

The Influences of Geocoronal Variability

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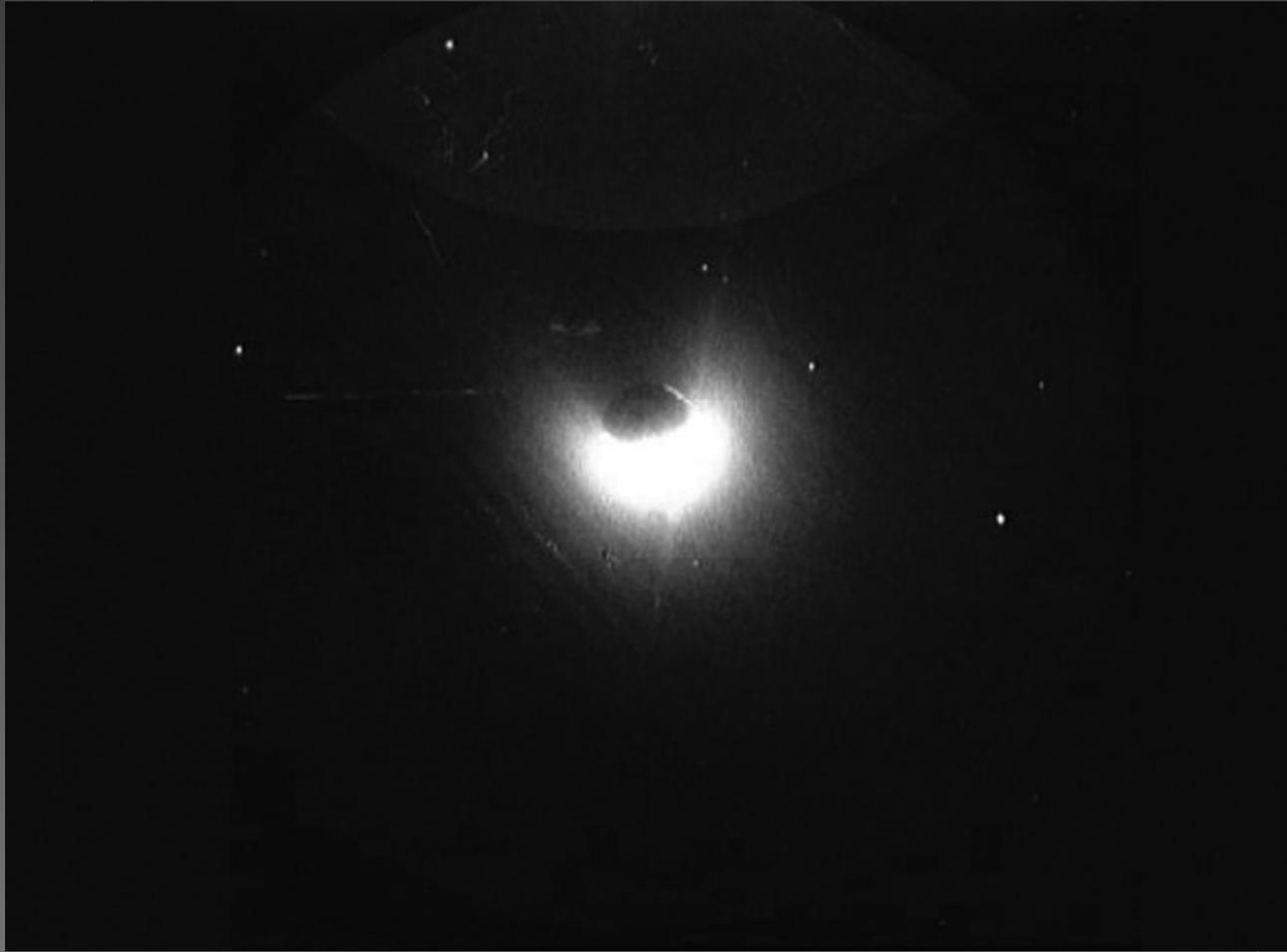
Mentor: Marty Snow

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- α (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.



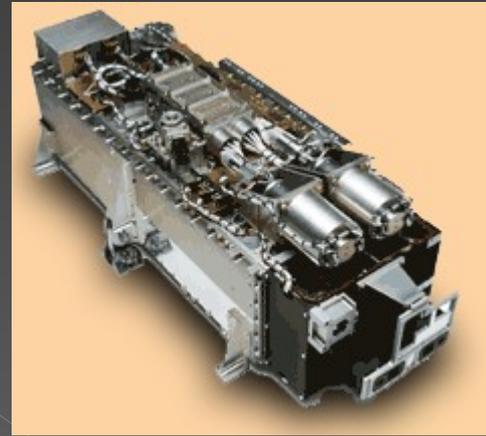
Solar Radiation and Climate Experiment: SORCE

- 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).

