Influence of terrestrial rotation on Auroral Kilometric Radiation observed by STEREO/WAVES

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Auroral Kilometric Radiation (AKR) is a strongly variable emission generated in the Earth's magnetosphere;

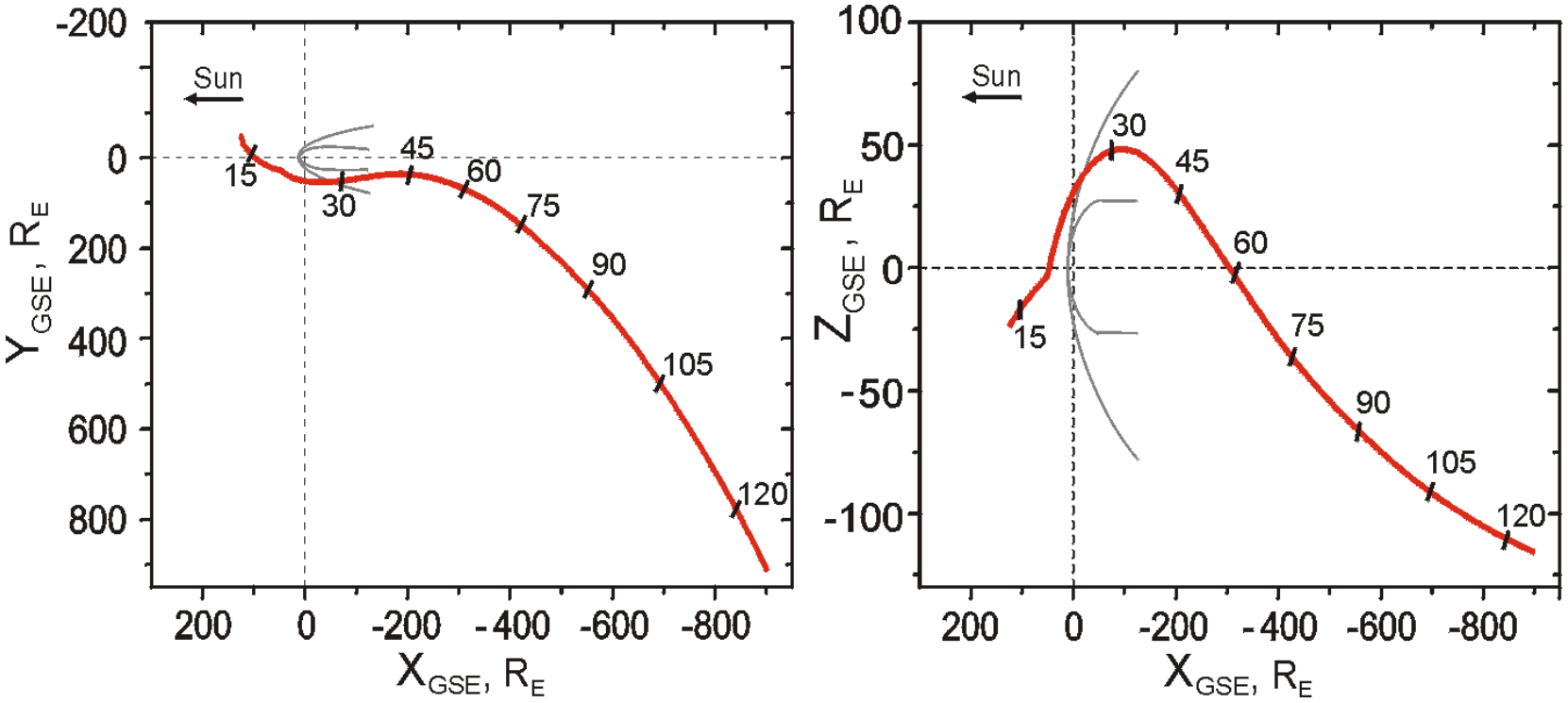
- emitted near the local gyro-frequency of electrons in low density source cavities, which are identified with acceleration regions characterized by upward directed parallel electric fields;
- frequency range 20 kHz -1000kHz (300 kHz –> λ = 1 km);
- generation mechanism - Cyclotron Maser Instability;

