Pre-Onset Azimuthal Pressure Gradient and Associated Auroral Intensifications Related to Dipolarization Fronts

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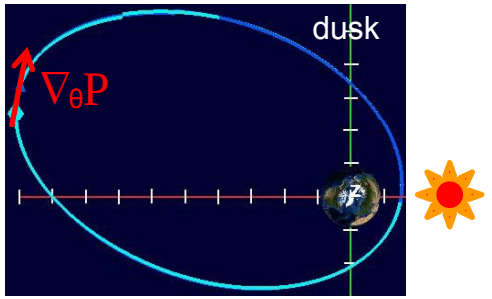
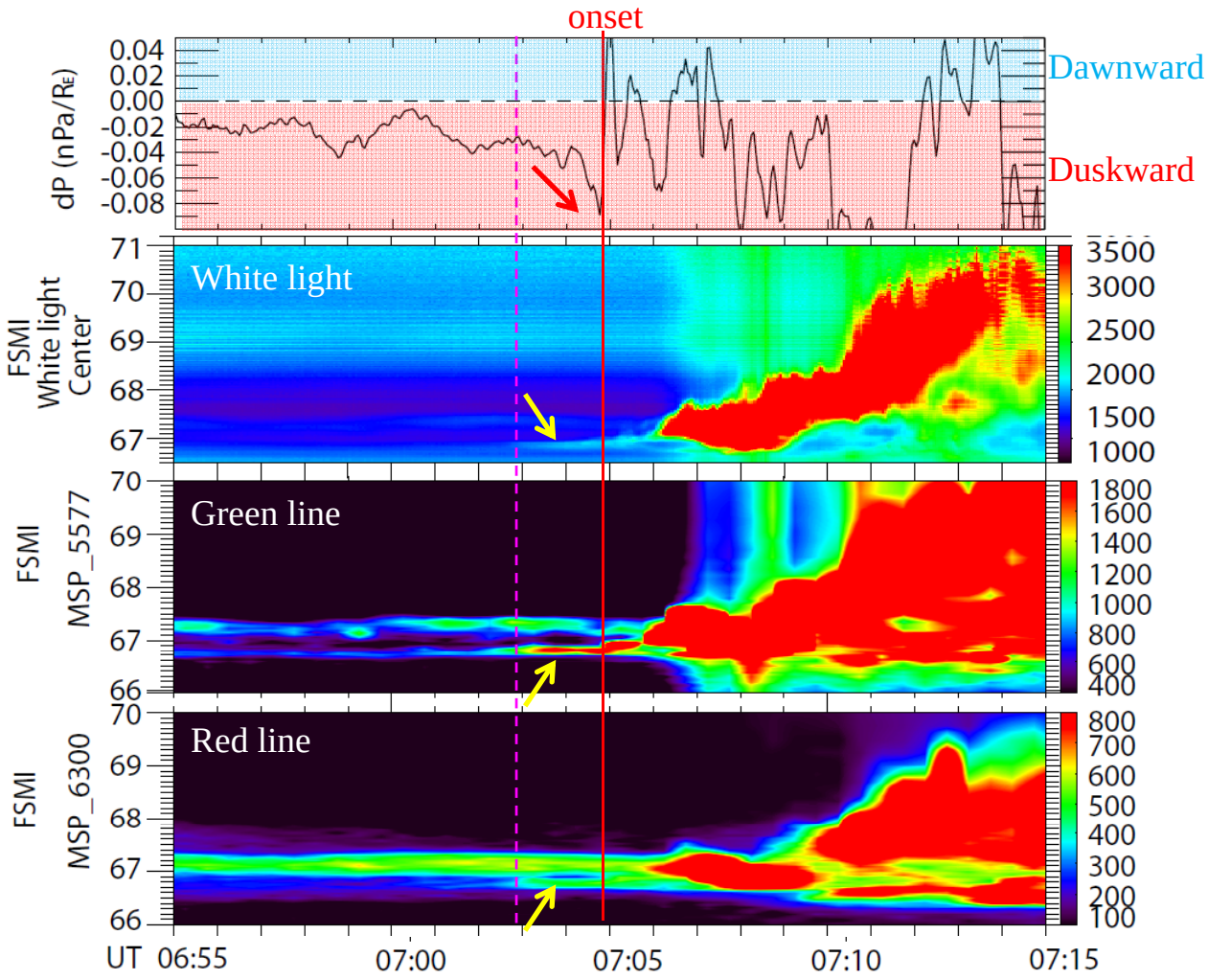
Case study show that the intensification of the auroral thin onset arc prior to the explosive expansion is correlated with the duskward equatorial plasma pressure enhancement in the near-Earth region close to the onset meridian (*Xing et al.*, 2011).



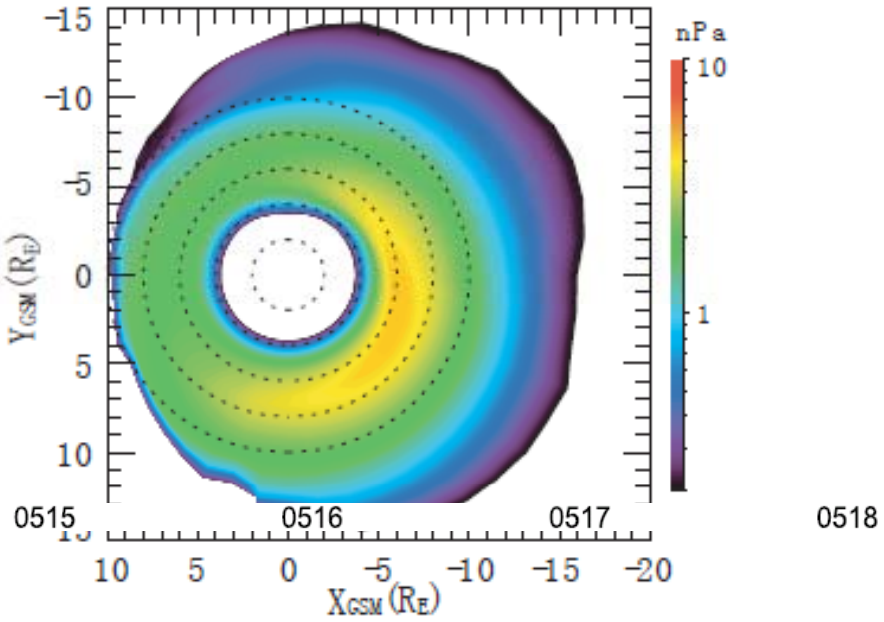
Tailward $\nabla_r(\int \frac{ds}{B})$ + Duskward $\nabla_\theta P$

