Solar Ultraviolet Spectral Irradiance: Early Results From the SOLar STellar Irradiance Comparison Experiment II Aboard the SORCE Spacecraft

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Outline

- SOLSTICE Experiment Overview
  - Objectives and Measurements
  - Experiment Summary and Data Products
  - Routine UV Observations
- Fun with SOLSTICE
  - Flare Observations
  - Mg II Studies
  - Stellar Occultation Measurements of the Thermosphere
  - Lunar Ultraviolet Reflectance Measurements

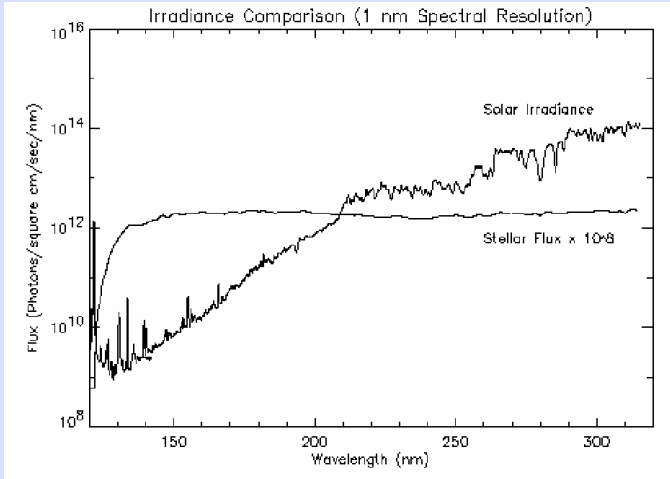
SOLSTICE: Science Objectives and Measurements

Science Objectives:

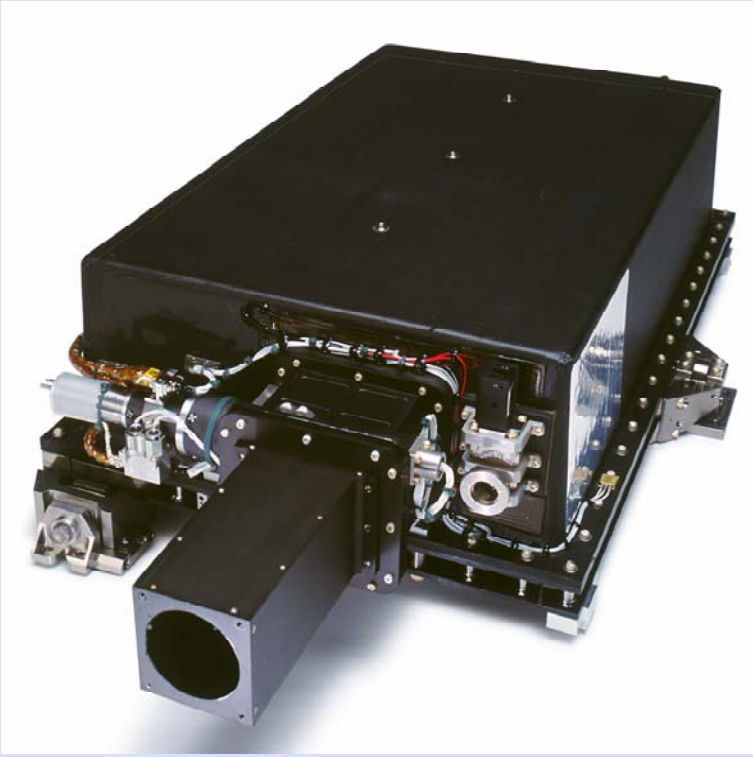
- Measure solar irradiance from 115 to 320 nm with 0.5 nm spectral resolution and 5% or better accuracy
- Monitor solar irradiance variation with 0.5% accuracy during the SORCE mission
- Establish the ratio of solar irradiance to the average flux from an ensemble of bright early-type stars with 0.5% accuracy for future studies of long-term solar variability

Measurements:

- Wavelength Coverage: 115 - 320 nm
- Solar Spectral Resolution: 0.1 nm
- Stellar Spectral Resolution : 1.1 - 2.2 nm



SOLSTICE Experiment

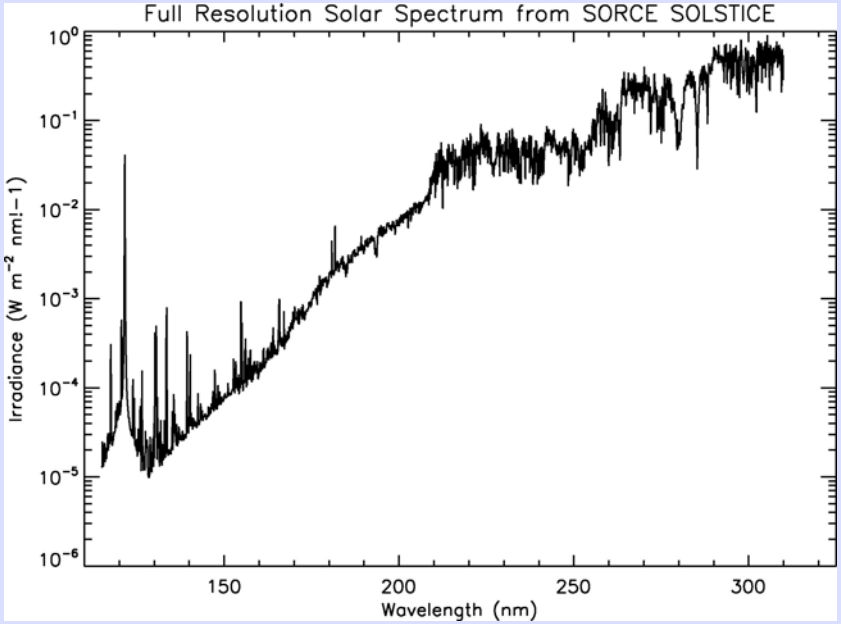


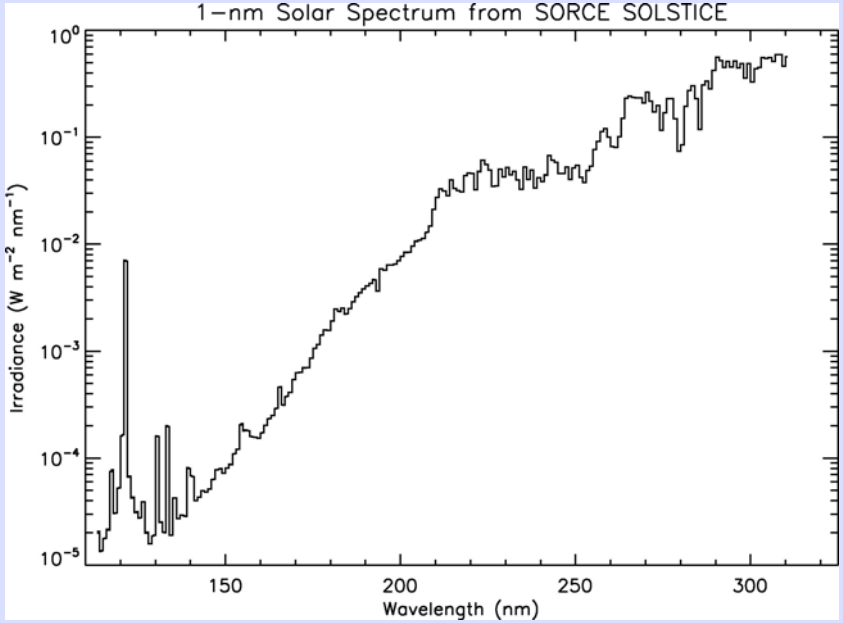
- Two identical instrument channels meet the SORCE Mission lifetime requirement:
  - -Channel A primary wavelength range: 170-320 nm
  - -Channel B primary wavelength range: 115-180 nm
- Each channel covers both wavelength ranges for redundancy and cross calibration.
- Solar and stellar irradiance are measured with the same optical-detector chain.
- Accurate pre-flight calibration using the NASA beam line at the NIST Synchrotron Ultraviolet Radiation Facility (SURF III)
- Precise measurements of solar and stellar irradiance of bright, early-type stars that, according to stellar theory, vary by <1% in 10^4 years
- Stellar measurements provide:
  - - Accurate in-flight instrument calibration tracking
  - - The basis for comparing SOLSTICE solar irradiance measurements with future work