STEREO Behind orbit

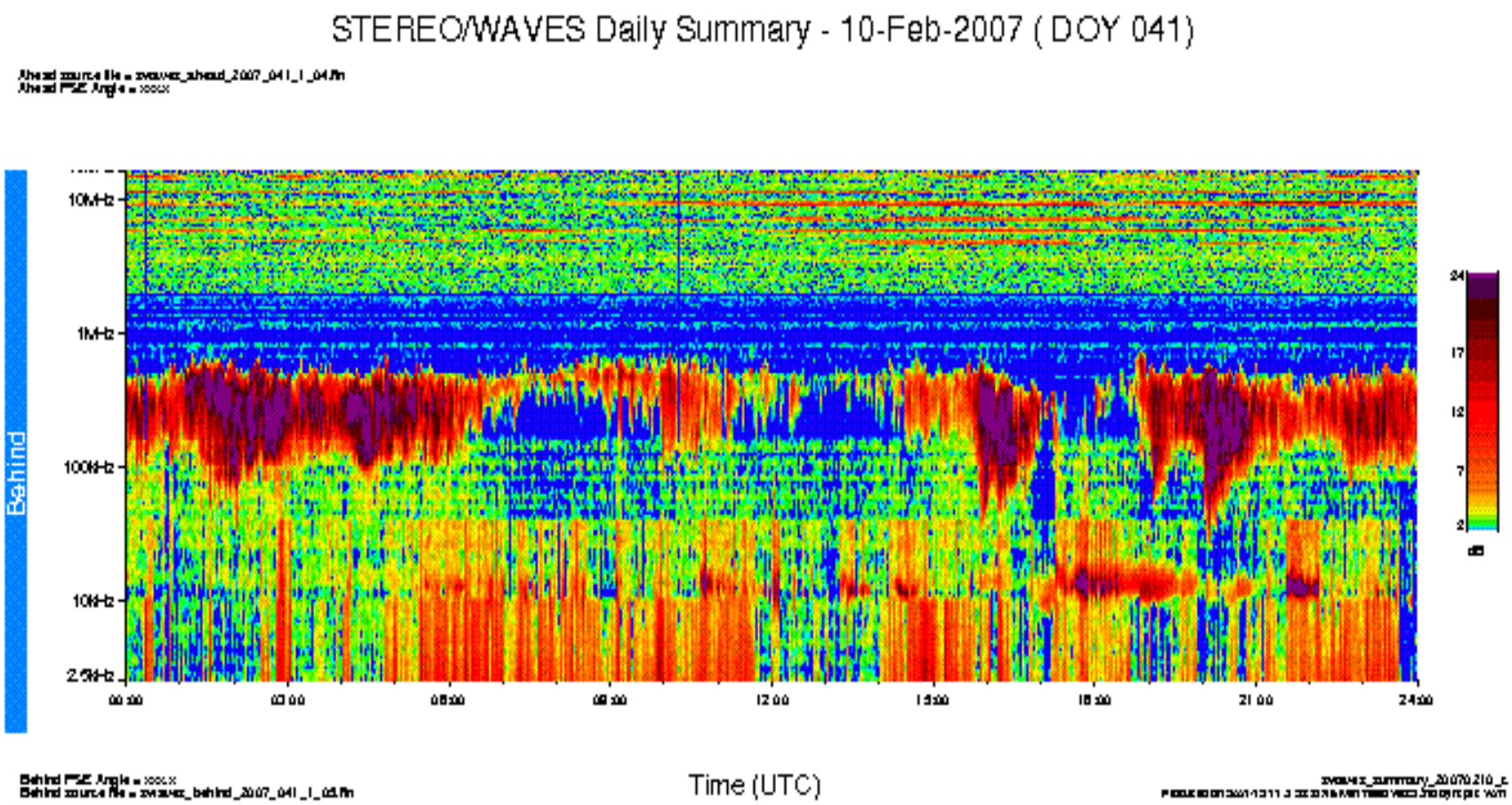
STEREO, Solar TErrestrial RElations Observatory consists of two (STEREO A and B) spacecraft, launched on Oct. 25, 2006.