Enhanced upward FAC

Enhanced electron precipitation intensifying the thin onset arc

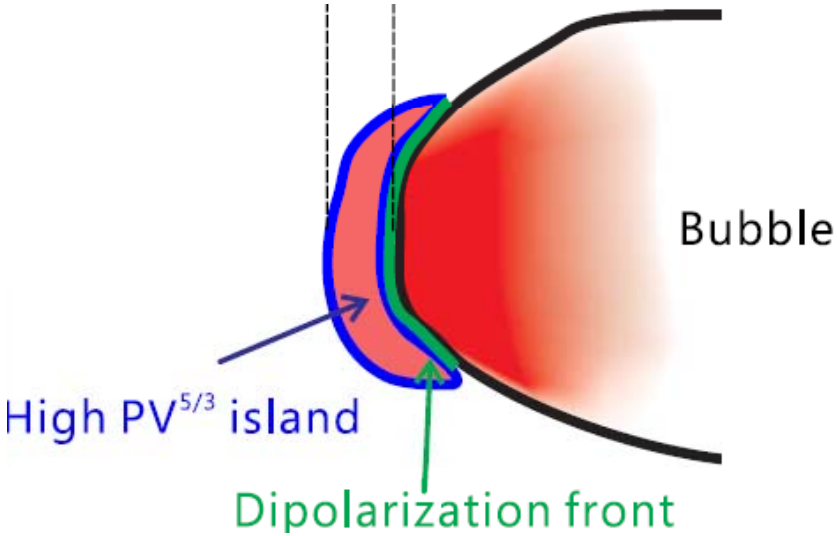


What drives the duskward pressure gradient enhancement near the onset meridian?



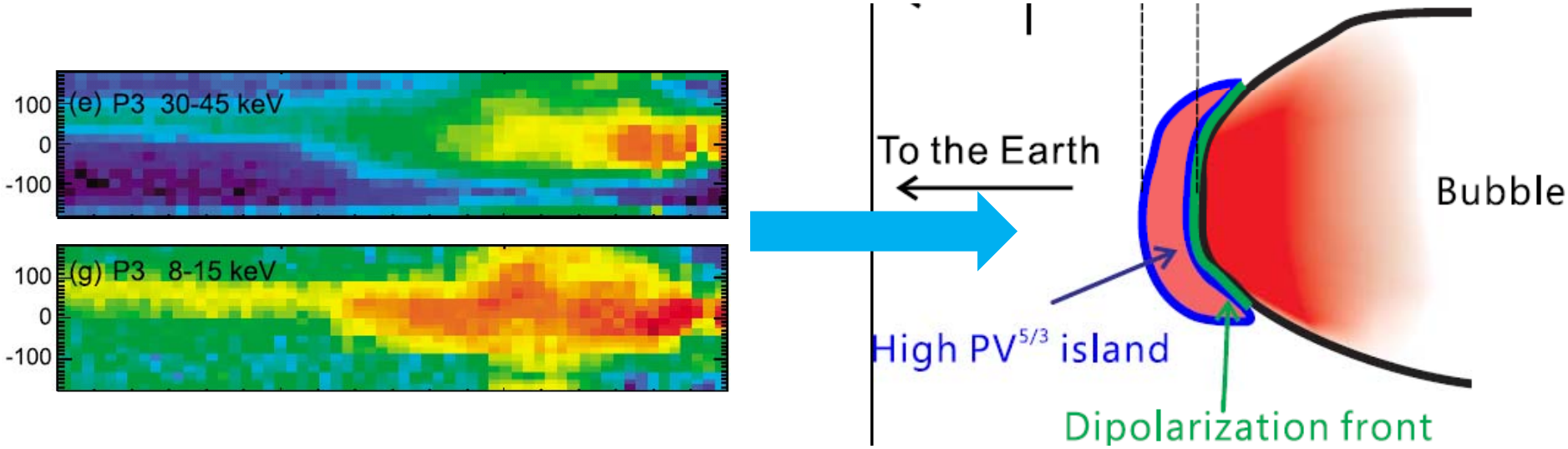
Growth phase pressure redistribution under enhanced convection in the near-Earth region.
(courtesy of *Matina Gkioulidou*)

Longer time scale



Plasma compression ahead of the earthward moving dipolarization front leading to pressure gradient.
(*Yang et al.*, 2011)

Localized in space

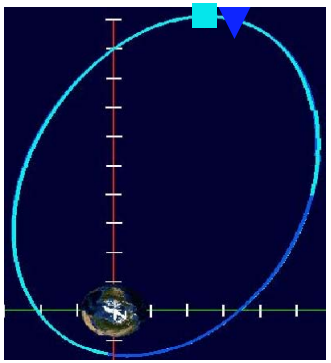


Ions upstream the earthward moving dipolarization fronts is accelerated before the front arrival
(*Zhou et al.*, 2010)

