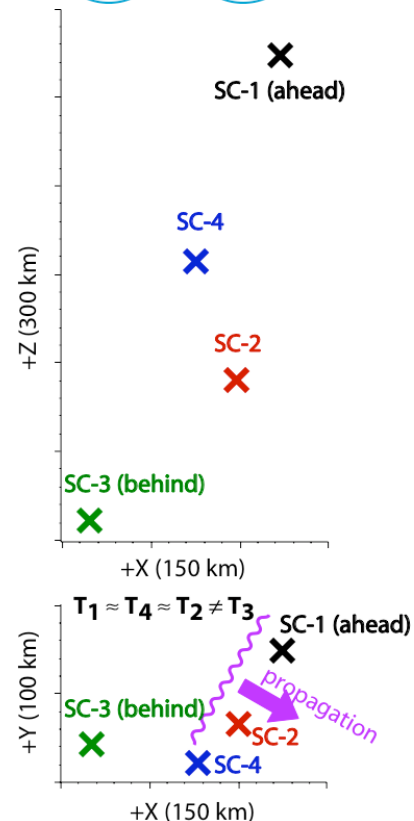
Convection = $E \times B$

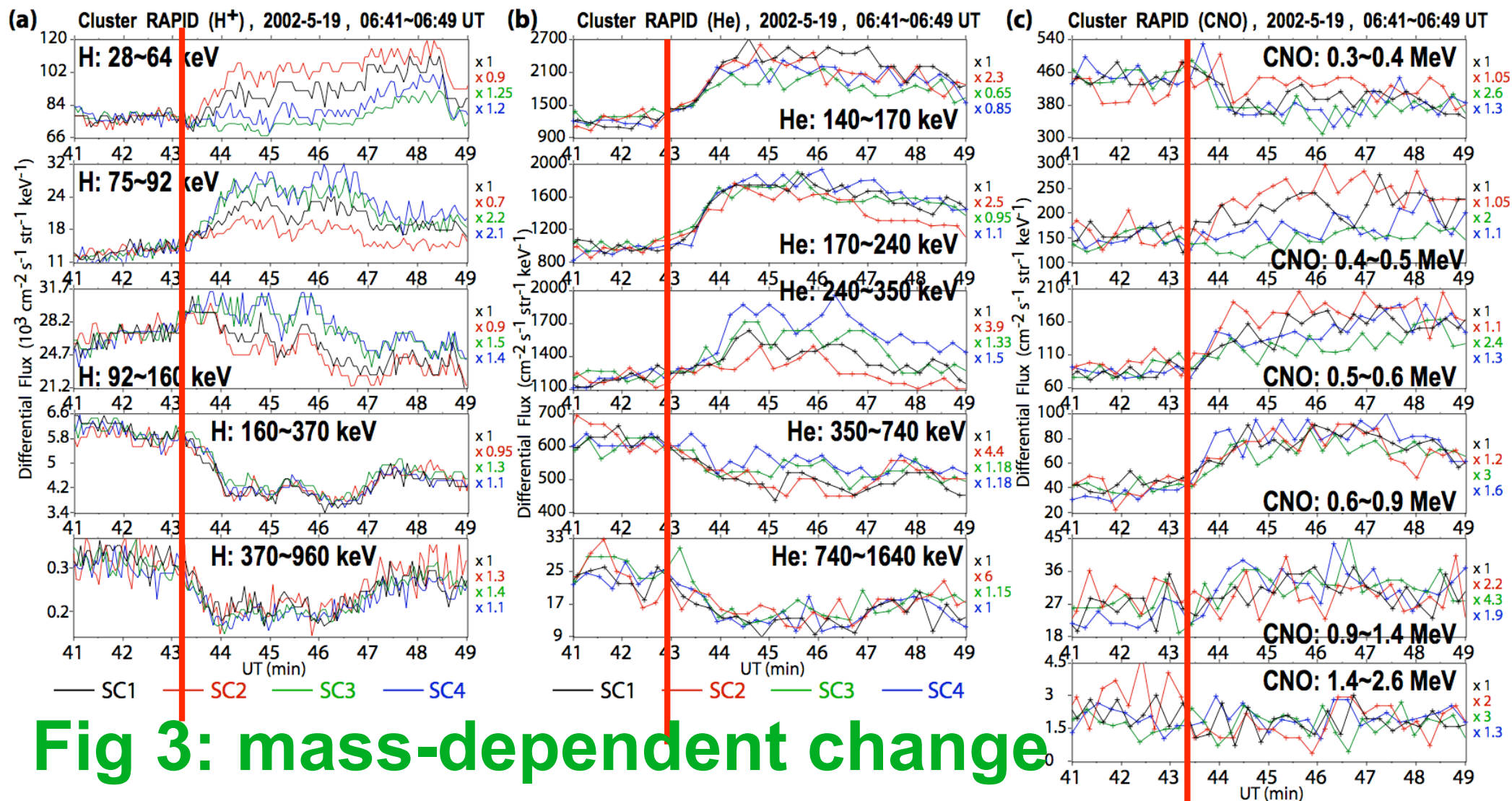
Composition = He⁺ and H⁺ (O⁺)

