Poynting flux at the PSBL in conjunction with the ground aurora

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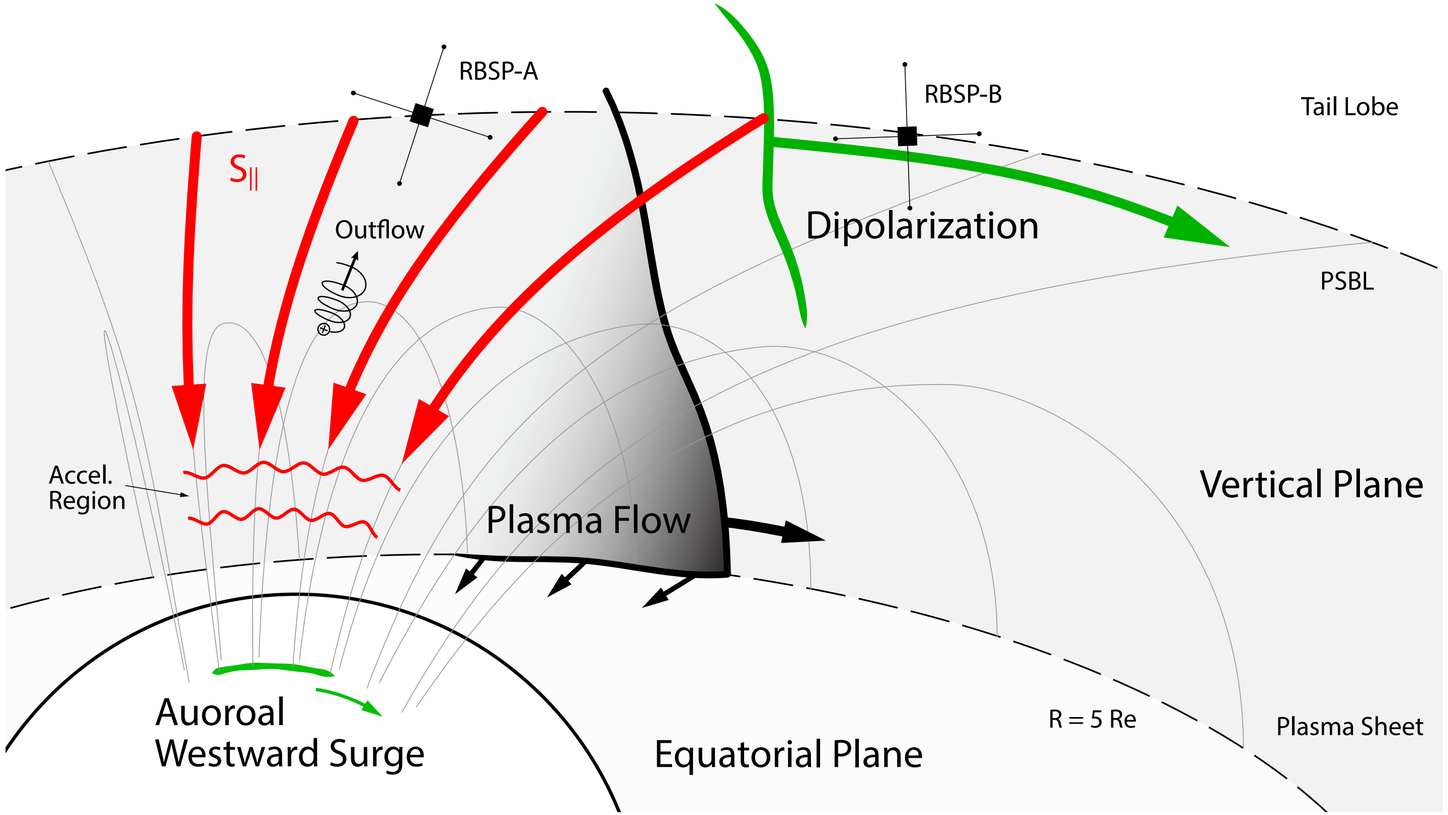
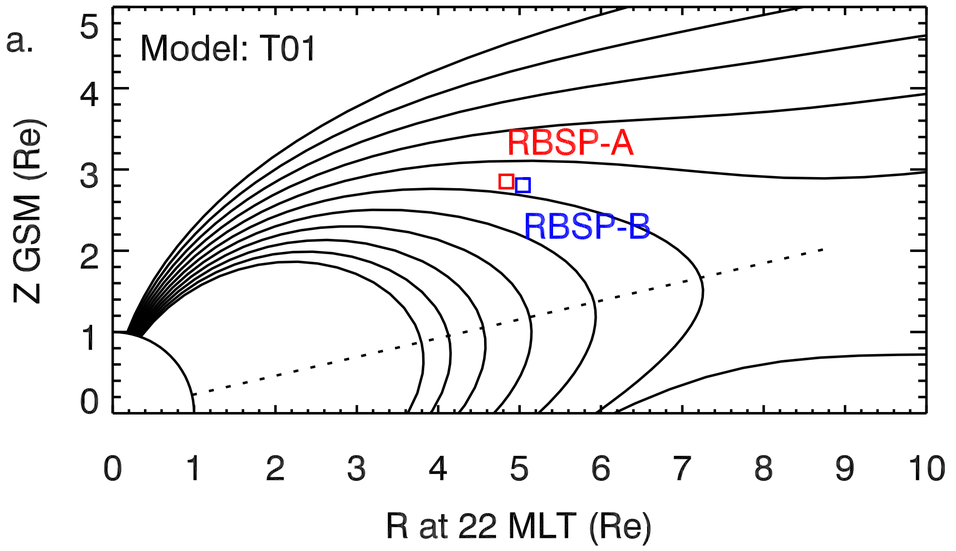
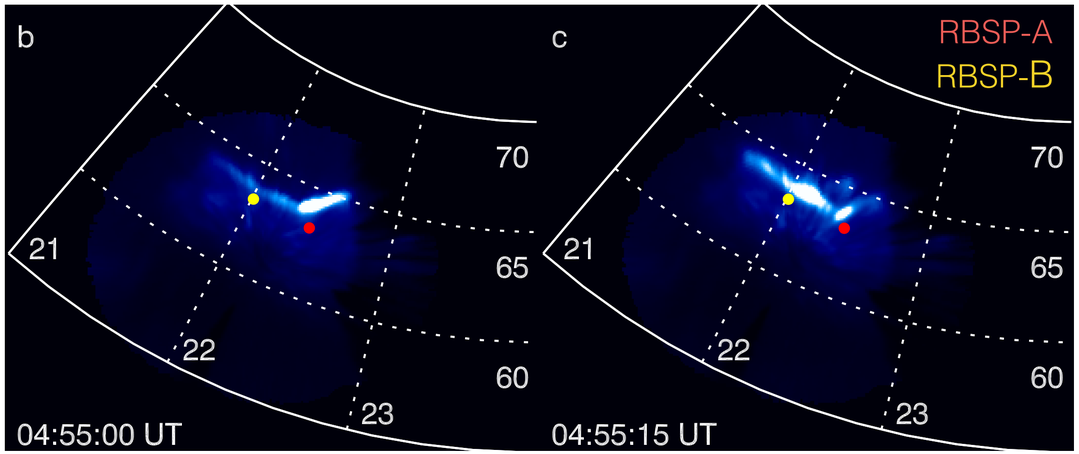
Overview — Jun 07, 2013 event