STEREO/WAVES (SWAVES) experiment

- high frequency receiver HFR1 (0.125 – 2 MHz); measures spectral and cross-spectral power densities; determination of the radio wave polarization.
- 1.02.2007–1.05.2007 (DOY 32–122) – quasi-continuous observations of AKR.



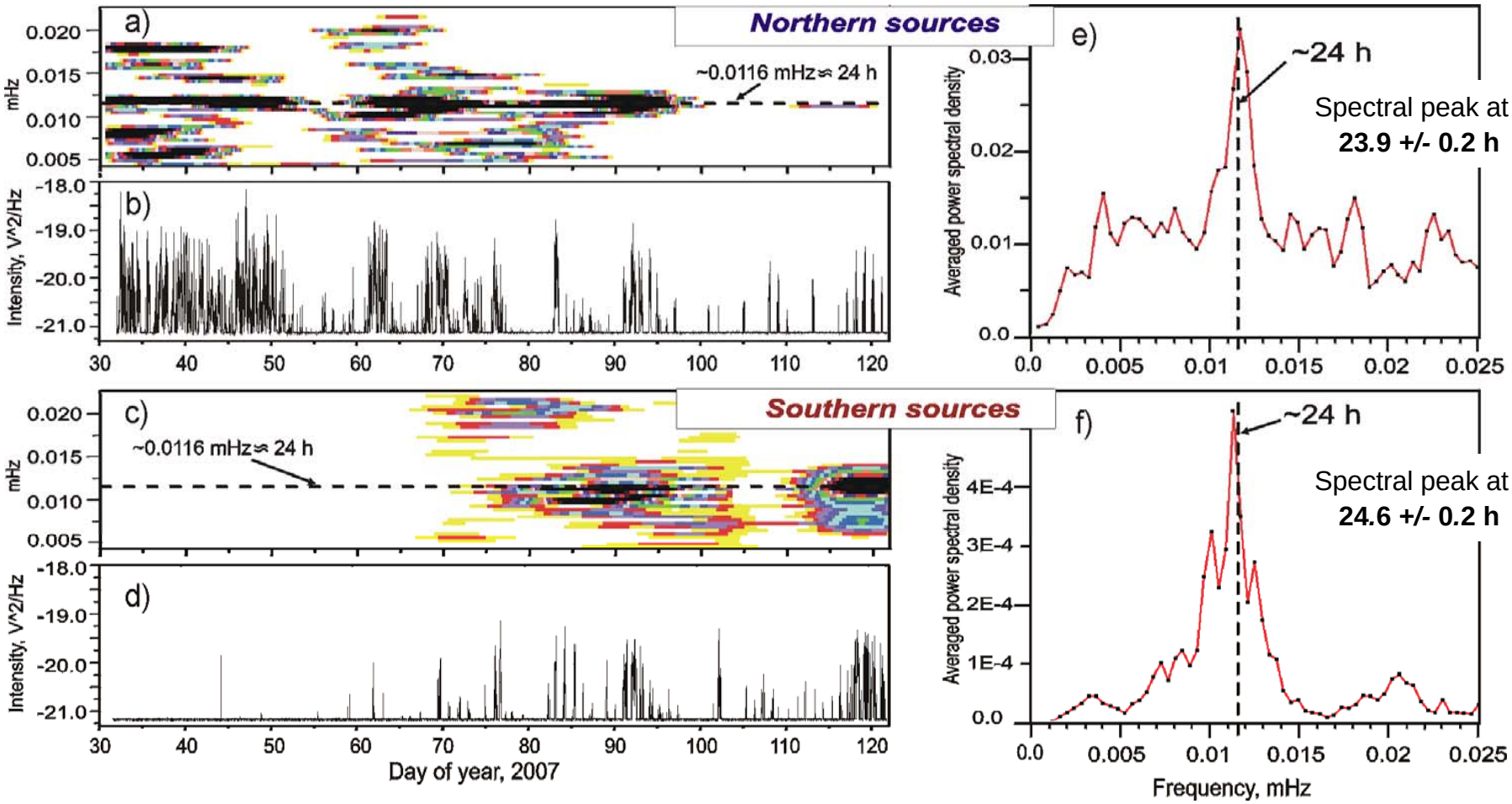
AKR observations



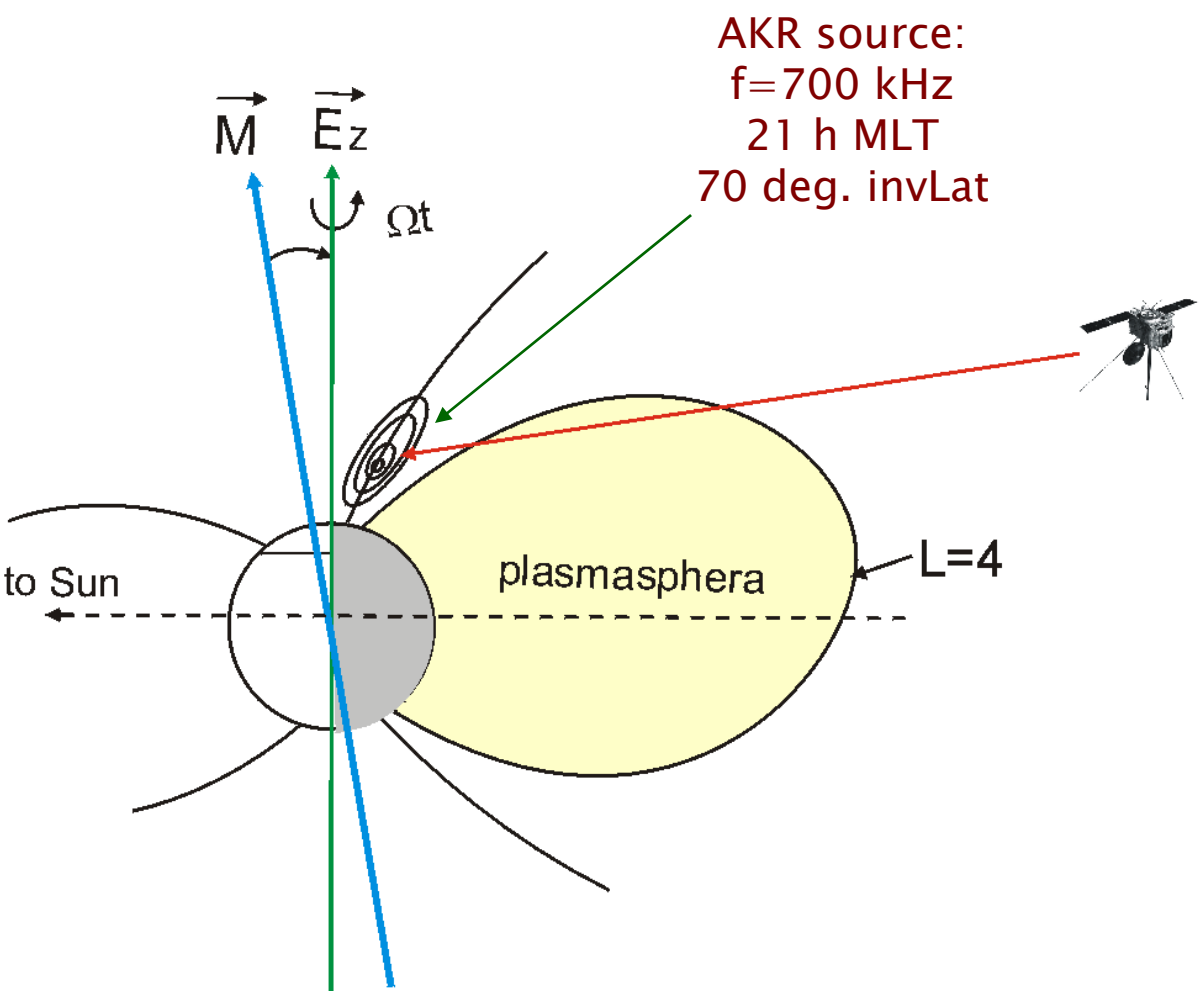
