

# The Influences of Geocoronal Variability

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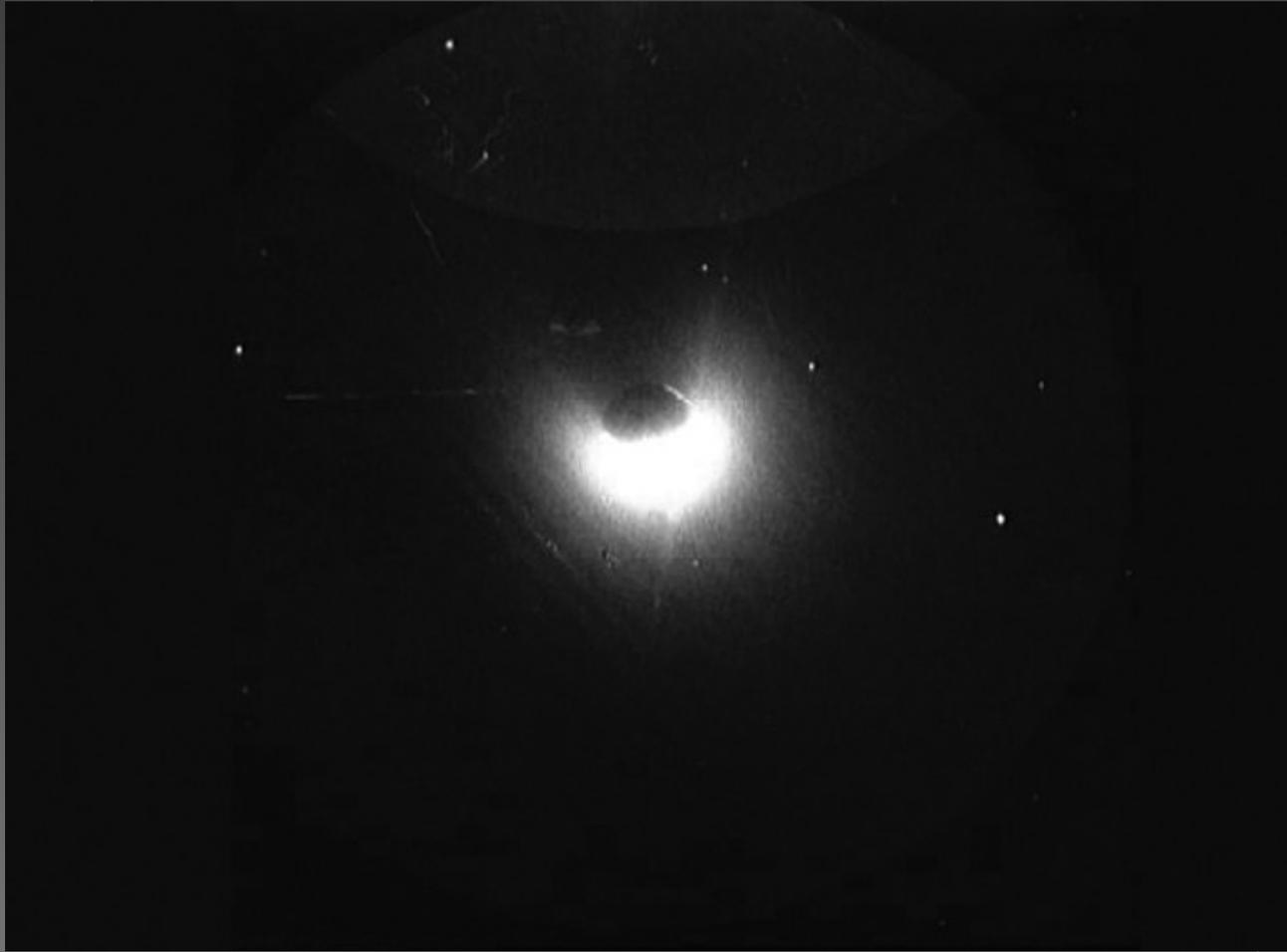
Mentor: Marty Snow

Helpful insight from: Greg Holsclaw and  
Gary Thomas

# To Do List

- ◎ Background
  - > Geocorona
  - > What is airglow?
- ◎ Instrumentation
  - > SORCE
  - > SOLSTICE
- ◎ Methods of interpreting the data
- ◎ Data Analysis
- ◎ Conclusion

# The Geocorona



*Photo taken with a UV filter by Apollo 16 commander John Young.  
April 21, 1972*

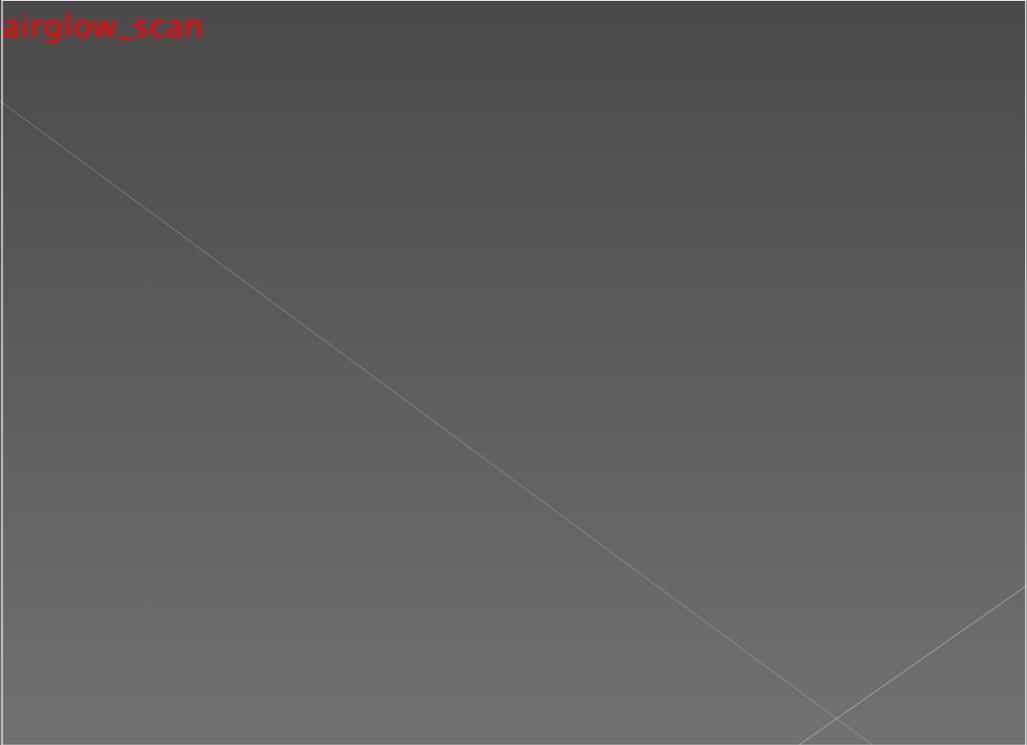
# The Geocorona

- ◉ Composed of neutral hydrogen atoms
- ◉ Hydrogen → since it has a small mass, its scale height is larger than for heavier atoms.
- ◉ When solar UV radiation impacts the geocorona, it is either scattered or absorbed.
- ◉ Extends to about 15 Earth radii

# Airglow

- ◉ Lyman- $\alpha$  (121.5 nm)
- ◉ This scattered radiation is known as airglow.

airglow\_scan



# Airglow (cont.)

- ◉ Naturally, this occurs on both sides of the Earth (dayglow on the sunlit side and nightglow in the shadow region)
- ◉ Instruments are only measuring airglow in the shadow if the Earth.



# Instrumentation

- This instruments responsible for supplying the data for this project were designed and built at the Laboratory for Atmospheric and Space Physics (LASP).
- They are also controlled here by scientists and students from the University of Colorado at Boulder.



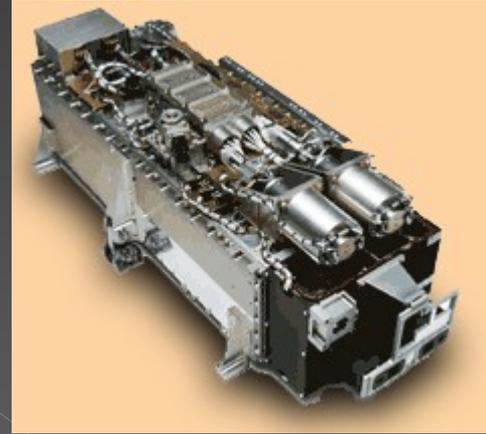
# SOLAR Radiation and Climate Experiment: SORCE

- NASA sponsored satellite used to measure x-ray, ultraviolet, visible, near-infrared, and total solar radiation.
- Launched on January 25, 2003 and continues to return data.
- Orbits at ~600km above the surface of the Earth.



# SORCE (cont.)

- Four instruments on board including, Spectral Irradiance Monitor (SIM), Total Irradiance Monitor (TIM), XUV Photometer System (XPS), and Solar Stellar Irradiance Comparison Experiment (SOLSTICE).

