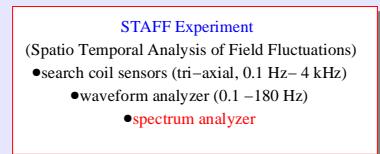


# A TOOL TO INVESTIGATE THE PROPAGATION OF WAVES MEASURED BY THE STAFF EXPERIMENT ONBOARD CLUSTER

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**Plane-wave methods**

$$\nabla \times \mathcal{E} = -\partial \mathcal{B} / \partial t \quad \text{Faraday's law}$$

$$\mathbf{k} \times \mathbf{E} = \omega \mathbf{B} \quad (\mathbf{k} \text{ wave vector})$$

$$\omega = \mathbf{k} \cdot \mathbf{B} \quad (\omega \text{ frequency})$$

$$\mathbf{E} \cdot \mathbf{B} = 0 \quad (\mathbf{B} \perp \mathbf{E})$$

$$\mathbf{k} \cdot \mathbf{B} = 0 \quad (\mathbf{B} \perp \mathbf{k})$$

**Wavevector direction (180° ambiguity):**

$$\mathbf{B} \cdot \mathbf{k} = 0 \quad (\mathbf{B} \perp \mathbf{k})$$

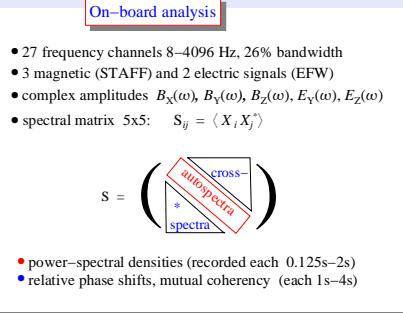
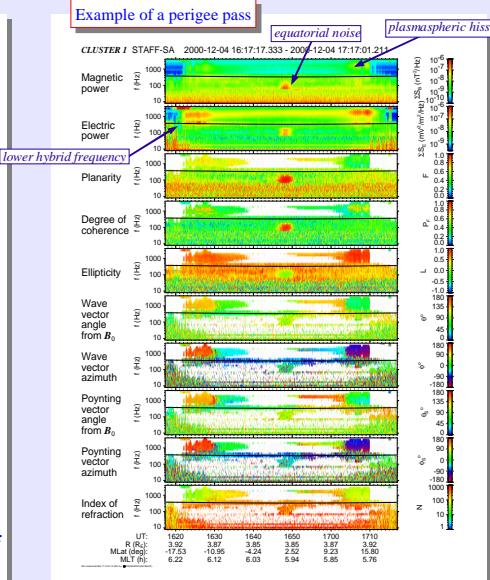
$$\begin{vmatrix} \Re S_{11} & \Re S_{12} & \Re S_{13} \\ \Re S_{21} & \Re S_{22} & \Re S_{23} \\ \Re S_{31} & \Re S_{32} & \Re S_{33} \end{vmatrix} \begin{pmatrix} |k_1| \\ |k_2| \\ |k_3| \end{pmatrix} = 0$$

**The third electric component:**

$$\mathbf{B} \cdot \mathbf{E} = 0 \quad (\mathbf{B} \perp \mathbf{E})$$

$$E_3 = (E_1 B_1 + E_2 B_2) / B_3$$

**Wavevector direction, Refractive index ( $k_c/\omega$ ) → wavelength, phase speed:**

$$\mathbf{n} \times \mathbf{E} = e \mathbf{B}$$


## Data processing using PRASSADCO

(PRopagation Analysis of STAFF-SA Data with COherency tests, <http://www-pw.physics.uiowa.edu/~os/PRASSADCO/>) Computer program designed to analyze multicomponent measurements of electromagnetic waves.

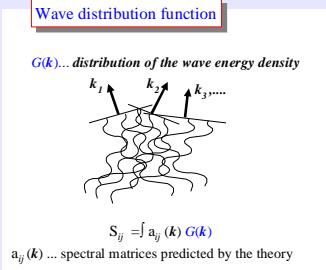
**Data:** spectral matrices (1) from ESA CD-ROM data, preprocessed by a calibration program, or (2) calculated from another source

## Results:

- power-spectral densities,
- wavevector direction from the magnetic field fluctuations
- planarity, ellipticity of polarization, sense of polarization
- mutual coherence of components, degree of polarization
- axes of the polarization ellipsoid
- wavevector direction from both electric and magnetic fields
- index of refraction (wavelength, phase speed)
- parallel component of the Poynting vector
- complete direction of the Poynting vector
- Poynting flux
- auxiliary data (position, DC magnetic field)