Case 1: 2009-04-05

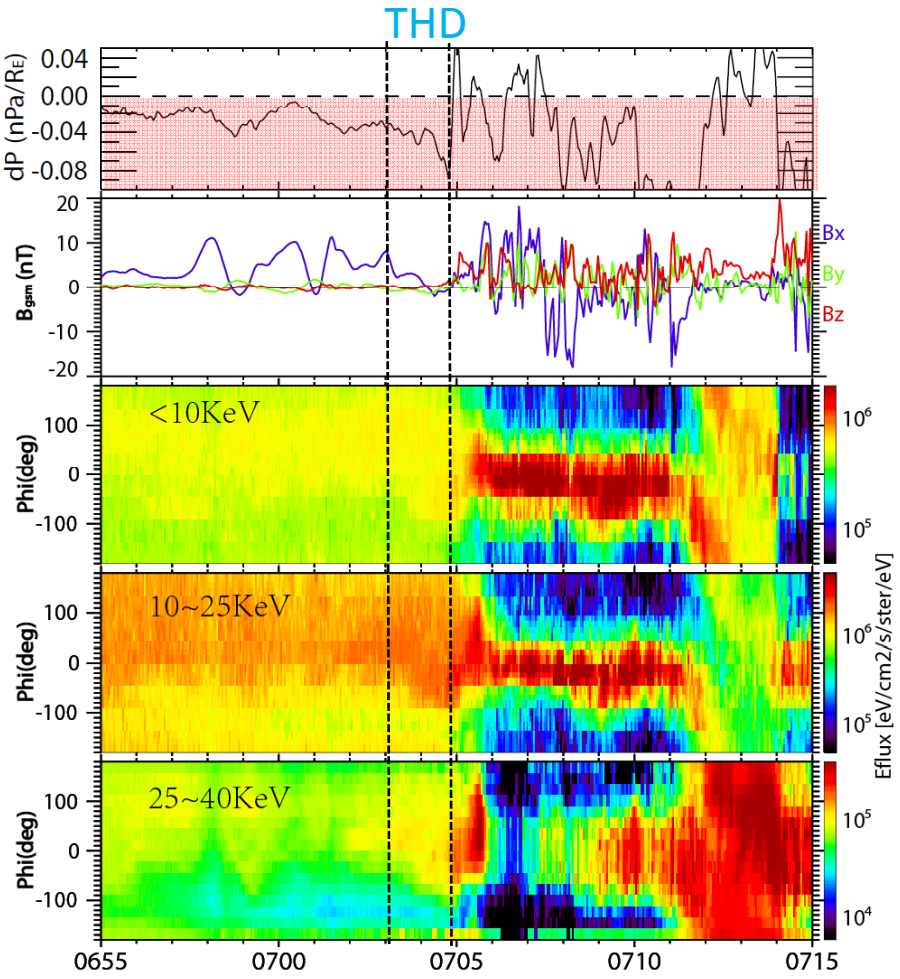
THD observed continuous diamagnetic drift during the growth phase

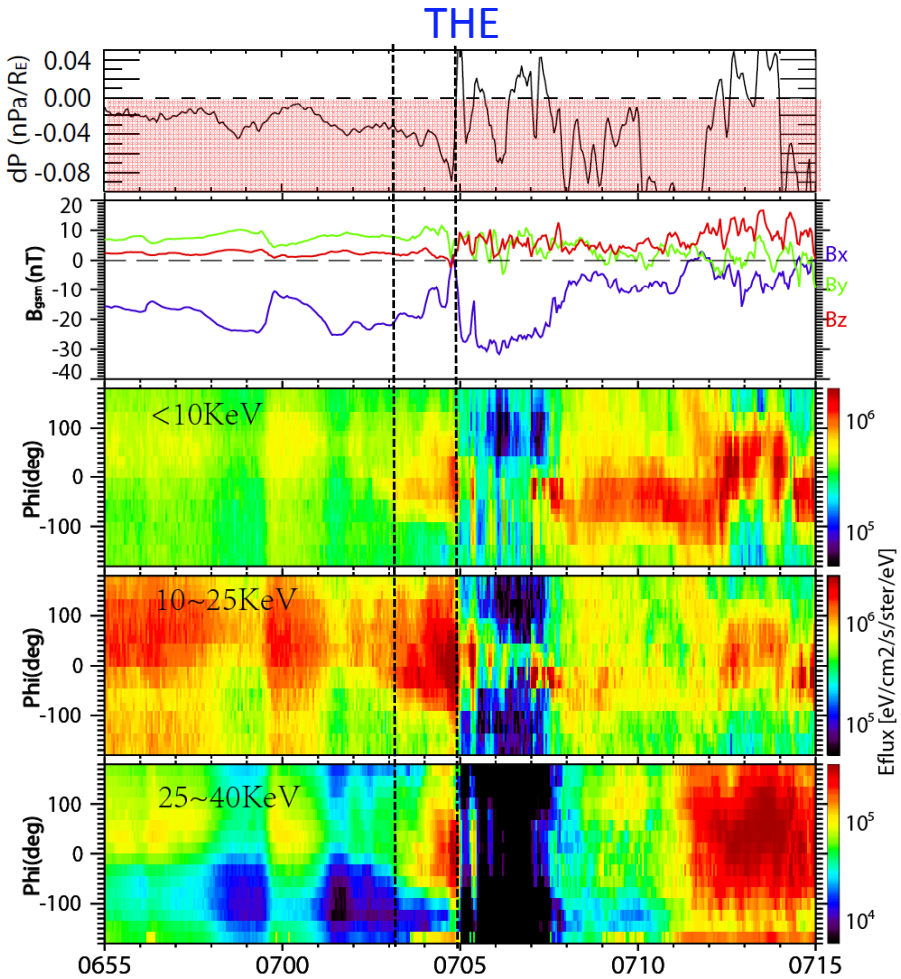
There are weak earthward ion acceleration at the energy range of 10~25KeV from ~1min before onset



THE observed continuous diamagnetic drift during the growth phase

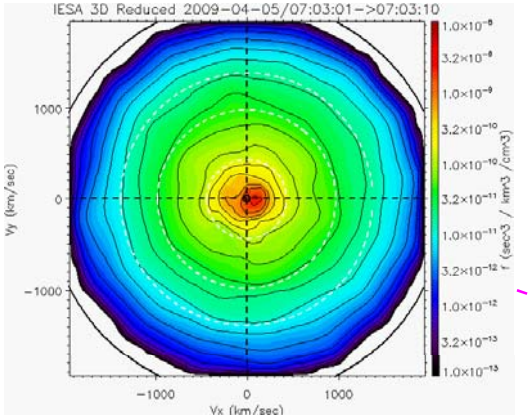
There are strong earthward ion acceleration at all energy ranges from ~2min before onset