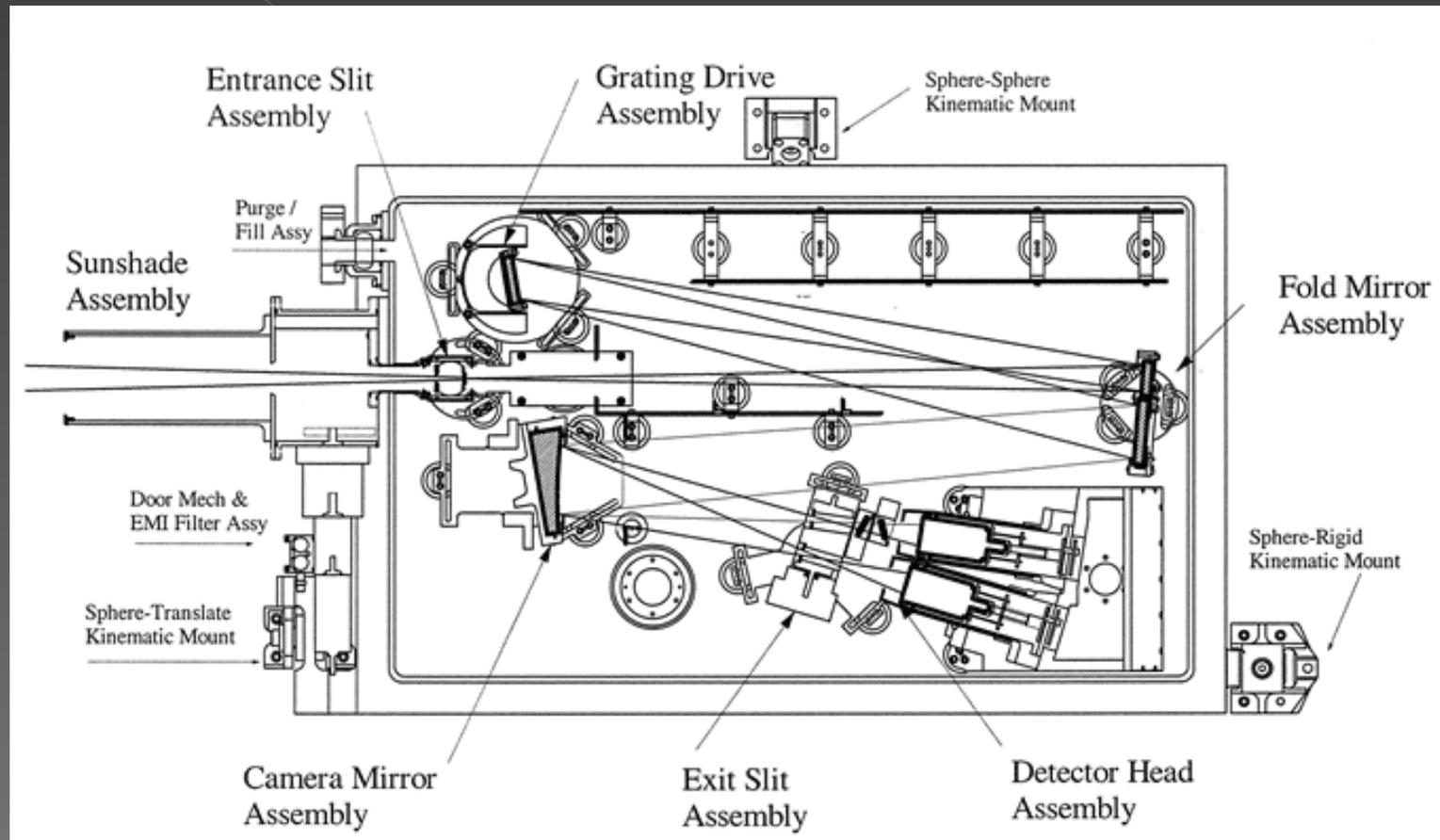


SOLar STellar Irradiance Comparison Experiment: SOLSTICE

- 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

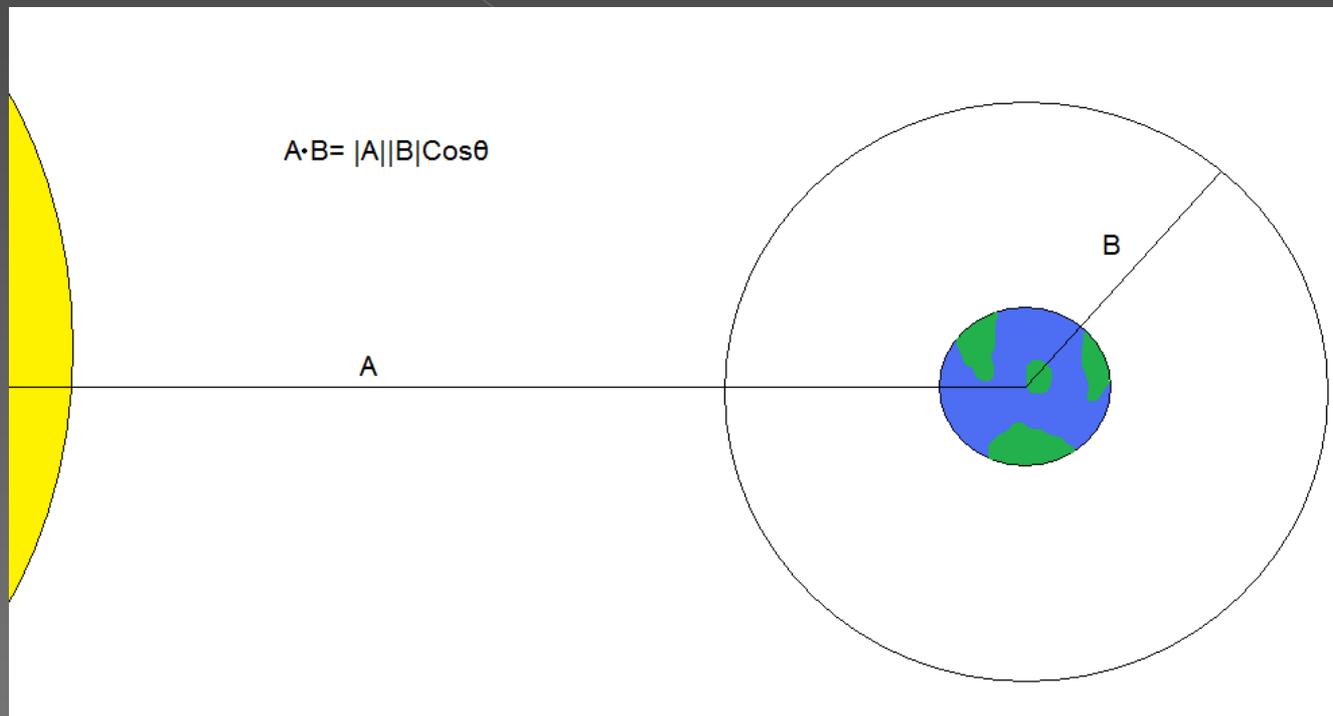


Optical Thickness

- **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.

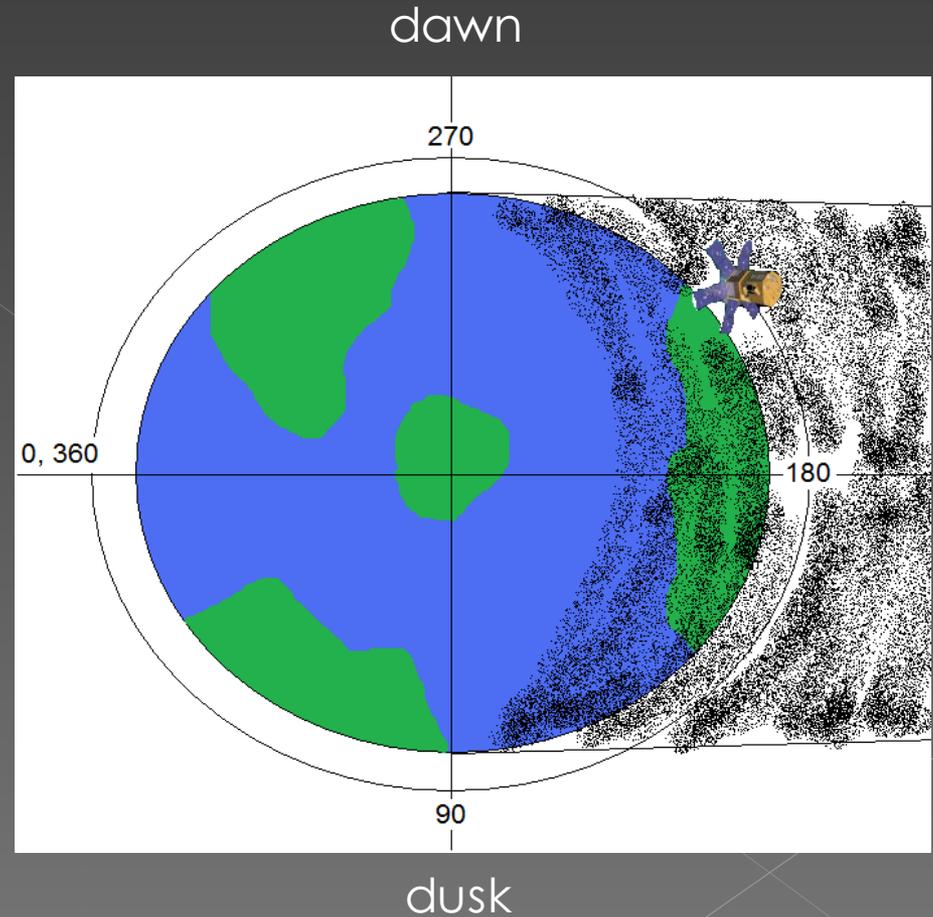
Where is the Spacecraft?

