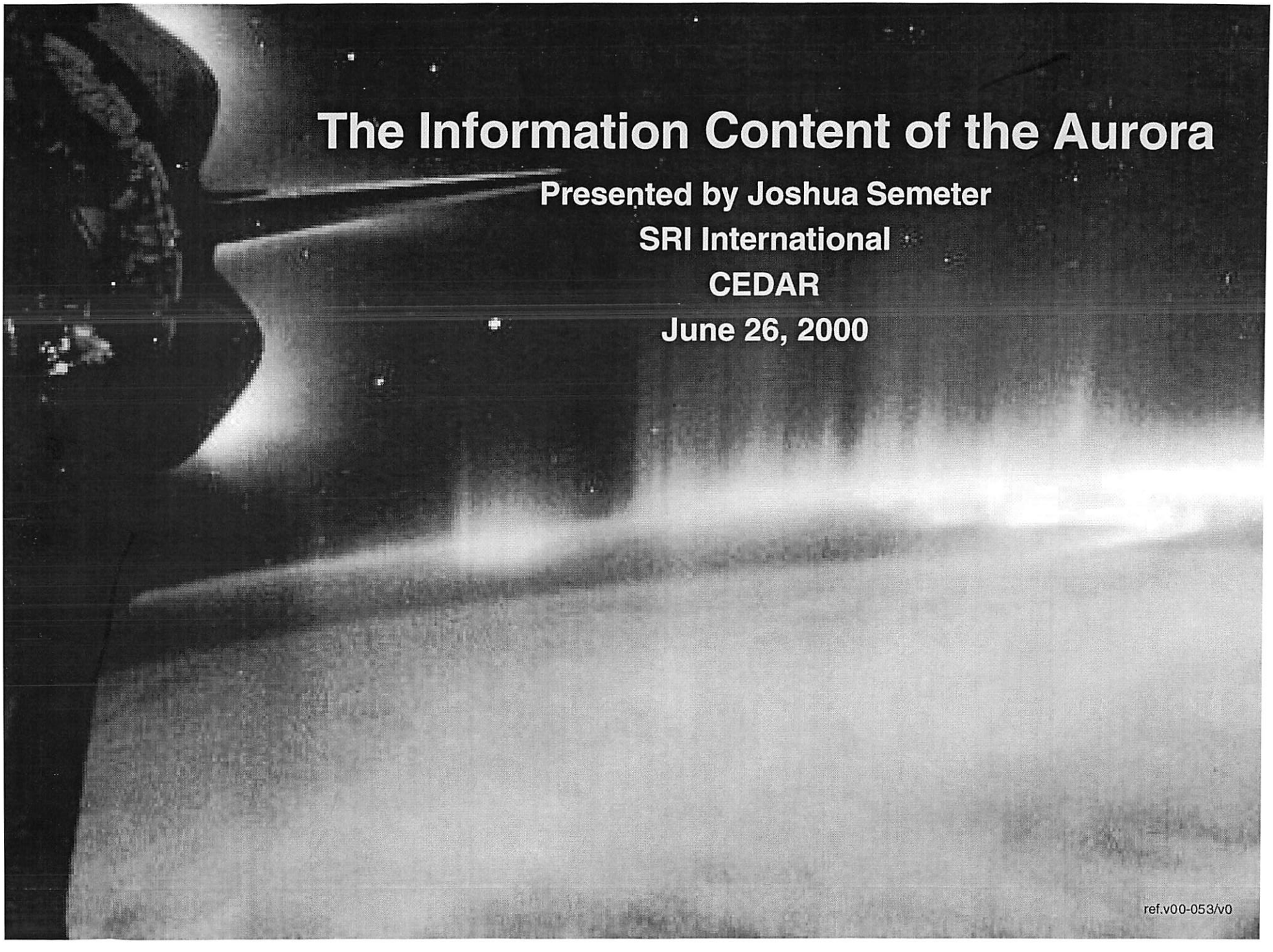
Extra black and white slides



Dimensions of Auroral Information

Magnetospheric Process

v(space,wavelength,time)