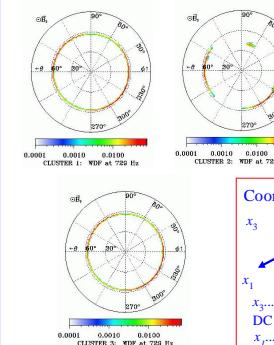
**Methods:** Means [1972], McPherron et al. [1972], Samson and Olson [1980], Santolík and Parrot [1999], Singular value decomposition of the magnetic spectral matrix ( $\mathbf{k} \cdot \mathbf{B} = 0$ ), or SVD solution to the set of equations from  $\mathbf{k} \times \mathbf{E} = \omega \mathbf{B}$  using a combined electromagnetic matrix

**Formats:** PostScript figures, GIF figures, ASCII files

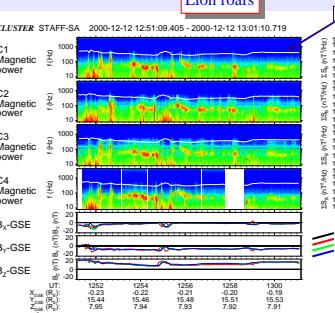


## Analysis of upgoing auroral hiss

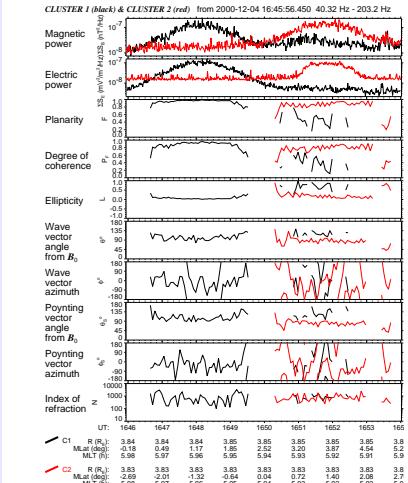
Cluster STAFF-SA Wave distribution functions 2000–12–12 0257:36



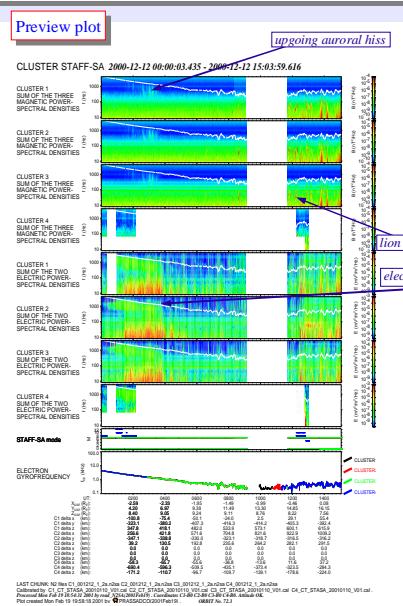
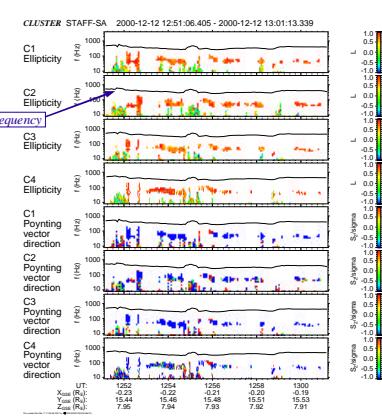
## Lion roars



## Analysis of equatorial noise



## Analysis of lion roar waves



LAST CHINE, ND file C1\_001212\_1\_2a and C2\_001212\_1\_2a and C3\_001212\_1\_2a and C4\_001212\_1\_2a and C5\_001212\_1\_2a and C6\_001212\_1\_2a and C7\_001212\_1\_2a and C8\_001212\_1\_2a and C9\_001212\_1\_2a and C10\_001212\_1\_2a and C11\_001212\_1\_2a and C12\_001212\_1\_2a and C13\_001212\_1\_2a and C14\_001212\_1\_2a and C15\_001212\_1\_2a and C16\_001212\_1\_2a and C17\_001212\_1\_2a and C18\_001212\_1\_2a and C19\_001212\_1\_2a and C20\_001212\_1\_2a and C21\_001212\_1\_2a and C22\_001212\_1\_2a and C23\_001212\_1\_2a and C24\_001212\_1\_2a and C25\_001212\_1\_2a and C26\_001212\_1\_2a and C27\_001212\_1\_2a and C28\_001212\_1\_2a and C29\_001212\_1\_2a and C30\_001212\_1\_2a and C31\_001212\_1\_2a and C32\_001212\_1\_2a and C33\_001212\_1\_2a and C34\_001212\_1\_2a and C35\_001212\_1\_2a and C36\_001212\_1\_2a and C37\_001212\_1\_2a and C38\_001212\_1\_2a and C39\_001212\_1\_2a and C40\_001212\_1\_2a and C41\_001212\_1\_2a and C42\_001212\_1\_2a and C43\_001212\_1\_2a and 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