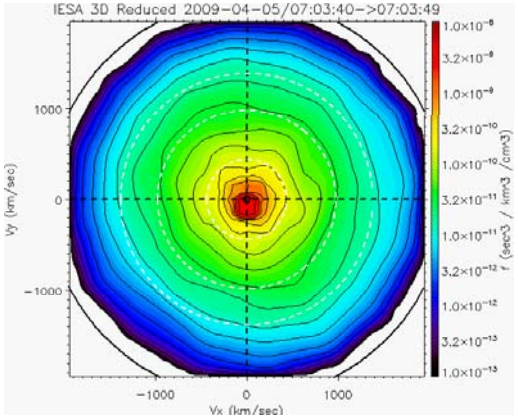


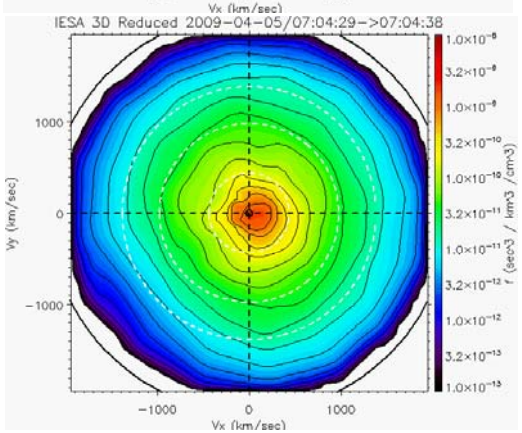


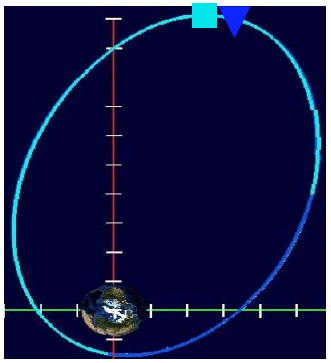
Case 1: 2009-04-05

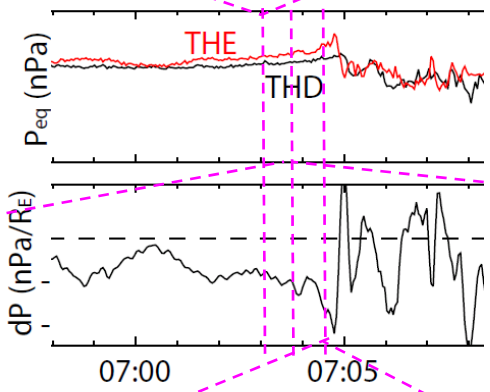
THD



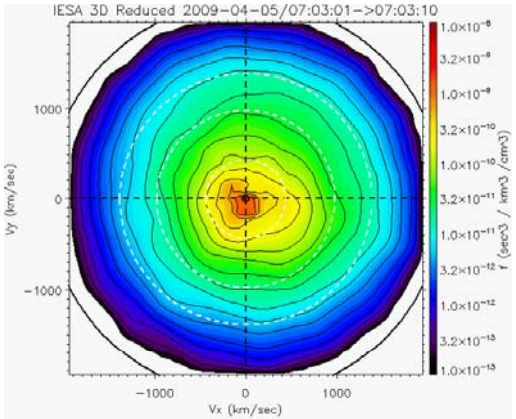


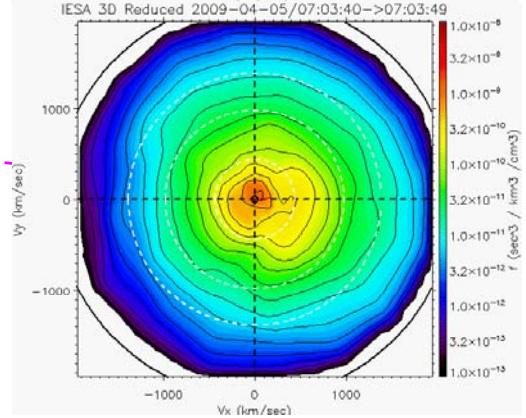


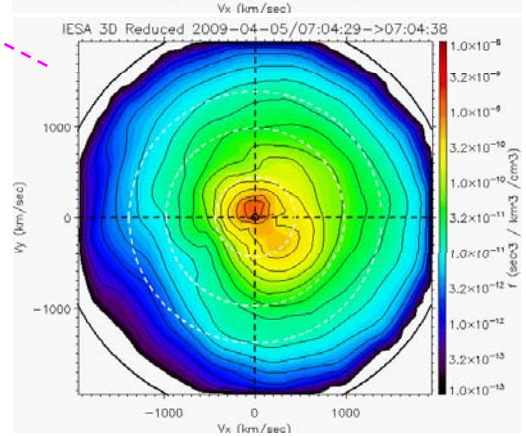




THE



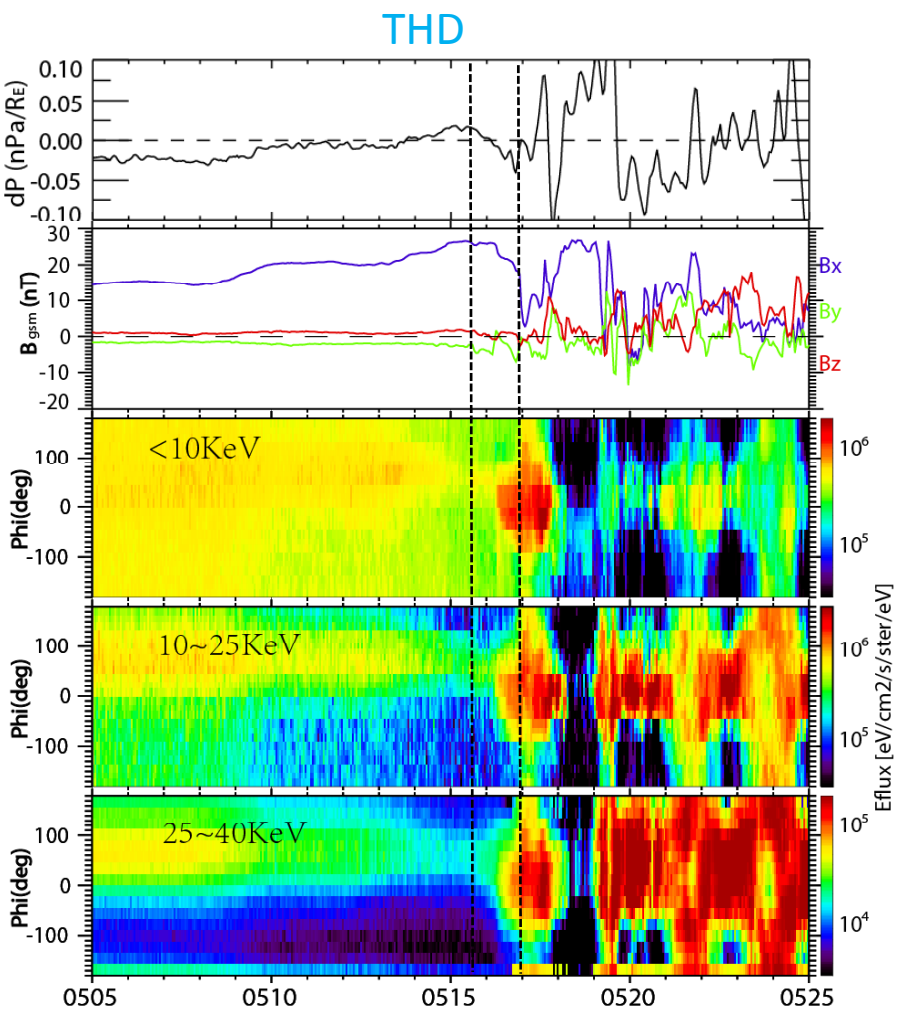


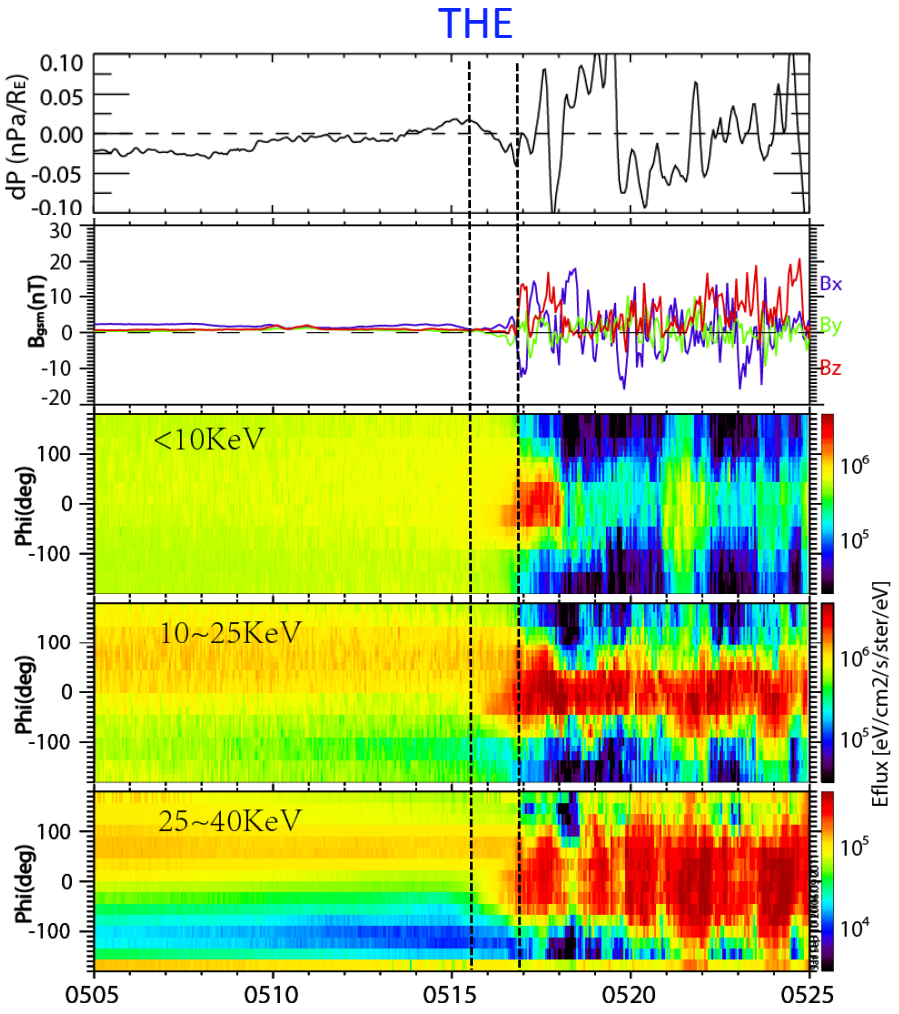


More pronounced ion acceleration at THE location