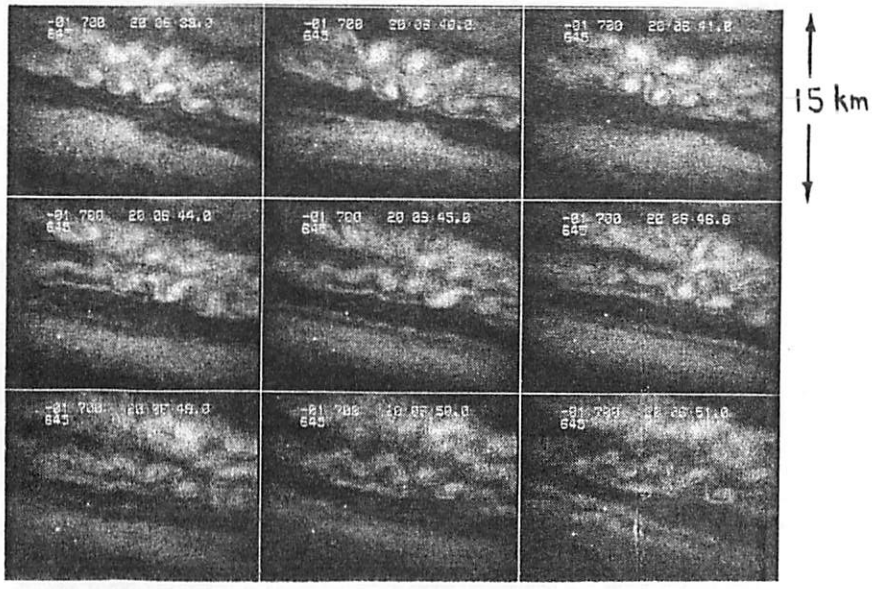
⊥ B

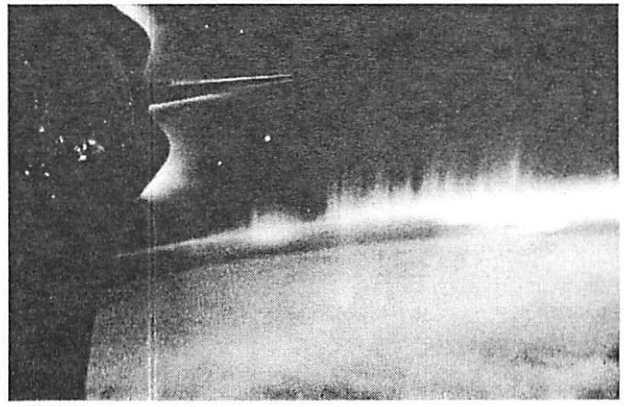
|| B

Horizontal Structuring

Auroral Motions

Altitude Emission Profile





Does a Meaningful Solution to d=Lv+n exist?

Overdetermined does not mean least squares solution exists!
Must determine the rank of **L**.

For linear discrete inverse problems, **L** should be diagnosed through a singular value decomposition.

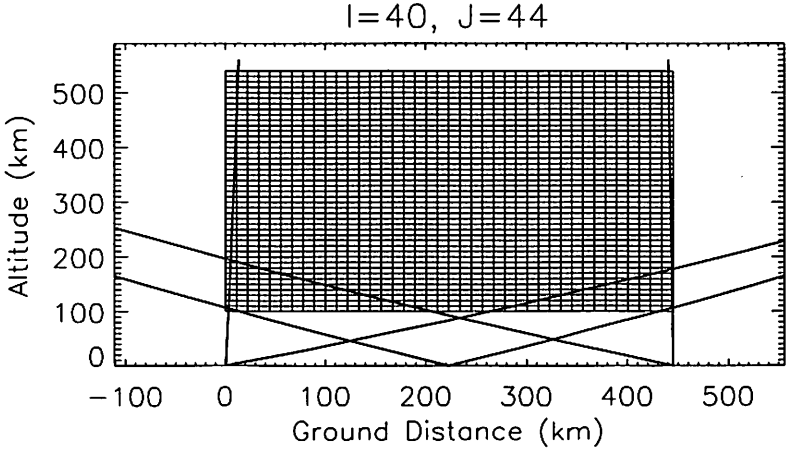
$$\mathbf{L} = \mathbf{U}[\mathrm{diag}(\mathbf{s})]\mathbf{V}^T \qquad \mathbf{L}^{\mathrm{inv}} = \mathbf{V}[\mathrm{diag}(1/\mathbf{s})]\mathbf{U}^T \qquad (1)$$

U forms a basis for the range of L. V forms basis for the null space $\Leftarrow$ The rank is reflected in SVD's.