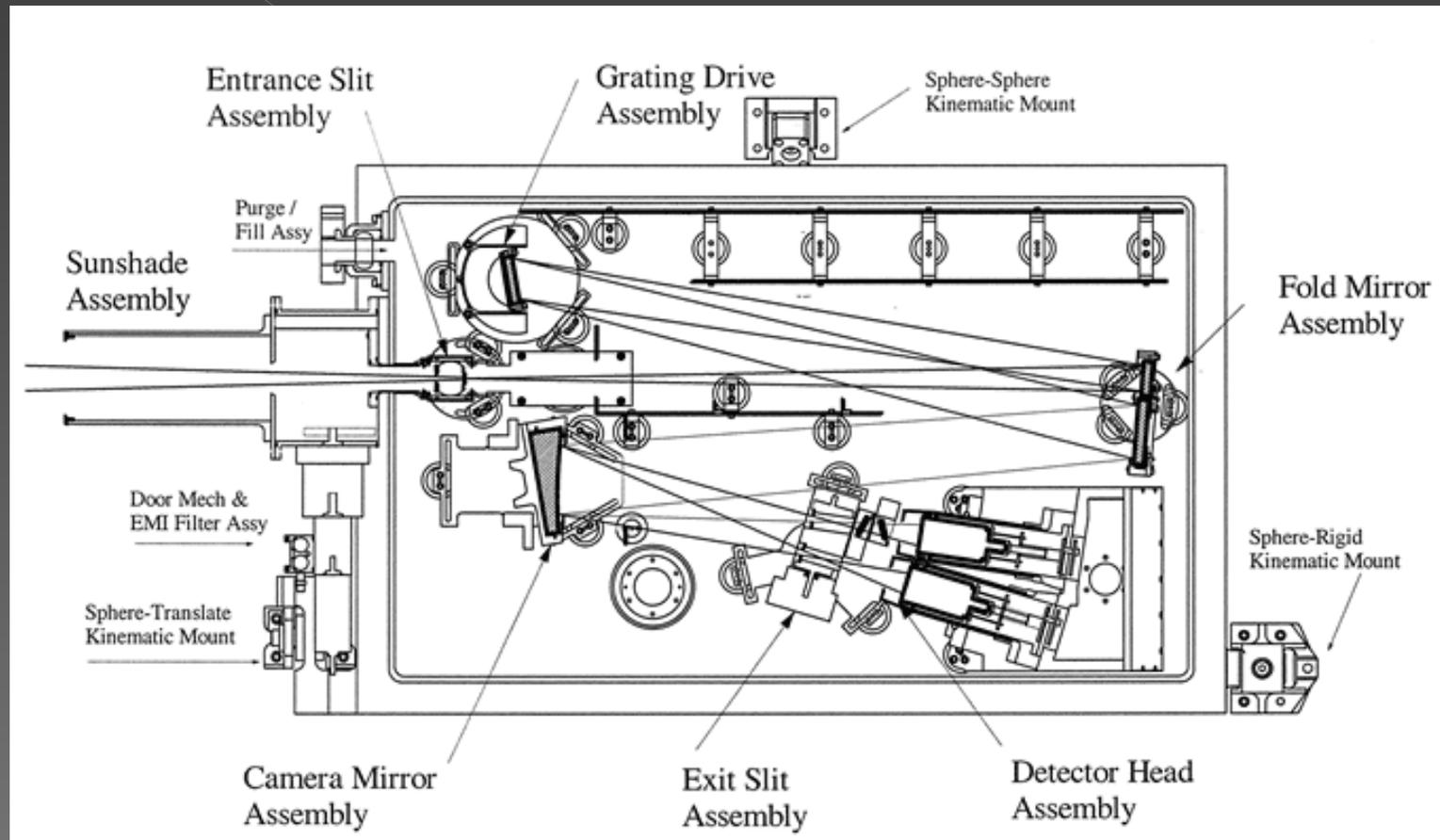


# SOLar STellar Irradiance Comparison Experiment: SOLSTICE

- Makes daily measurements of solar ultraviolet irradiance (115 – 325 nm).
- I primarily used SOLSTICE B data.
- Solar and Stellar mode.



# How SOLSTICE operates



# Interpreting the data

- Not all of the data we receive from SOLSTICE is straight forward.
- We need to work with parameters to determine information about the mission to obtain reliable results.
- There were already written procedures and functions to use but it took awhile to learn how to use them and that they actually exist.
- Astronomy lesson

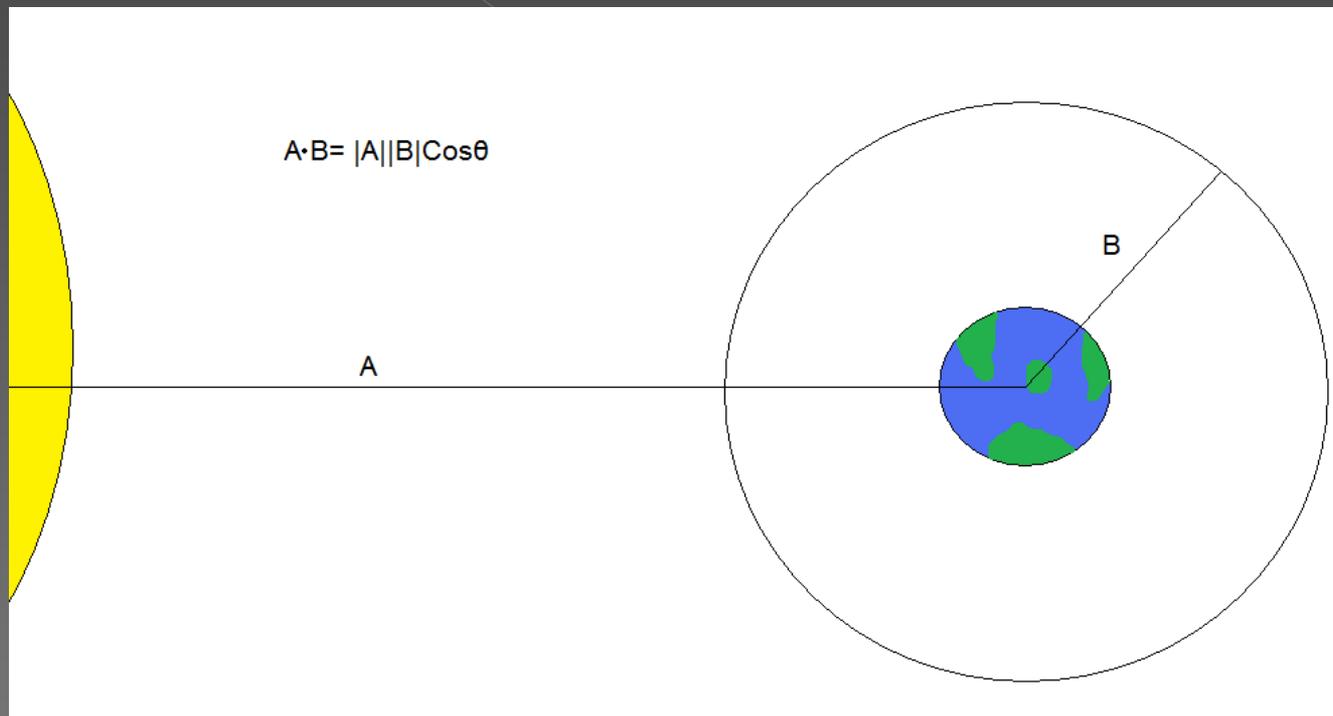


# Optical Thickness

- **Optical Depth:** A measure of transparency, the fraction of radiation that is not scattered or absorbed along a path.
- One key aspect we need to determine is whether the geocorona is optically thick or thin.
- If the geocorona is optically thick, there will be no dependence on look direction or orbit location.

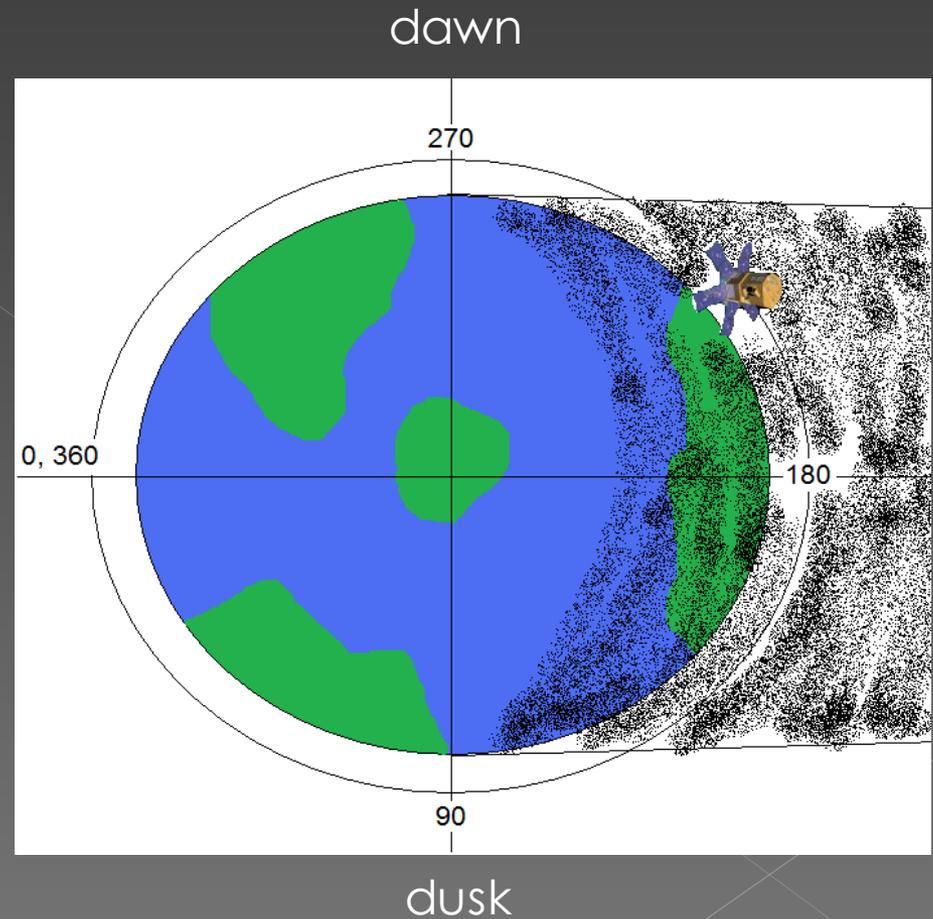
# Where is the Spacecraft?

