SM53B-01
What Controls the Degree of Conjugacy in Aurora Phenomena? III Posters

On the Conjugacy of Auroral Afternoon Bright Spots

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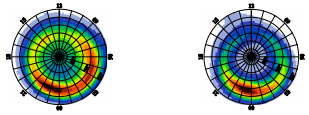
Previous Work

has shown that the afternoon auroral bright spot

- Is located near 15 MLT and 75° ILAT
- Is persistent in image data [Cogger et al., 1977; Liou et al., 1997] and particle data [McDiarmid et al., 1975; Newell et al., 1996]
- Is co-located with a statistical maximum in upward field-aligned current [Iijima and Potemra, 1978; Liou et al., 1999]
- Is influenced by the interplanetary magnetic field; more common when $B_Y < 0$ (dawnward) [Murphree et al., 1981; Vo and Murphree, 1995]
- Can be structured and dynamic ("string of pearls") [Lui et al., 1987; Potemra et al., 1990; Rostoker et al., 1992]
- Varies with season: Stronger in summer than in winter [Liou et al., 2001] Summer in one hemisphere, winter in the other → hemispheric difference

Summer Winter



(from Liou et al., 2001)

Previous Dayside Aurora Conjugacy Investigations

Optical-Non-optical comparisons:

- Dickinson et al., 1986, compared low-altitude satellite particle data to ground-based images
  - Northern hemisphere aurora poleward of southern aurora
  - Technique only sensitive to shifts in latitude
- Mende et al., 1990, compared ground-based magnetometer data to ground-based images
  - Timing of events the same in both hemispheres
  - Unable to determine spatial conjugacy
- Vo et al., 1995, compared satellite-based images to low-altitude satellite particle data
  - Northern aurora poleward of southern aurora
  - Only sensitive to shifts in latitude

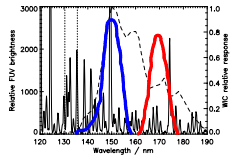
Instrumentation

IMAGE Wideband Imaging Camera (WIC) &
Polar Ultraviolet Imager (UVI) LBHS & LBHL

Temporal resolution
WIC: 10 second integration every 2 minutes
LBHS & LBHL: 18 & 36 second integration cyclic

Spatial resolution (at apogee)
WIC: ~ 50 km
LBHS & LBHL: ~ 30 km

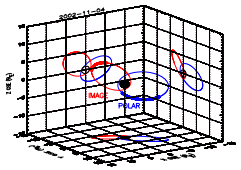
Spectral resolution
WIC: 140 to 190 nm ---
LBHS: 140 to 160 nm ---
LBHL: 160 to 180 nm ---



Spacecraft Orbits

IMAGE
Launch: March 25, 2000
Apogee: 8.2 R_E
Perigee: 1.15 R_E
Period: 14 hours

Polar
Launch: Feb. 24, 1996
Apogee: 9 R_E
Perigee: 1.8 R_E
Period: 18 hours



Previous Dayside Aurora Conjugacy Investigations

Optical-Optical comparison:

- Burns et al., 1990, 1992, compared satellite-based images to ground-based images
  - Northern aurora poleward and eastward of southern aurora
  - Short lived features seen in one hemisphere but not the other

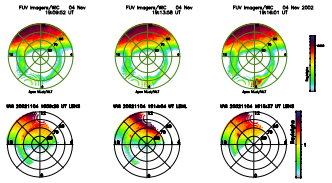
All previous studies limited by ***local*** observations (either in-situ point measurements or ground based instruments) in at least one hemisphere.

We present the first simultaneous images of afternoon aurora from two global auroral imagers in opposite hemispheres.

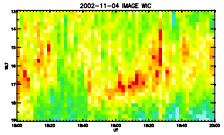
Using these data, we are able to address the issue of the conjugacy of afternoon aurora on a synoptic scale for the first time.

November 4, 2002

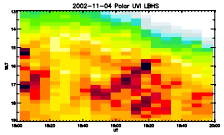
Northern Hemisphere
Southern Hemisphere

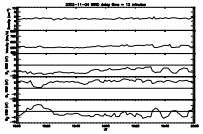


Northern Hemisphere: enhanced emission in afternoon (15 – 18 MLT) emission unstructured
Southern Hemisphere: multiple spots ("string of pearls" configuration) number, location, and intensity of spots change on timescales of a few minutes



- Emission in both hemispheres
- Multiple spots only in south
- Trend toward noon

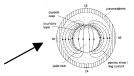




- Solar wind & IMF steady
- IMF $B_Y > 0$

Interpretation

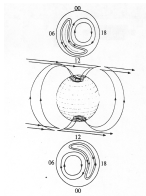
Interplanetary magnetic field influences ionospheric convection pattern:



For $B_Y \sim 0$, two symmetric circularly (or "D") shaped convection cells.

For $B_Y > 0$ (duskward), a crescent shaped cell on the dawnside and a circularly shaped cell on the duskside in the northern hemisphere and a circular cell on the dawn side and a crescent cell on the duskside in the southern hemipsphere.

IMF merges with Earth's magnetic field and drags the footpoints of the magnetic field dawnward in the northern hemisphere and duskward in the southern hemisphere.



(from Clauer et al., 1997)

Summary

- First global-scale conjugate observations of afternoon aurora
- Multiple spots only seen in one hemisphere → non-conjugate
- Predict conjugacy of afternoon aurora
  → depends on IMF direction
- KHI only operating in one hemisphere
  → High latitude, not at the equator

Future Directions

- Enlarge database (6 months of observations) → test prediction
- Other factors (e.g., ionospheric conductivity)
- Compare with ground-based radar observations (flow velocity)
- Compare with low altitude satellite current measurements
- Model KHI at low altitudes
- 2 global imagers with identical instrumentation

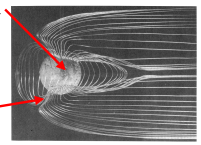
Why Spots in the Southern Hemisphere?

The presence of multiple auroral spots ("string of pearls" configuration) is consistent with being the result of Kelvin-Helmholtz Instability (KHI) Lui et al., 1989; Rostoker et al., 1992; Wei and Lee, 1993].

KHI occurs in regions of velocity shear and is assumed to be occur the equator.

Multiple spots only seen in one hemisphere, not both as expected if instability occurs at the equator.

We propose that the KHI occurs at high latitude near the ionosphere (crescent shaped convection cell).



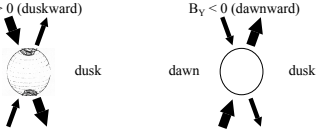
(from Podgorny, 1976)

Interpretation (cont'd)

Convection pattern influences field-aligned current:

- Ionospheric electric field perpendicular to flow
- Converging (CW) and diverging (CCW) horizontal currents
  → Must be balanced by field-aligned currents (FACs)
- Stronger flow gradients (crescent cells) → stronger FACs

$B_Y > 0$ (duskward) $B_Y < 0$ (dawnward)



Prediction: for $B_Y > 0$, afternoon aurora more intense in south;
for $B_Y < 0$, afternoon aurora more intense in north.