THE is located closer to the incoming dipolarization front, whereas THD is located to the east, which leads to duskward pressure gradient.

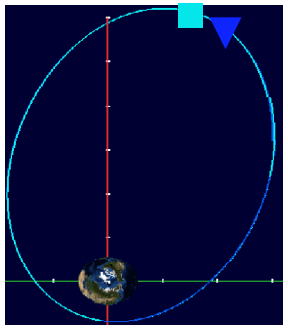
Case 2: 2009-03-29





THD observed continuous diamagnetic drift for warmer ions during the growth phase

Ion acceleration at all energy range from ~1.5 min before onset



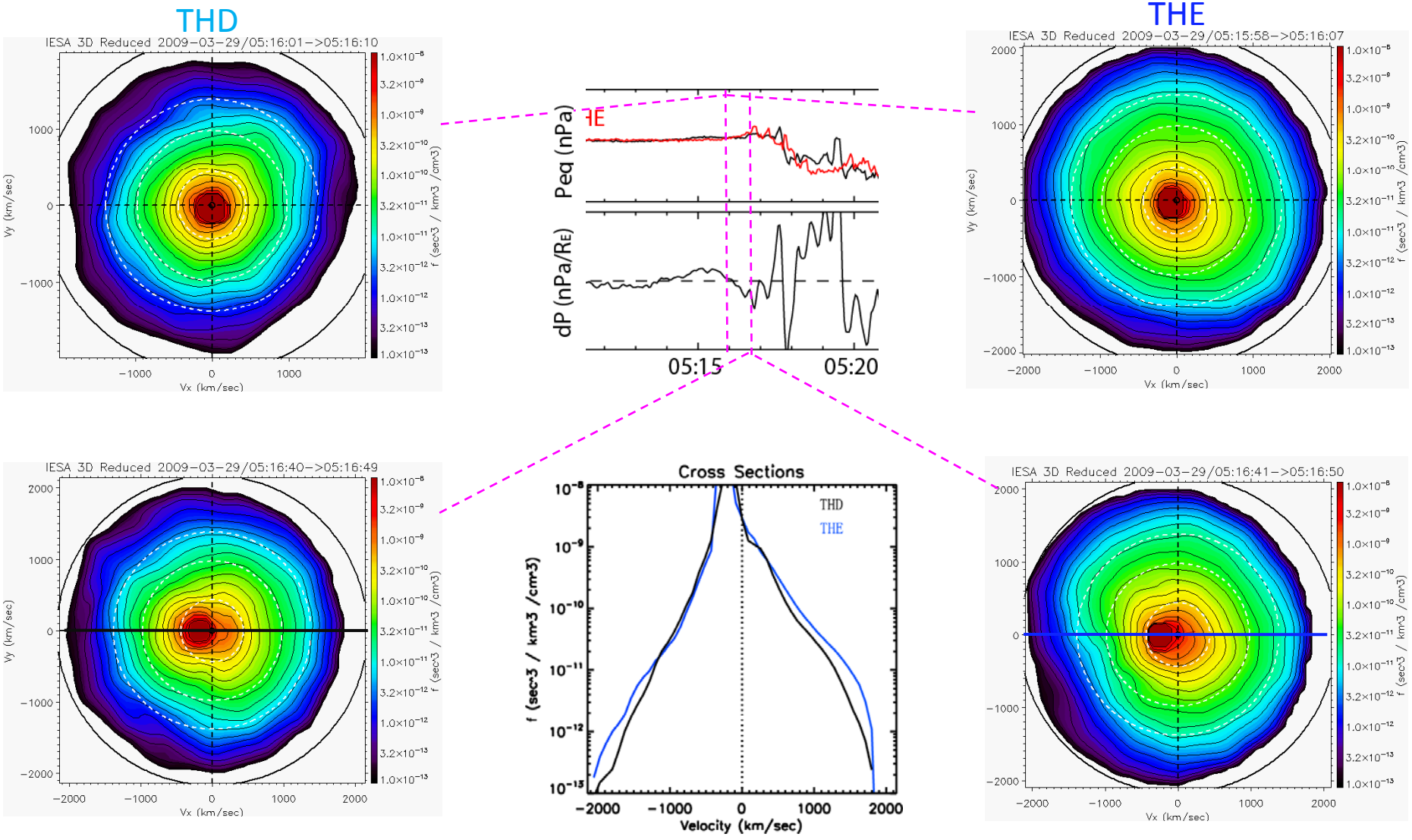
THE observed continuous diamagnetic drift for warmer ions during the growth phase