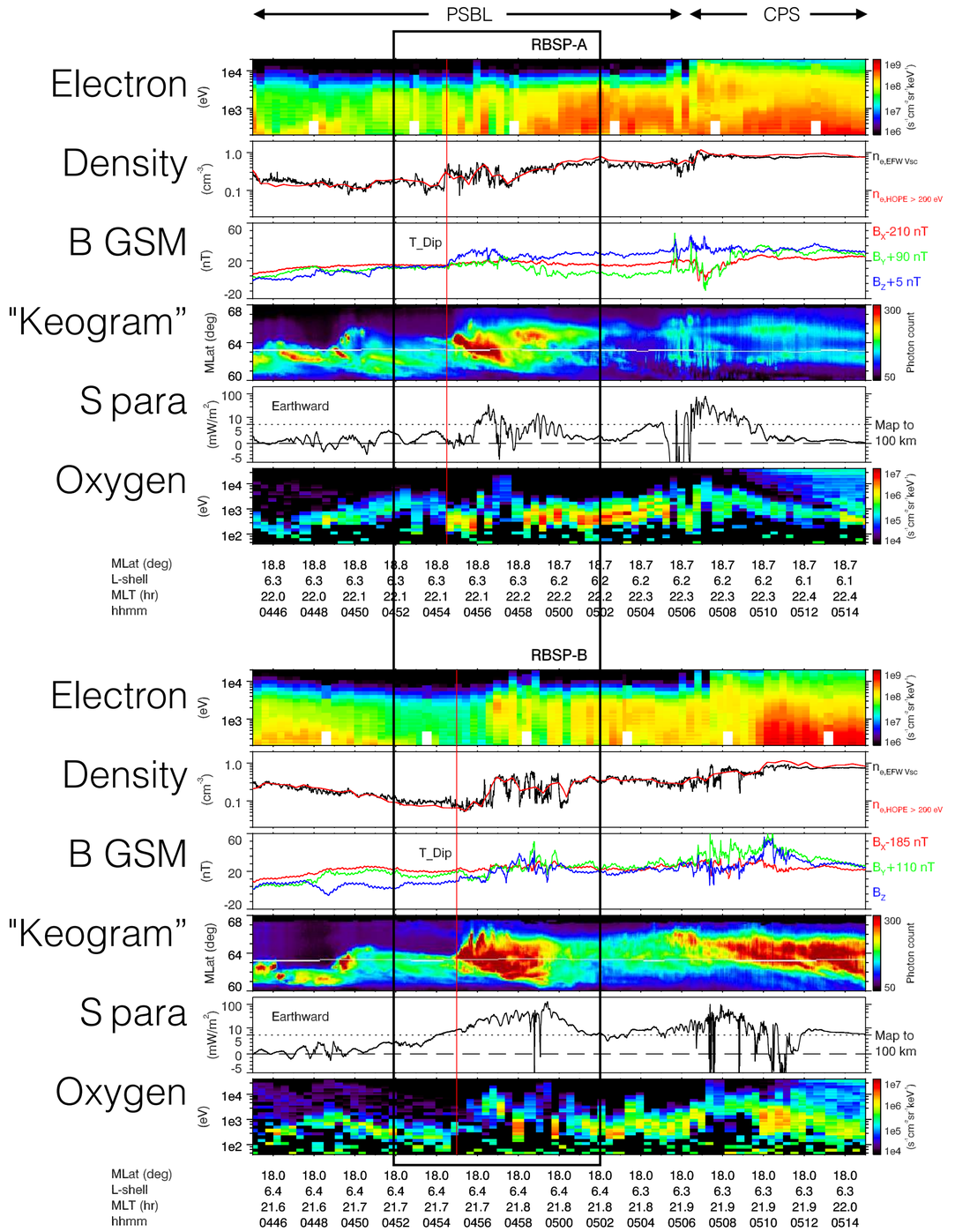


- Earthward Alfvénic Poynting flux S in conjunction with discrete aurora, good correlation in time & location.
- Evidence for O+ outflows powered by $S_{||}$ (timing and energy budget).
- The speed of aurora westward traveling surge matched the westward