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

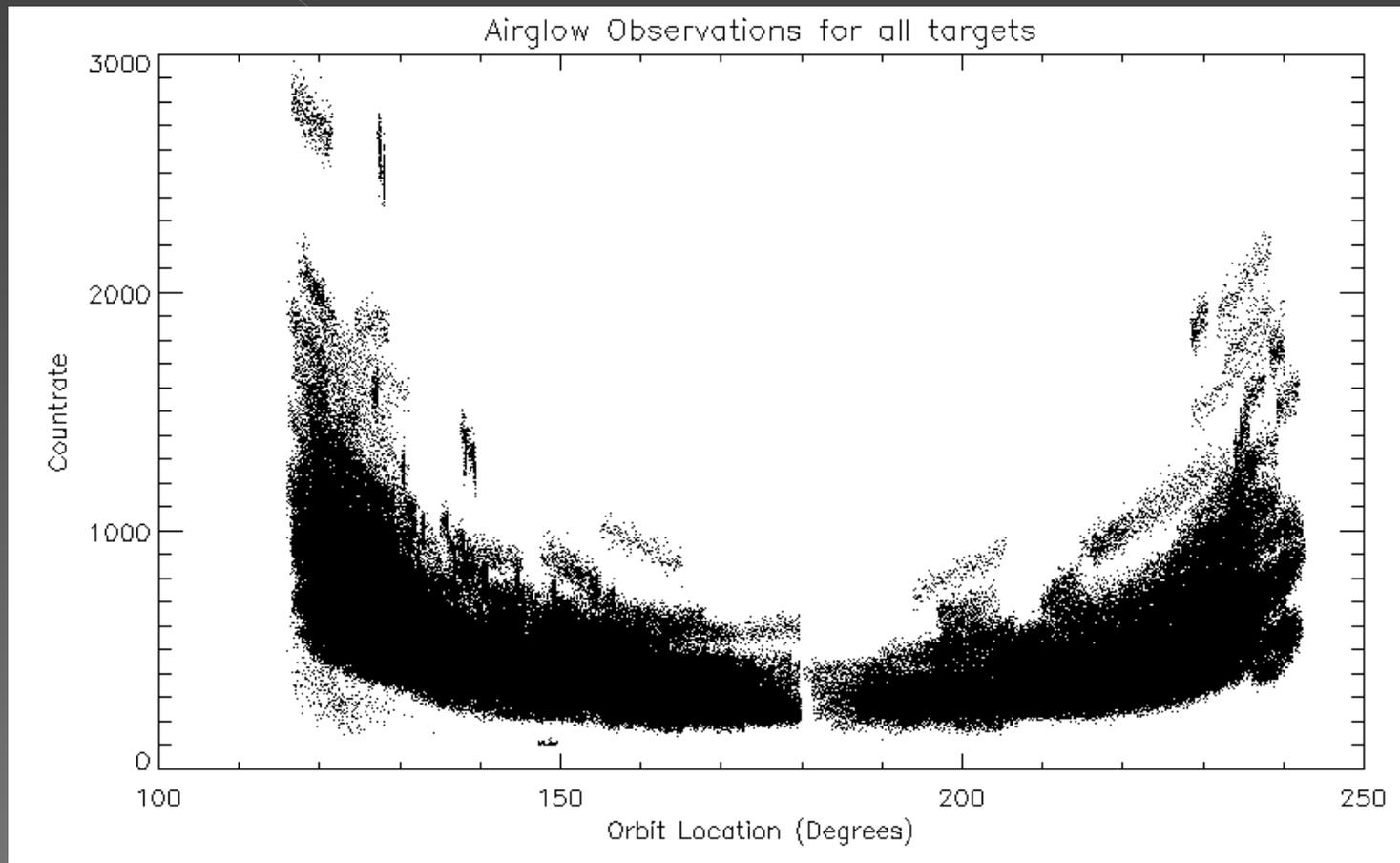


Where is the Spacecraft? (cont.)

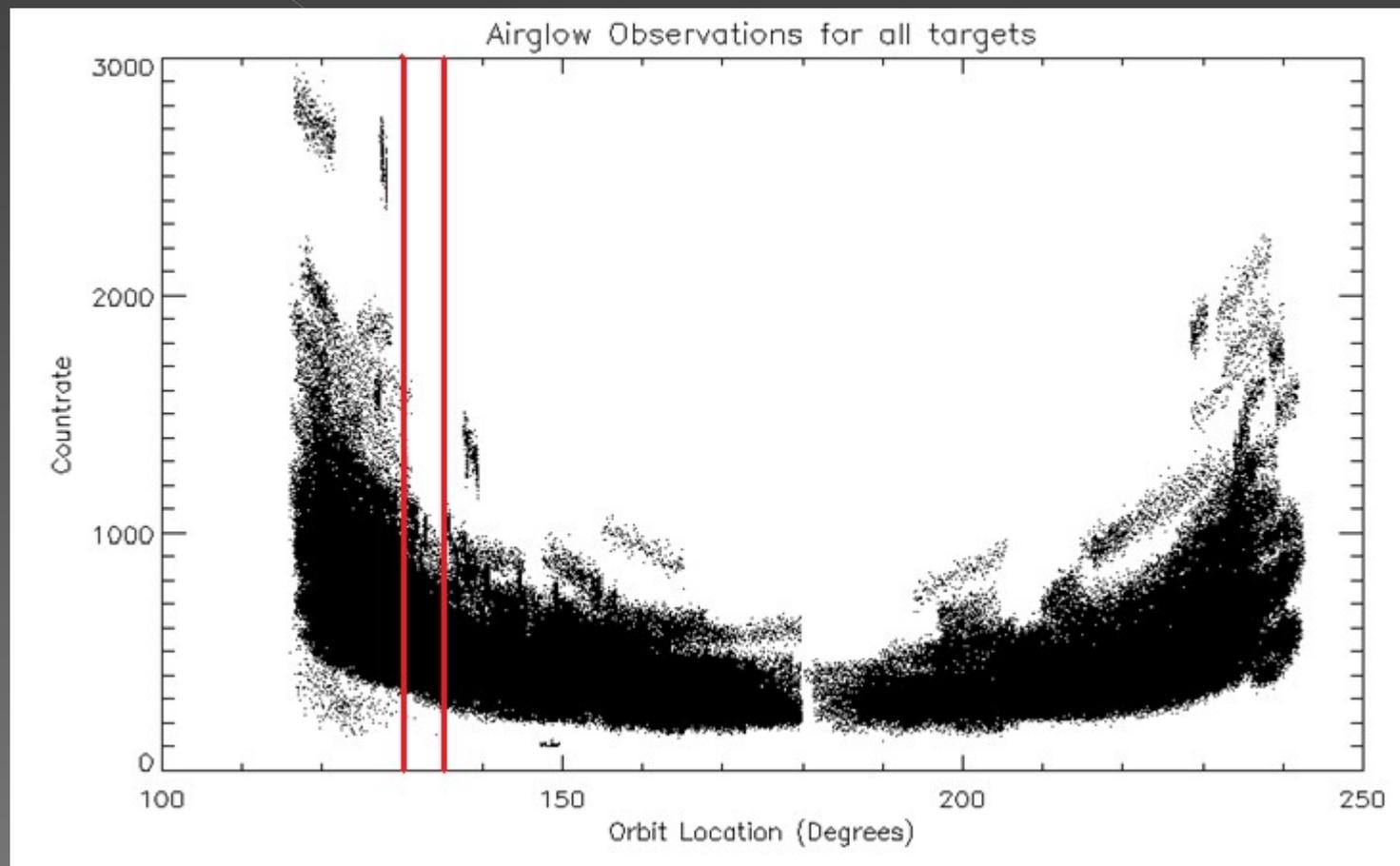
- Calculated θ is between 0° and 180° .
- This doesn't help much with determining which side of the Earth (dawn or dusk) the spacecraft is located.
 - Spacecraft is moving in the same direction as the Earth.
 - Decide where angles $>180^\circ$ will be located.



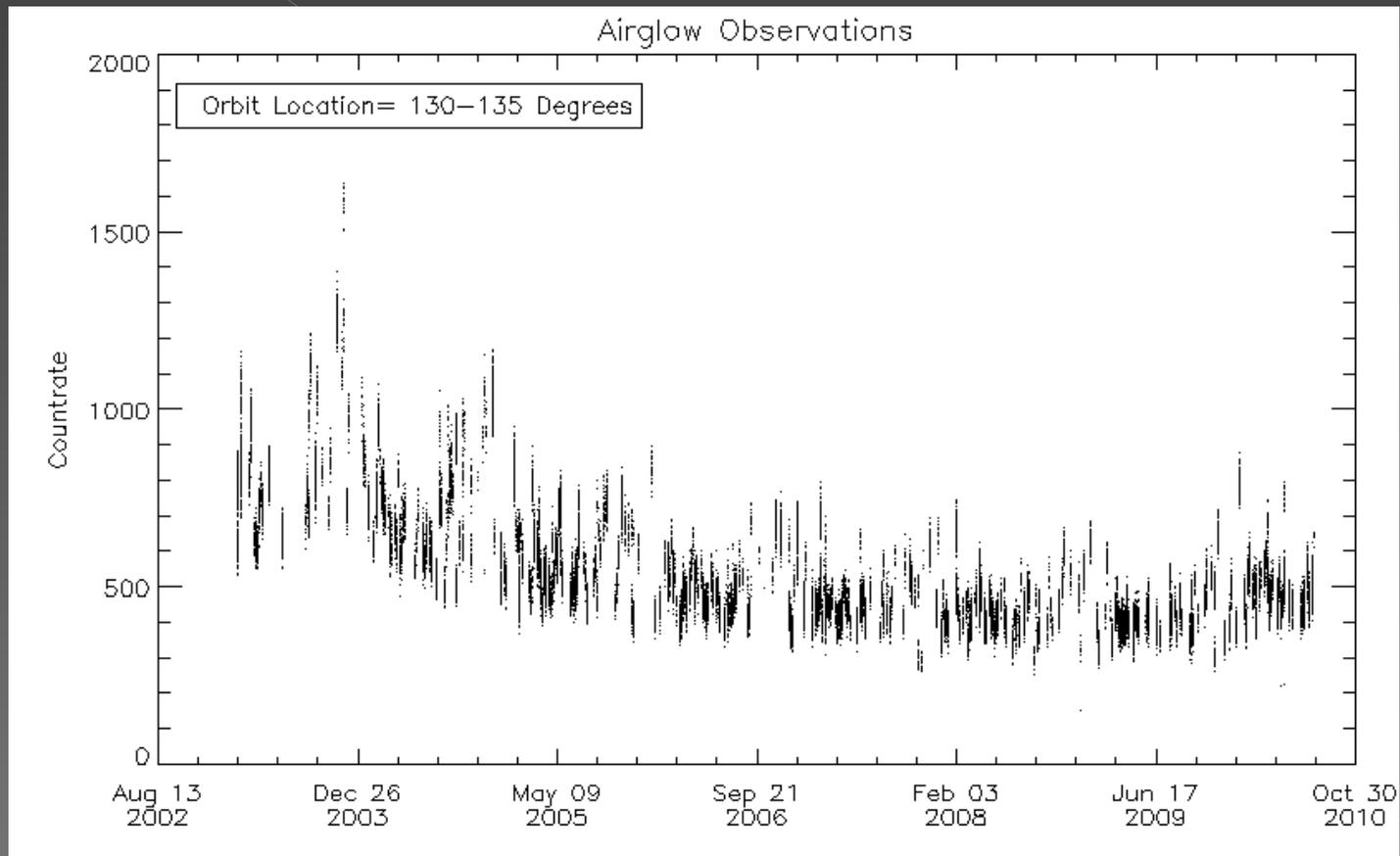
Airglow Observations at location of the spacecraft