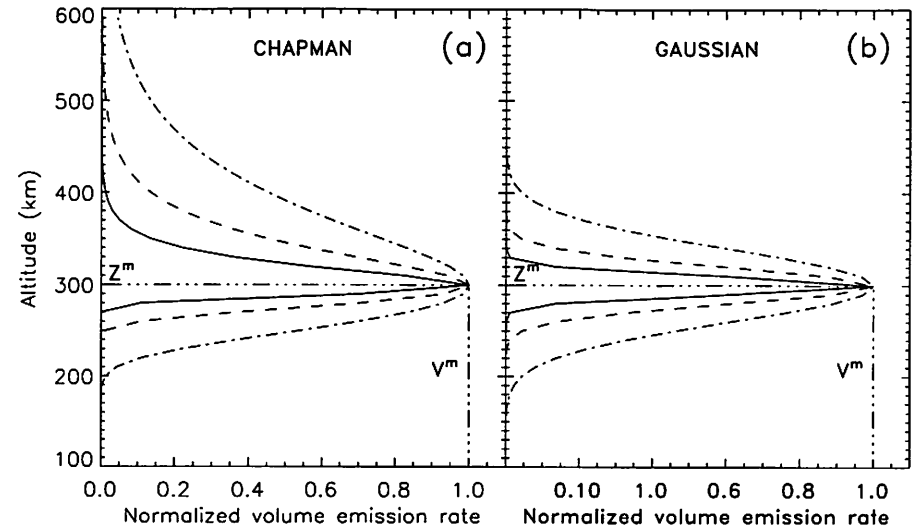
Conundrum for Pixel-based Auroral Tomography

A well-conditioned pixel-based auroral tomography problem will have little useful solution resolution.

An auroral tomography problem with useful resolution will be ill-conditioned.



Parametric regularization.



Replace pixel basis with simpler 3 parameter model. Many simple non-linear parameterizations are possible, but a gaussian is a very good fit to modeled redline emission profiles.

$$f(x,z) = V_0(x)\exp[-\left(\frac{z - Z_0(x)}{H_0(x)}\right)^2]$$

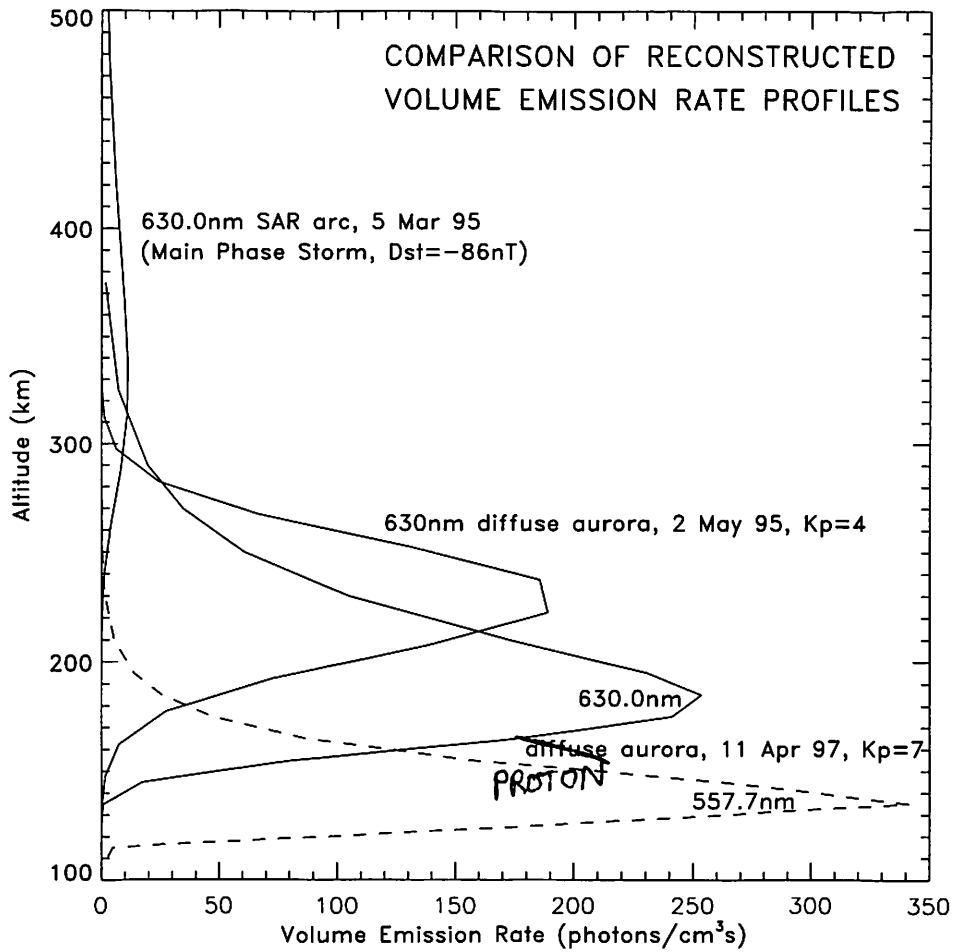
An attractive property.