propagation of the dipolarization front (DF).
- Plasma flow was much slower than DF, but may carry enough kinetic energy flux to explain $S_{||}$.

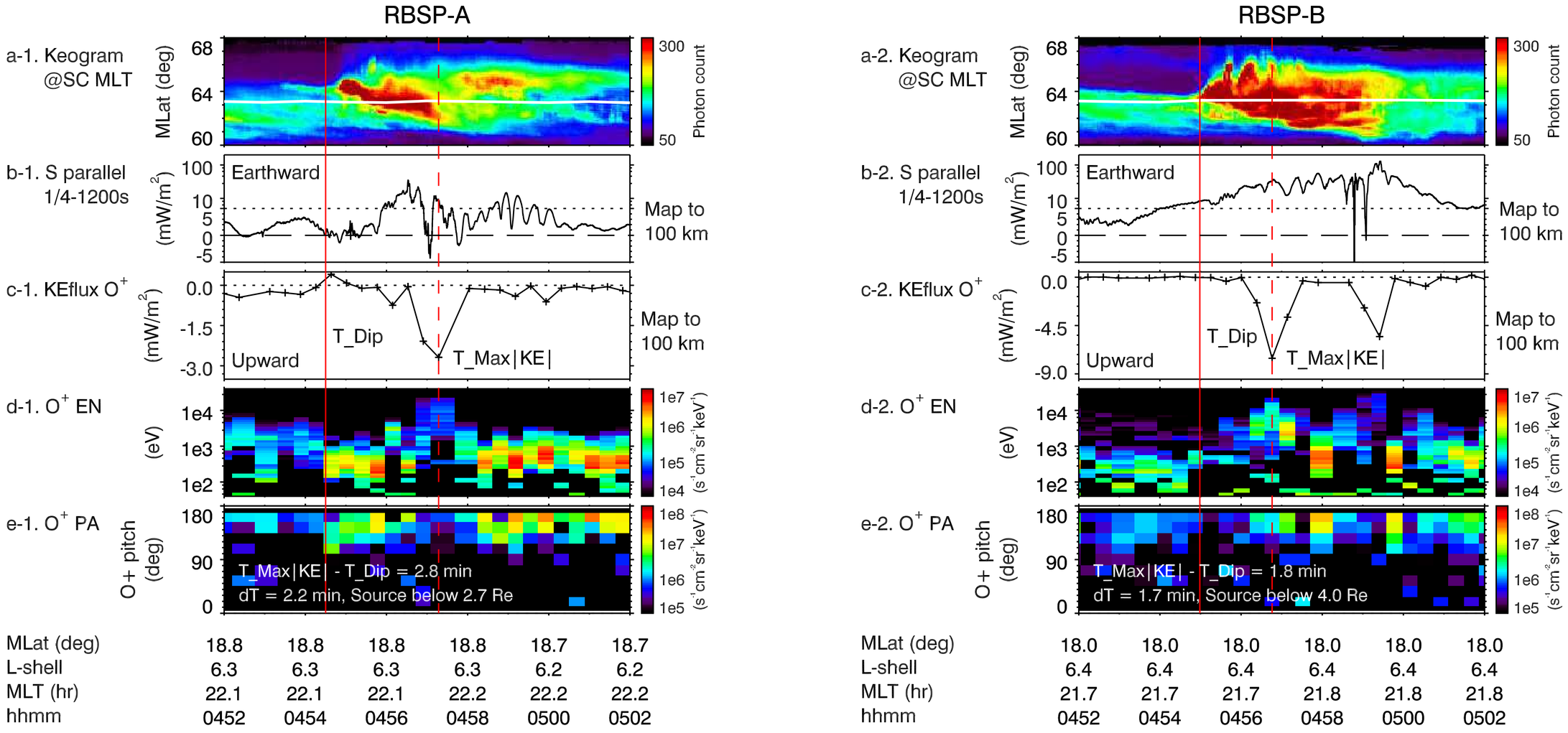
Key observations: in PSBL, density structure, dipolarization, aurora motion, large $S_{||}$, O+ outflow





