



PHYSICS AND ENGINEERING PHYSICS

# Rankin Inlet radar observations of duskward moving Sun-aligned optical forms

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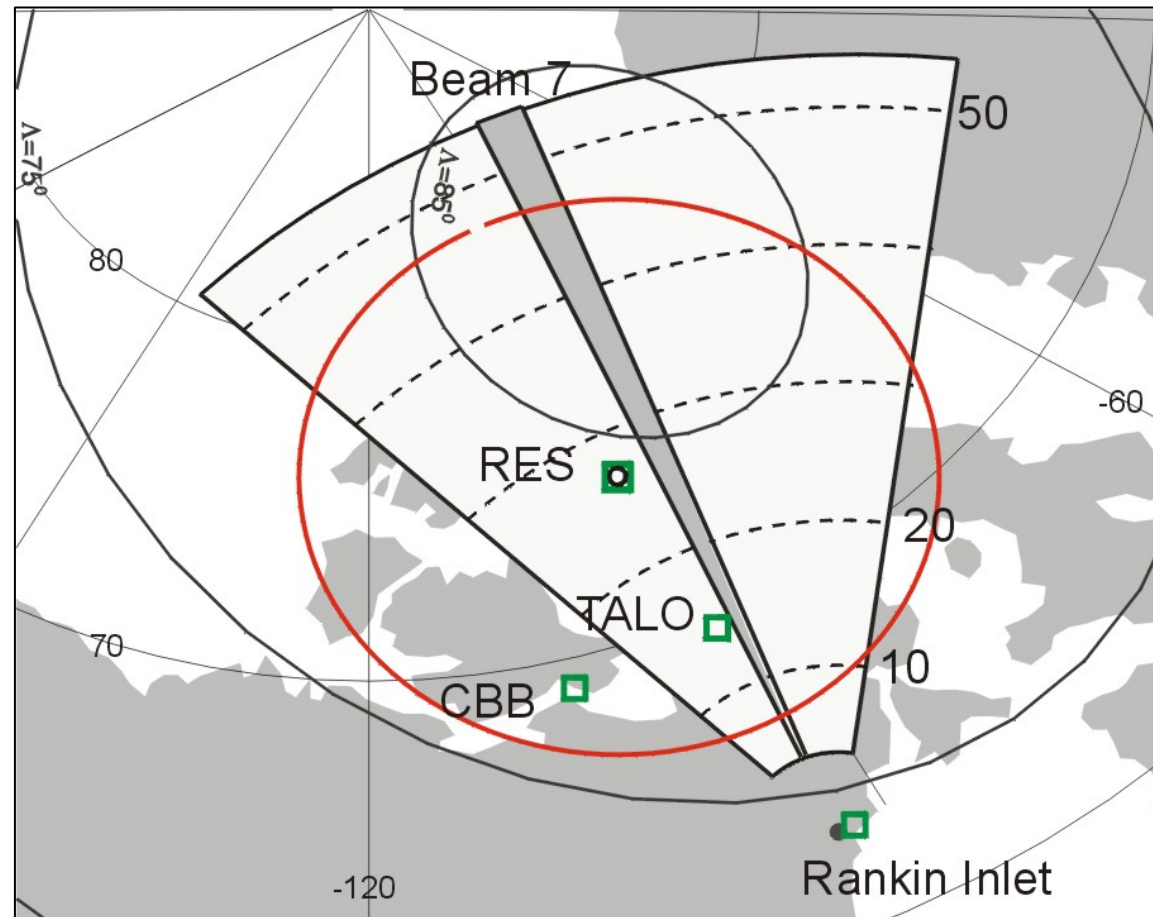
University of  
Saskatchewan



On 15 February 2007, several duskward moving sun-aligned (SA) auroral forms have been observed by the all-sky camera at Resolute Bay, NWT (Canada). Concurrent observations with the Rankin Inlet (RANK) PolarDARN HF radar within the field-of-view of the camera showed signatures of moving auroral forms in all signal parameters with the most remarkable effects being the echo power drop and velocity reversal as the arc reached a specific radar beam/gate. Spatial and temporal variations of the velocity in the vicinity of the SA form are investigated. It is shown that the form-associated convection reversal was located poleward (duskward) of the global-scale convection reversal associated with the dawn cell of the large-scale convection pattern. Thus, the RANK radar was monitoring the polar cap portion of the global-scale convection pattern and its transition from the IMF  $B_y < 0$  to the  $B_y > 0$  situation. Magnetic perturbations associated with the SA form passing the zenith of several magnetometers are investigated. It is shown that although magnetometer signatures of the moving form were clear, the convection pattern derivation from magnetometer records alone is not straightforward.

# Rankin HF radar and Resolute OMTI camera common observational area

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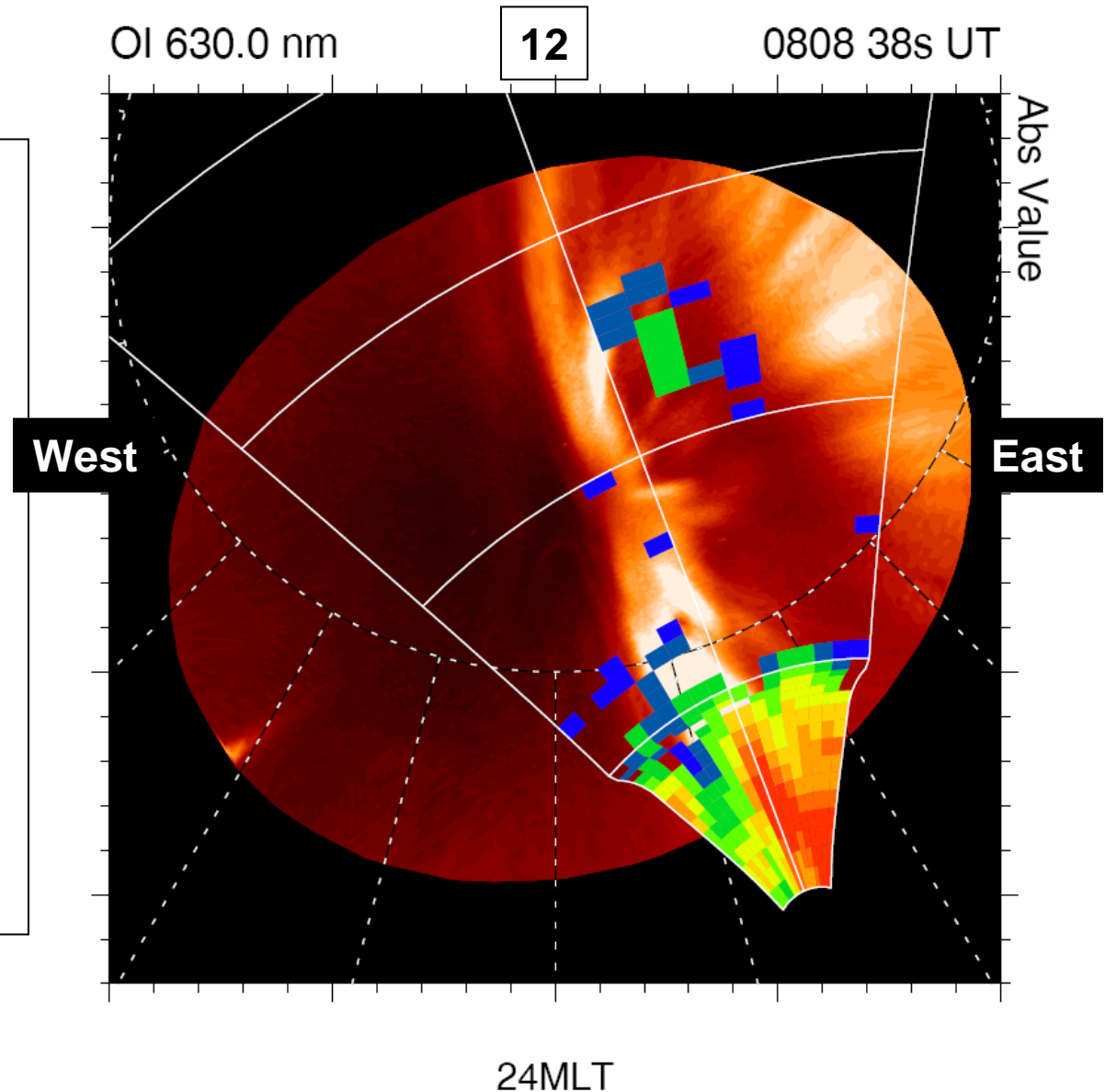
**Short Rankin ranges are not covered by OMTI. Data from beam 7 are investigated in detail. Magnetometer data at RES, CBB, TALO and RANK are also considered.**