Observations and data analysis

- Poynting flux and Stokes parameters of the analyzed AKR were derived from the same direction-finding algorithm (for two antenna mode) as developed for the Cassini/RPWS instrument [Cecconi and Zarka, 2005].
- LH polarized wave – AKR from Northern sources; RH polarized – Southern sources.
- AKR time profile has been produced by integration of the AKR intensities, over frequency ranges from 125 to 700 kHz.
- **Sliding-window Fourier (SWF)** transform consists in application of the classical Fourier transform within a certain interval of time (so called "window") and in consequent shift of this "window" along the time axis.

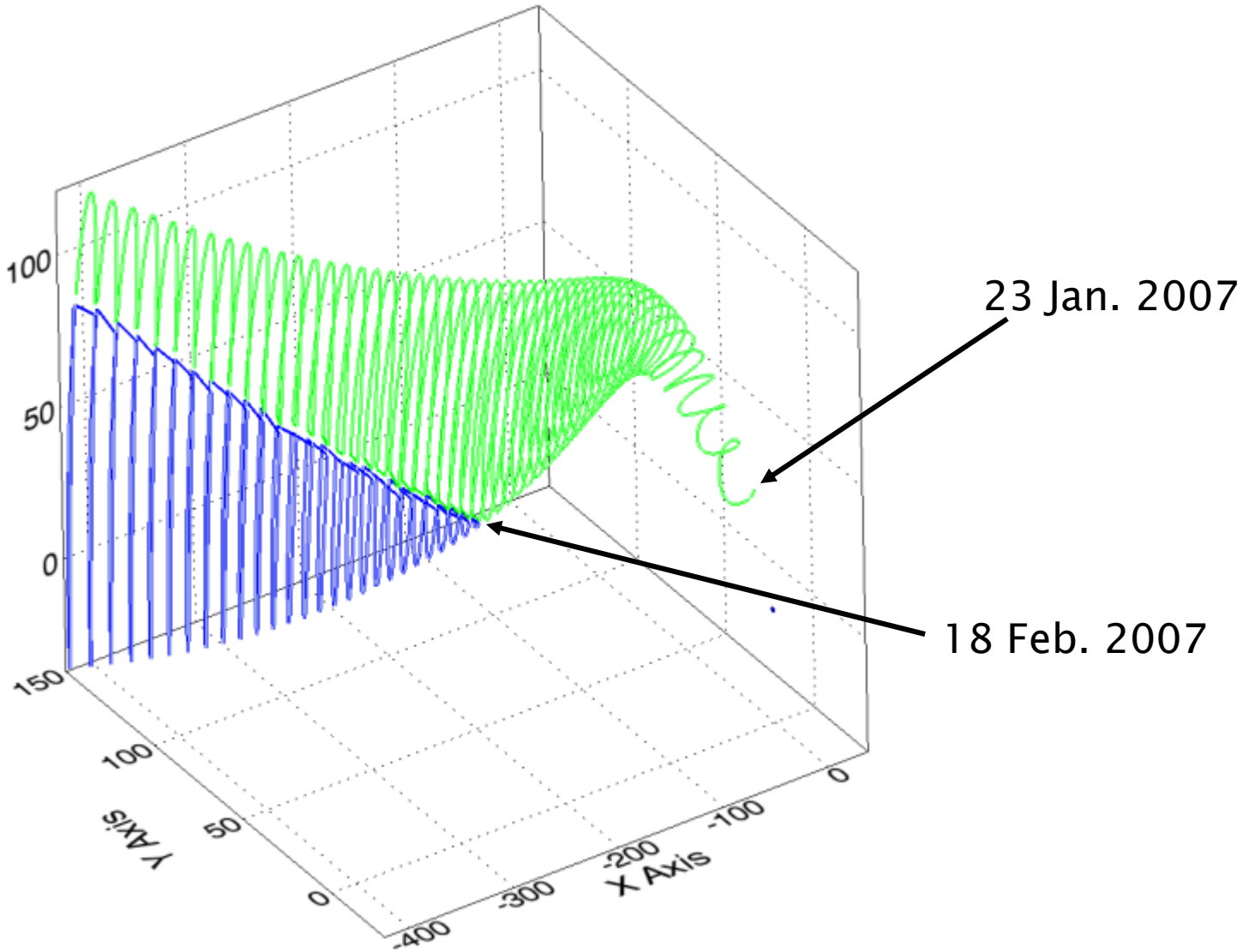
SWF dynamical spectra of the AKR modulations