SOLSTICE: Data Products

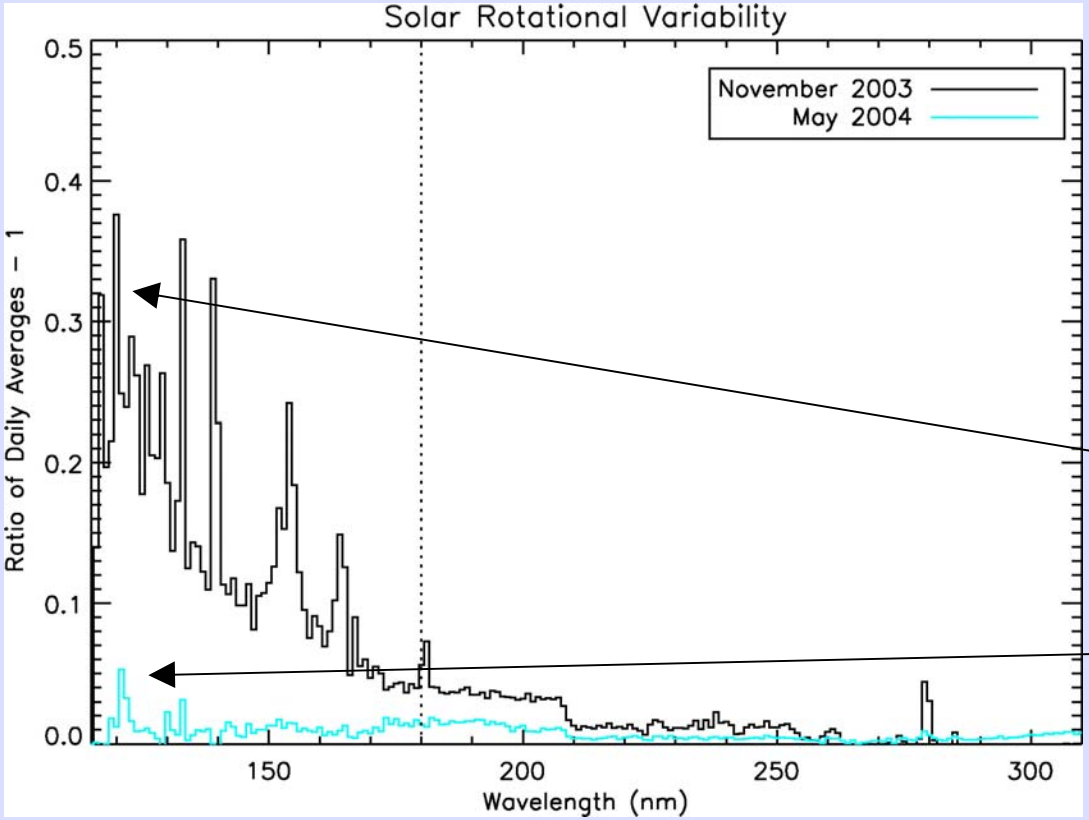
Approximately 12 complete spectra with~ 0.1 nm native resolution are acquired daily

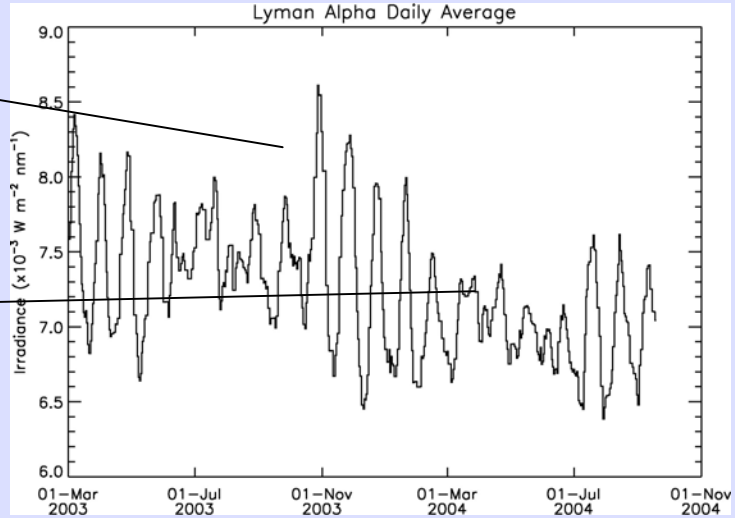
Daily averaged spectra binned to 1 nm resolution are available to the user community