$$\lim_{H_0 \to 0} f(z) = V_0\delta(z - Z_0))$$

(Semeter & Mendillo, IEEE TGARS, 1996)

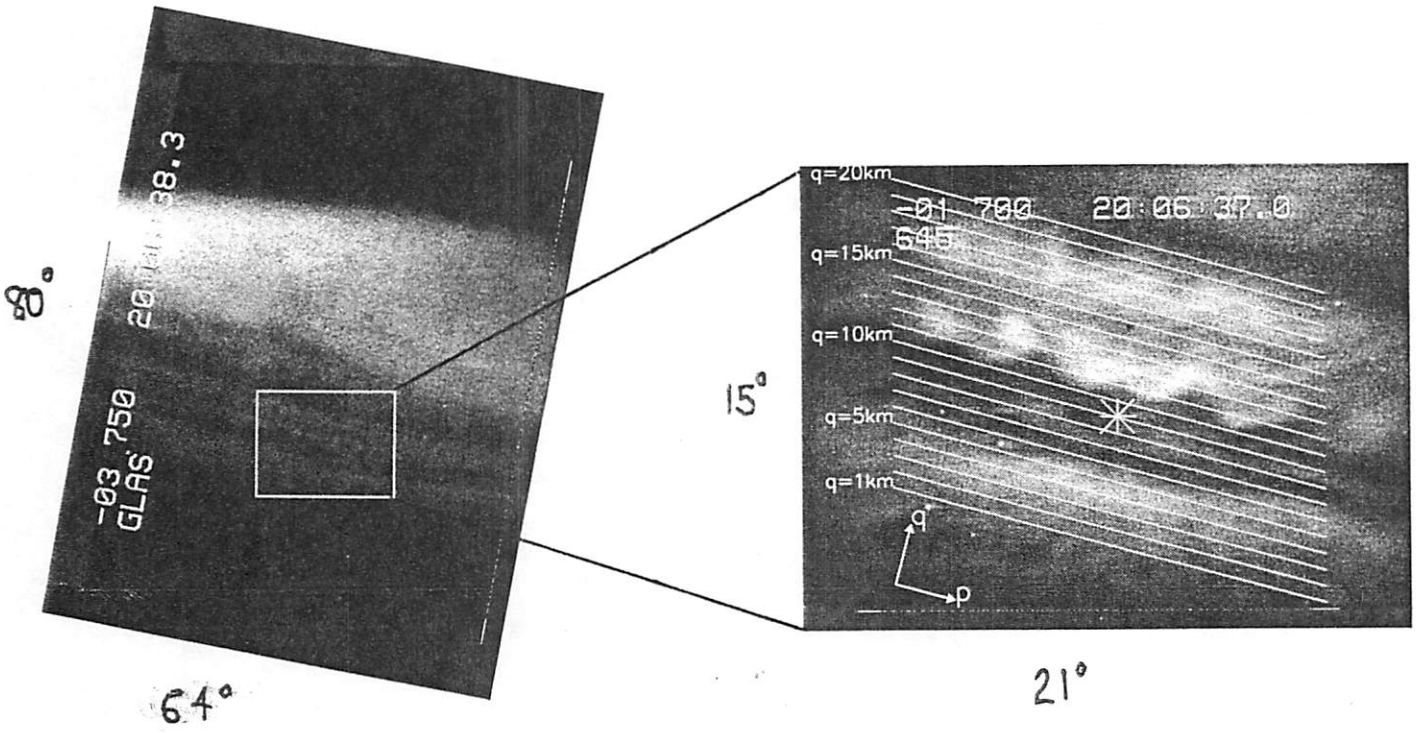
So it is possible to use this model for a thin layer inversion where we seek $V_0(x)$ and $Z_0(x)$.