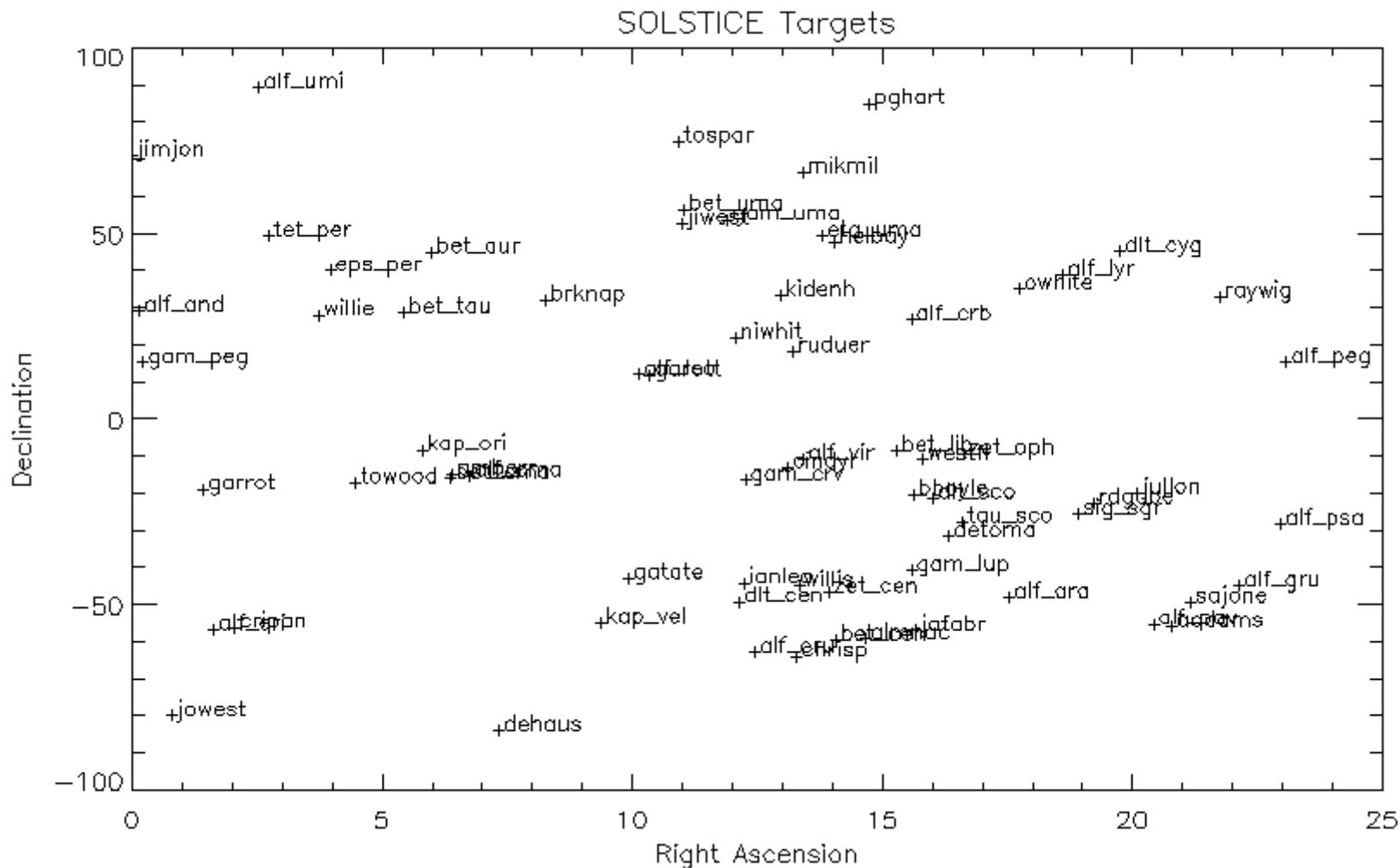
Airglow Observations at location of the spacecraft