Ion acceleration at all energy range from ~2 min before onset

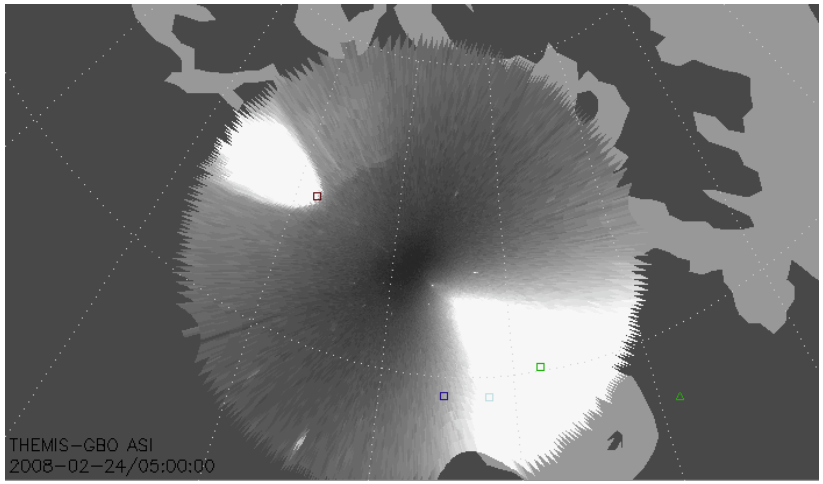
Case 2: 2009-03-29

Both THD and THE observed mushroom-shape ion distributions

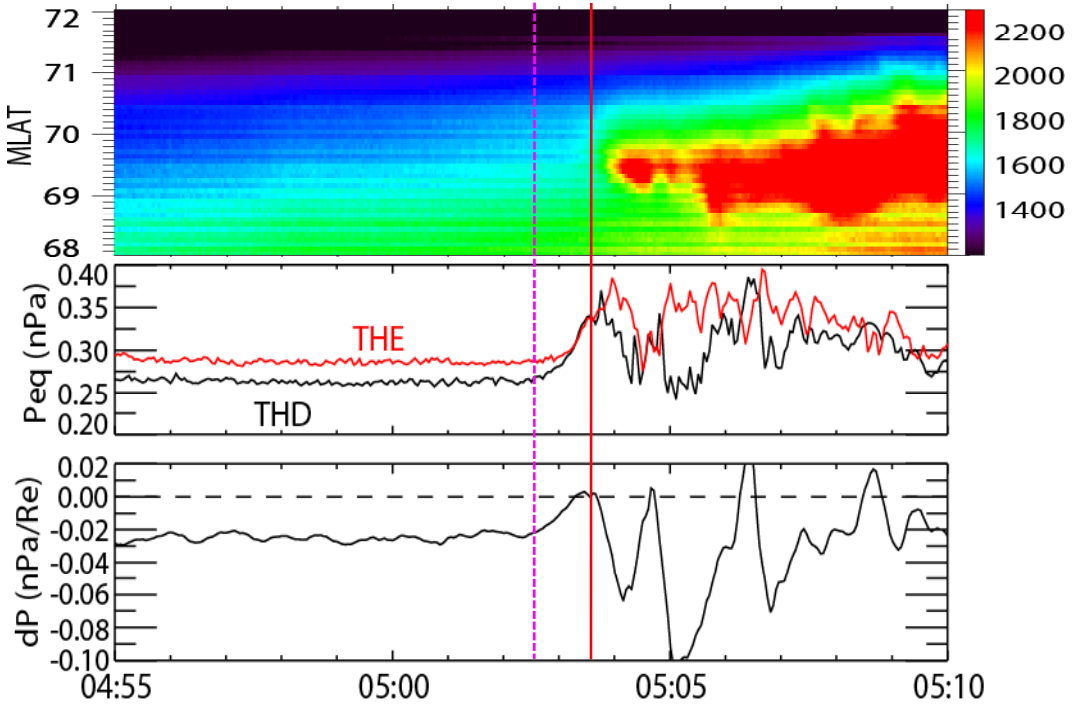
THE distribution shift in velocity space is stronger than that of THD, indicating stronger ion acceleration, which may be responsible for the duskward pressure gradient