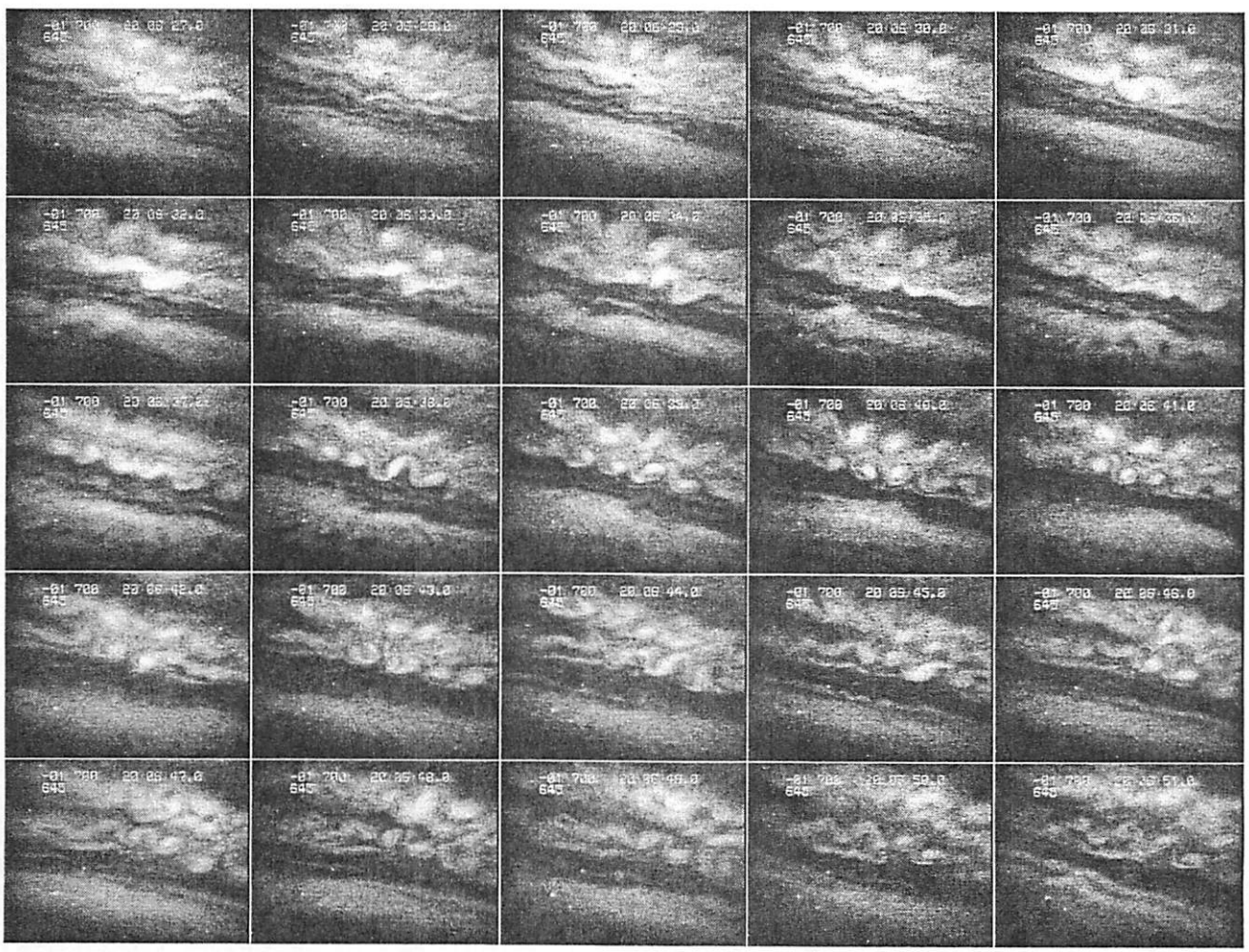
Summary of COTIF Tomographic Results