- There are IDL procedures to provide Earth-Sun and Earth-spacecraft vectors.

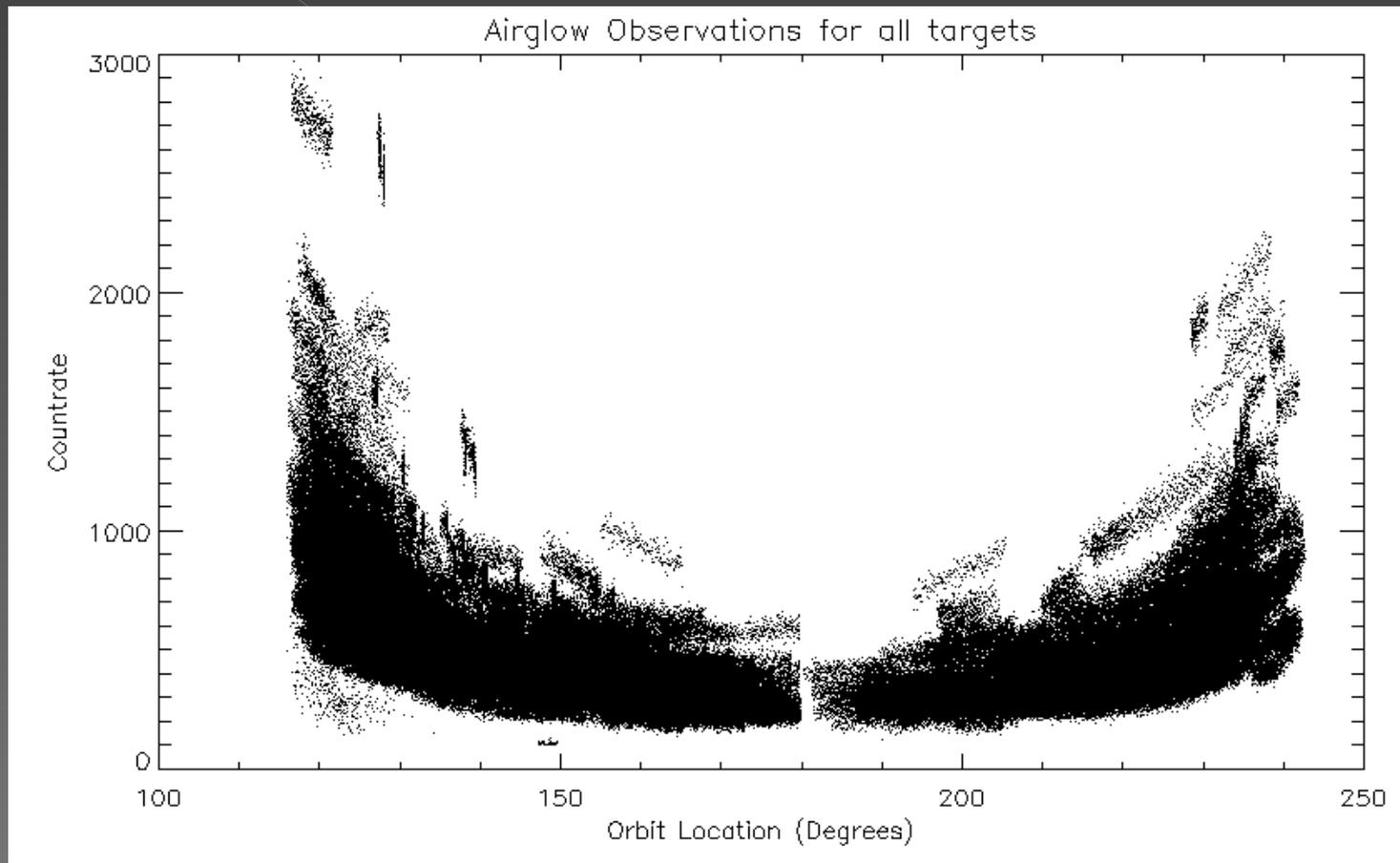


# Where is the Spacecraft? (cont.)

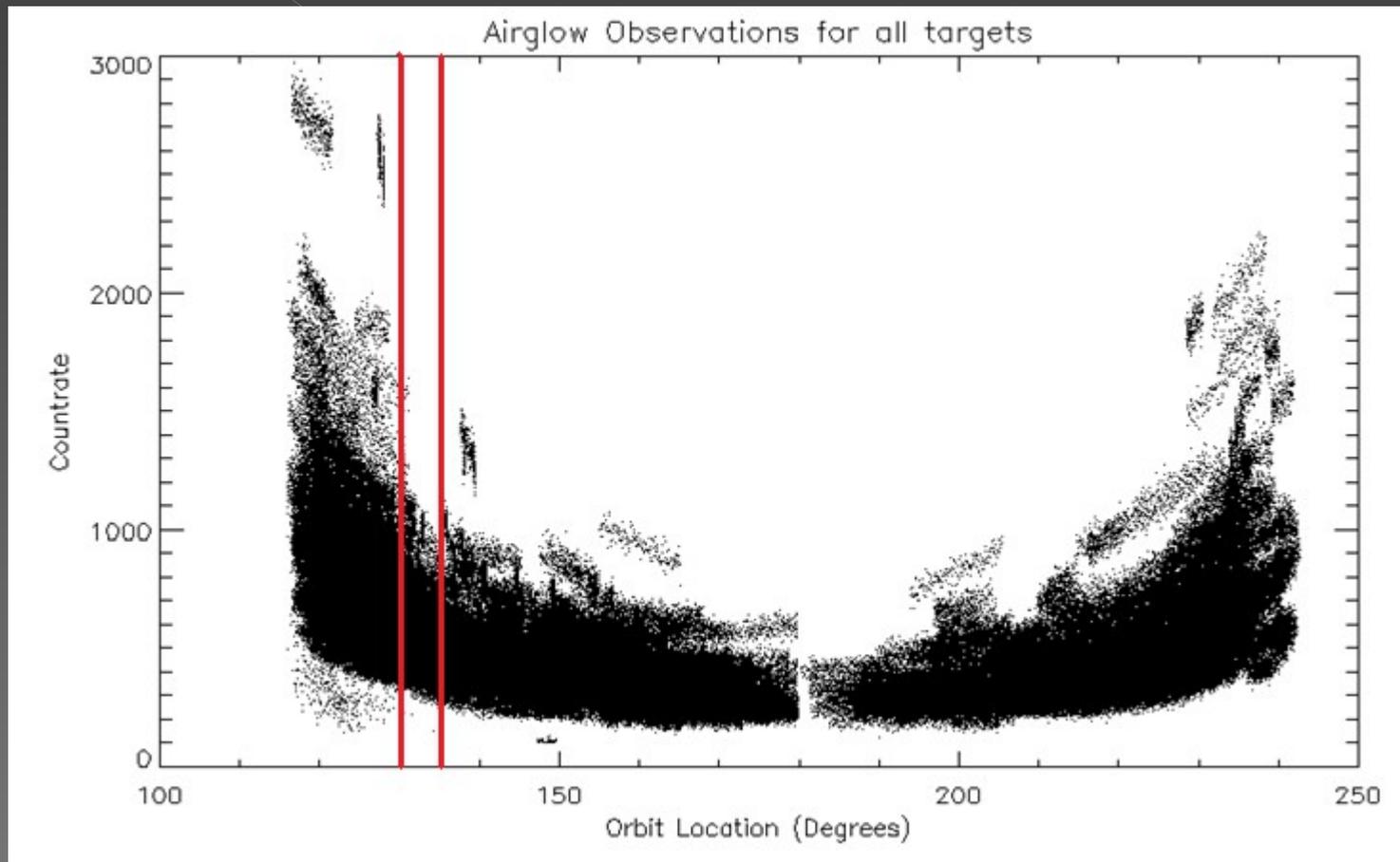
- Calculated  $\theta$  is between  $0^\circ$  and  $180^\circ$ .
- This doesn't help much with determining which side of the Earth (dawn or dusk) the spacecraft is located.
  - Spacecraft is moving in the same direction as the Earth.
  - Decide where angles  $>180^\circ$  will be located.