Airglow Observations



Target Location



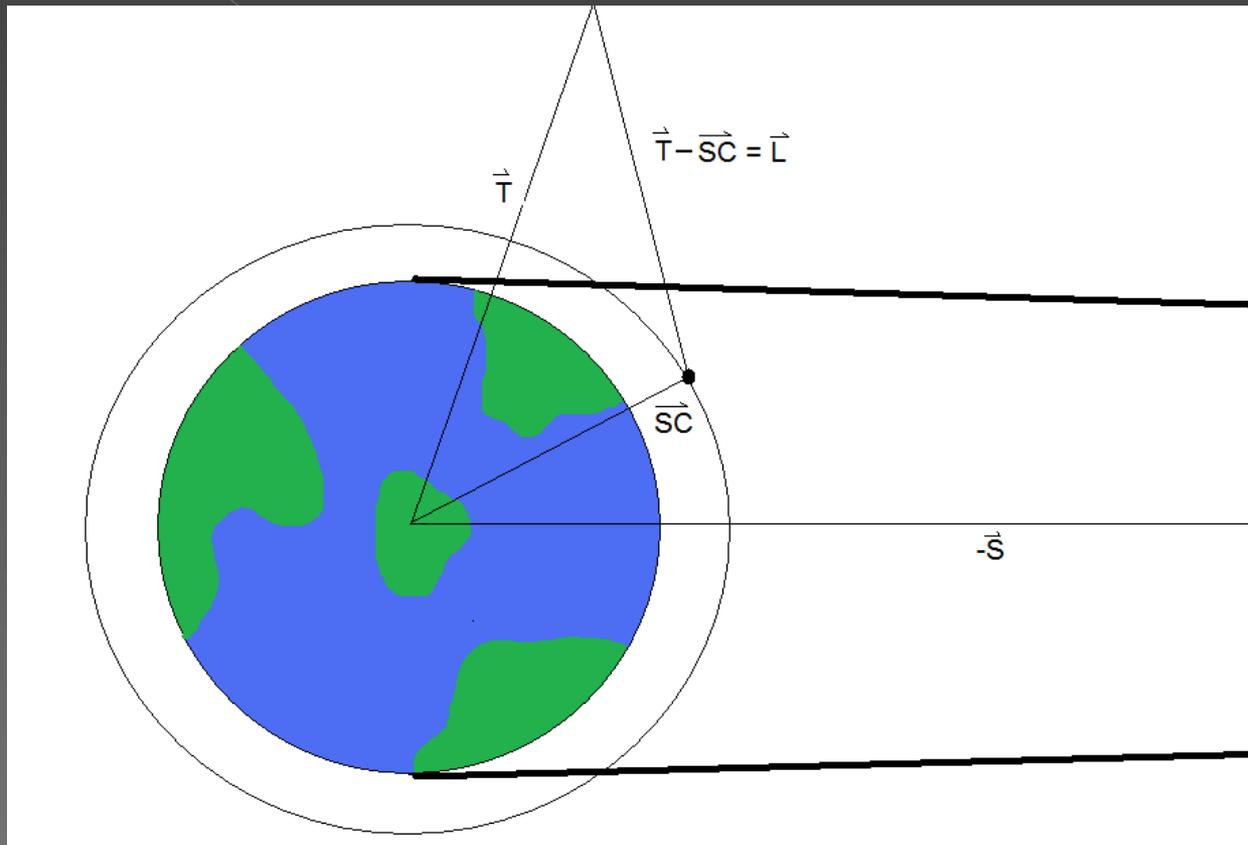
Stellar Companion Observation

companion_stellar_observation

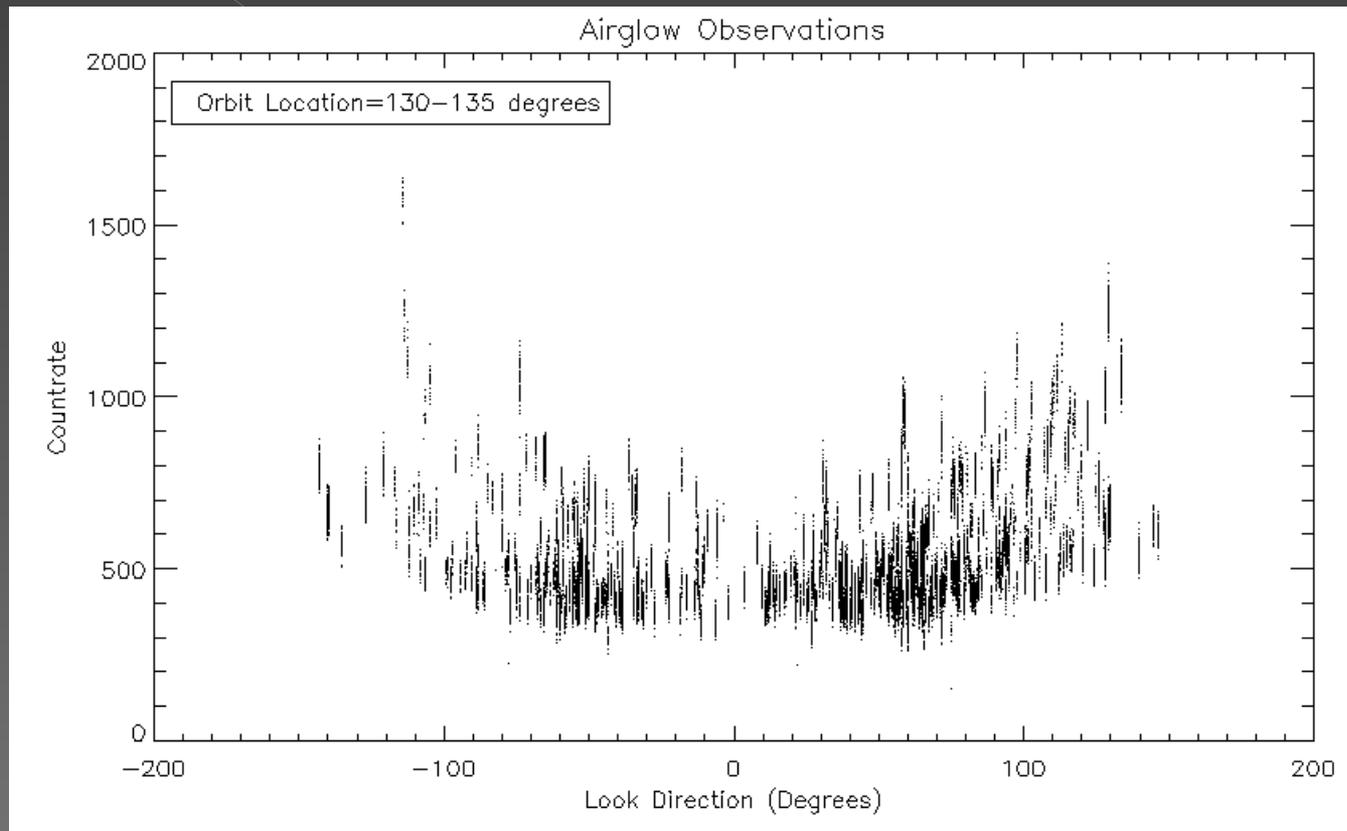
Look Direction

- ⦿ 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.)

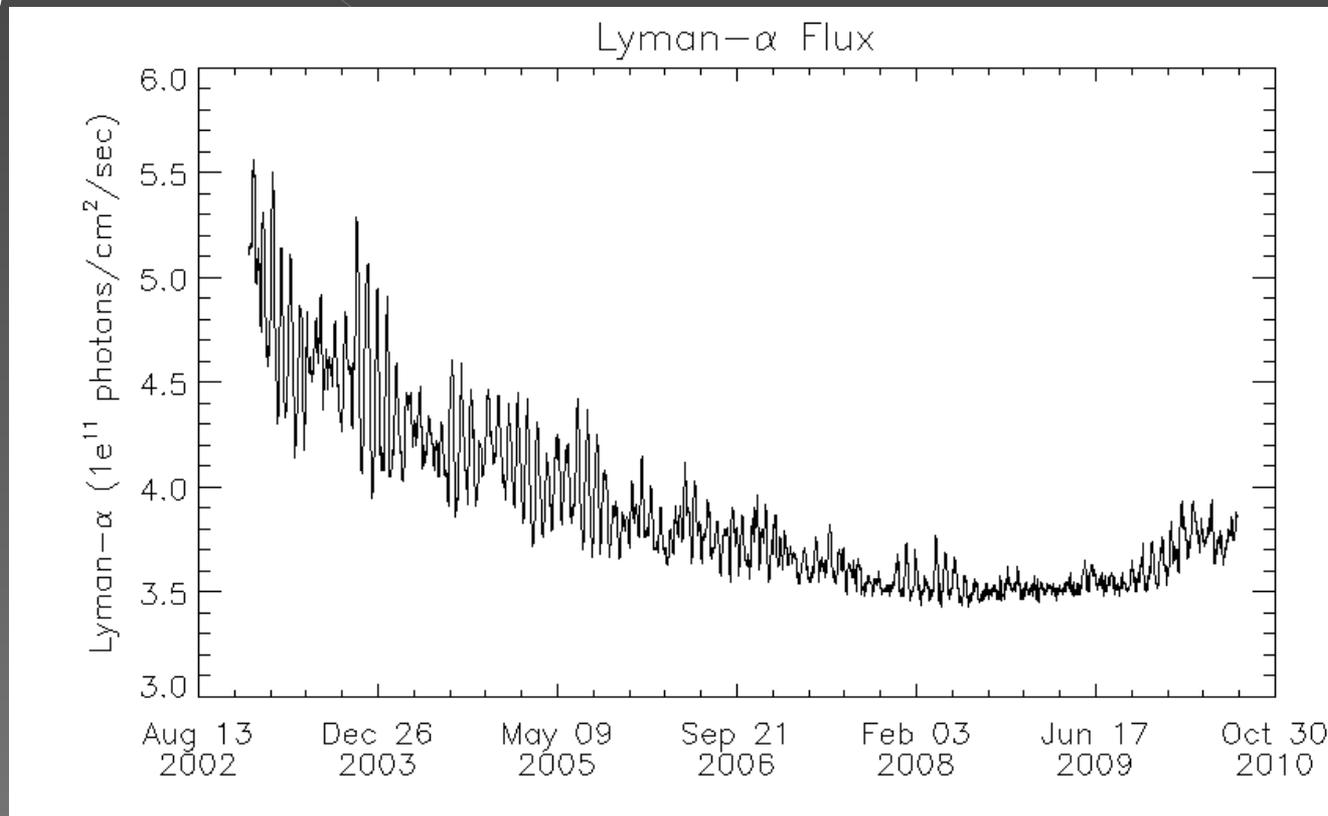


Look Direction (cont.)