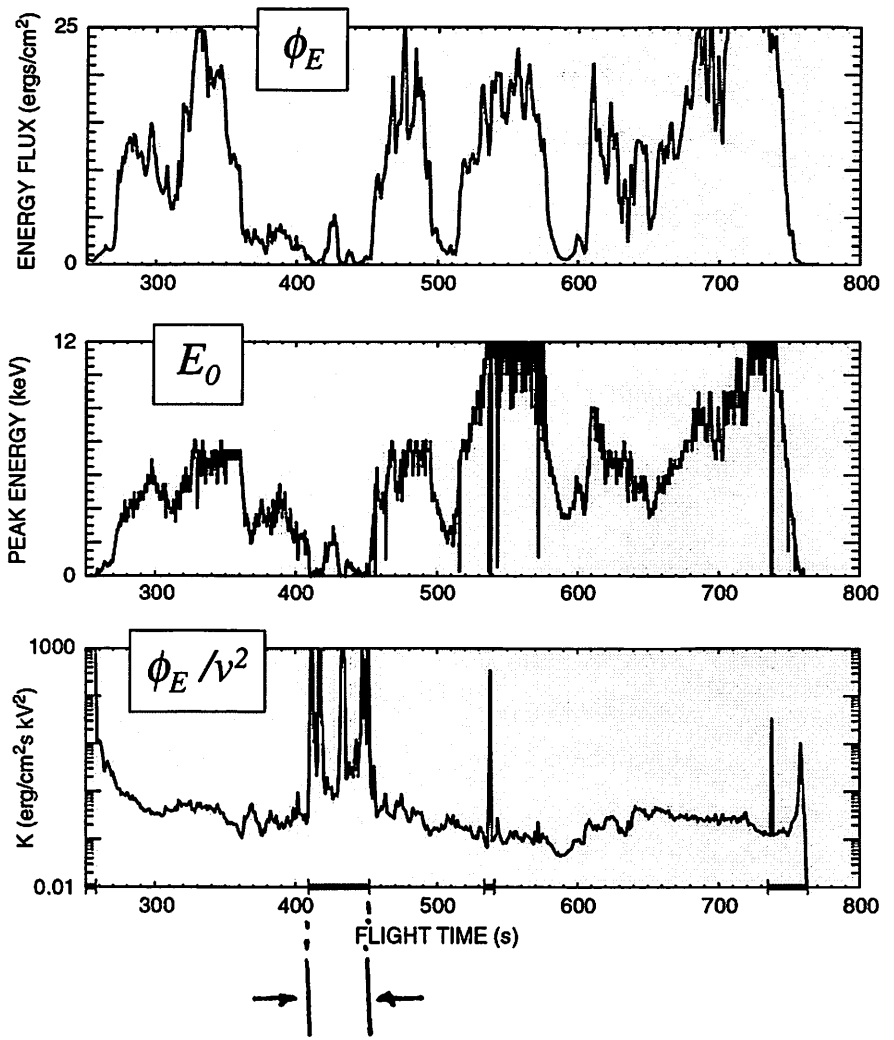
(Semeter et al, JGRA, 1999)

Does tomography make sense for active aurora?