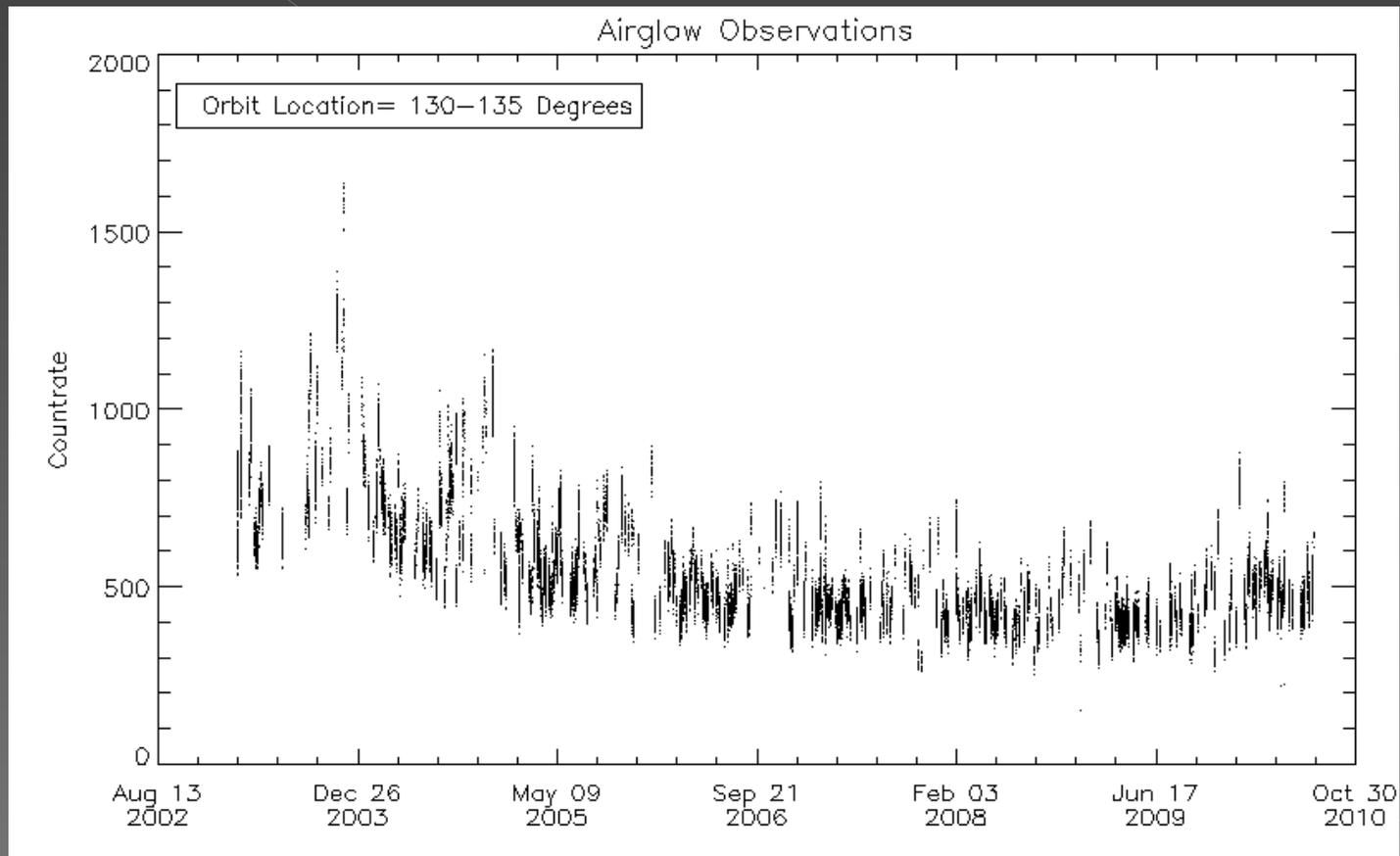
# Airglow Observations at location of the spacecraft



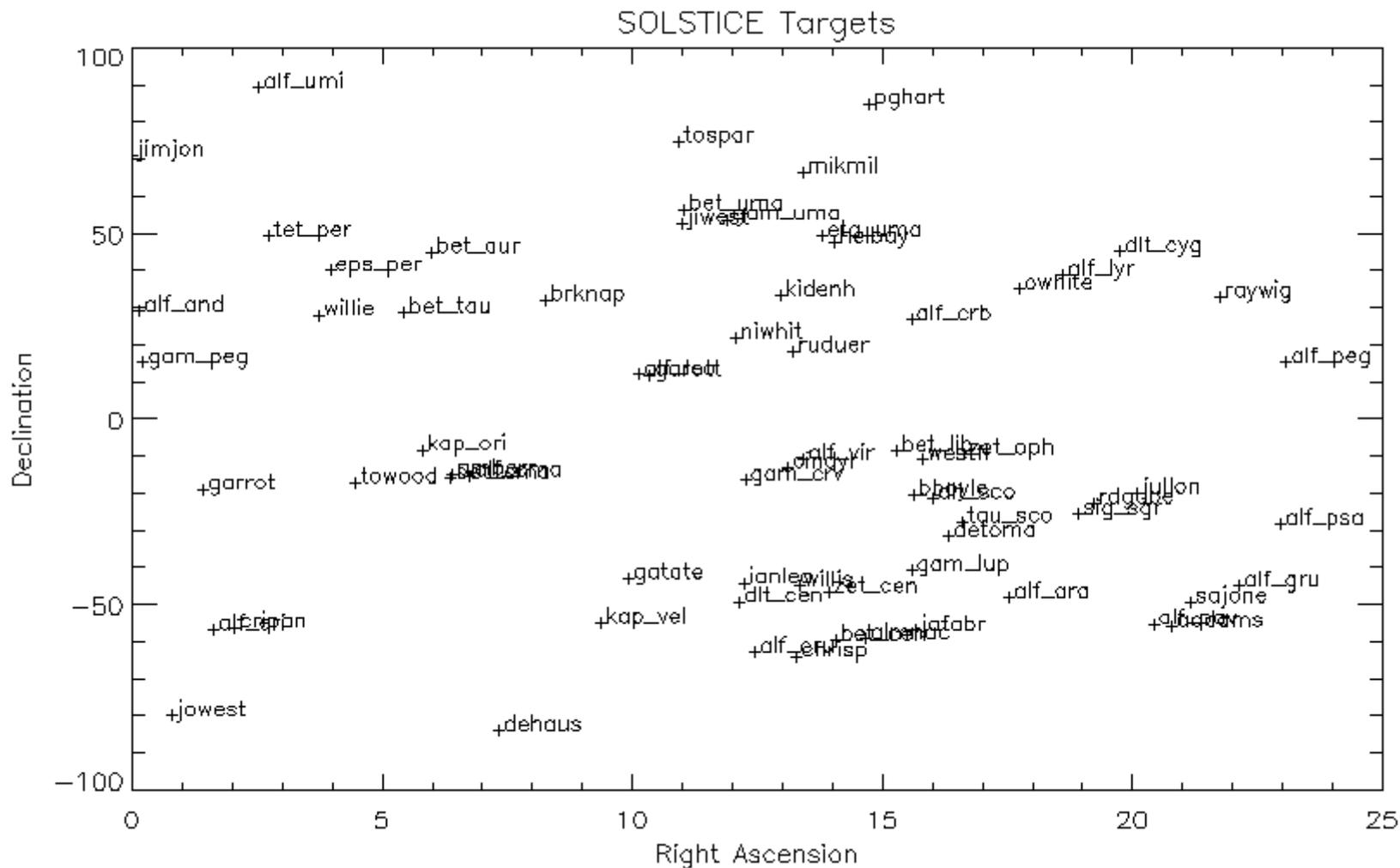
# Airglow Observations at location of the spacecraft