# The arc event of 15 February 2007

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Arc like auroral form, located on the morning side, is stretched towards noon.

The luminosity to the East is perhaps the poleward edge of the expanded auroral oval.



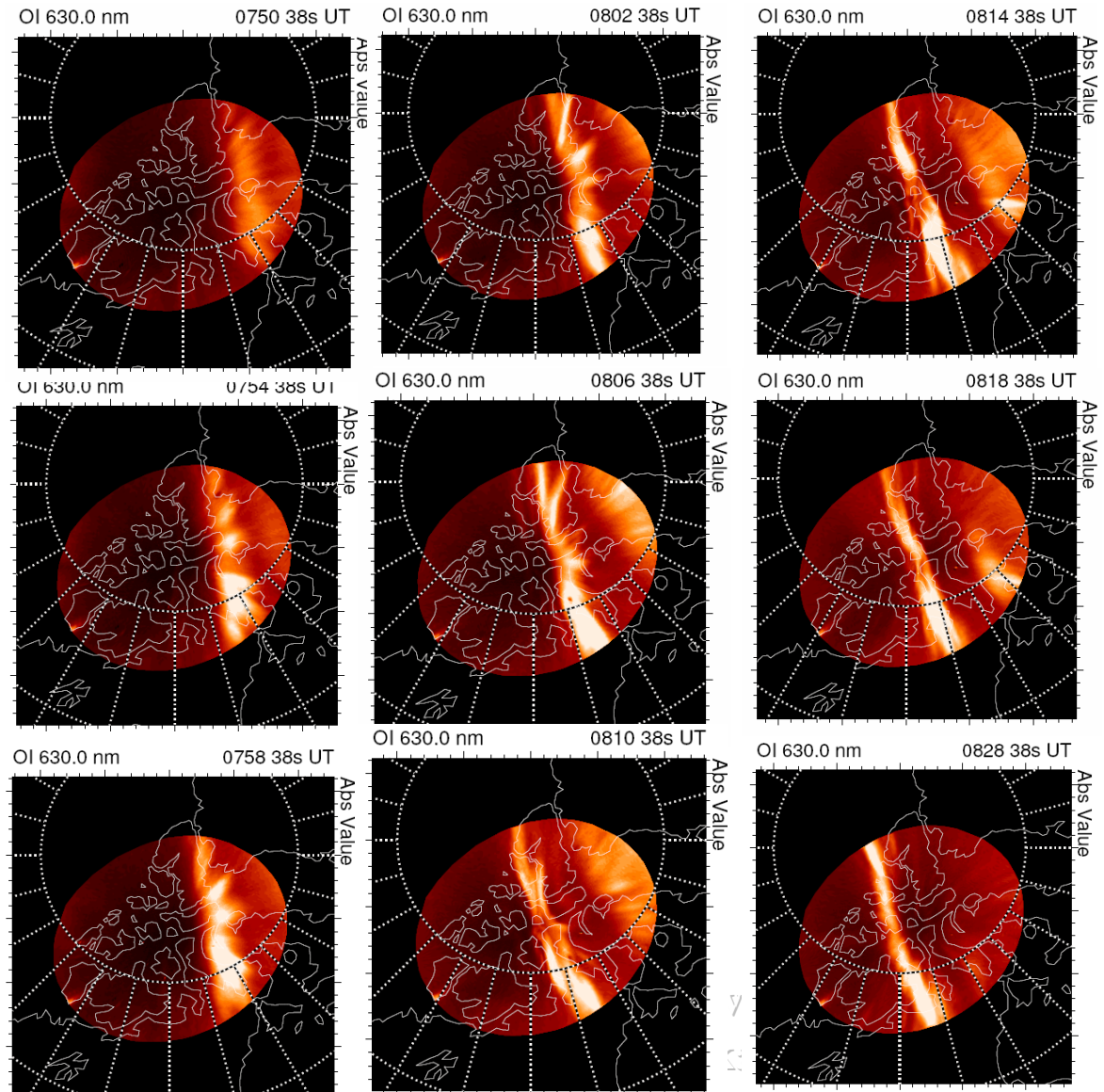
# Sun-aligned arc within Rankin FoV

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**Arc detached from the morning oval.**