ϕ_E / v^2 for PHAZE 2

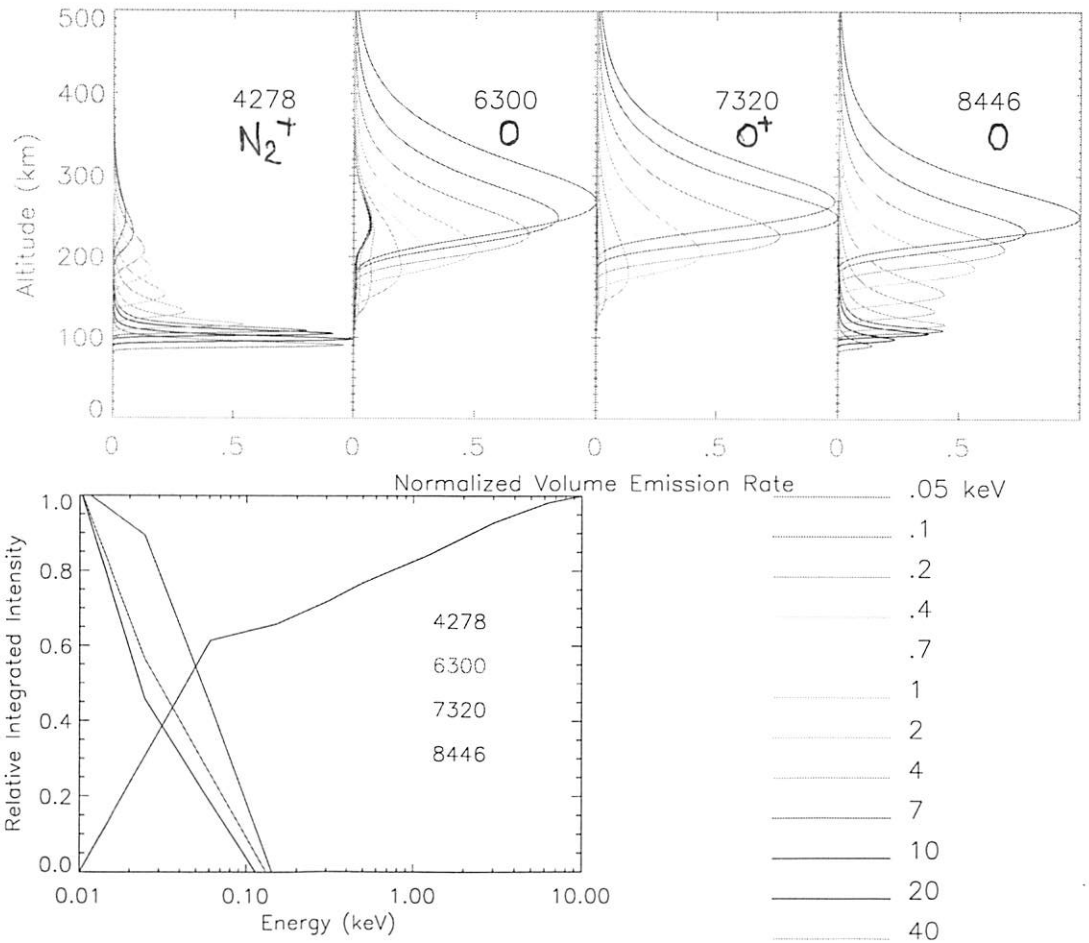


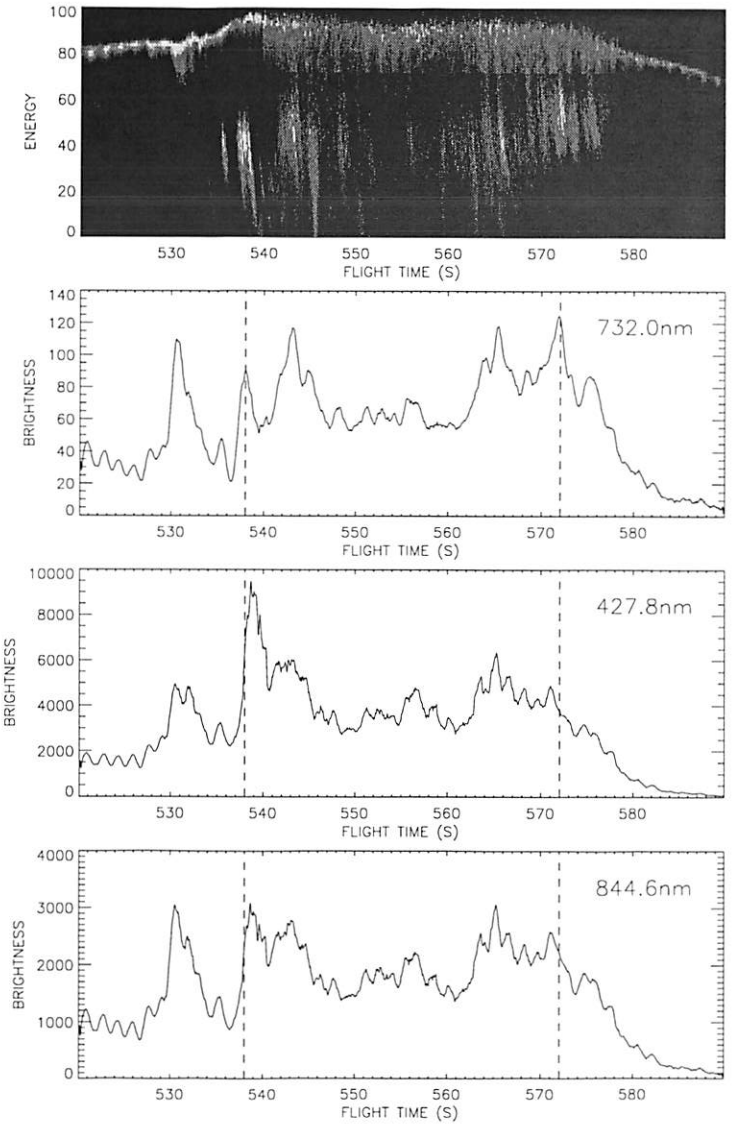
The simple relationships predicted by kinetic theory do not hold in regions where $\phi_E(E)$ is non-Maxwellian, i.e.,

- **When the aurora is very weak**
- **When the aurora is very energetic**
- **When the aurora is very turbulent**

Simultaneous Spatial-Spectral-Temporal Analysis

Choose a set of discrete wavelengths that mimic the logarithmic energy spacing of particle detectors.