# Airglow Observations



# Target Location



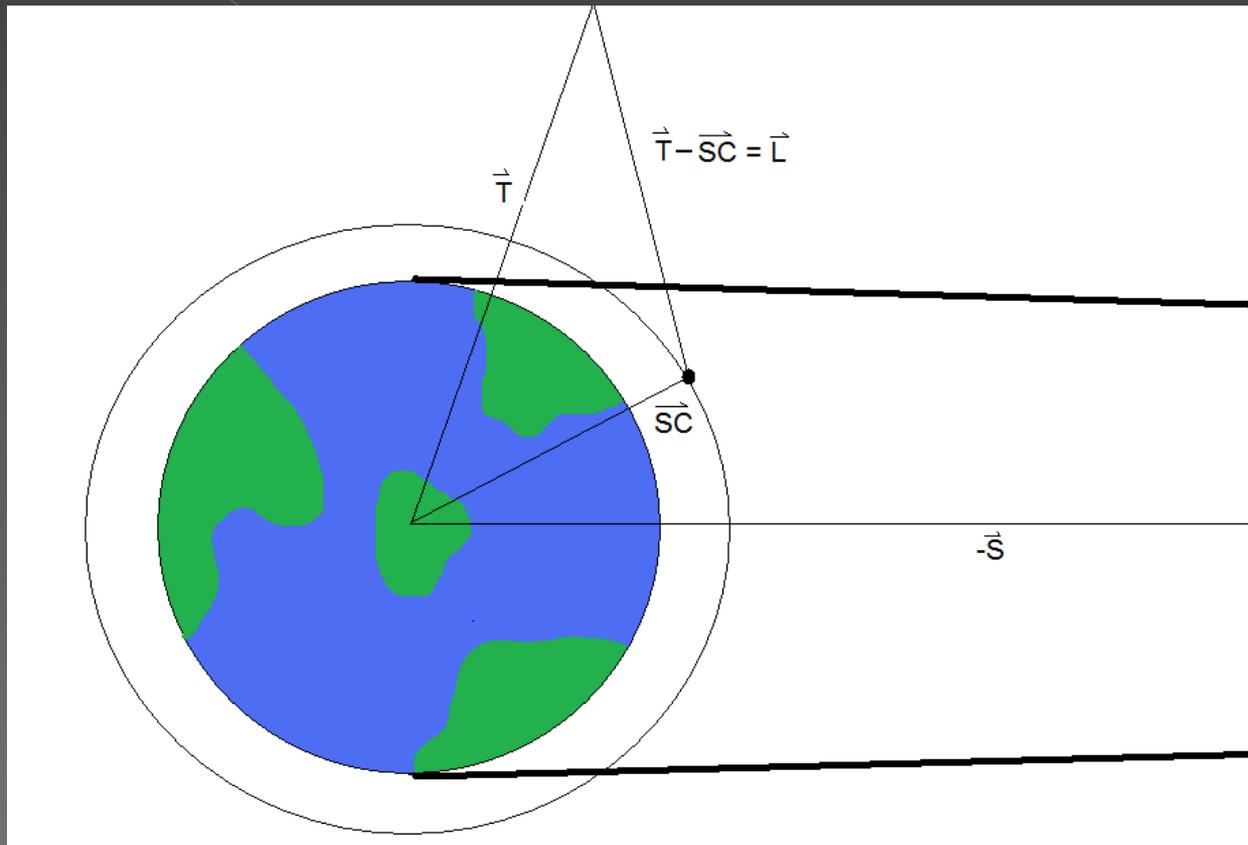
# Stellar Companion Observation

companion\_stellar\_observation

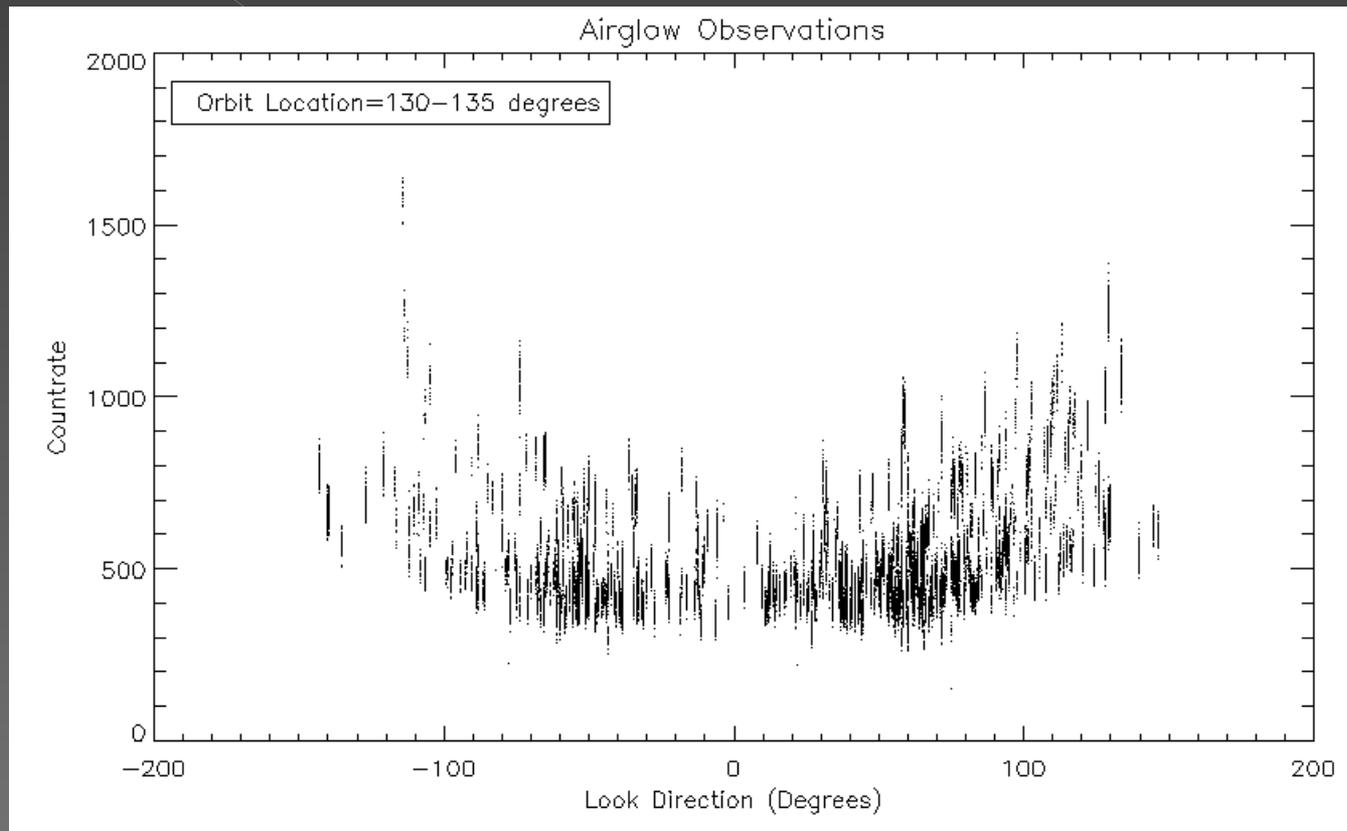
# Look Direction

- ⦿ There is also an IDL procedure to determine the vector from Earth to the Target.
- ⦿ The difference between the Earth-target and Earth-spacecraft vectors is the look direction.
- ⦿ We can use these vectors to calculate how the angle between the anti-sunward vector and look direction changes.