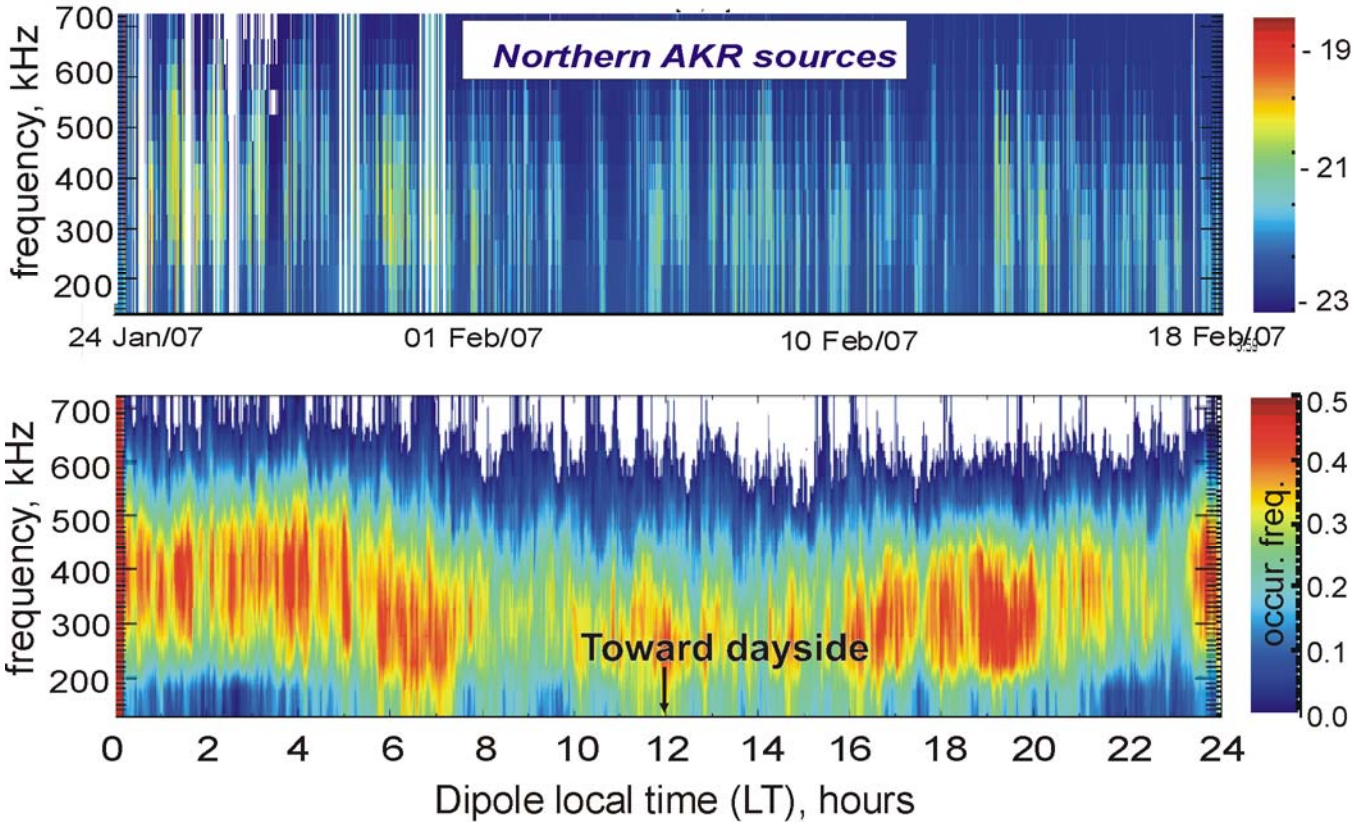
SWF dynamical spectra of modulations (a, c) and intensity profiles (panels b, d) of AKR emitted by Northern and Southern sources. (e) and (f) show the time averaged profiles of the SWF dynamical spectra.