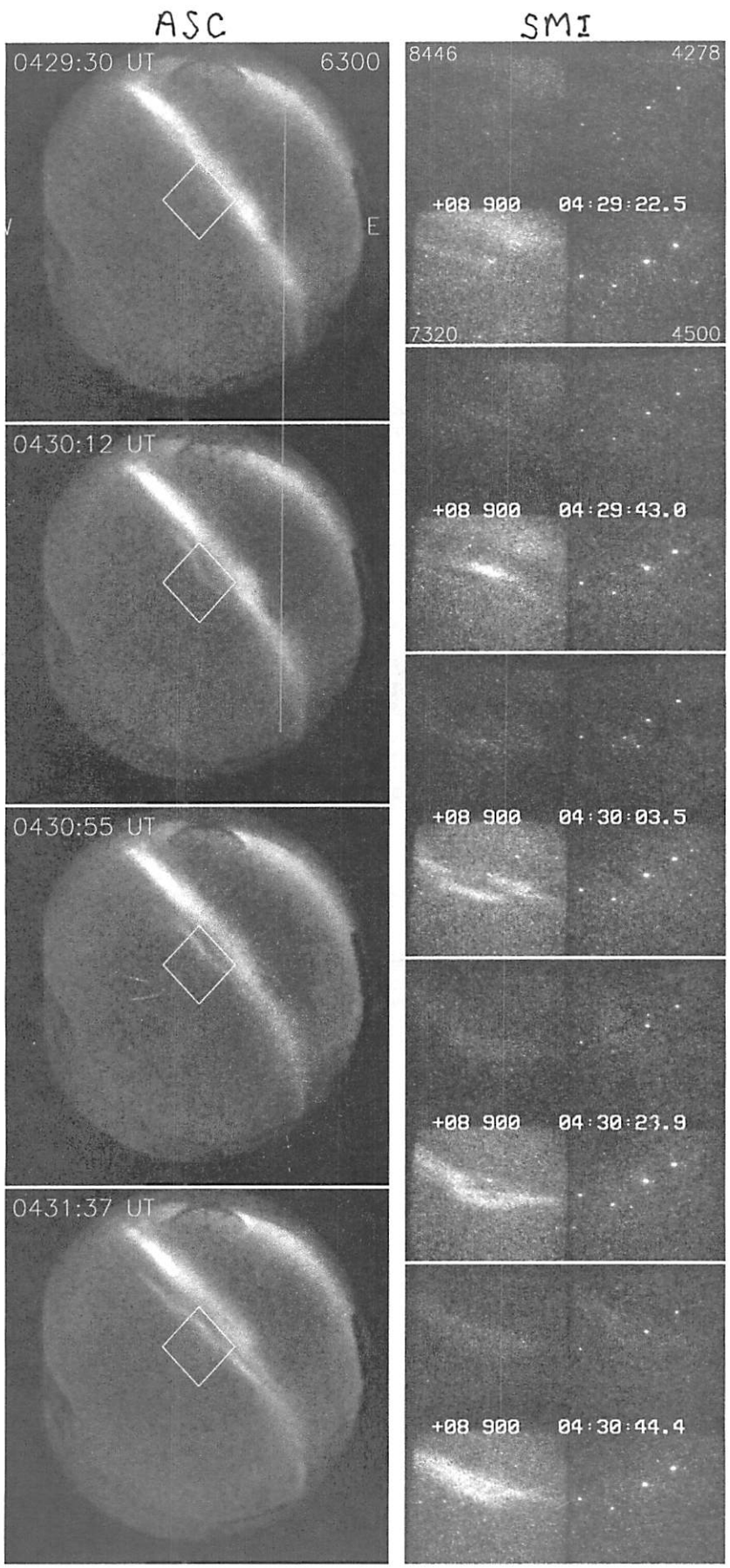


Figure 5: Simultaneous Allsky (6300) and SMI (λ's as labeled) measurements of a developing auroral arc on March 6, 2000.

Summary

- Tomography is a valuable tool for studying stable features such as the diffuse aurora, but is not suitable for active auroral forms.
- The physics of auroral formation will benefit from a consideration of detection problems associated with simultaneous 2-dimensional spectral imaging.
- The general bias towards imaging bright aurora is physically unjustified.