SC-3 leads against SC-2 / SC-4
 ΔB is more complicated than E

sunward propagation
of solitary structure
of 2000 km length

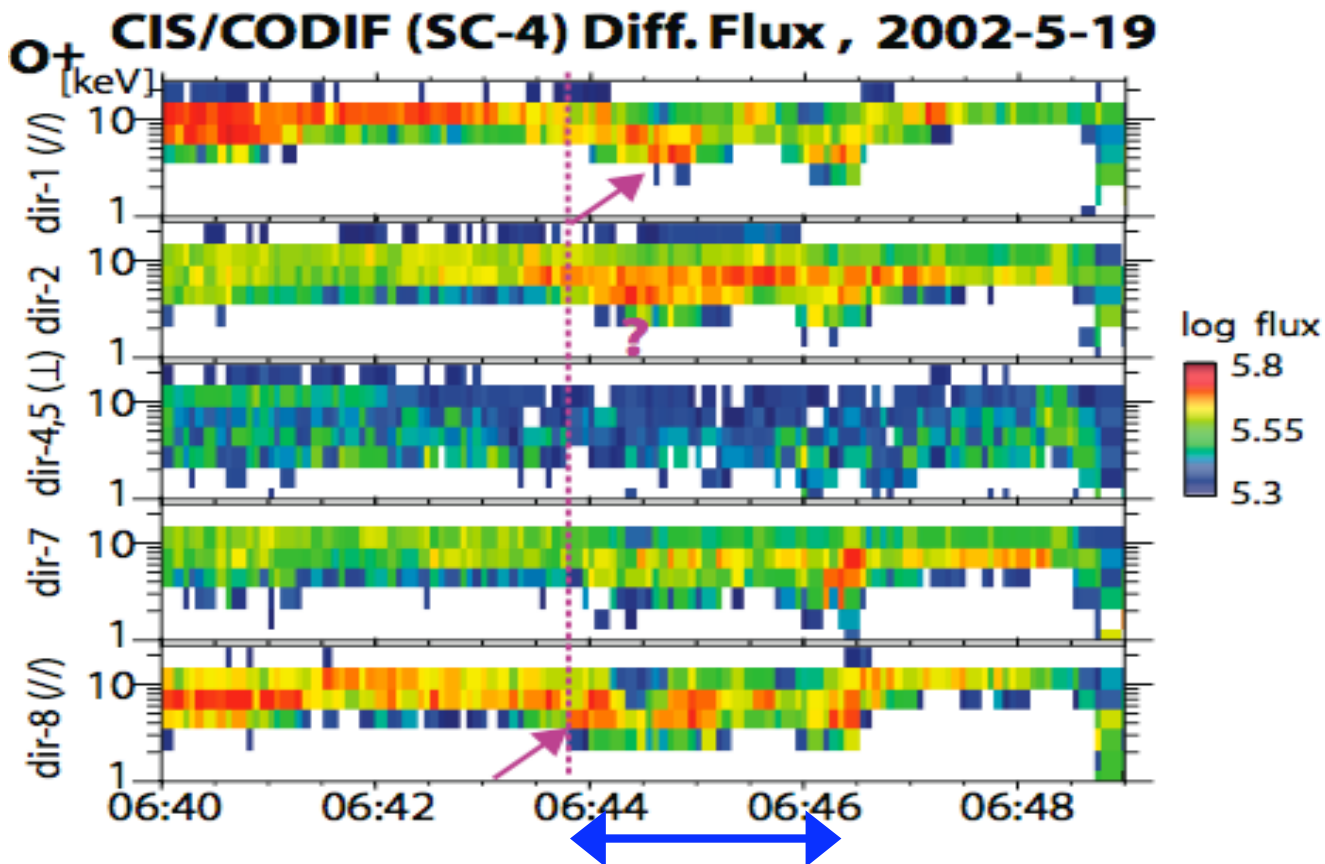
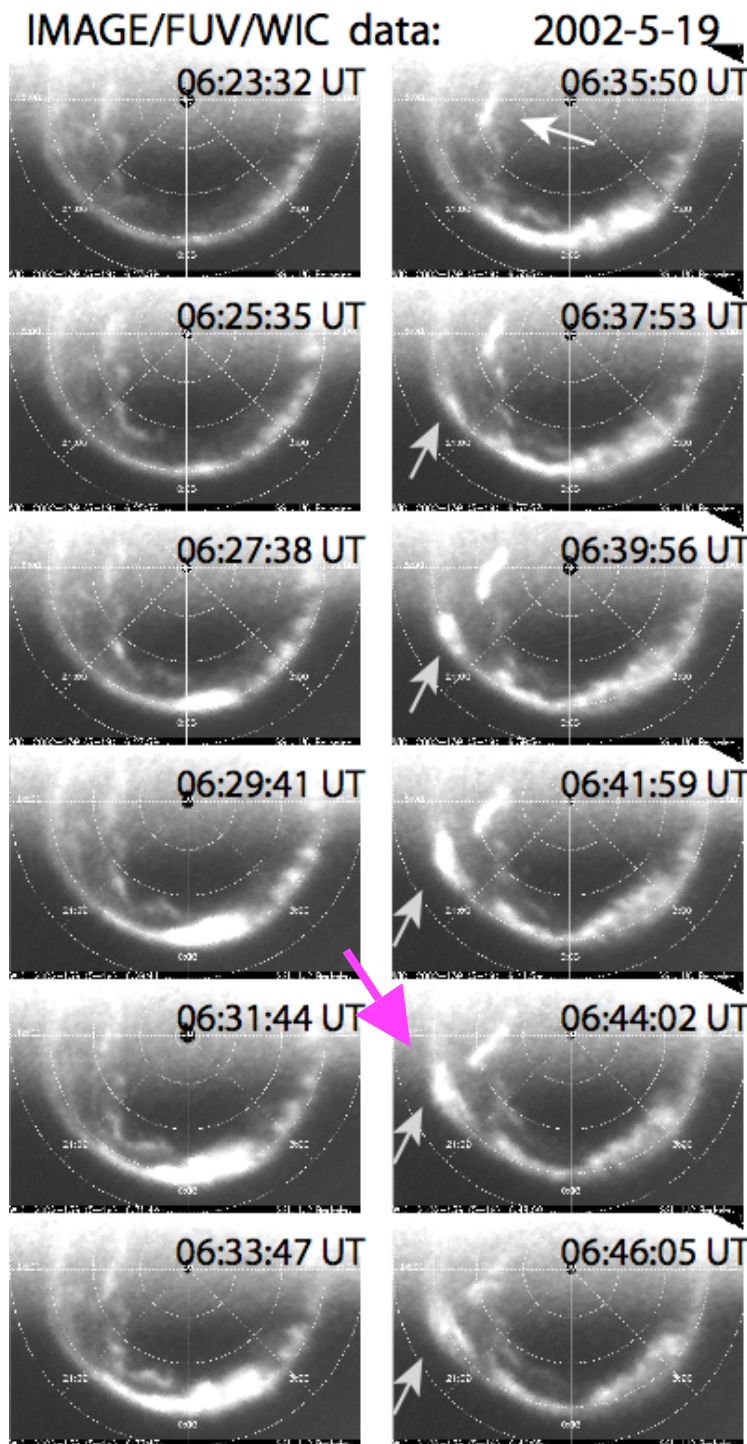
Fig 2: timing





3000 km/s = 50 keV (H), 190 keV (He), 740 keV (O) = Flux increase
 R_g = 200 km (H), 800 km (He), 3200 km (O)

5000 km/s = 130 keV (H), 500 keV (He), 2 MeV (O) = Flux decrease



7 keV // O+, from both hemispheres
End at 06:46 UT = boundary crossing

Fig 4: relation to aurora

sunward < 0.1 MLT/min (stagnate at 06:44)
≈ 10 km/s at Cluster (L=4, equator)

Conclusion

Observed westward moving auroral bulge at 19 MLT on 2002-5-19 is caused by a solitary structure in the magnetosphere.

This solitary structure consists of polarization E-field (up to 9 mV/m) and depletion of $B \approx B_z$.

This solitary structure is maintained by energetic ions of 3000 km/s speed for all ions.

Size of this solitary structure is comparable to the ion gyro radius of carrier ions.