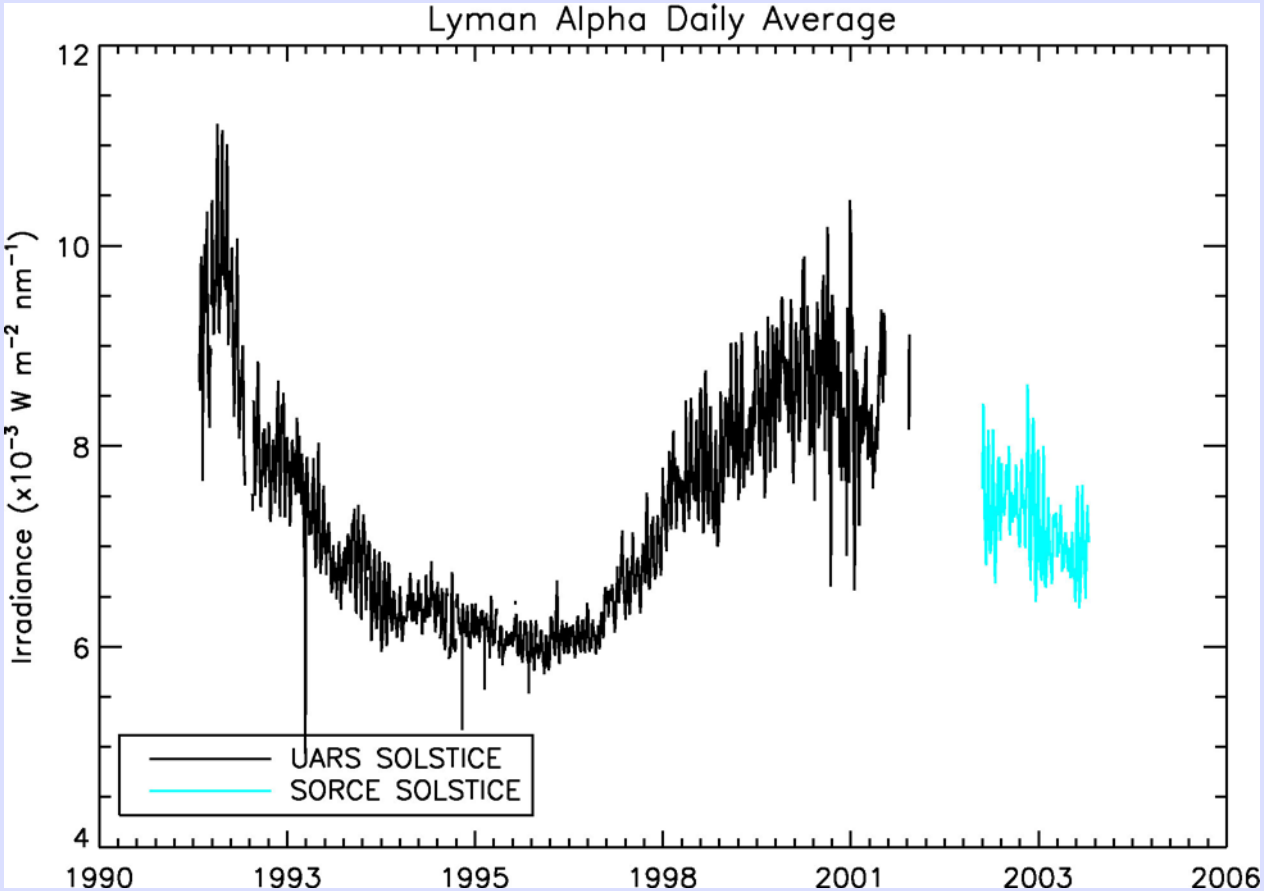
Solar Rotation Variability



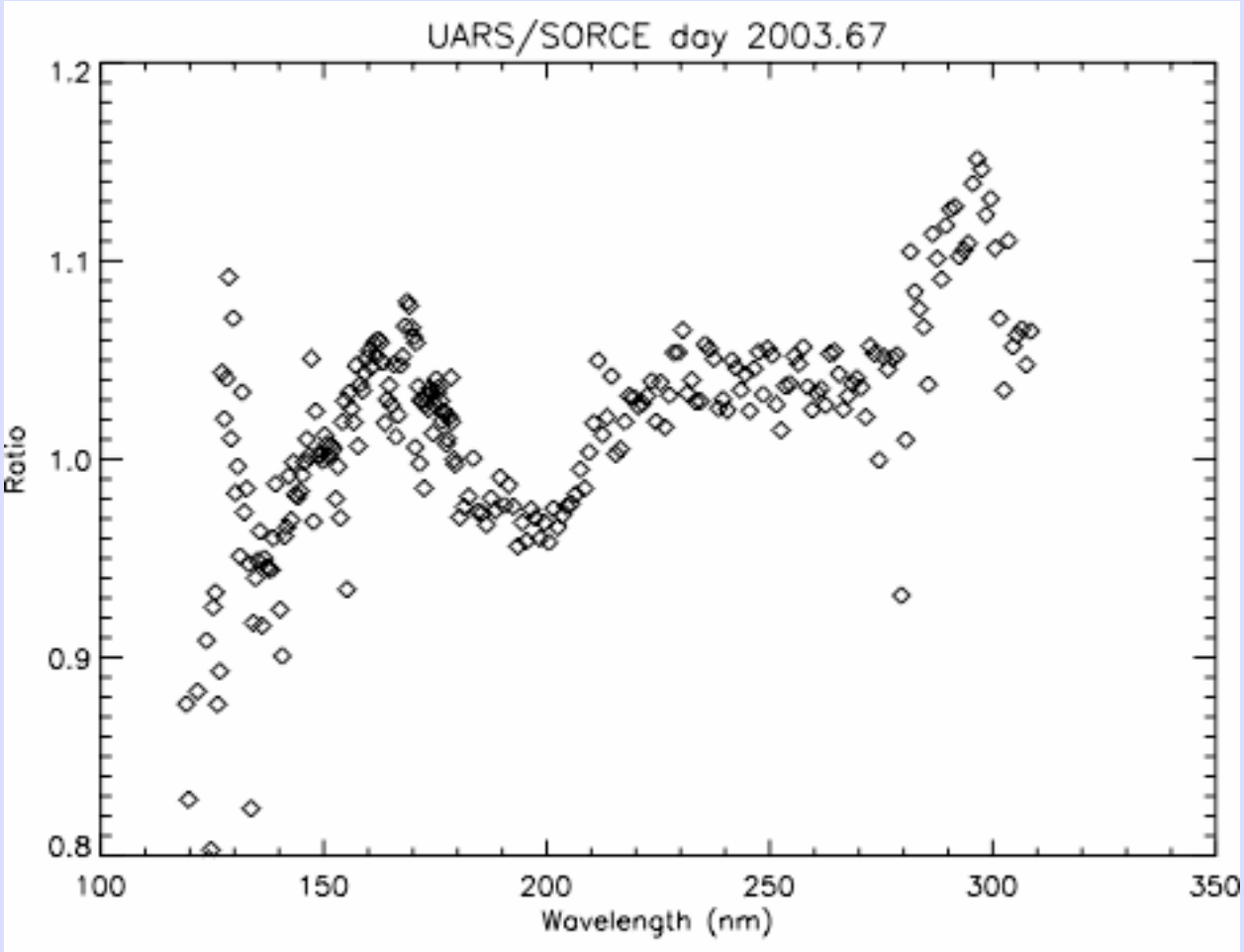


Solar Cycle Variability

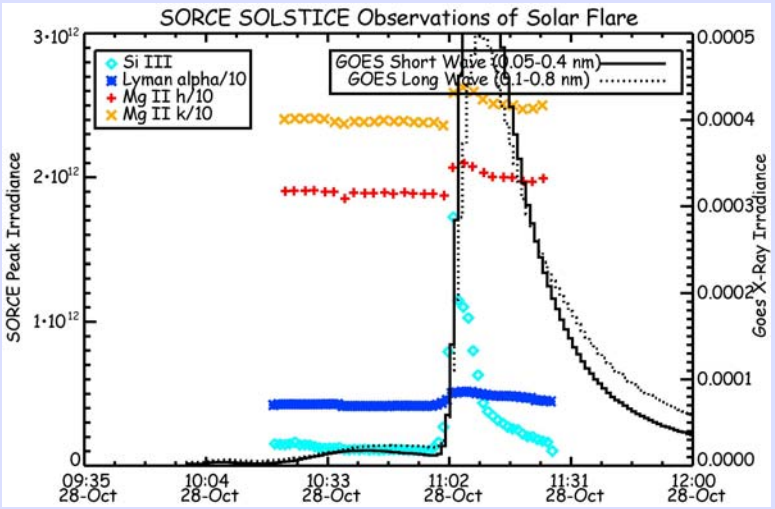
UARS and SORCE measurements of Lyman Alpha variability are consistent on solar cycle time scales



UARS-SORCE Irradiance Comparison for days with similar F10.7



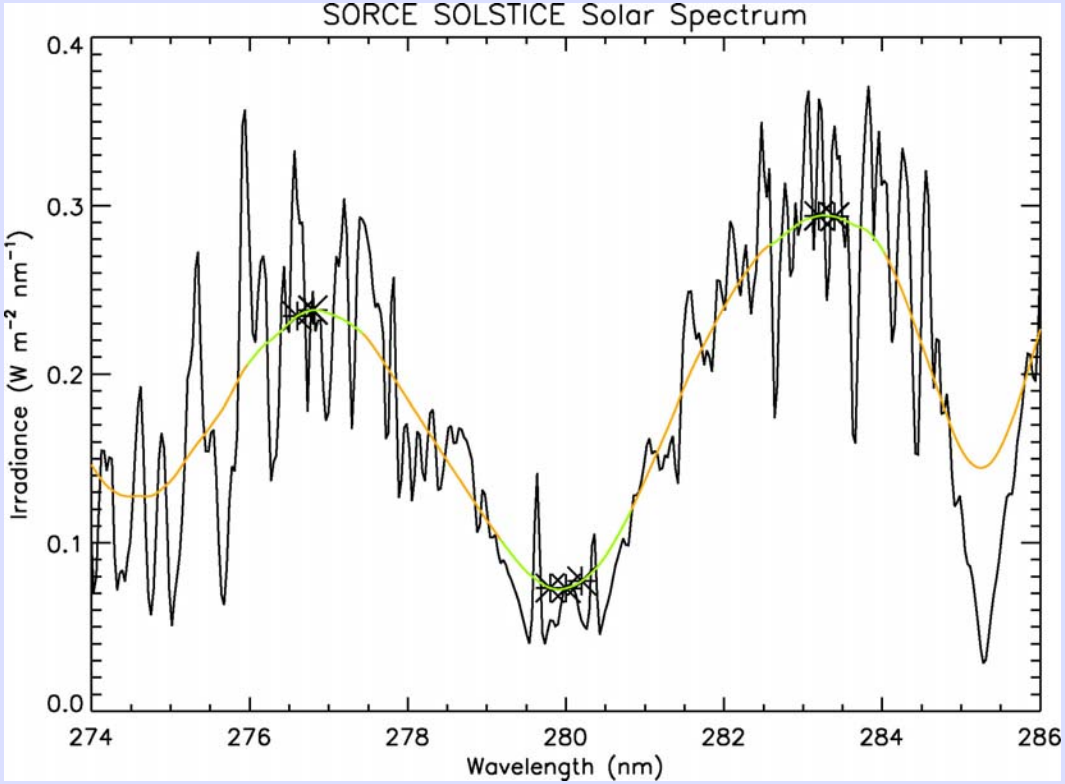
SOLSTICE: Flare Observations from 28 October 2003



QuickTime™ and a
YUV420 codec decompressor
are needed to see this picture.