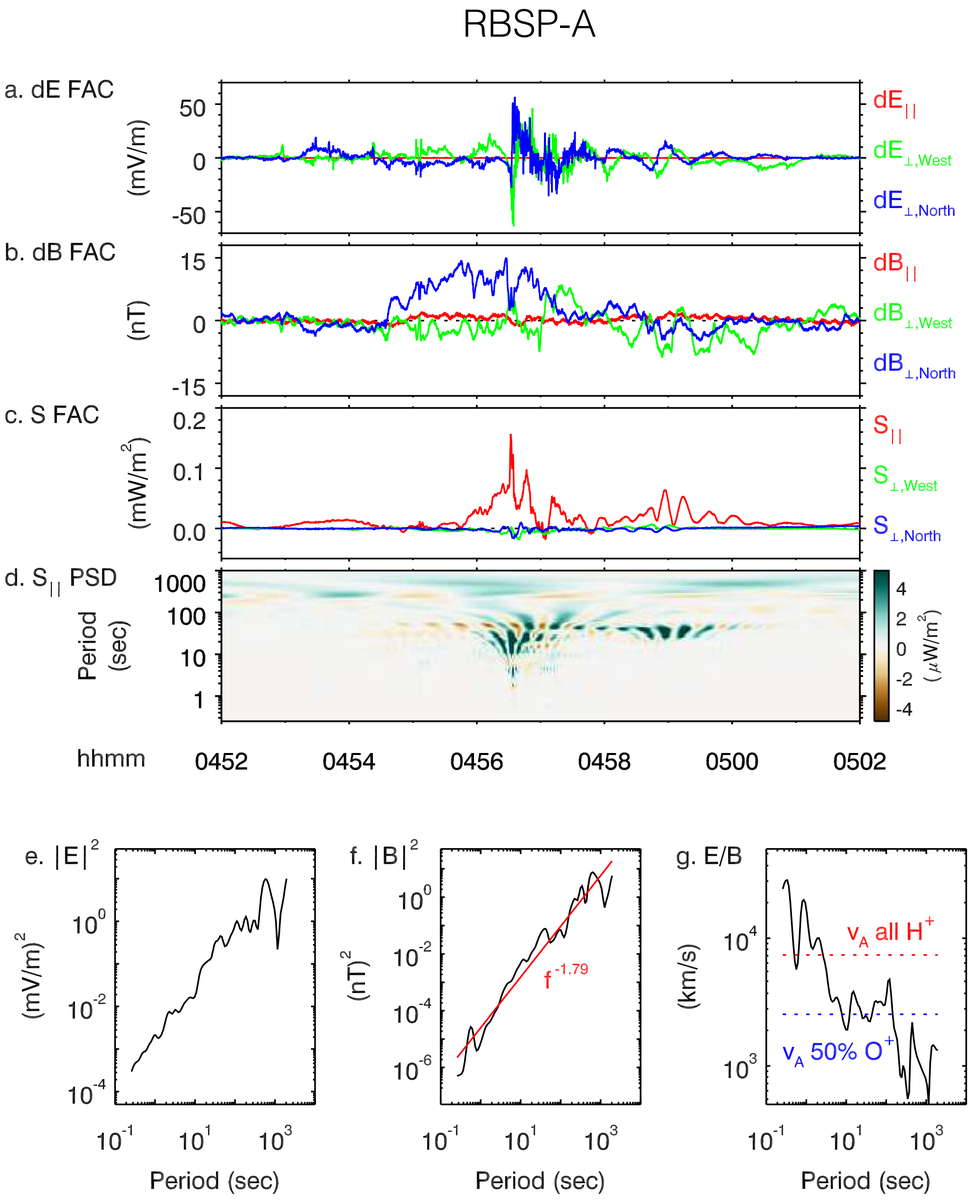


Poynting flux powers discrete aurora and oxygen outflow

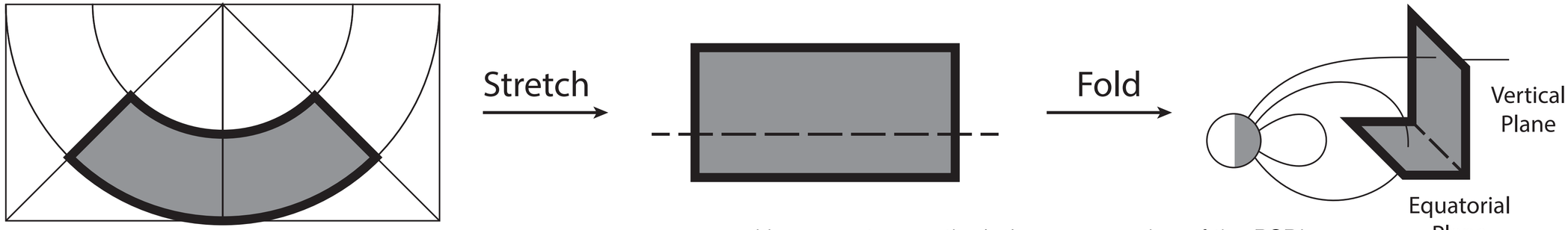


Poynting flux properties

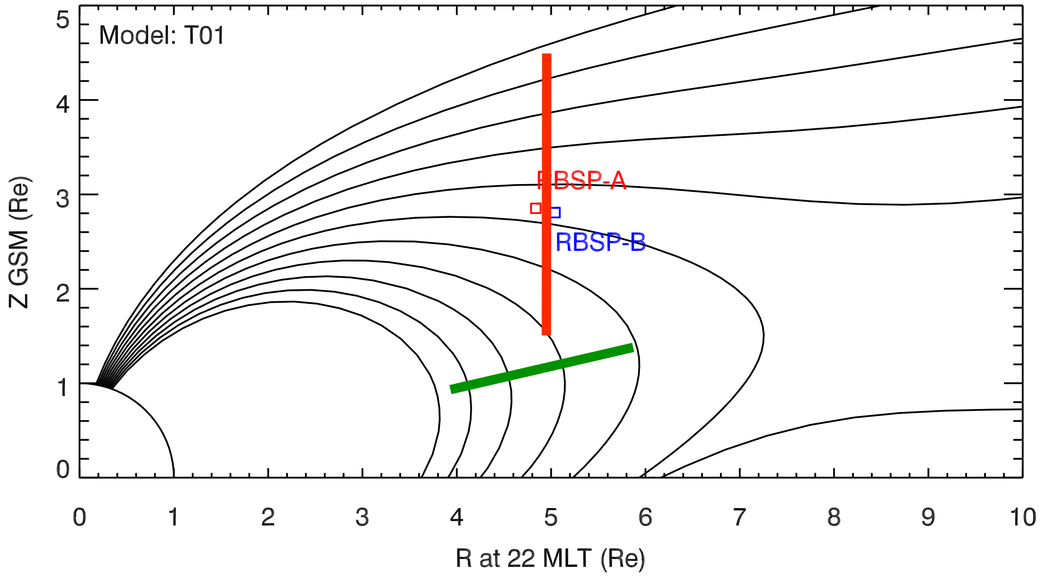
- Total Poynting flux is predominantly earthward
- Magnetic energy is mostly efficiently transmitted within 5 to 200 sec, where the E/B ratio is comparable to local Alfvén speed