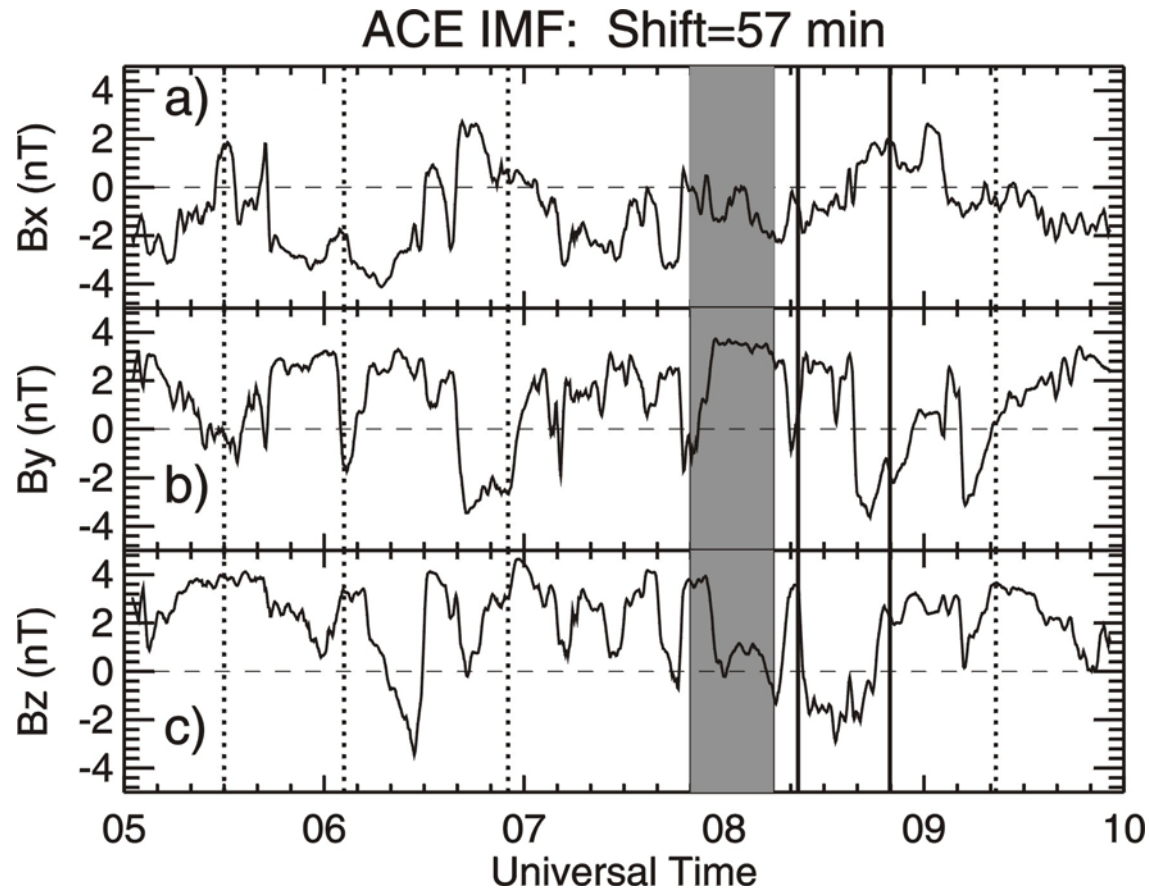
**It is progressing duskward with the speed of  $\sim 200$  m/s. The motion is not always uniform.**

**At 08:10 UT, a double structure of the arc is clearly seen.**



# IMF conditions for the event

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**Arc was moving while  $B_y$  was changing polarity from  $B_{y-}$  to  $B_{y+}$ .  $B_z$  was mostly positive. Consistent with previous studies.**

**A number of other duskward motion intensifications occurred under similar conditions.**

# The arc at 0756 UT and its radar signatures

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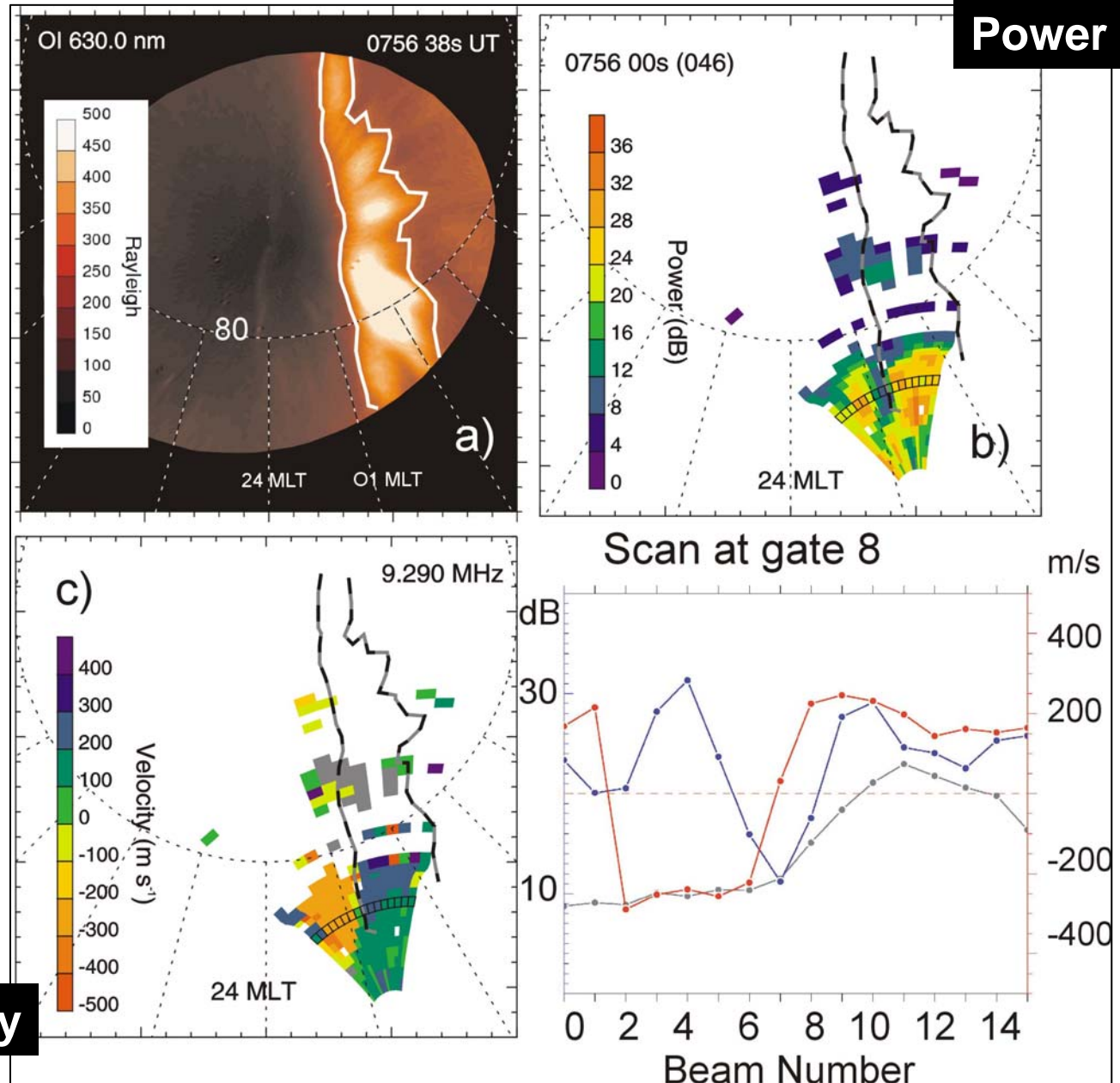
Signature in power:

Signal drop at the duskward edge

Signature in velocity:

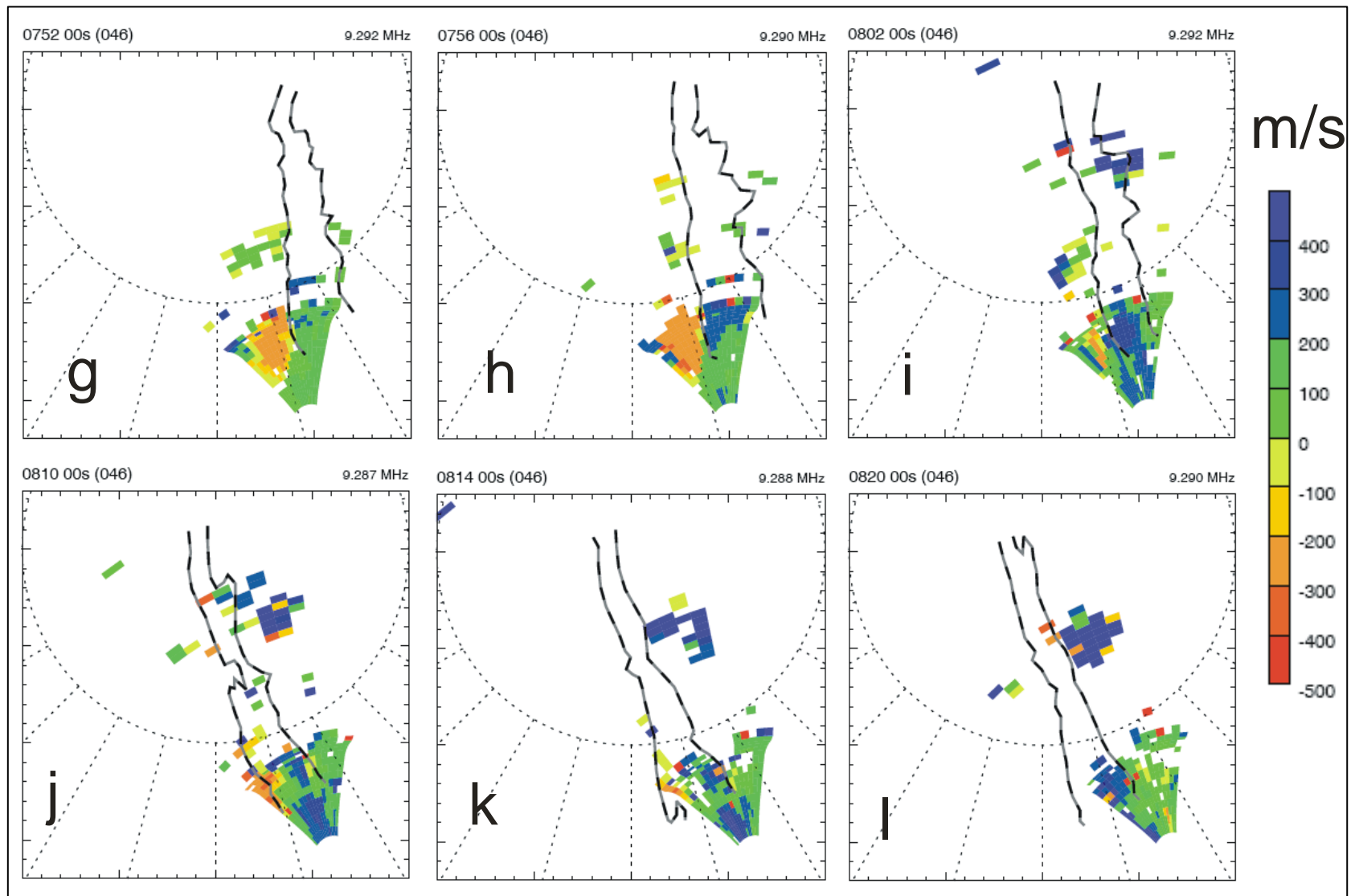
Polarity change at the duskward edge

Velocity



# Arc signatures in echo velocity

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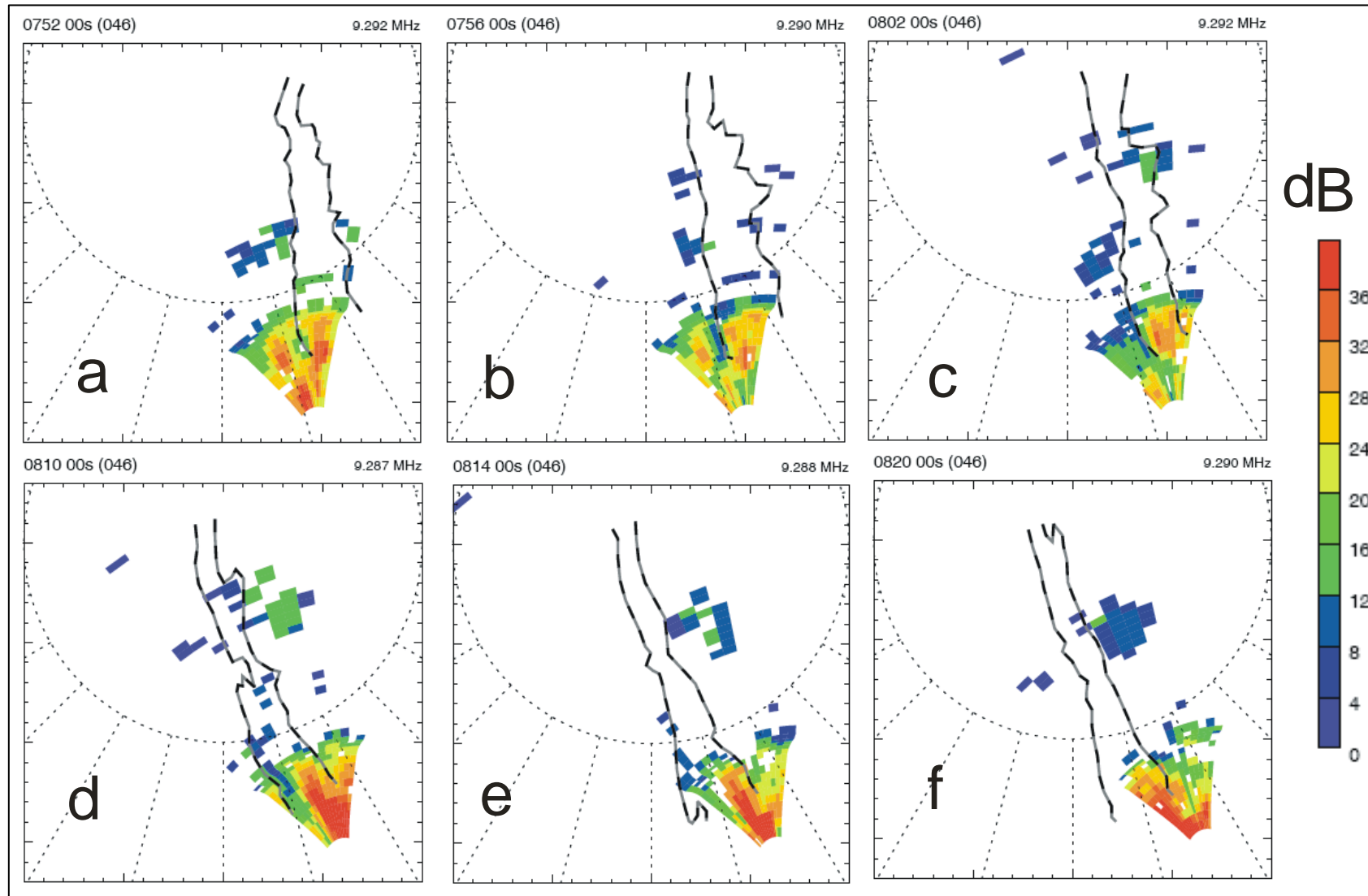