Mg II Observations

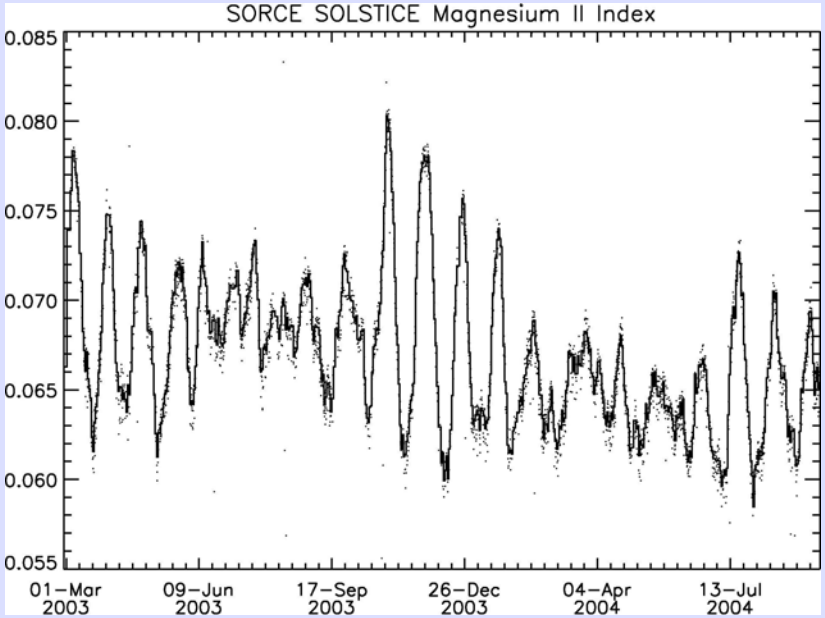
Solstice cleanly resolves the Mg II h and k lines



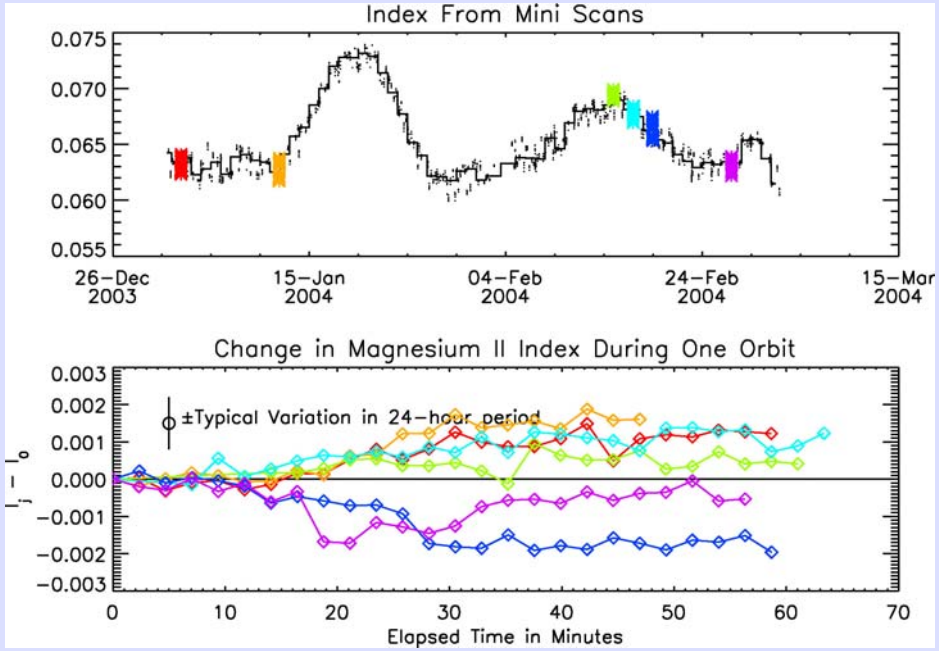
Mg II Index Studies (1)

Solstice Index: Computed from ratio of emission core to smoothed wings

Daily Averages

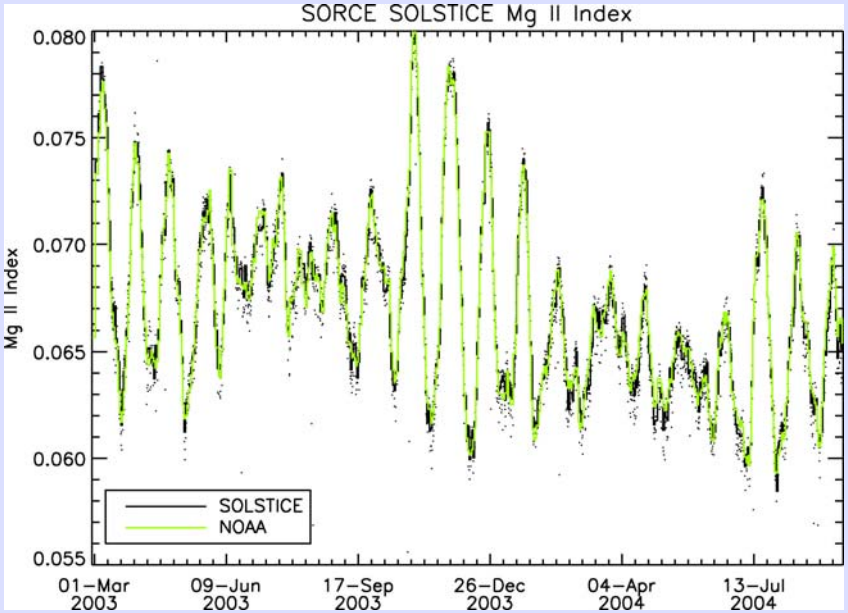


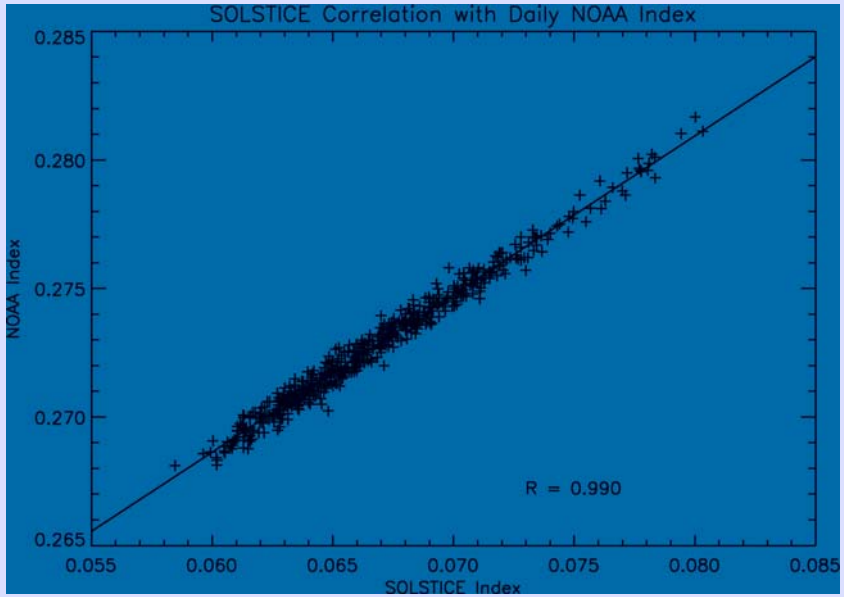
Scatter about the daily mean has a significant solar variability component



Mg II Index Studies (2)

Solstice index correlates well with the NOAA daily index. Details of this work are described on a poster presented by Snow et al





SOLSITCE Stellar Occultation Observations (Stolen from Jerry Lumpe)