- (overview plot) Poynting flux tends to concentrate at density gradients, which suggests phase mixing and/or mode conversion for Alfvén wave generation
- PSD of dB agrees with a Kolmogorov-like spectrum (5/3 law)

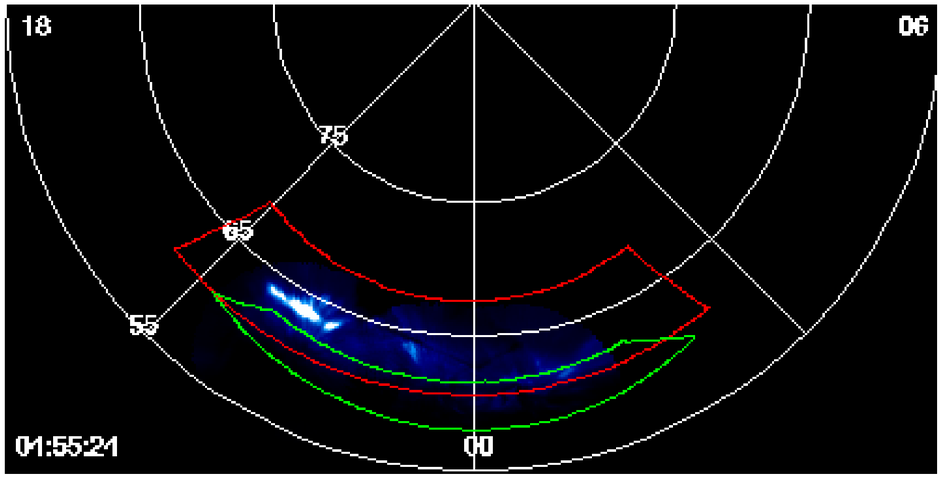


Determine aurora motion — minimizing mapping error



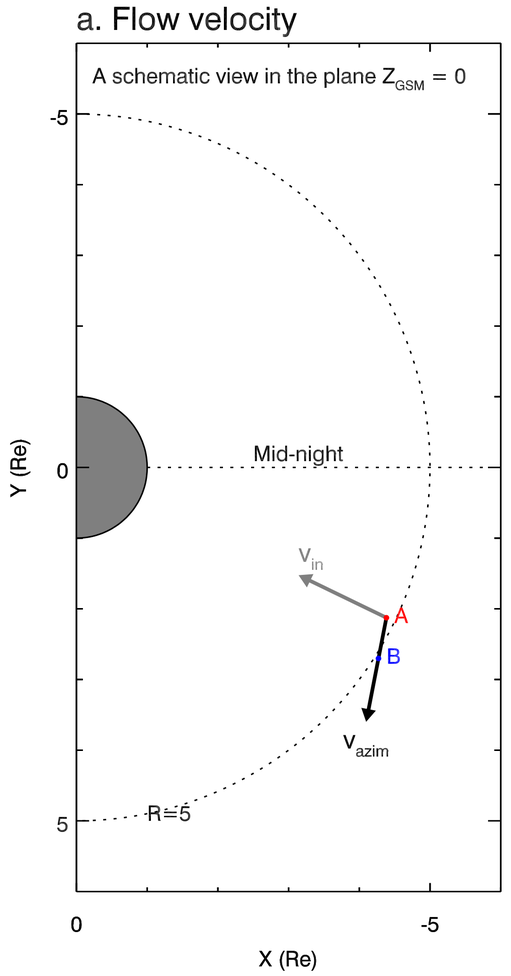
Upper part → vertical plane, expansion of the PSBL
Lower part → equatorial plane, earthward injections