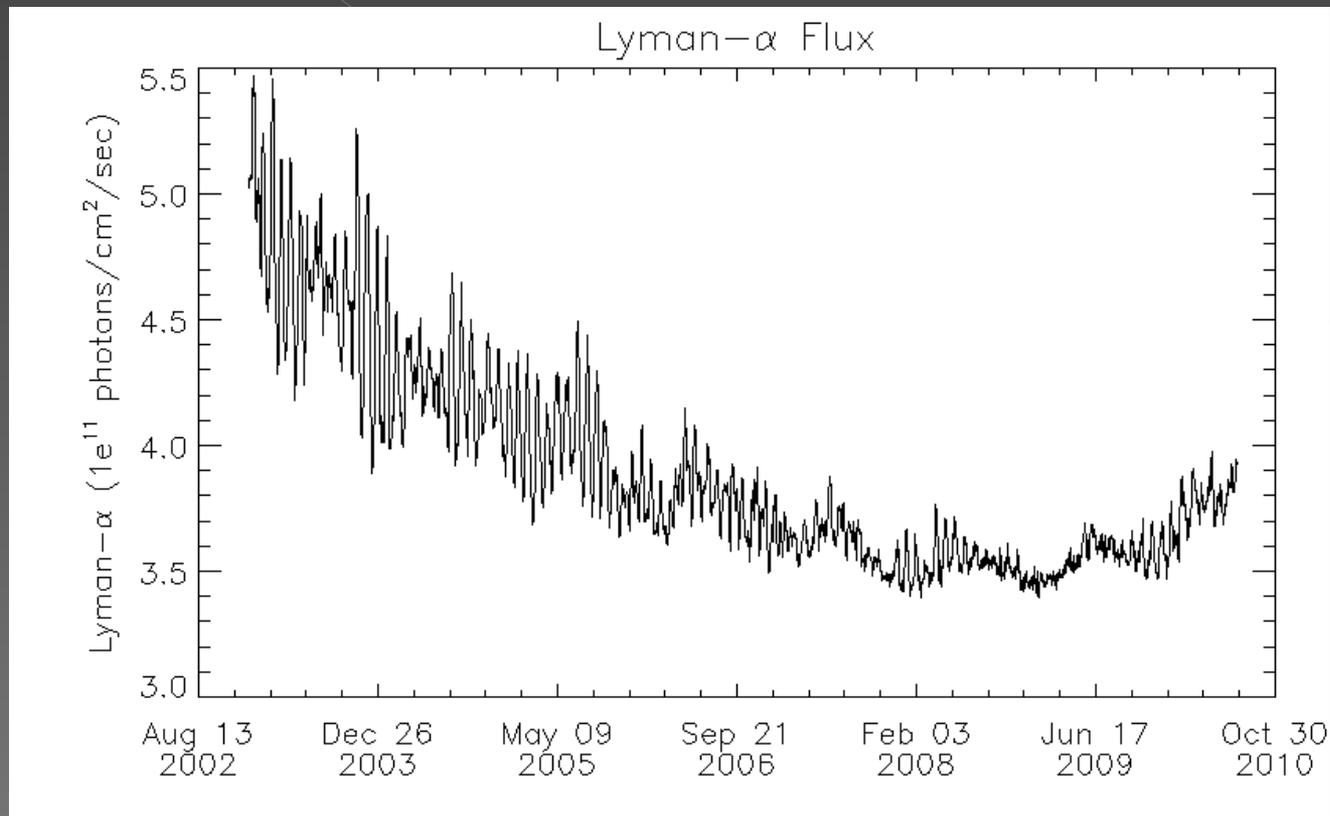
Lyman- α Flux

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

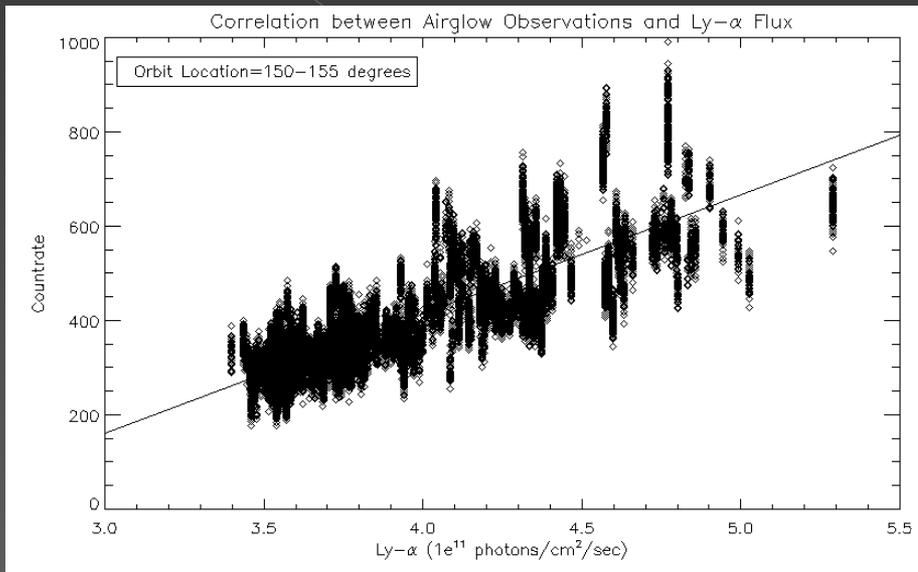


Lyman- α Flux

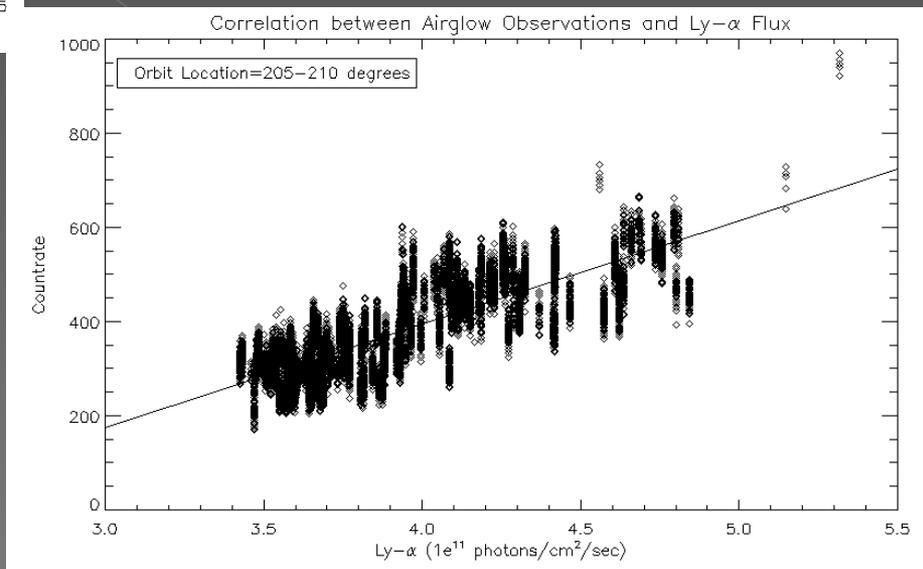
- A way to measure solar cycle



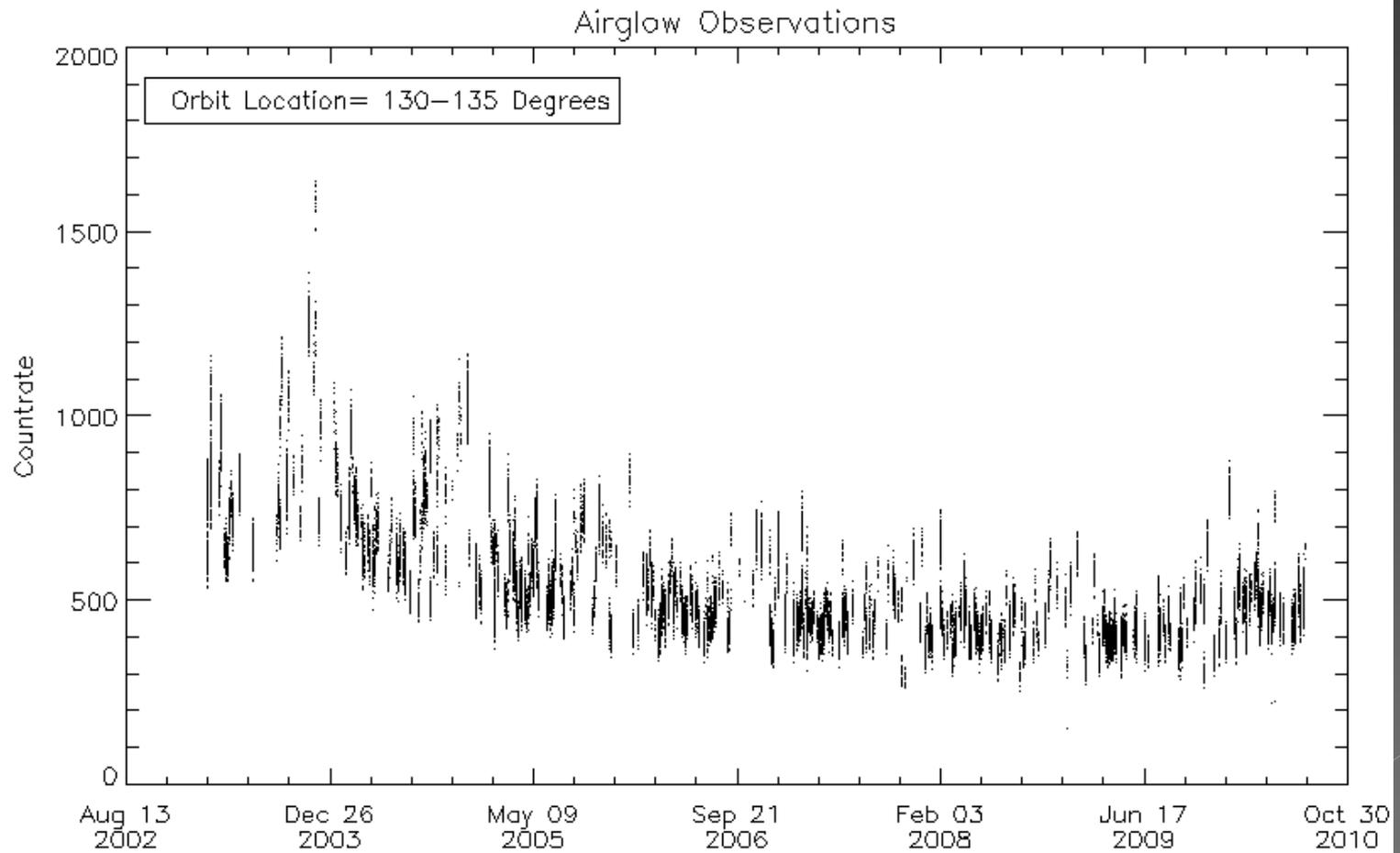
Lyman- α Flux (cont.)