Case 3: 2008-02-24



THD and THE may be mapped slightly to the west of auroral onset

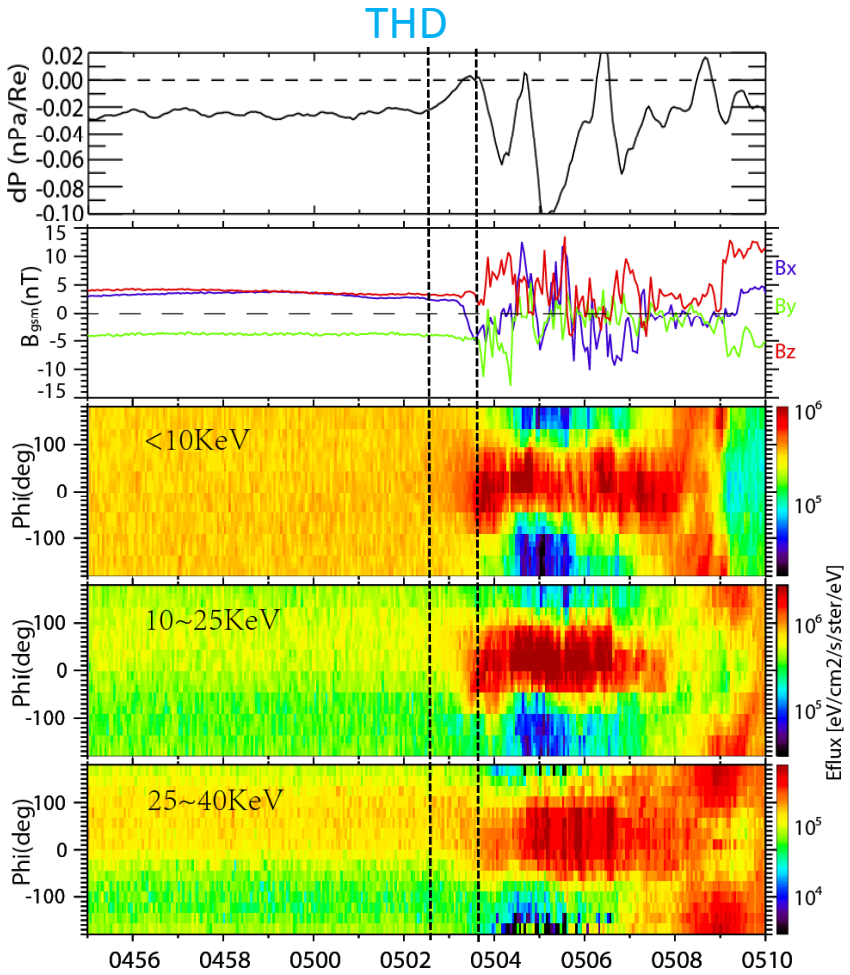


Moderate dawnward pressure gradient enhancement associated with pressure precursor increase ~ 1min before onset

Case 3: 2008-02-24

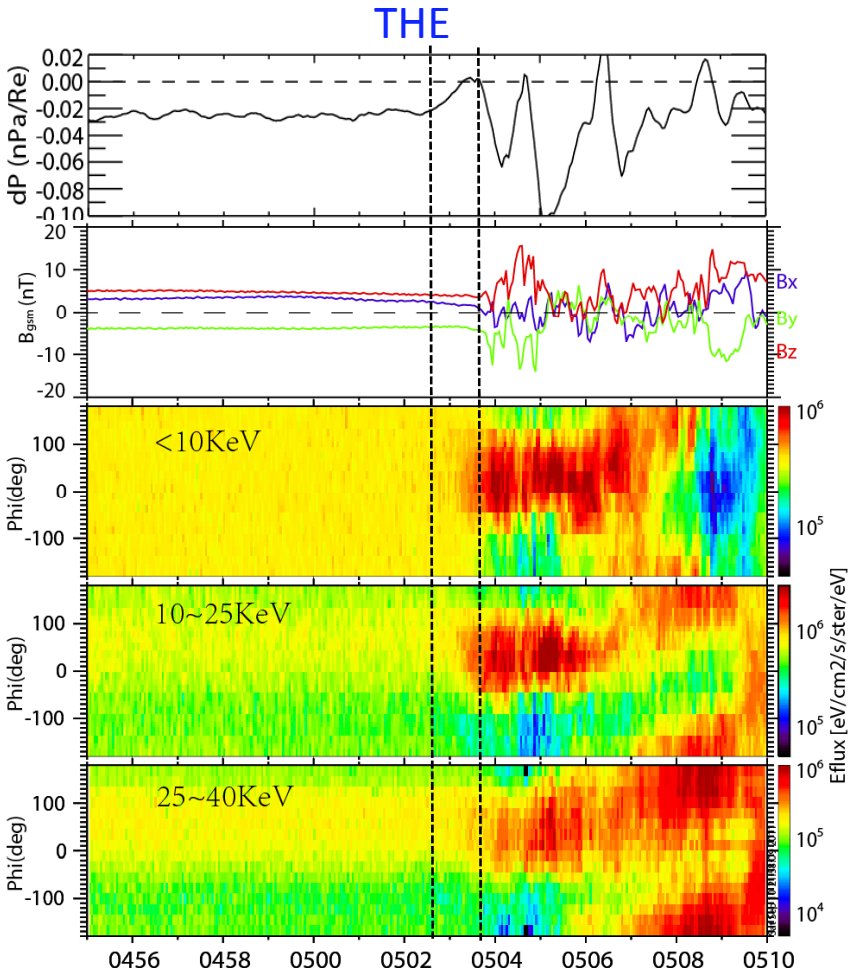
THD observed continuous diamagnetic drift for warmer ions during the growth phase

Weak ion acceleration at all energy range from ~1 min before onset



THE observed continuous diamagnetic drift for warmer ions during the growth phase