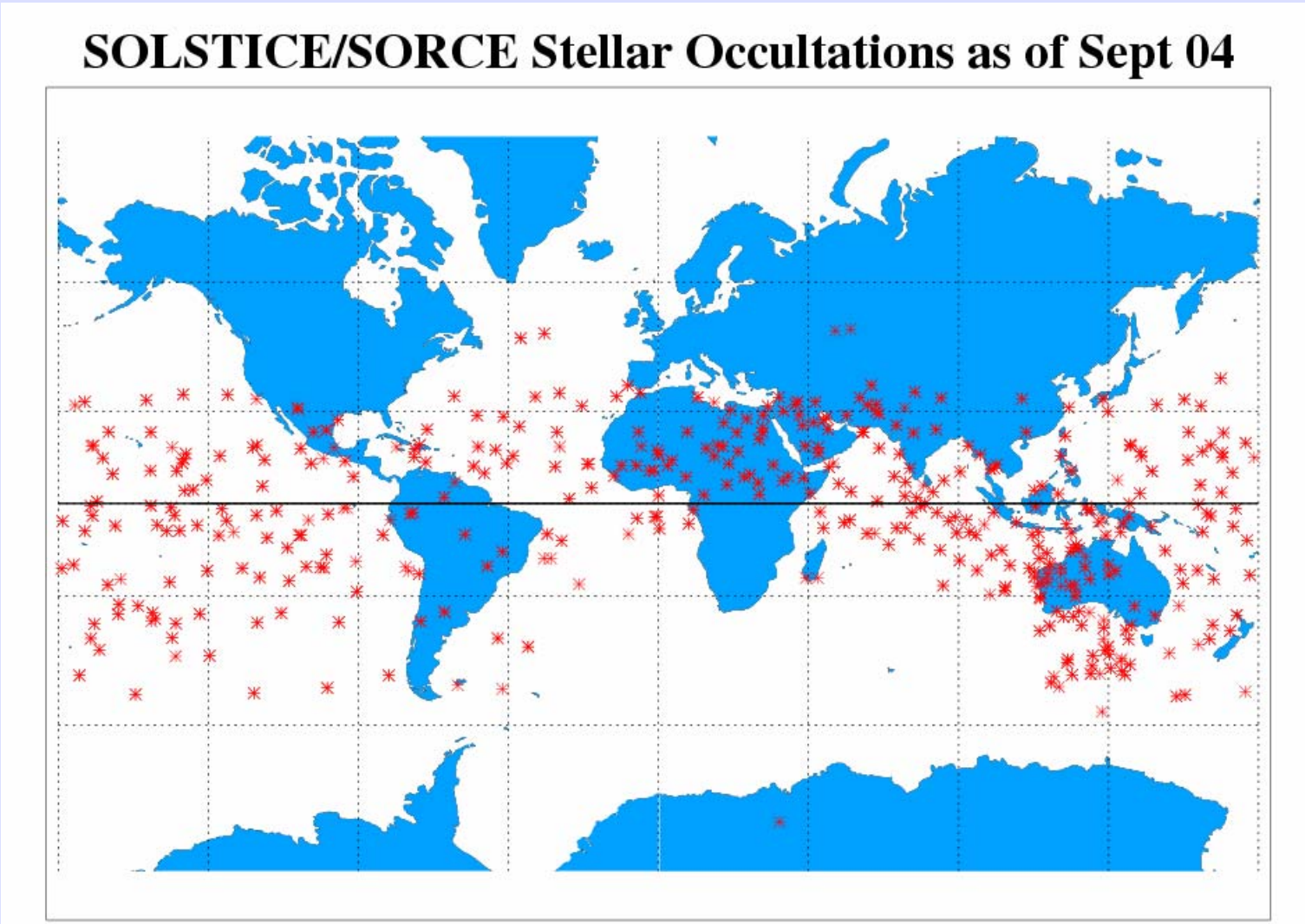
SOLSTICE makes routine stellar occultation measurements as an extension of the normal calibration sequence.

Measurement frequency is ~ 3 to 5 occultations per day, depending on target availability

Simultaneous measurements are made at two wavelengths in either the O_2 Schumann-Runge continuum (140/170 nm) to retrieve or the O_3 Hartley band (250/295 nm)

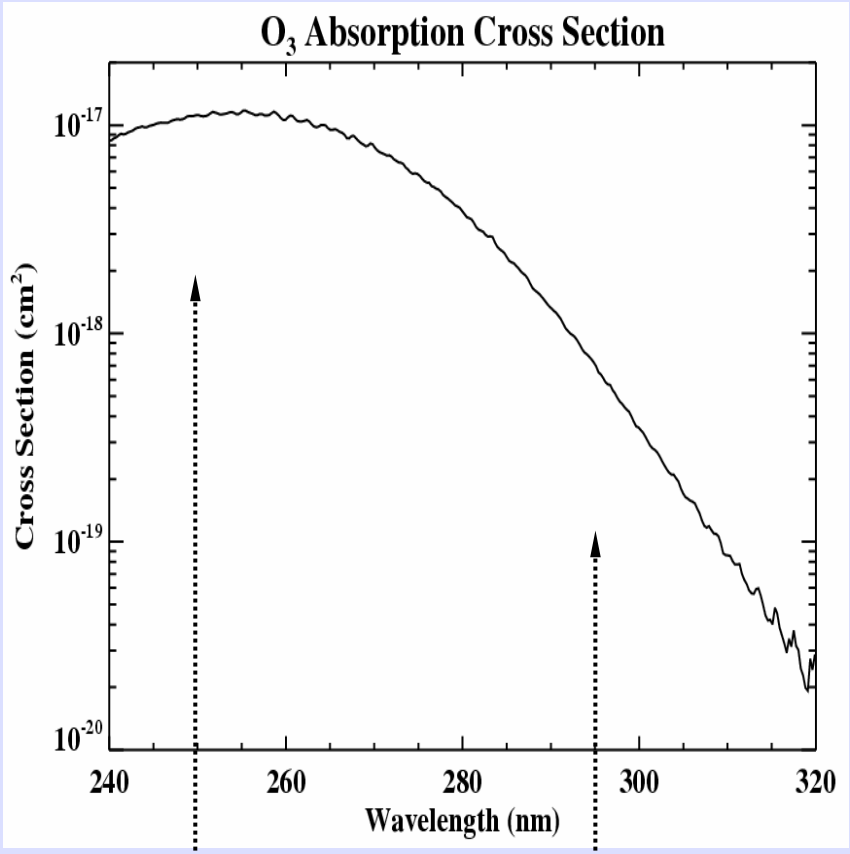
Update thermospheric O_2 densities originally derived from mass spectrometer observations

SORCE Occultations (~ 400 through 9-04)