**Velocity reversal boundary is progressing duskward synchronously with the arc.**



# Arc signatures in echo power

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**Power drop is progressing duskward synchronously with the arc.**

# Beam 7 observations

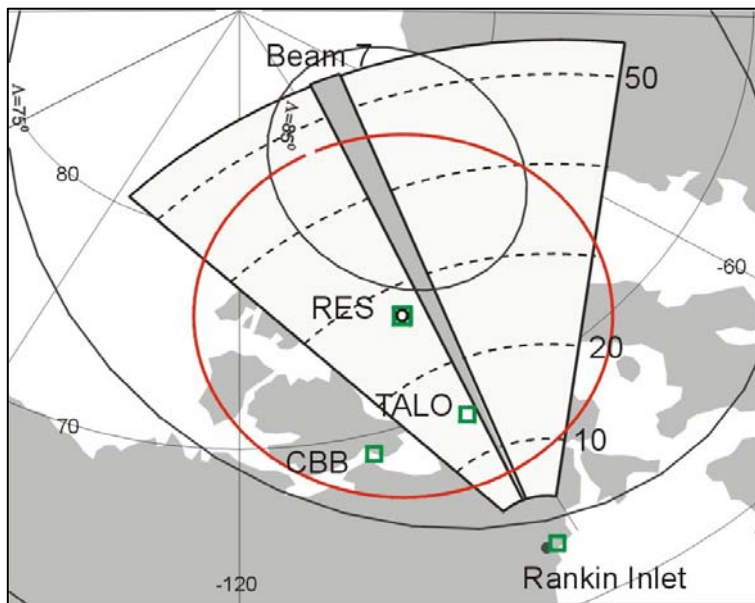
Power

Just a marker

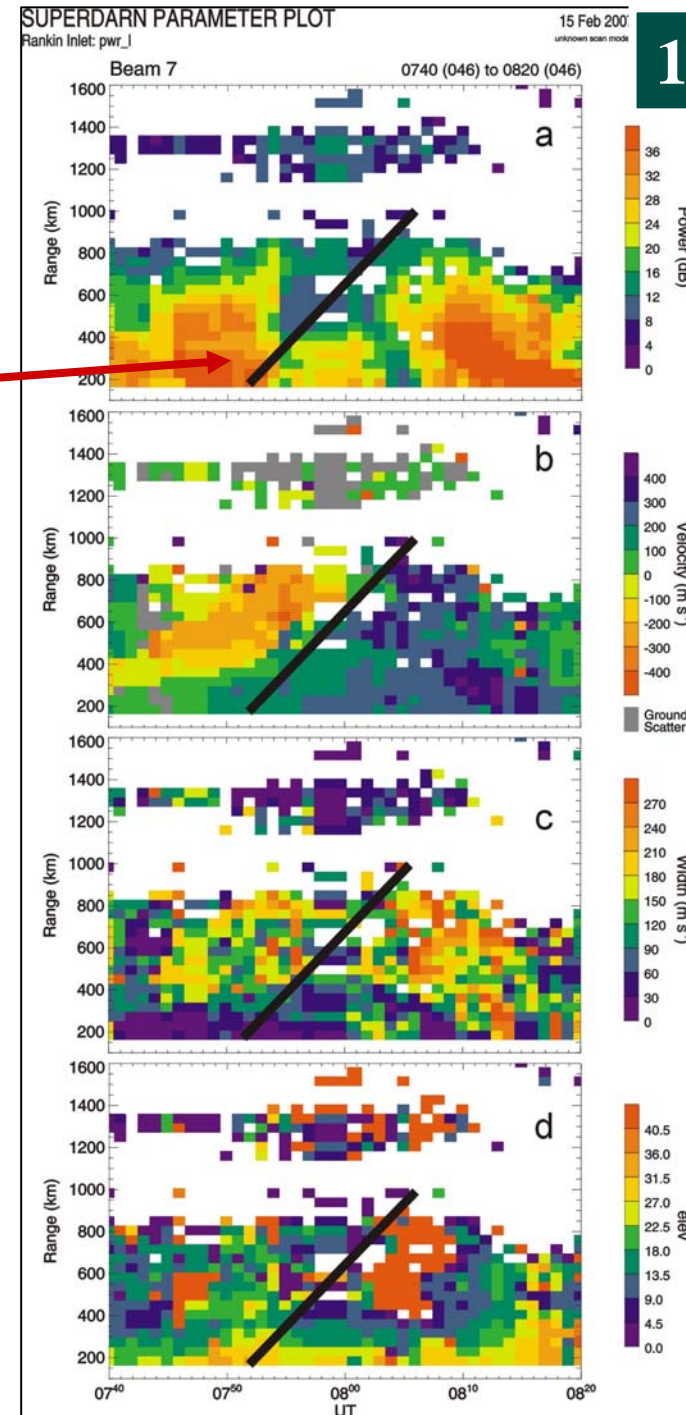
Velocity

Width

Elev. angle