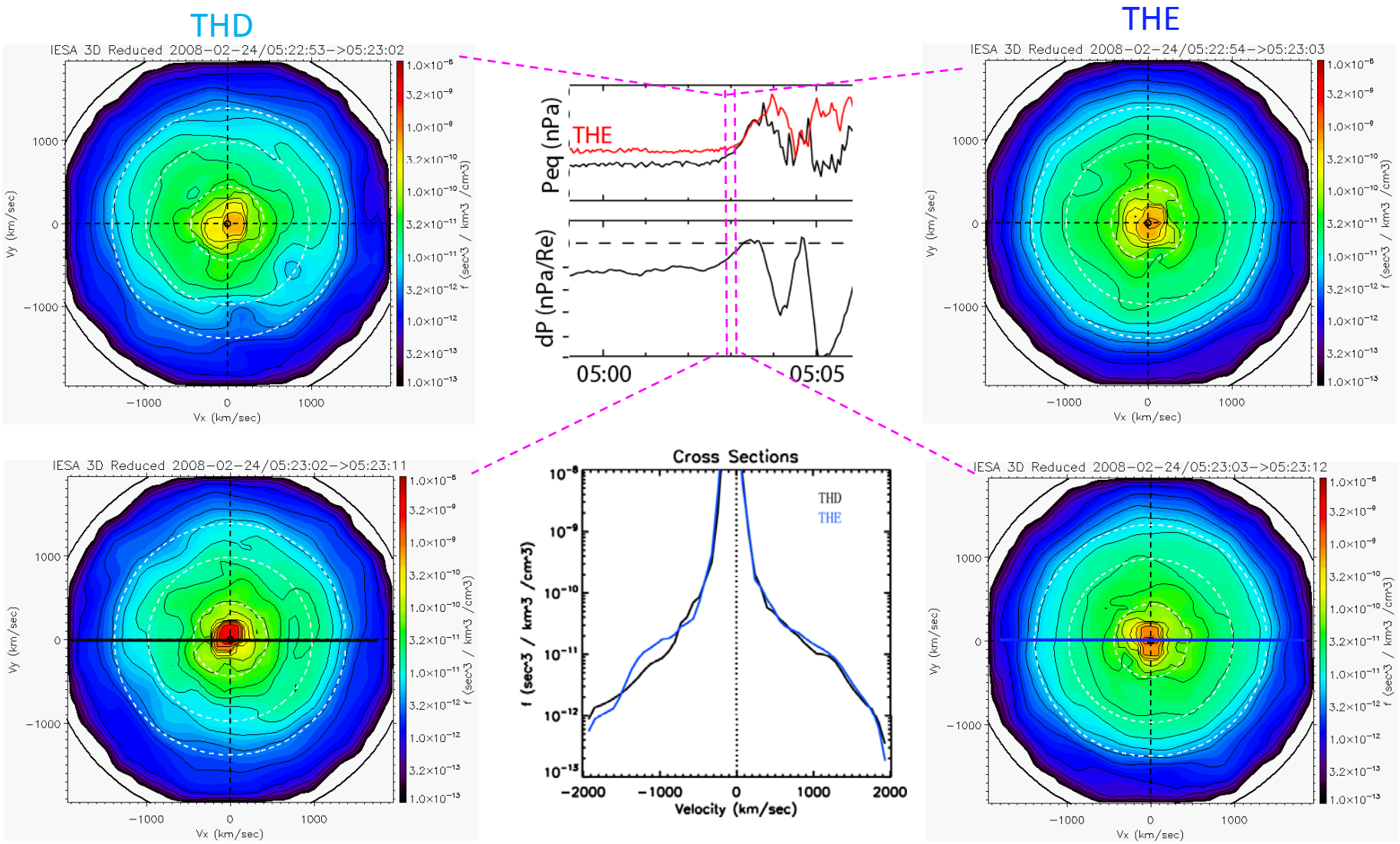
Weak ion acceleration at all energy range from ~1 min before onset



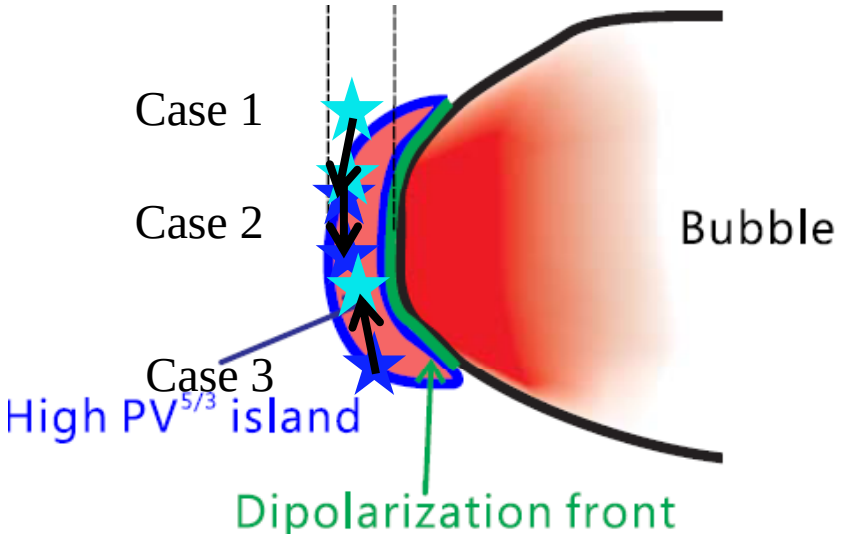
Case 3: 2008-02-24

THD observed distribution shift in velocity space first in duskward, then in earthward

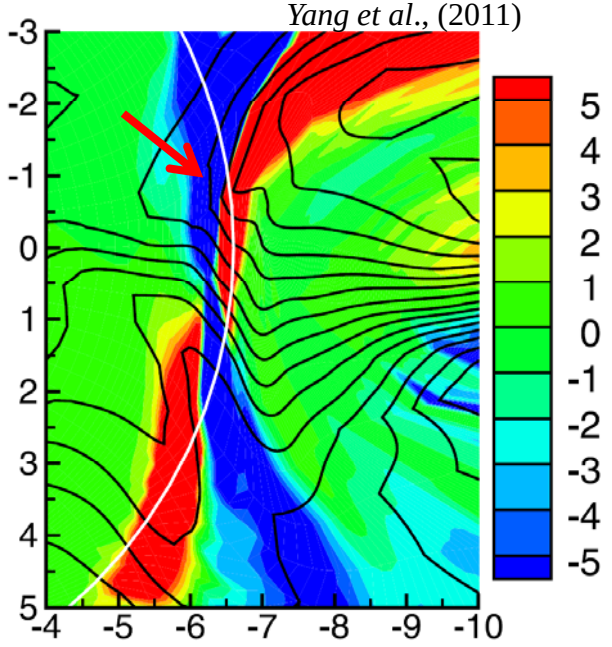
THE did not observe substantial shift



Summary



Yang et al., (2011)



1. Larger pre-onset pressure enhancement is associated with more pronounced ion acceleration by dipolarization fronts.
2. Pre-onset transient pressure gradient enhancement results from spatial difference of the ion acceleration due to the dipolarization front

3. The thin onset arc brightening may result from the enhanced upward FAC of the pair FAC upstream the dipolarization front

Question

1. What is the pressure gradient response to the equatorward moving growth phase arc?
2. What is the spatial extension of the onset arc in azimuth corresponds to the dipolarization front?