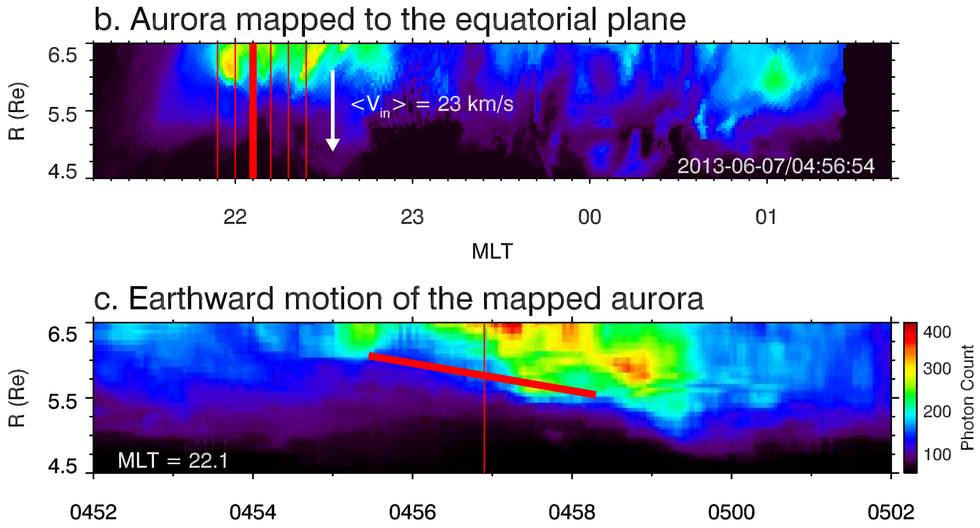


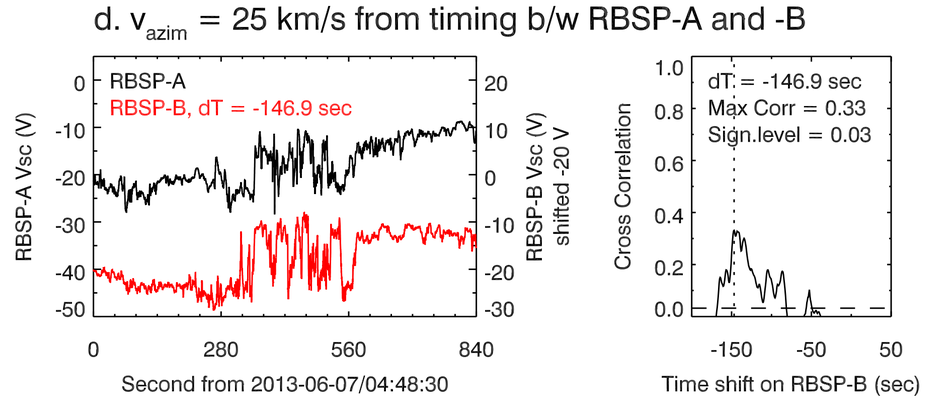


The motion of the plasma flow in the equatorial plane

- 25 km/s westward in the azimuthal direction, based on time lag of inter-spacecraft density structures
- 23 km/s inward in the radial direction, based on the motion of the inner boundary of the aurora oval in the equatorial plane