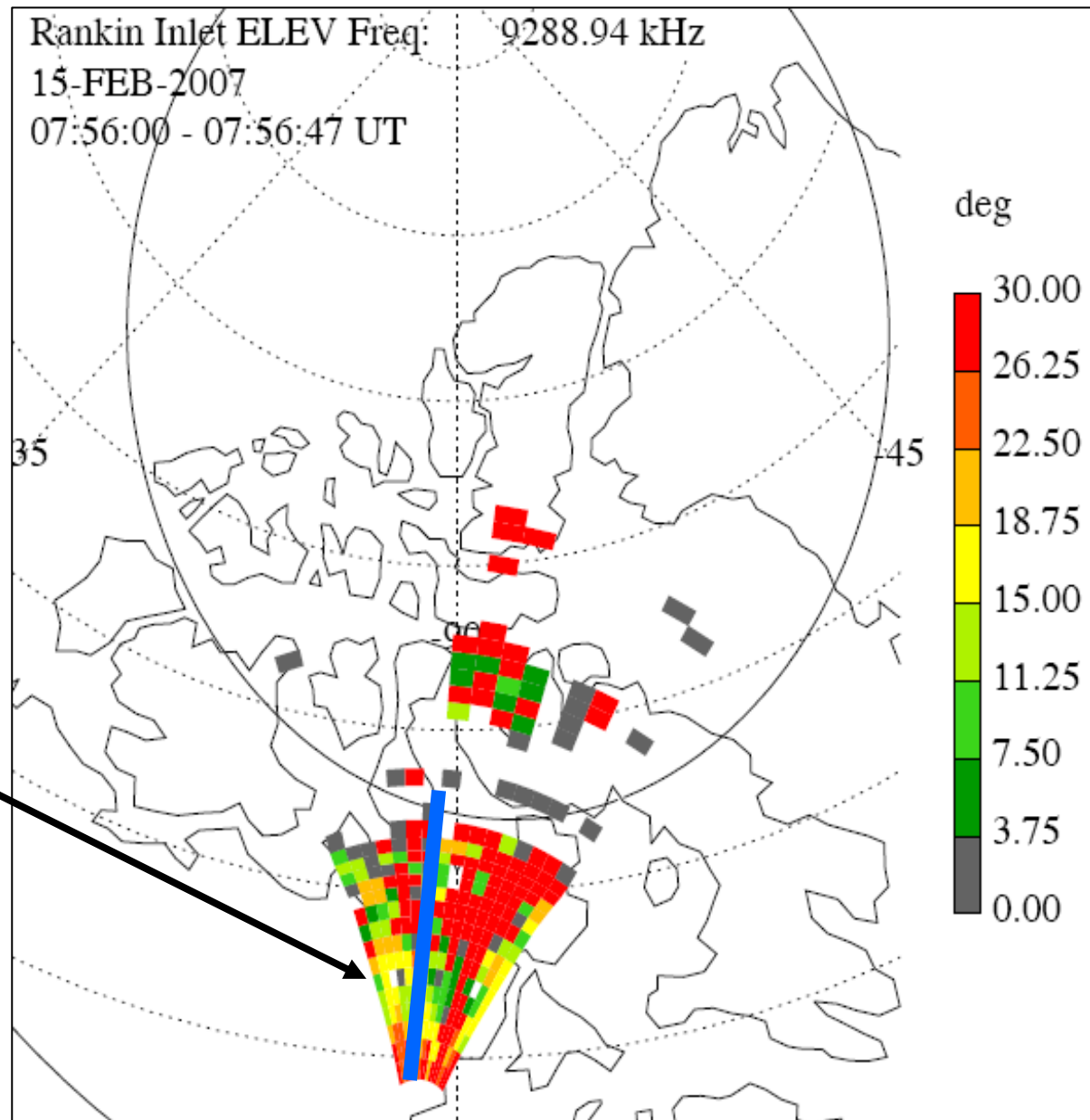


Echoes at very short ranges do not show polarity change, width enhancement and elevation angles increase.



# 2-D elevation angle plot

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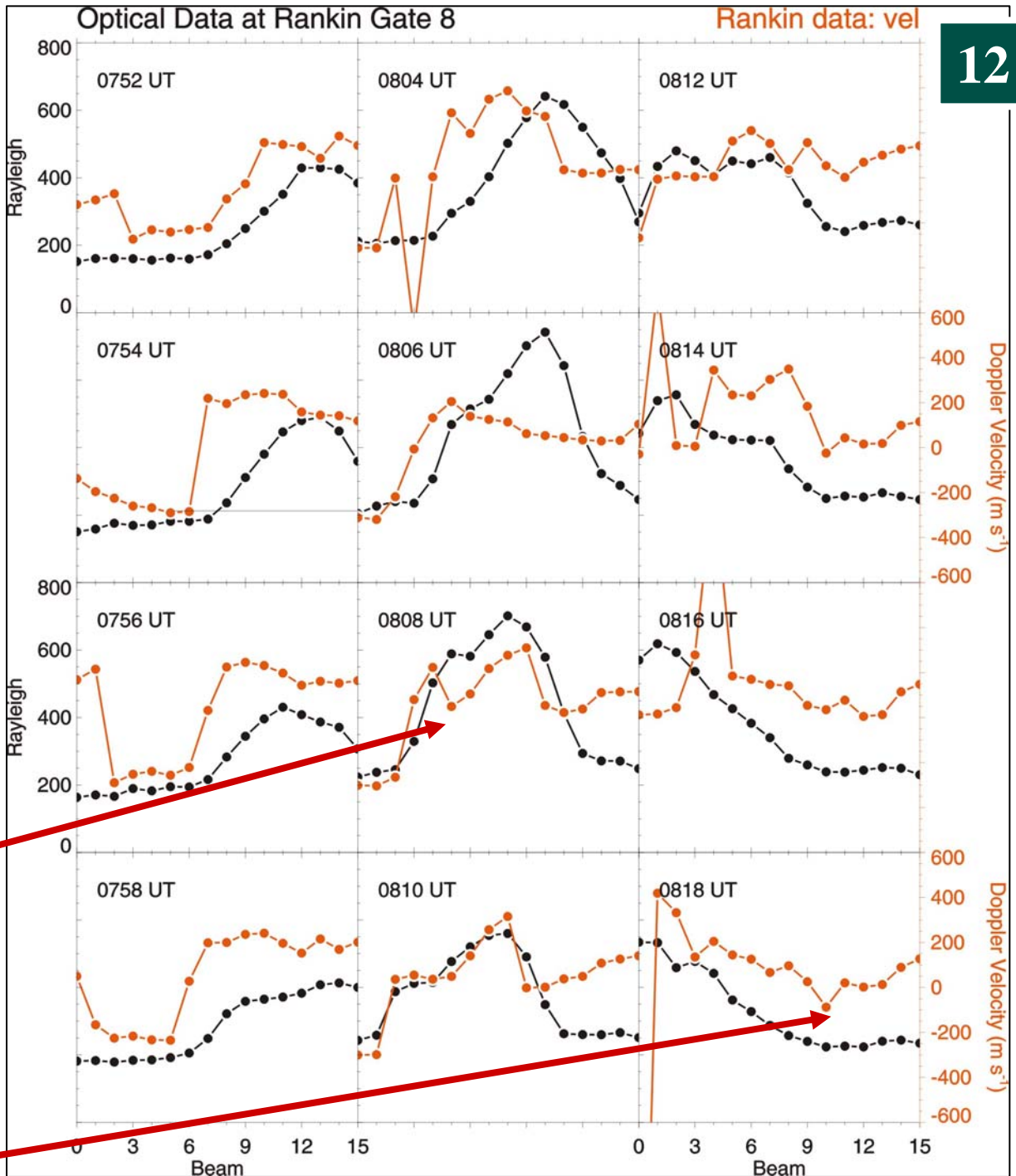
Sketch, not precise

# Luminosity and echo velocity

Velocity reversal shifts duskward together with the arc.