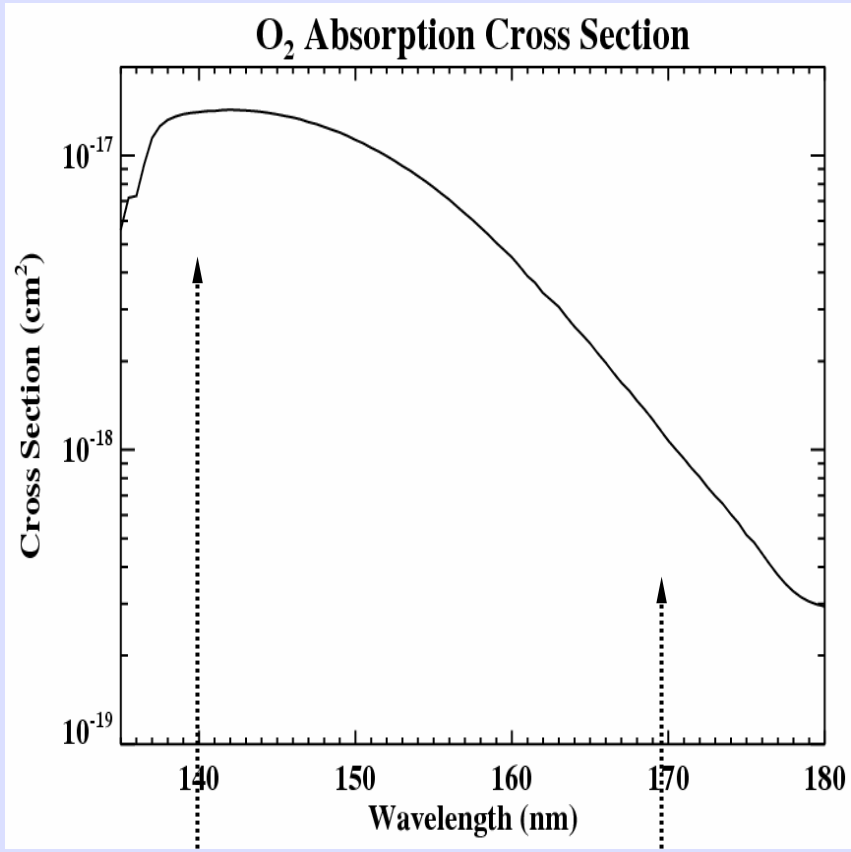


SOLSTICE Occultation Spectroscopy

Simultaneous measurements at "on/off" wavelengths maximize altitude range

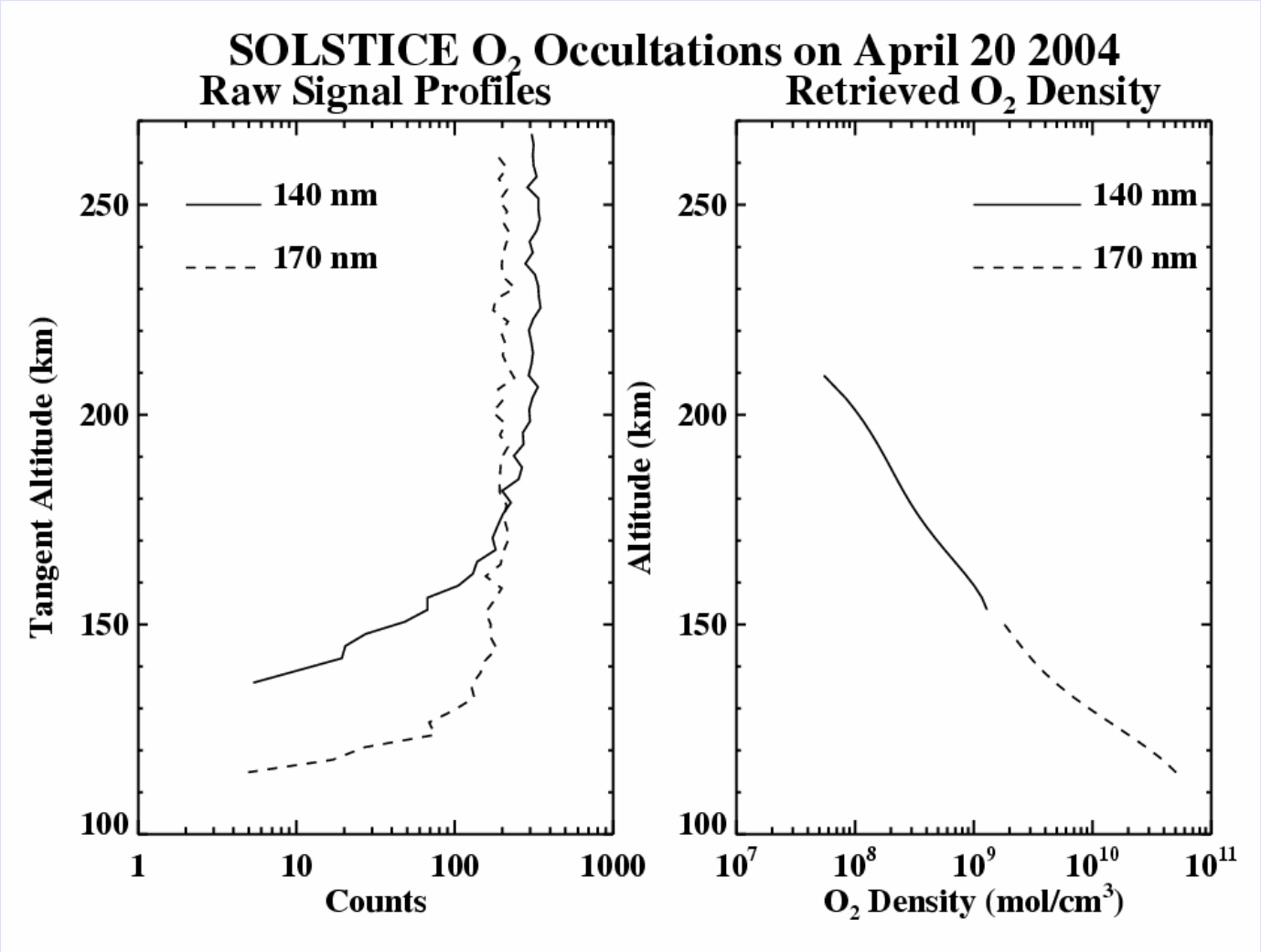


O_3 Hartley Band

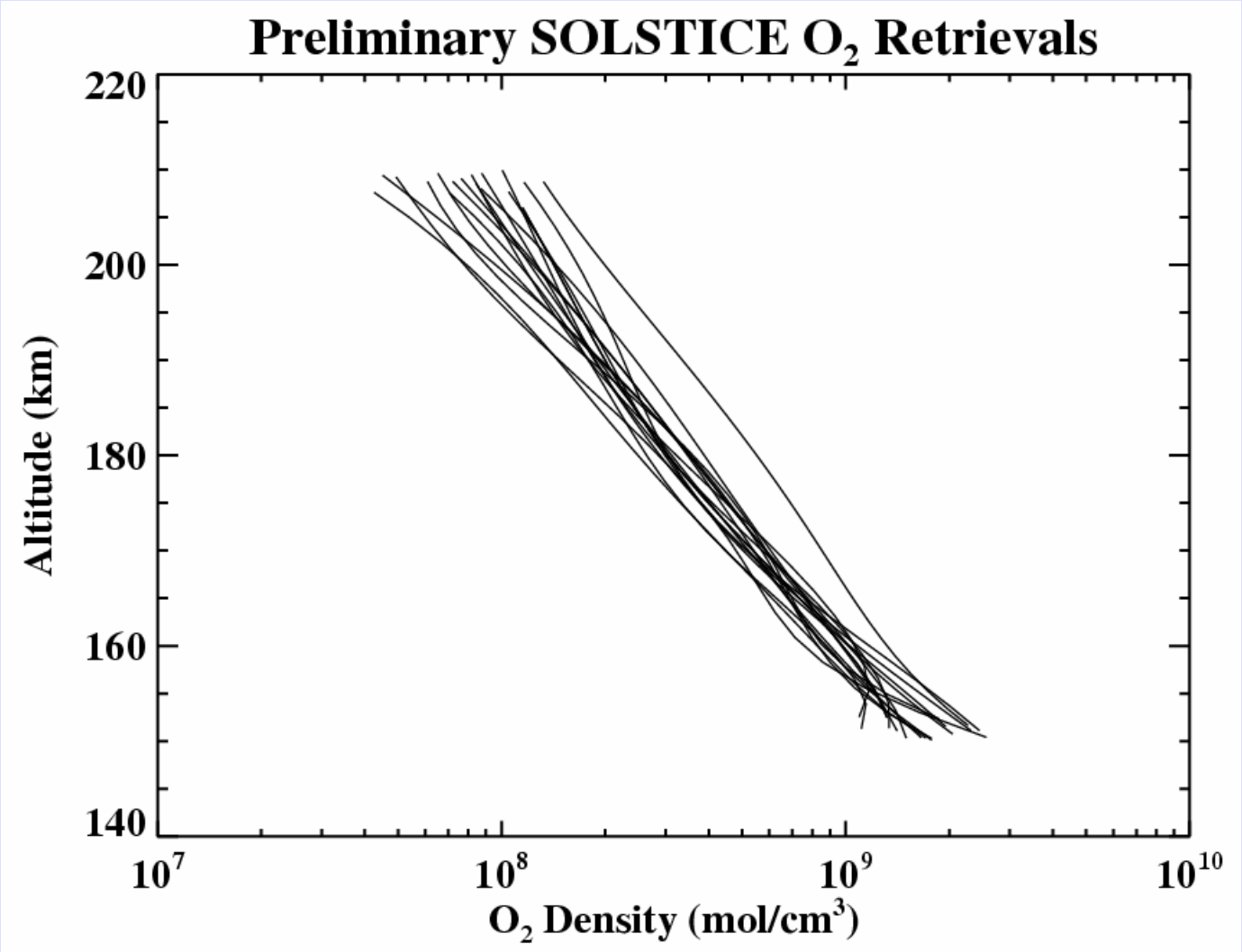


O_2 Schumann-Runge Continuum

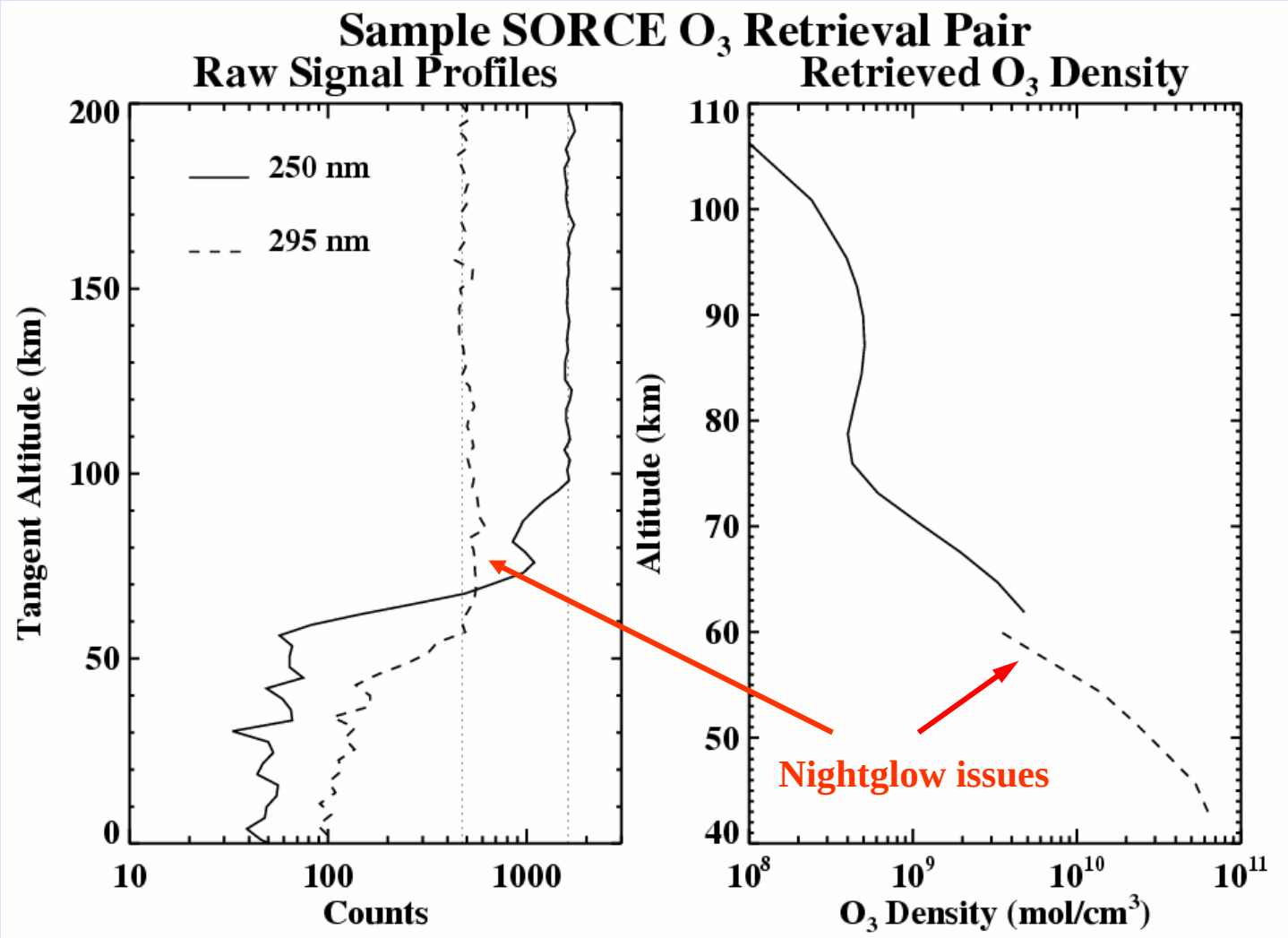
SORCE O_2 Occultations



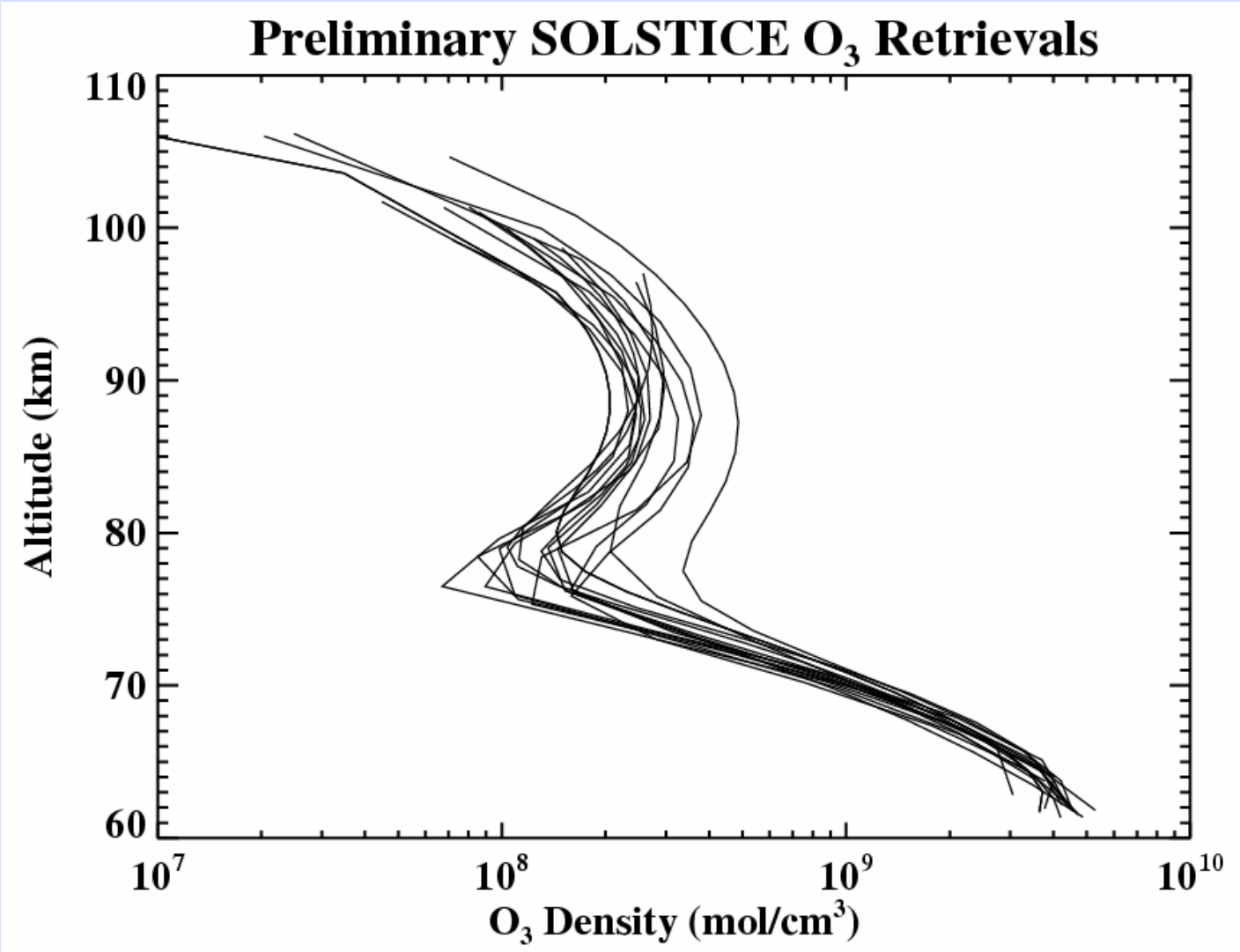
Sample 140-nm Occultations



SORCE O_3 Occultations