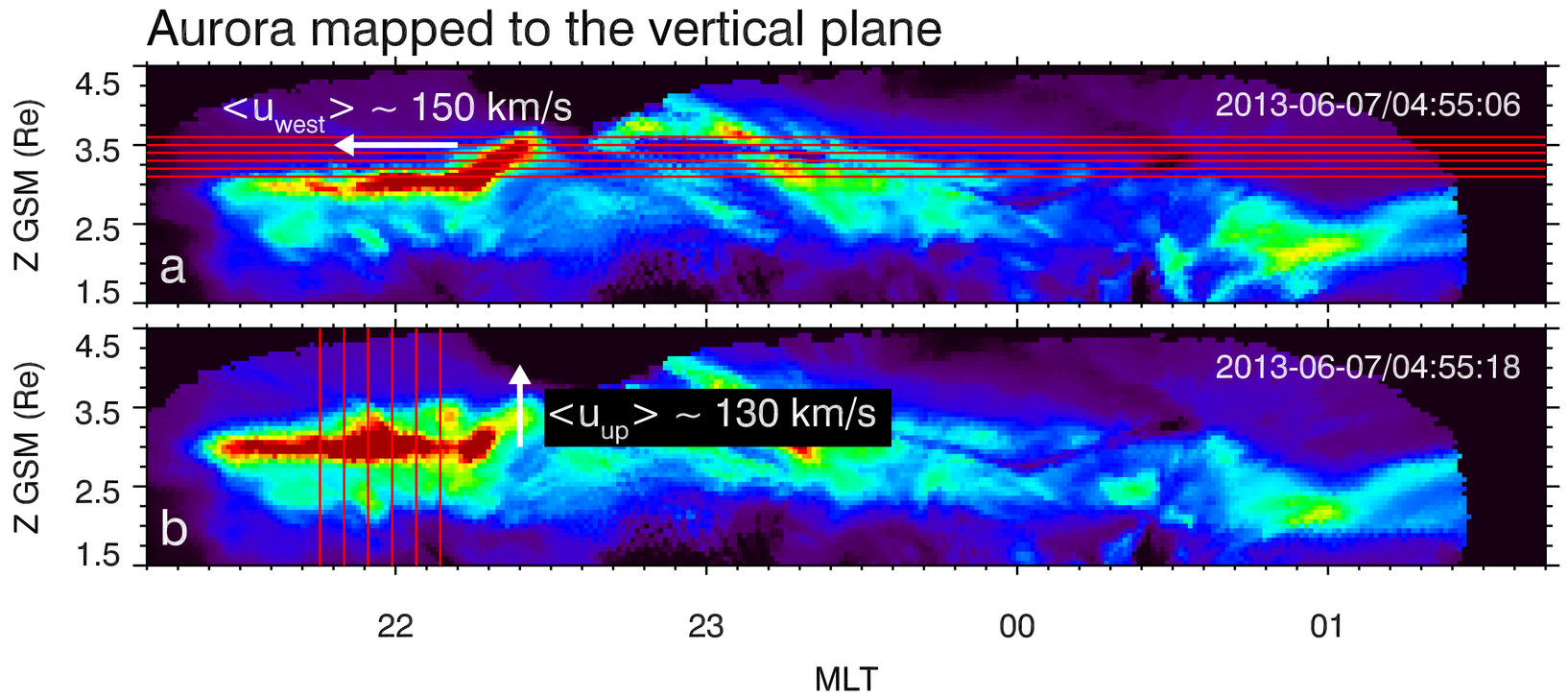




Aurora motion in the vertical plane

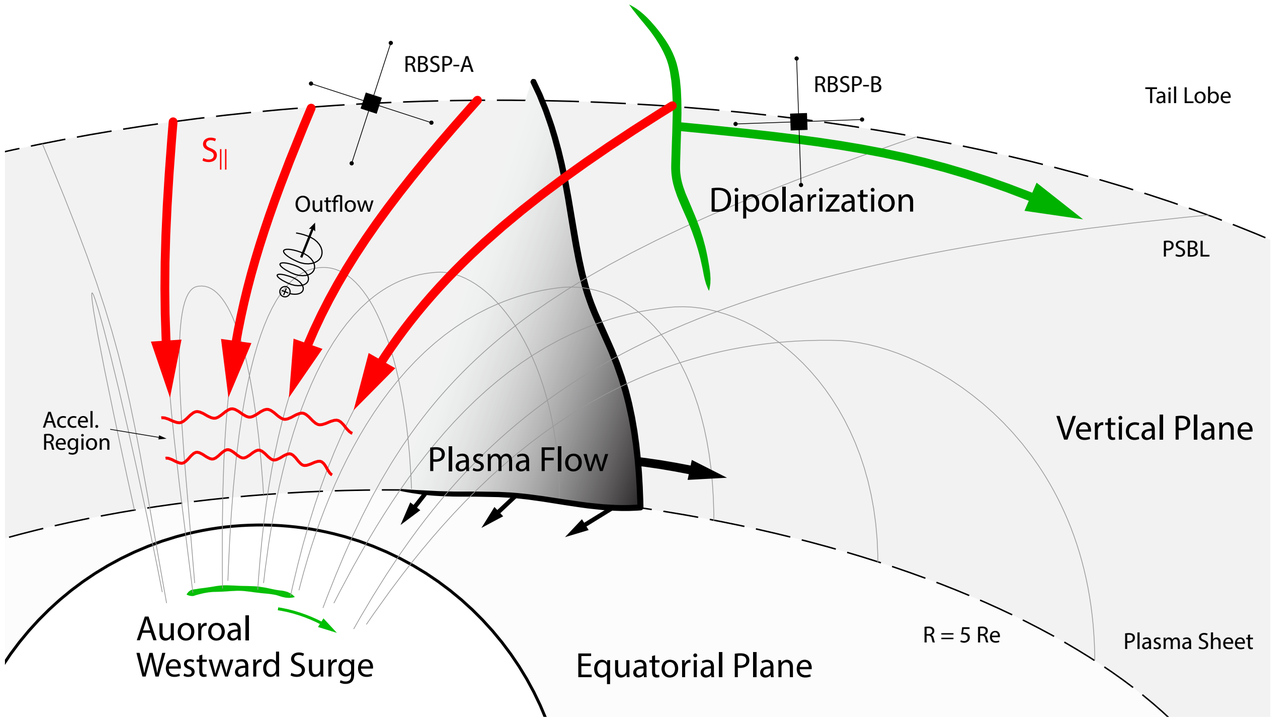
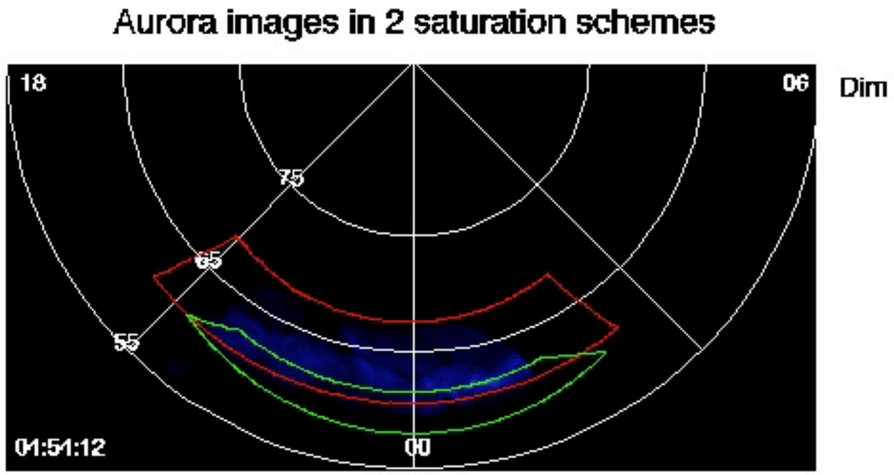
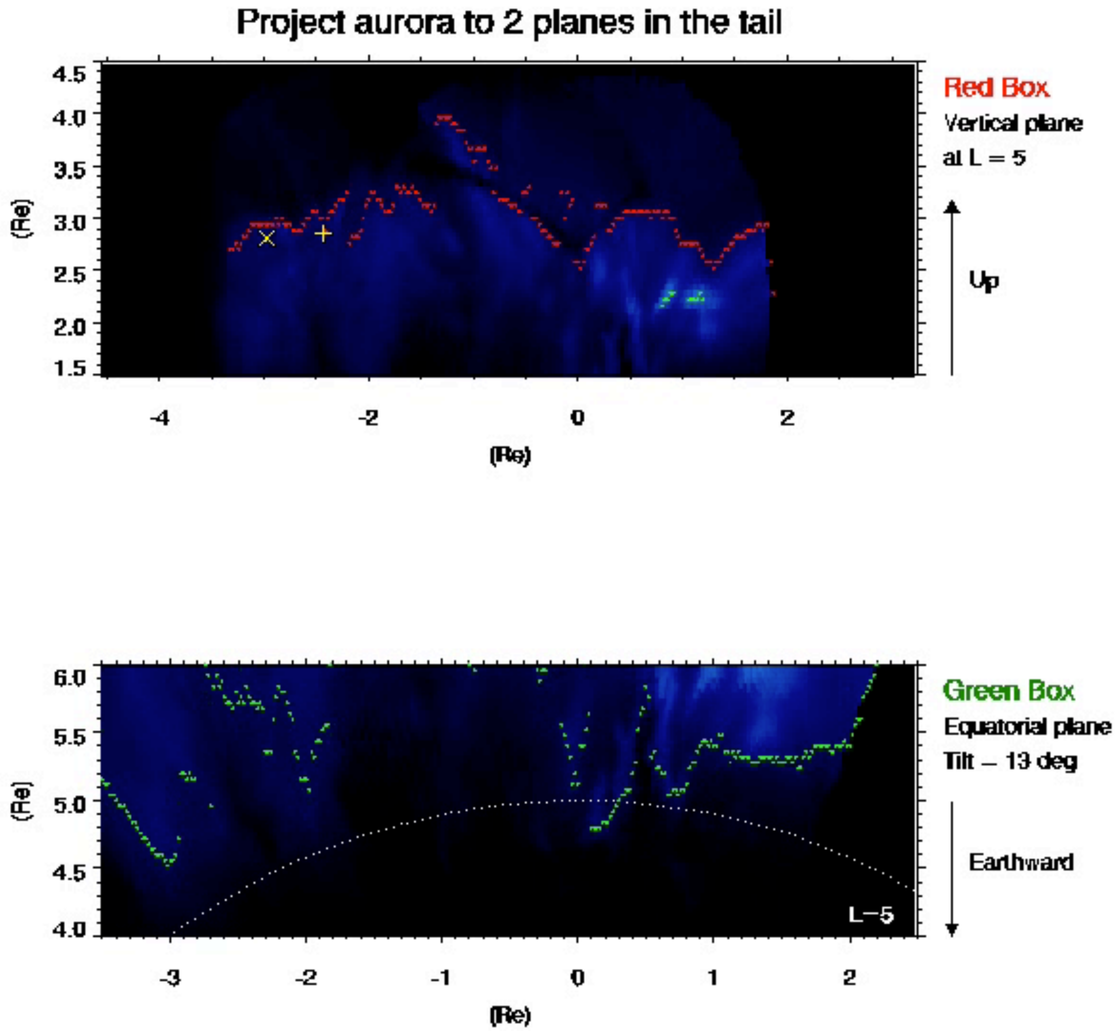
- Auroral westward traveling surge @150 km/s
- Poleward expansion @130 km/s

	V_{az} (km/s)	Notes
Aurora	150	Based on the ewogram mapped to SC location
Dipolarization	127	Time lag of the increase in B_z between SC
Plasma flow	25	Time lag of the density structure between SC
E_z/B	-100	Assuming E_z is due to convection instead of wave
$\delta E/\delta B1$	2500	E/B ratio of the Alfven wave
$\delta E/\delta B2$	500	E/B ratio of the FAC
Ionospheric flow	< 10	Typical flow speed mapped to SC location



Conclusions

- Direct observation on the spatially/ temporally correlated aurora arc and earthward Poynting flux
- The Poynting flux was Alfvénic and concentrated at PSBL density gradients
- Oxygen outflow powered by the Poynting flux
- The speed of auroral westward traveling surge matched the propagation of dipolarization



Aurora mapped to in-situ vertical and equatorial planes