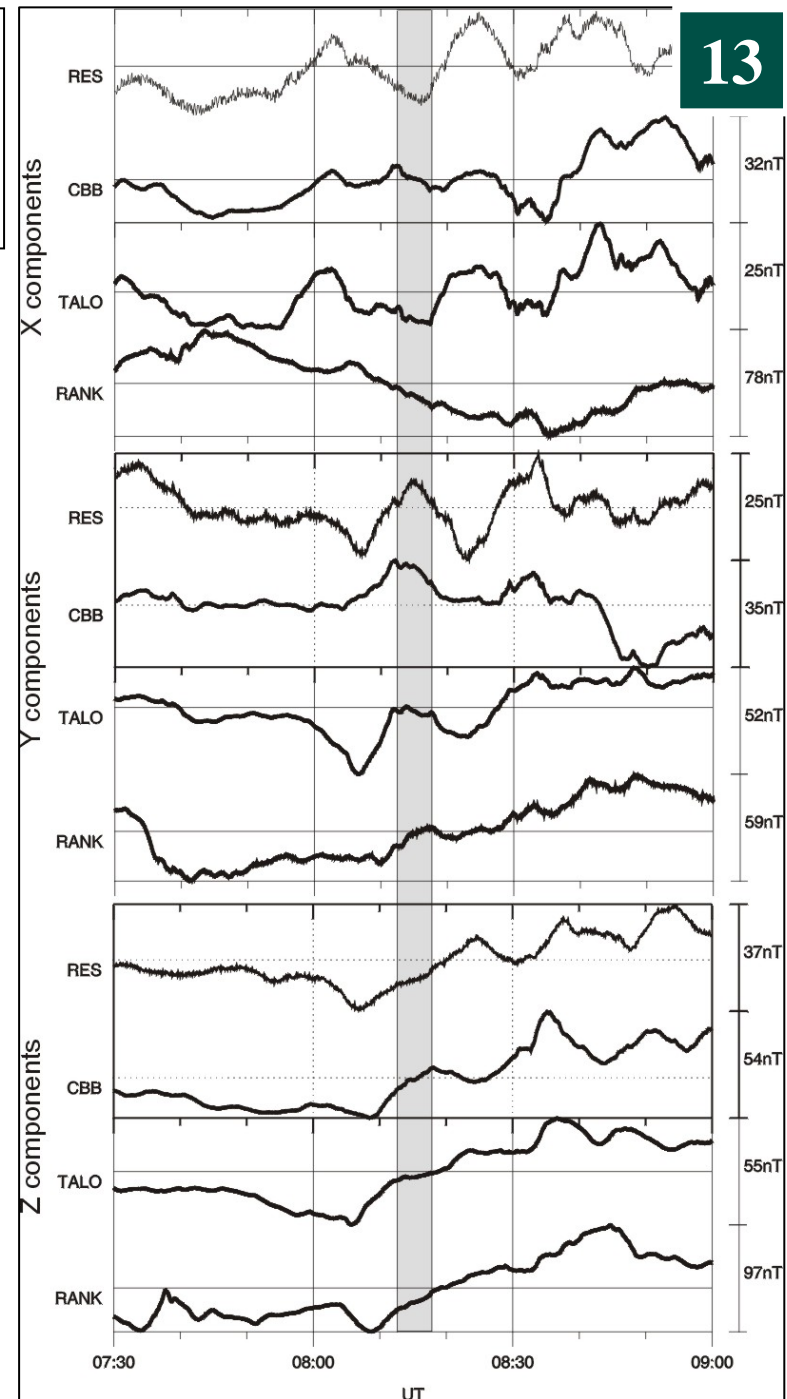
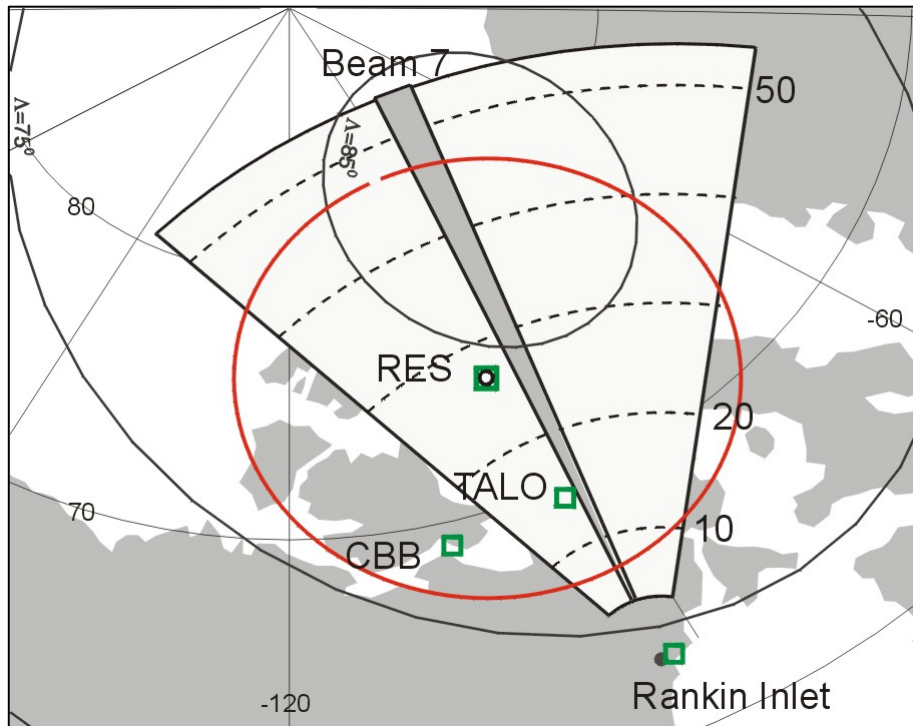
Velocity dip starts to form and the arc double structure becomes recognizable.

Velocity goes to the background level as the arc moves away duskward.