# Look Direction (cont.)

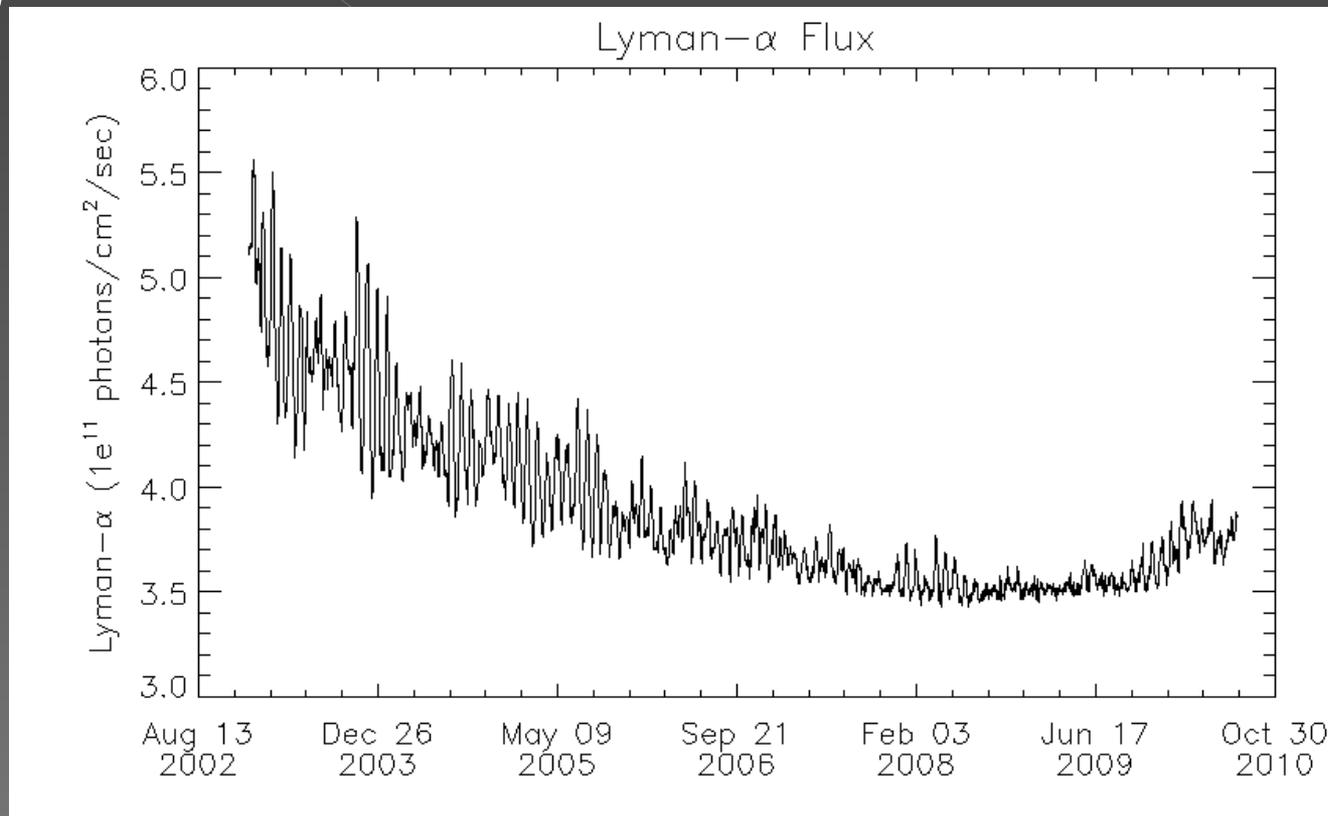


# Look Direction (cont.)



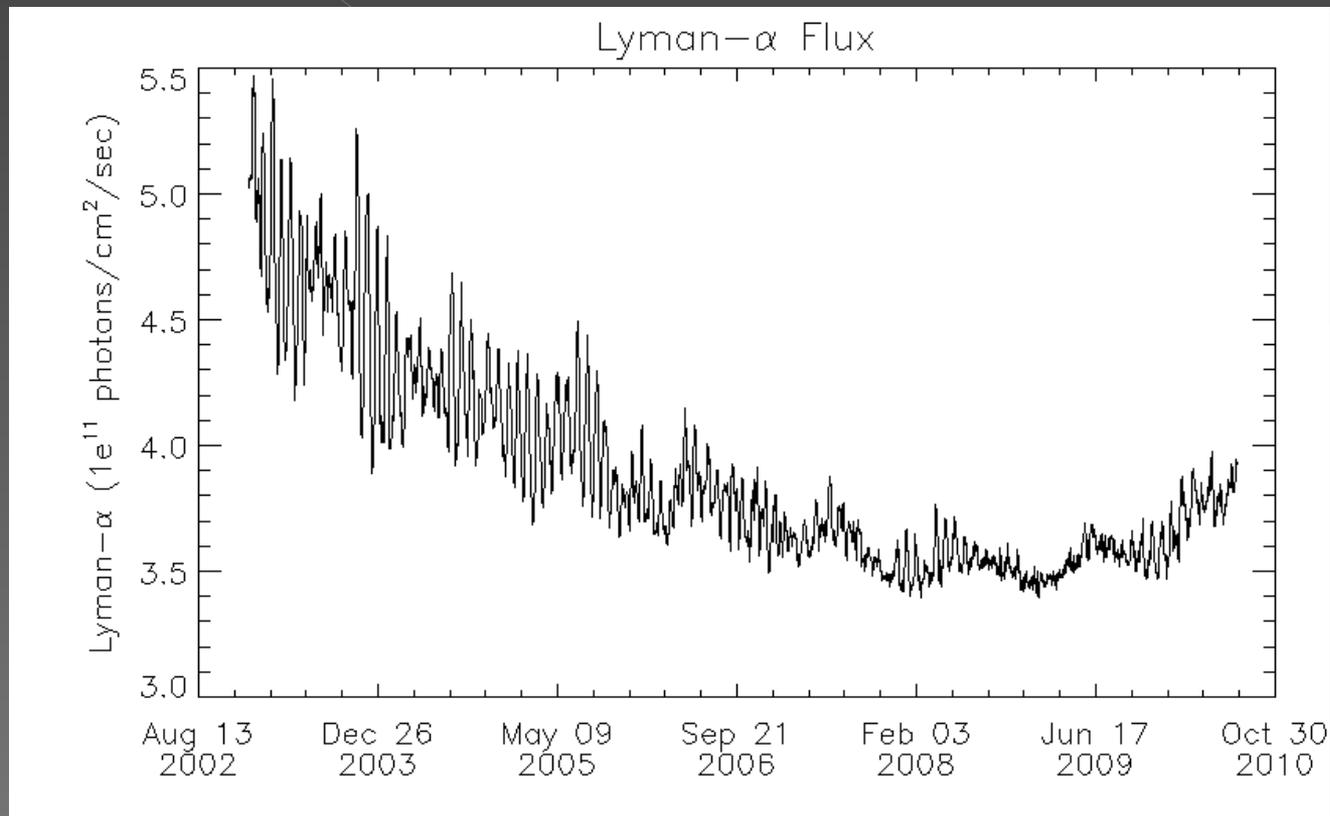
# Lyman- $\alpha$ Flux

- Have to (un)adjust for Sun-Earth distance (6%)