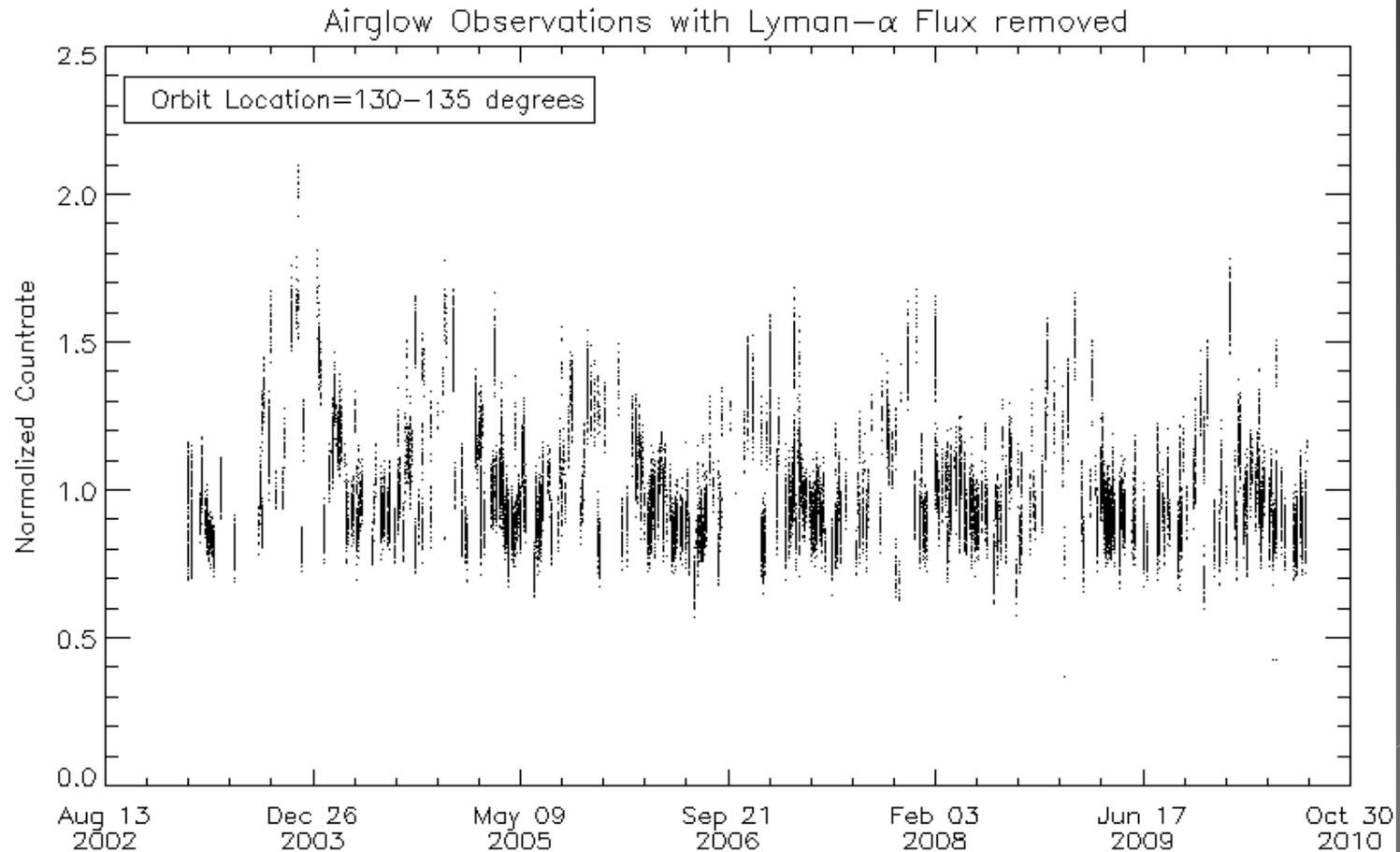
● What a nice fit!



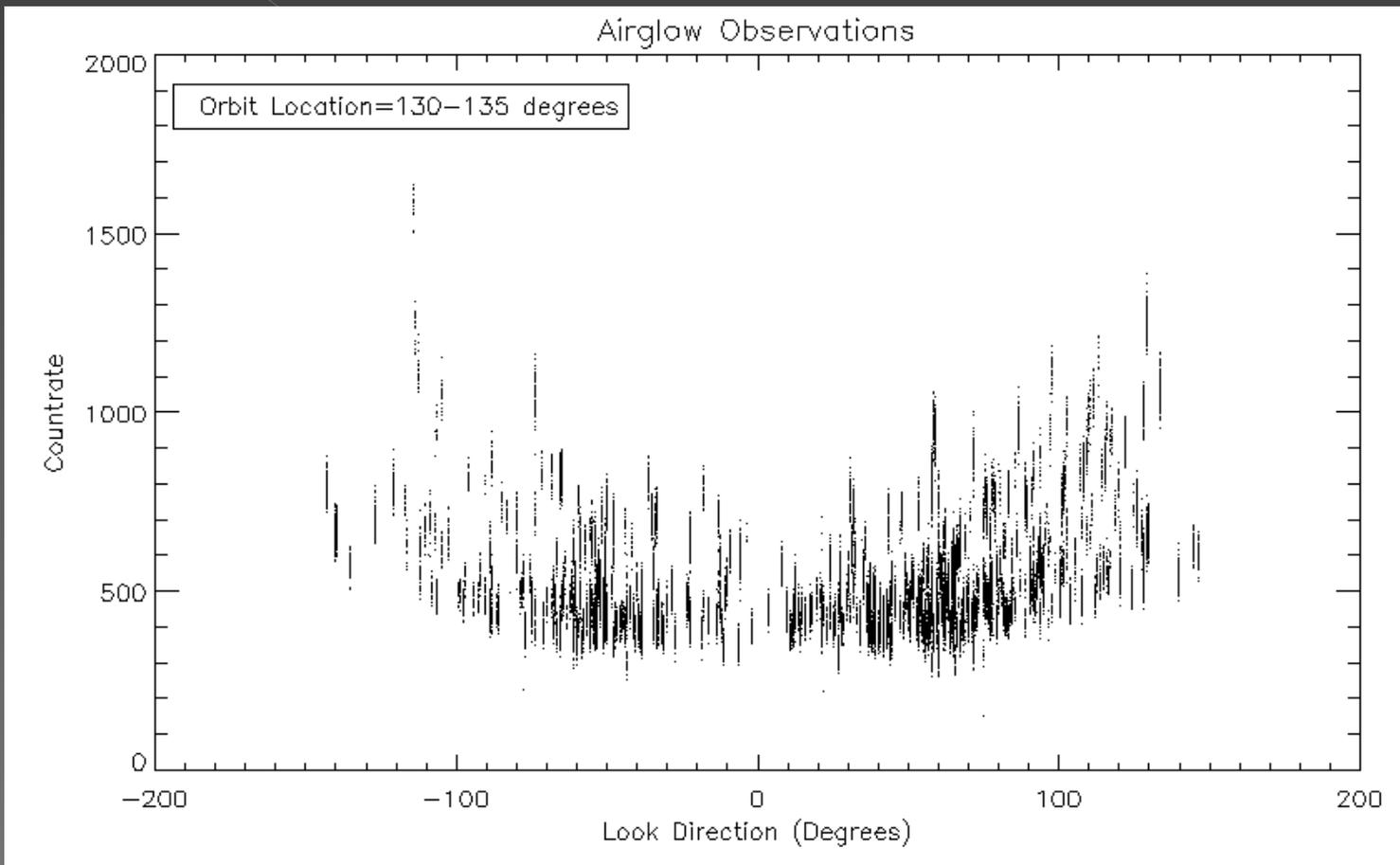
Recall..