# Magnetometer signatures

**RES, TALO and CBB show similar features. RANK is different.**

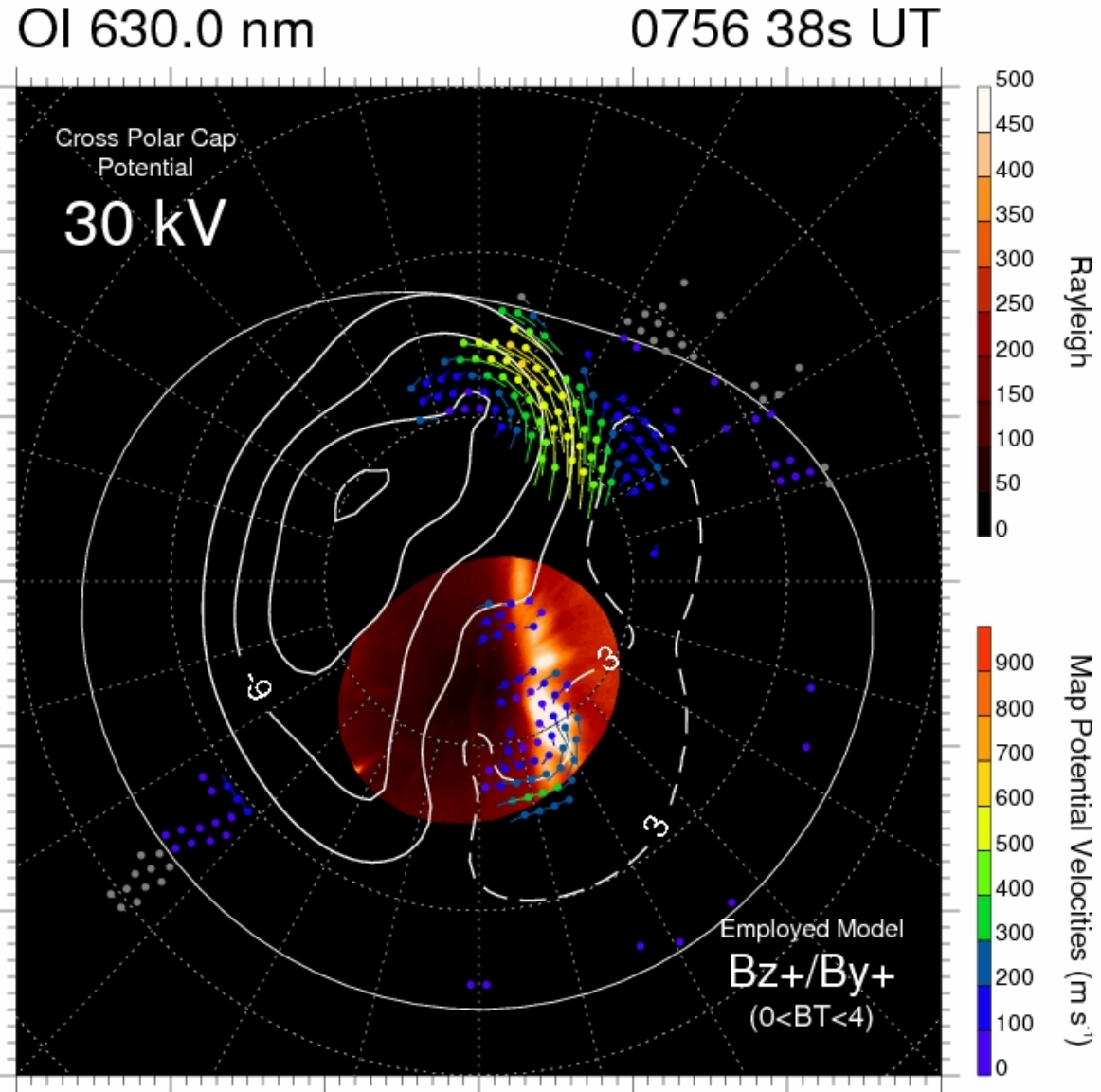


# OMTI ASI PARAMETER PLOT

RSB vs RKN (emission height: 250 km): abs-data

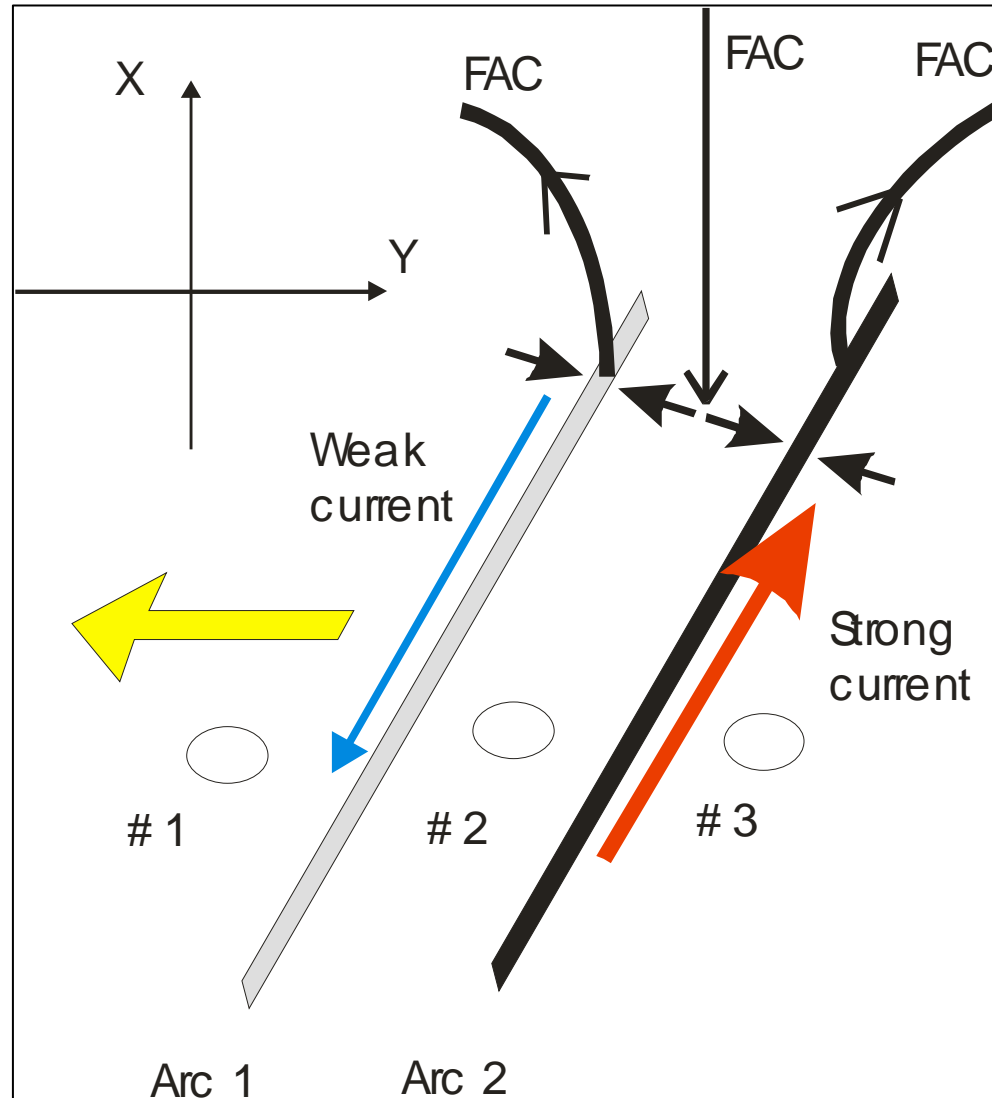
**Arc and global convection pattern**

Arc-related velocities form an “inclusion” in the global morning convection cell.



# Model illustrating currents associated with double-structured SA arc

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# Results:

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1. Rankin radar is shown to be convenient for SA arc studies. Radar signatures have been identified in echo power, velocity, width and elevation angle.
2. On a global scale, the arc looked as a structure separate from the global morning-side convection cell. Perhaps pattern reflected a change from  $B_y^-$  to  $B_y^+$  configurations.
3. Magnetic perturbations associated with the SA form passing the zenith of a magnetometer have been identified. Their magnitudes are  $\sim 20$  nT. Perturbations are consistent with a simple two-string current model.
4. More events are to come. Patterns seem to be complex.