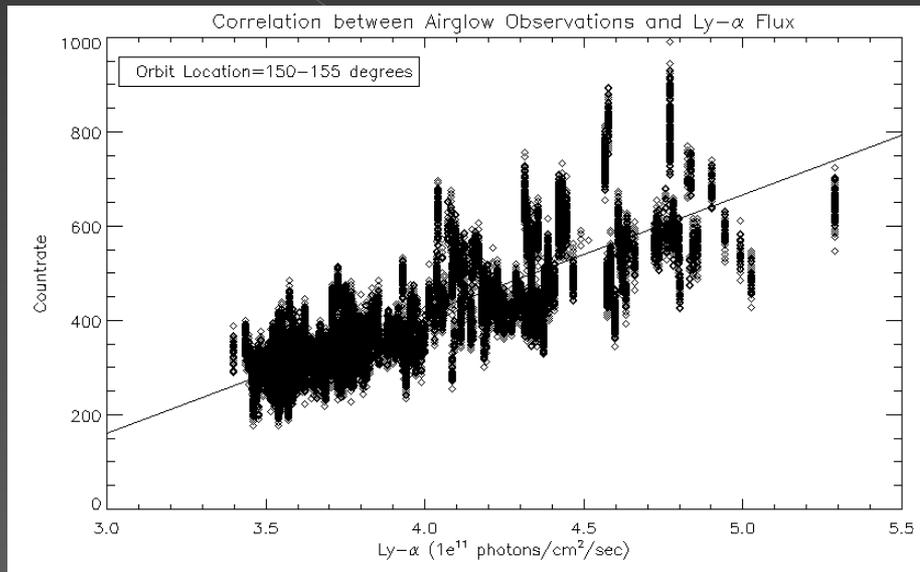


# Lyman- $\alpha$ Flux

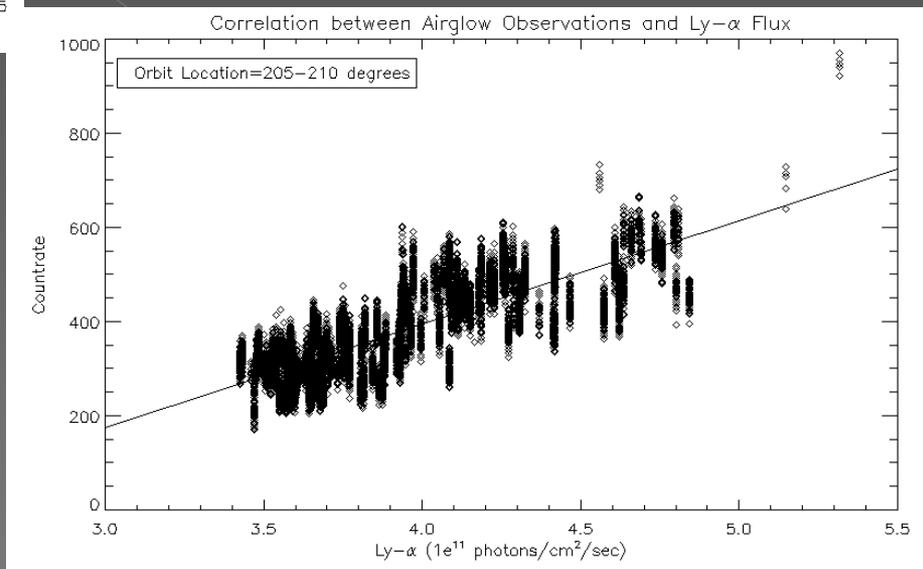
- A way to measure solar cycle



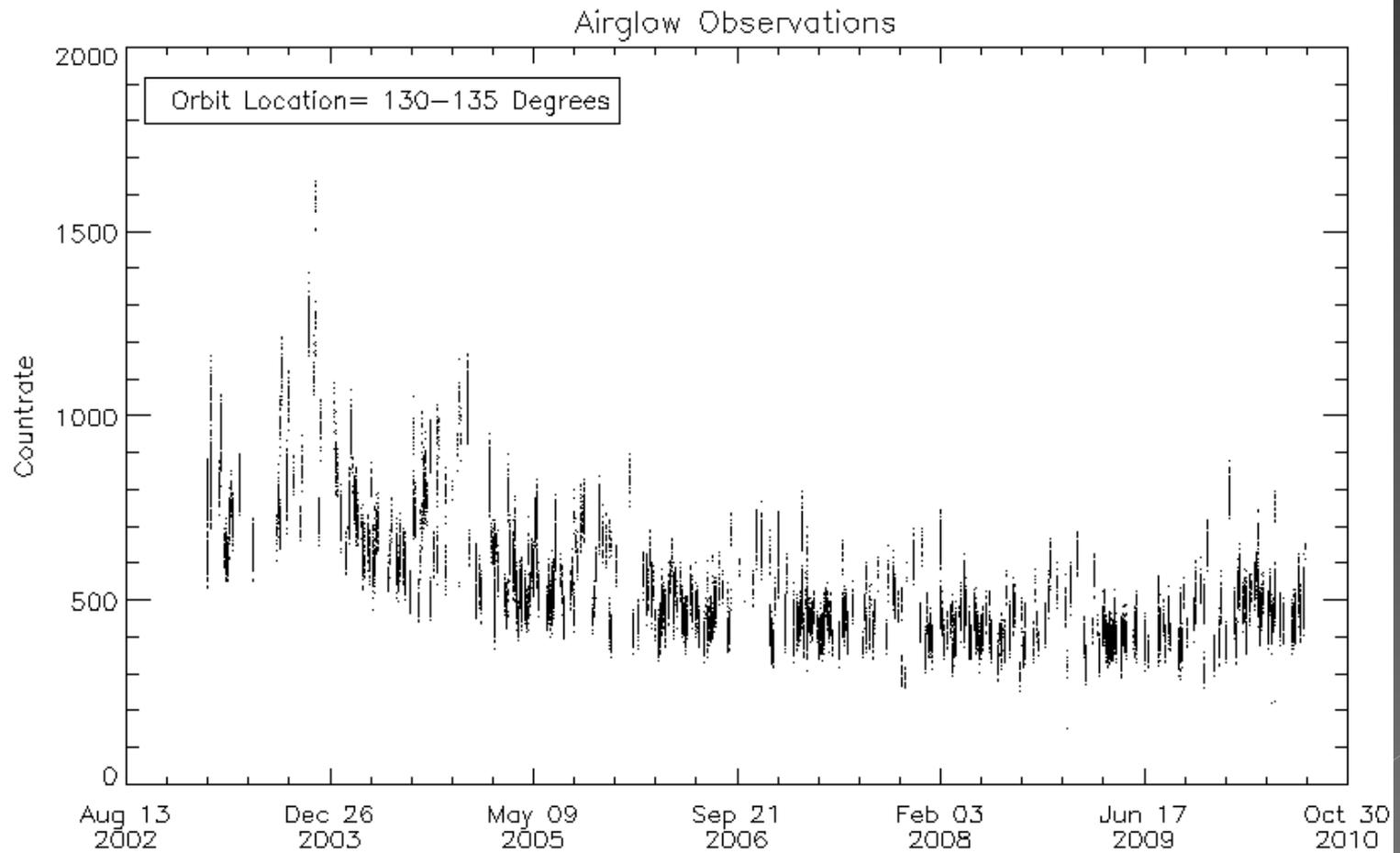
# Lyman- $\alpha$ Flux (cont.)



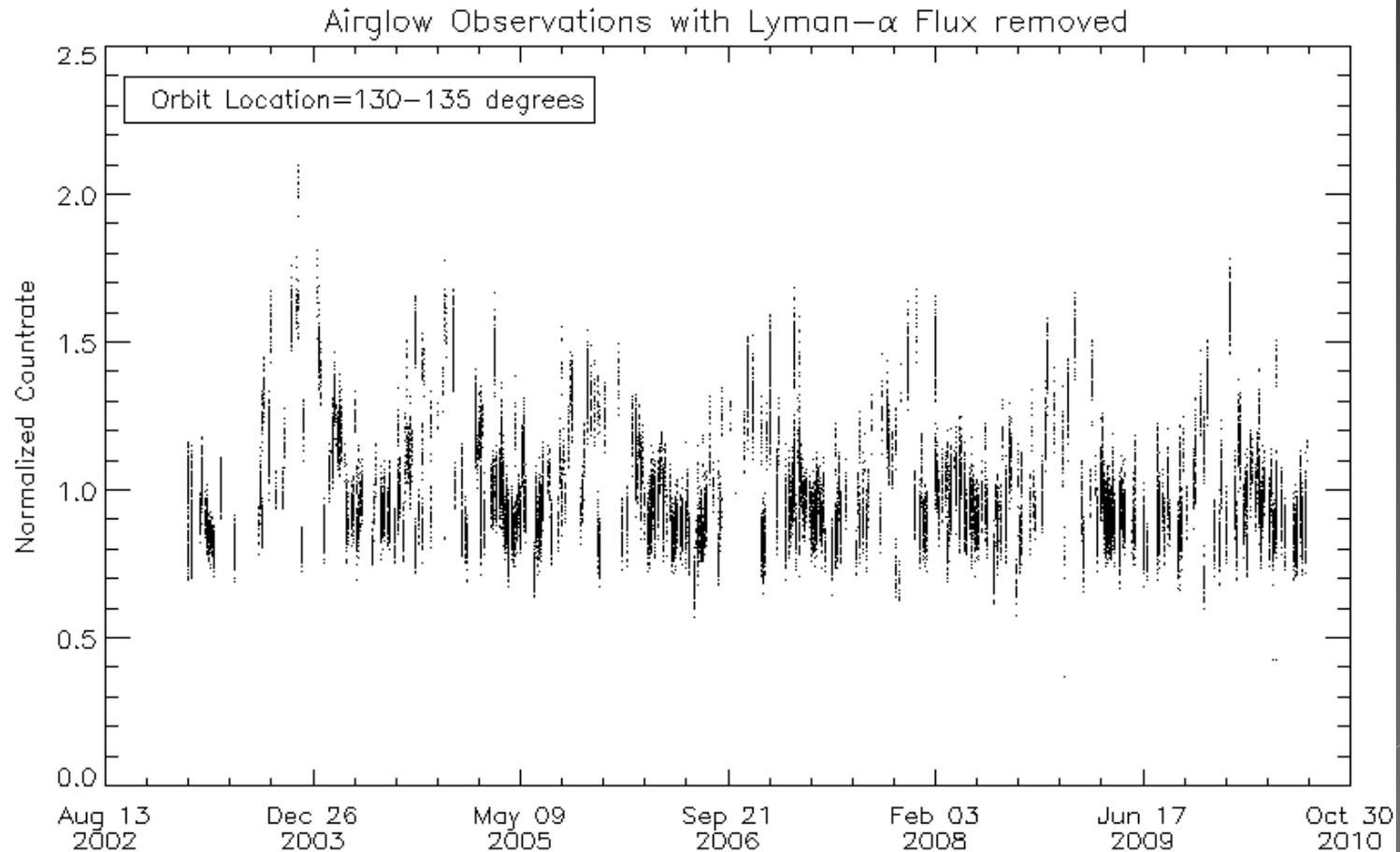
● What a nice fit!



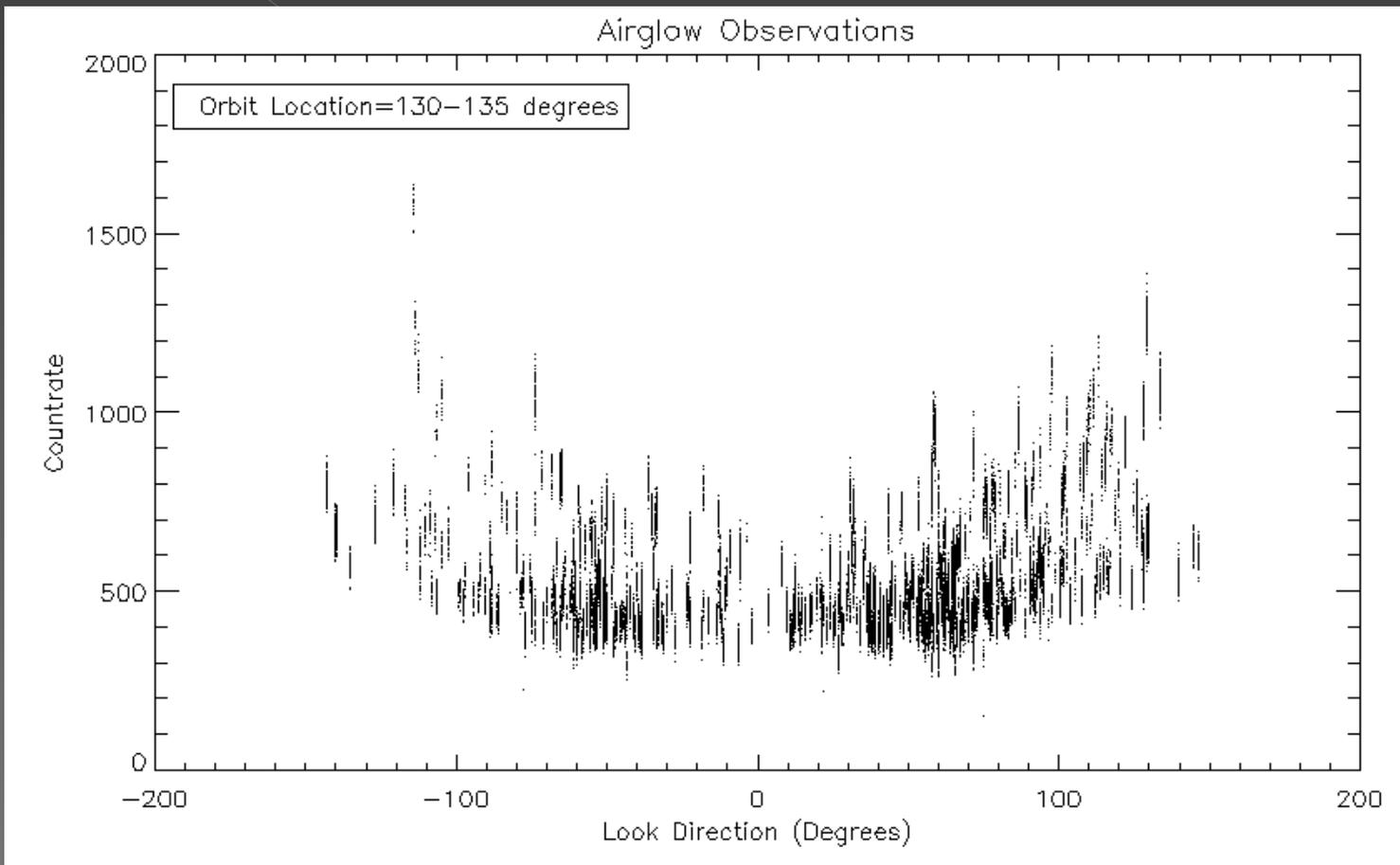
# Recall..