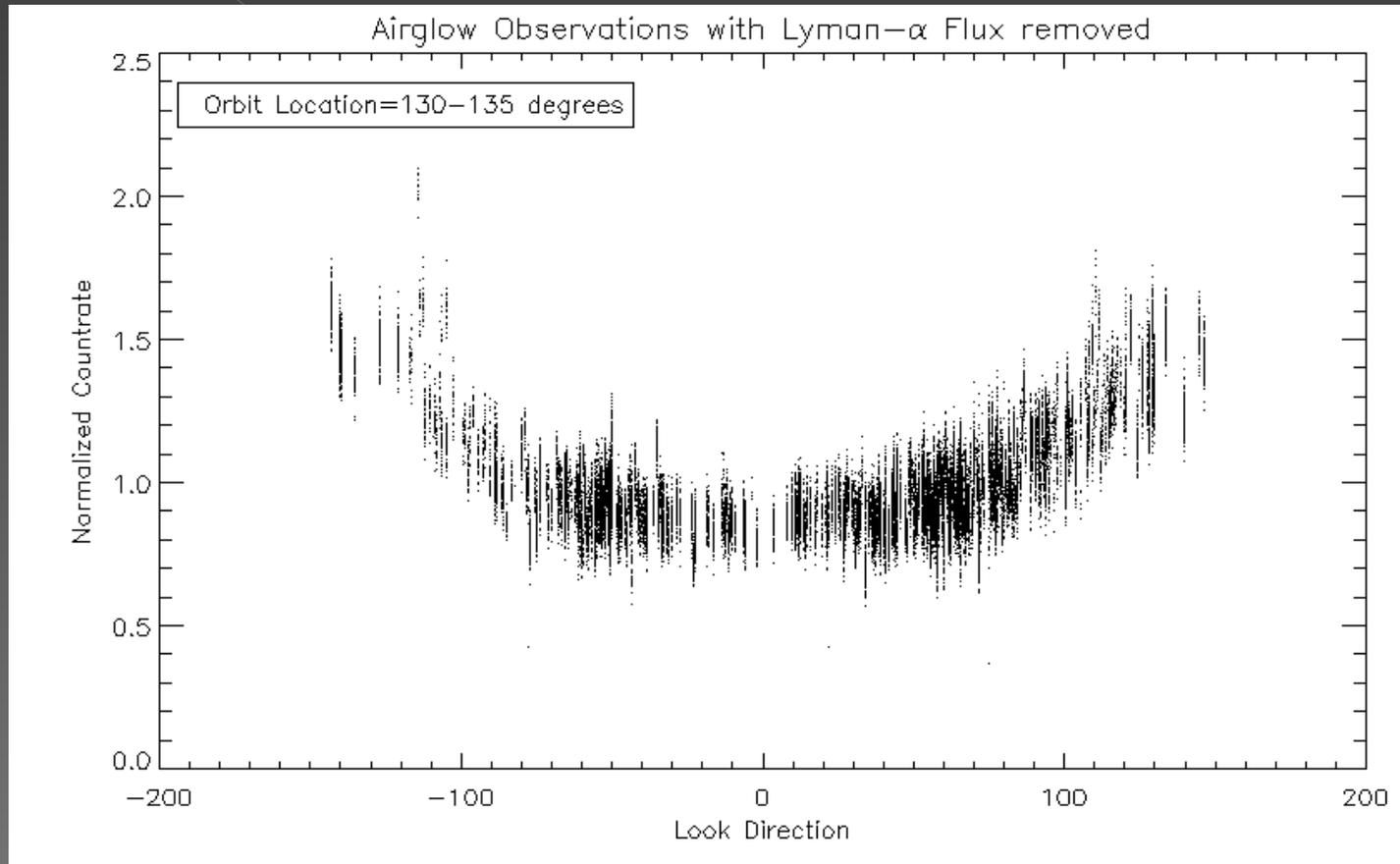
Solar Cycle Adjusted



Recall...



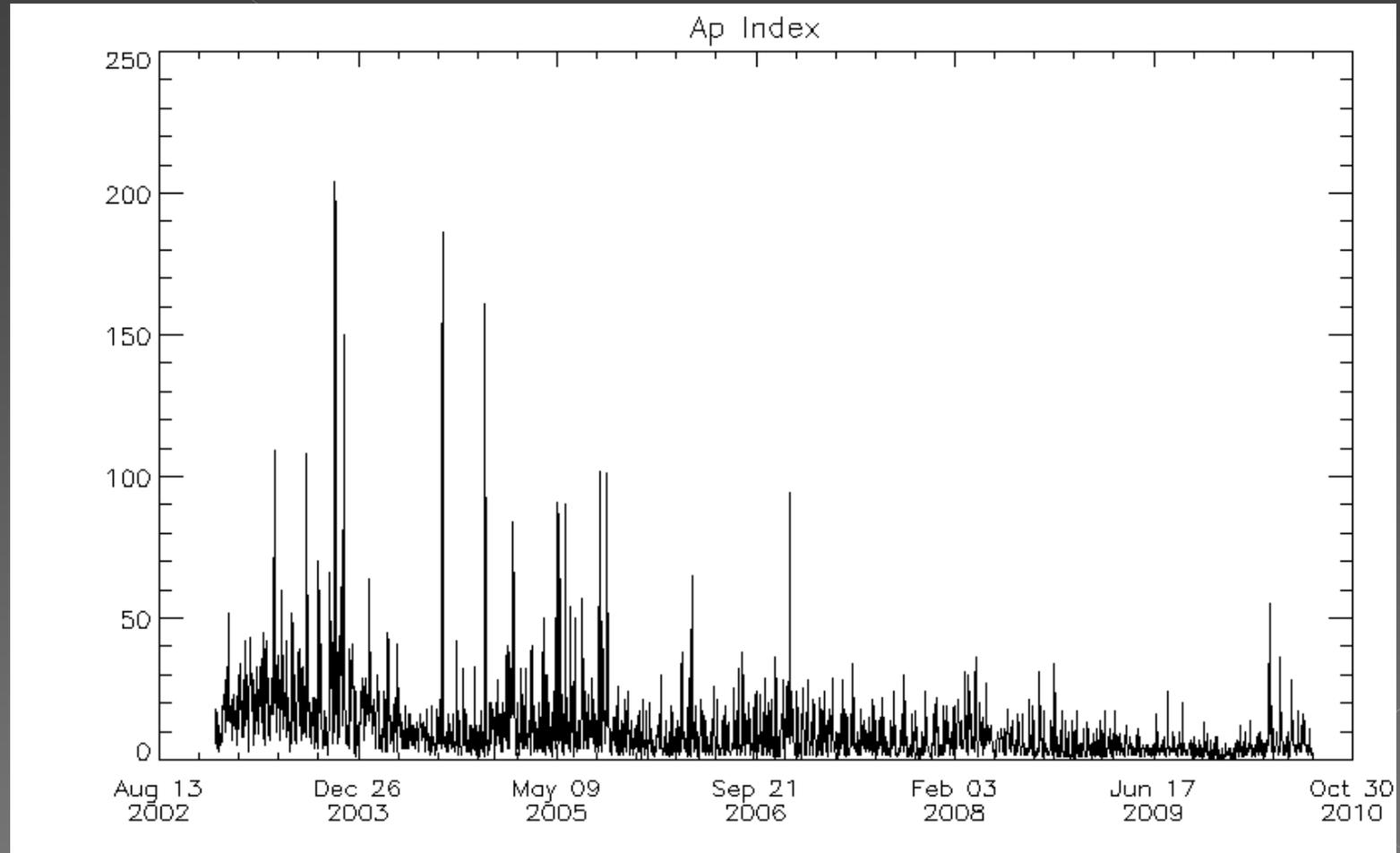
Solar Cycle Adjusted



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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