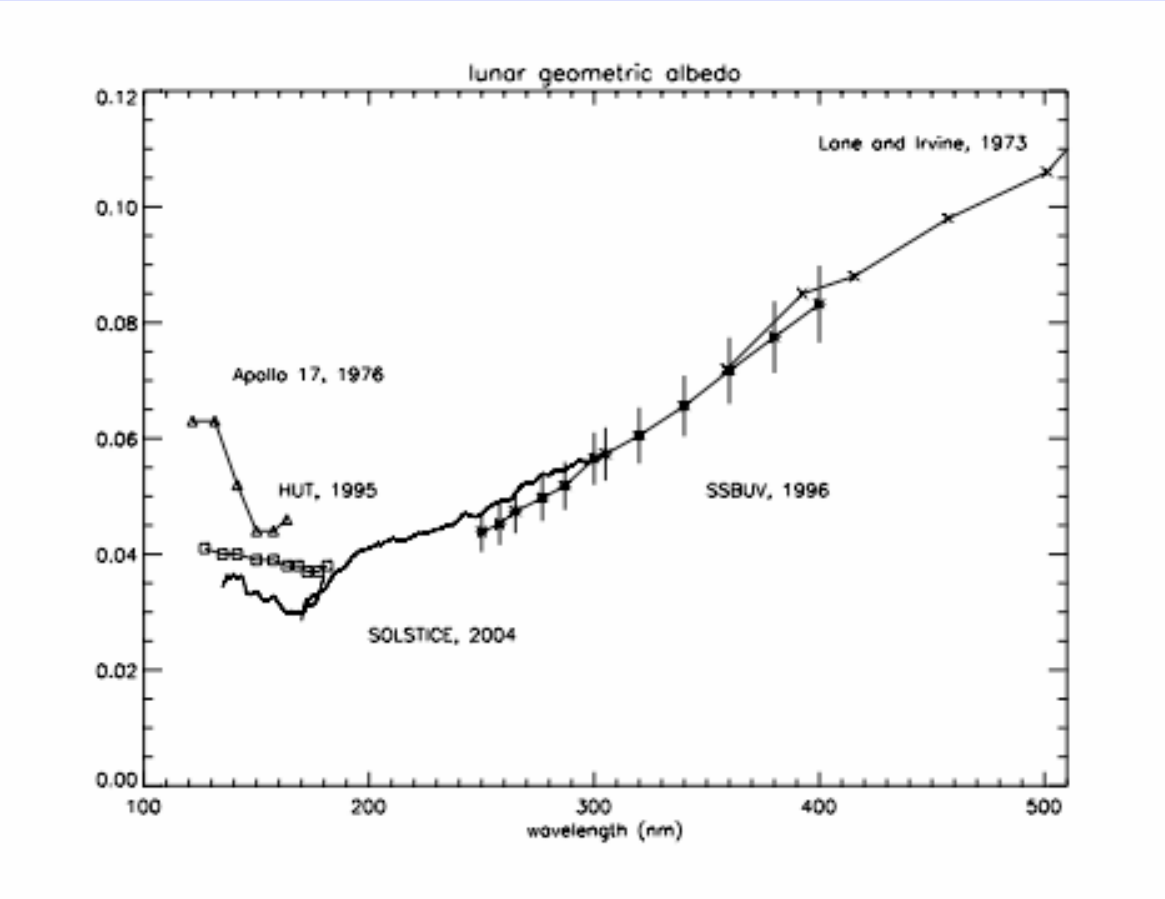


Sample 250-nm Occultations

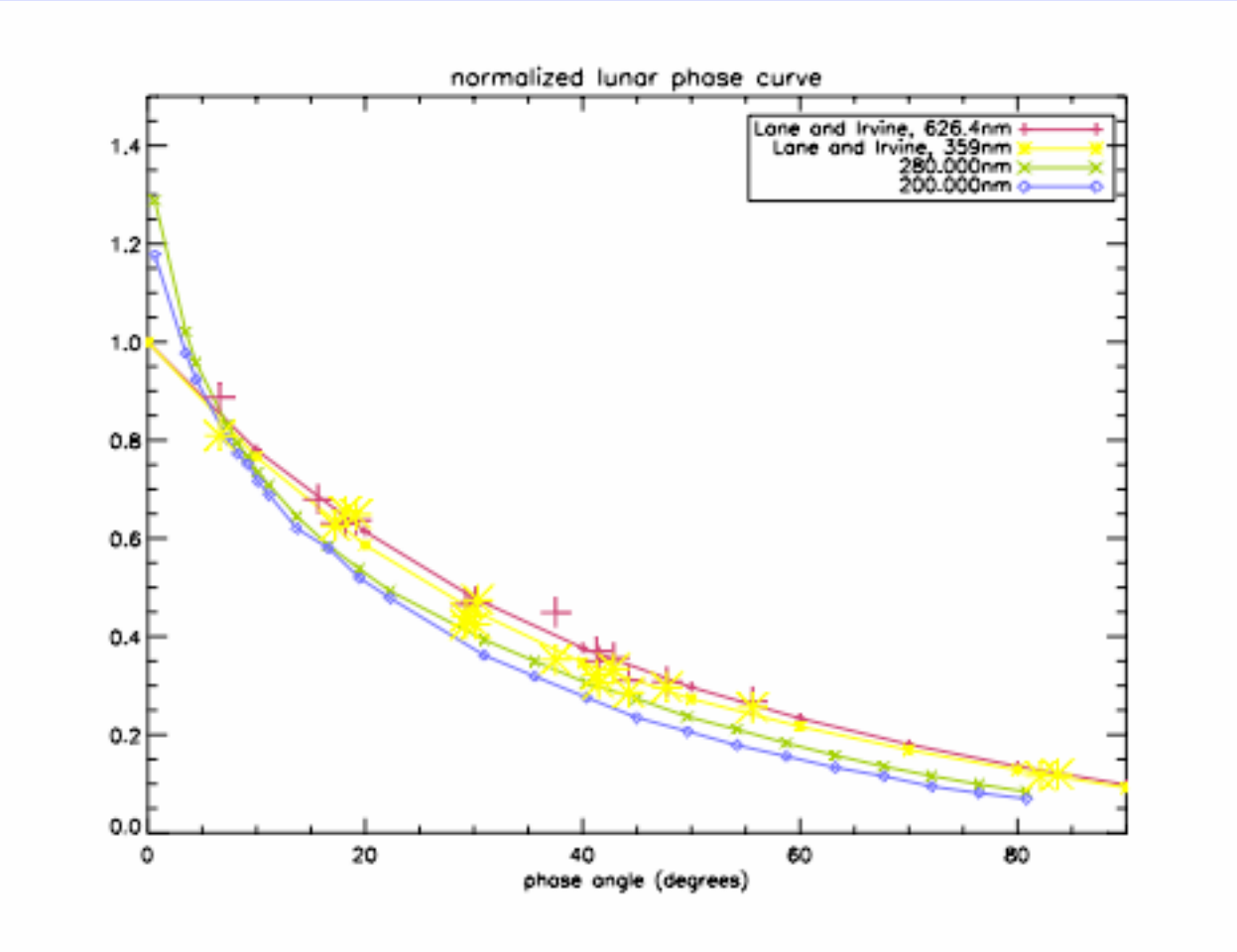


Lunar Reflectance Measurements (Stolen from Greg Holsclaw)

Solstice results suggest a lower lunar geometrical UV albedo than previous measurements



Lunar UV Phase Curves



- Lunar albedo reddens with increasing phase
- Opposition effect increases with increasing wavelength

SOLSTICE: Get more details about SOLSTICE results

Posters at this meeting:

The SOLSTICE Observing Technique

Marty Snow, William McClintock, Gary Rottman, and Tom Woods

The Role of Spectral Resolution in the Magnesium II Index

Marty Snow, William McClintock, Gary Rottman, and Tom Woods

Posters at fall the AGU:

Retrieval of Thermospheric Molecular Oxygen Profiles from Solar and Stellar Occultation Meausrements

Jerry Lumpe, Linton Floyd, Marty Snow, Michael Picone, David Siskind and Gary Rottman