AKR source:
f=700 kHz
21 h MLT
70 deg. invLat
M
Ez
Ωt
to Sun
plasmasphera
L=4

STEREO-B trajectory in SM coordinates



AKR occurrence frequency



Normalized occurrence frequency and frequency range of the AKR emitted from the Northern hemispheres as functions of local time of the axis of the magnetic dipole.

AKR spectra changes as a function of the terrestrial dipole orientation relative to the Sun (Green et al. 2004)

Electron Cyclotron Maser works most efficient within auroral cavities, where fp/fc < 0.14 (Hilgers, 1992)

During summer the local plasma frequency in auroral region increases due to higher Sun illumination of the ionosphere.

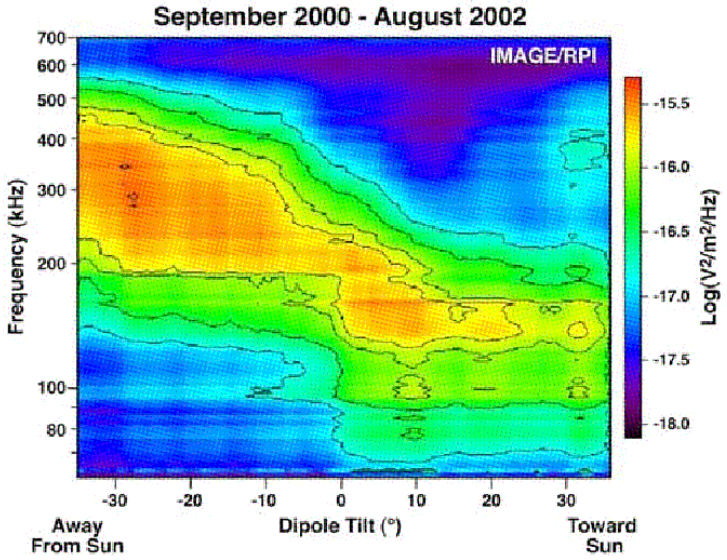


Figure 1. The average spectra of AKR as a function of dipole tilt angle from observations by the IMAGE/RPI instrument. For negative dipole tilt angles the average AKR spectrum peaks around ~260 kHz and is very broad extending from ~80 to nearly 500 kHz. In contrast, for positive dipole tilt angles the spectrum is narrower (from 60 to 250 kHz) and peaks near 150 kHz.

Green, J. L., S. Boardsen, L. Garcia, S. F. Fung, and B. W. Reinisch (2004), Seasonal and solar cycle dynamics of the auroral kilometric radiation source region, J. Geophys. Res., 109, A05223, doi:10.1029/ 2003JA010311

Conclusions:

1. Daily variations of terrestrial Auroral Kilometric Radiation (AKR) are considered. The effect is detected in course of the analysis of STEREO/WAVES data.

2. It has been found that the intensities of the AKR emitted from Northern and Southern sources are strongly modulated with a period of ~ 24 hours.

3. The occurrence frequency of the AKR has been shown to be strongly dependent on the orientation of the rotating oblique Earth's magnetic dipole relative to the Sun. AKR is found to occur more often and emit in a broader frequency range when the axis of the terrestrial magnetic dipole in the given hemisphere is oriented toward the nightside.

4. We suggest that the observed ~24 h variations of AKR are connected with the daily modulation of the local plasma density within the AKR source, caused by the varying solar illumination of the auroral ionosphere.