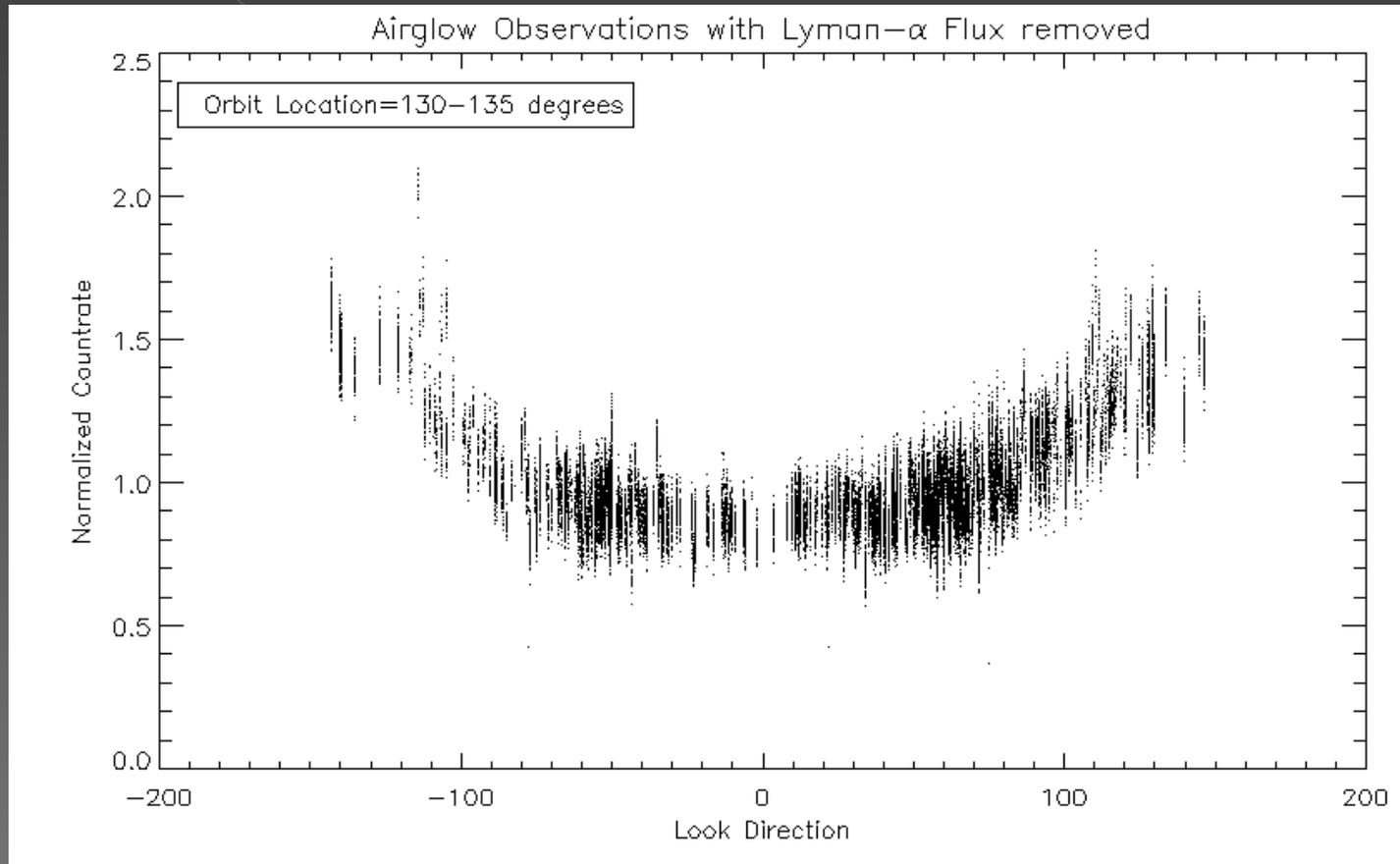
# Solar Cycle Adjusted



# Recall...



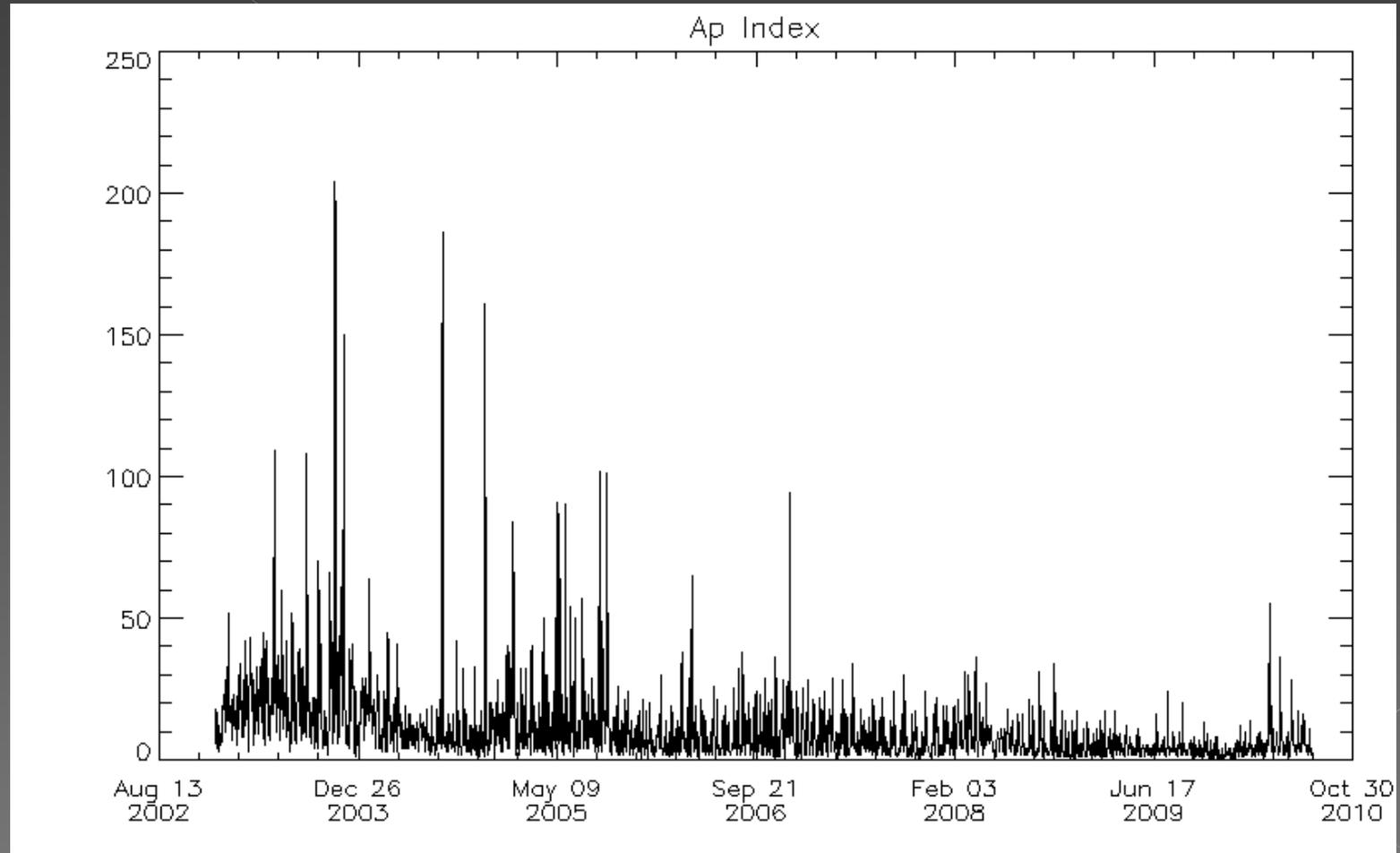
# Solar Cycle Adjusted



# Optical Thickness Results

- The corrected airglow signal shows a substantial change as a function of both orbit location and look direction.
- We can conclude that at the altitude of SORCE the geocorona is optically thin.

# Geomagnetic Activity



# Geomagnetic Activity

- ◉ I was unable to make any concrete conclusions on whether or not the influences of geomagnetic activity play a roll in impacting the geocorona.
- ◉ Why?
  - > The geocorona is comprised of neutral hydrogen atoms.
  - > Time...

# Final Thoughts...

- ◉ I would like to explore other factors effect the geocorona (27 day cycle)
- ◉ By being able to model the airglow signal in the geocorona, we can learn more about its physical state.
- ◉ If we can model, we can then remove it from other observations (stellar and lunar).

QUESTIONS?

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