Solar Ultraviolet Irradiances from SOLSTICE

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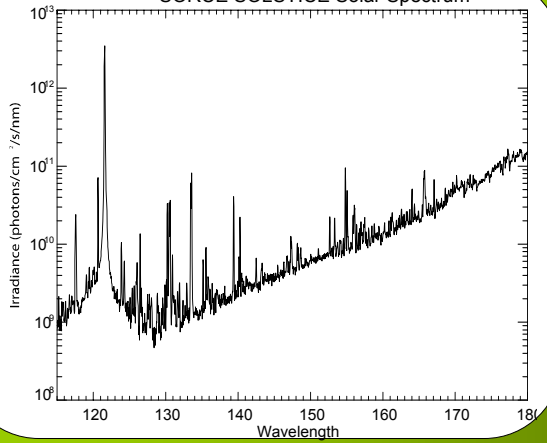
SORCE SOLSTICE Solar Spectrum



What is SOLSTICE?

The SOLar-STellar Irradiance Comparison Experiment is an spectrometer designed to measure the solar spectral irradiance in the ultraviolet to high accuracy and precision.

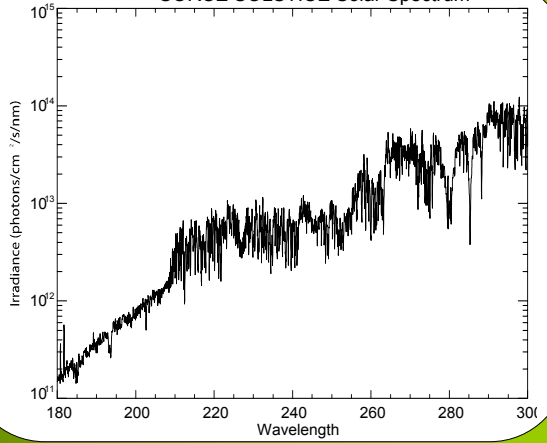
The SOLSTICE instrument observes both the sun and stars using the same optical path A factor of ~10^8 in dynamic range is achieved by changing apertures (~10^4), bandpass (~10^1), and exposure time (~10^3).

Science Objectives:

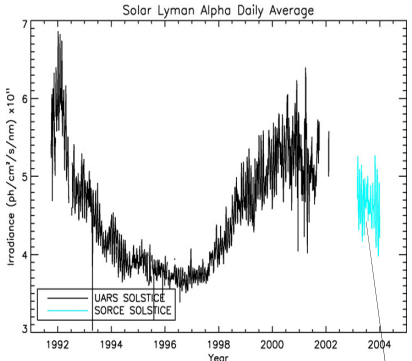
- Measure solar irradiance from 115 to 320 nm daily with a spectral resolution of 0.5 nm and an accuracy better than 5%.
- Monitor solar irradiance variation with an accuracy of 0.5%.
- Establish the ratio of solar irradiance to the average flux of an ensemble of bright, early-type stars with an accuracy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

Measurements:	UARS	SORCE
Wavelength Coverage:	118-320 nm	115-320 nm
Solar Spectral Resolution:	0.1 nm (FUV) 0.2 nm (MUV)	0.1 nm
Stellar Spectral Resolution:	1.1 nm (FUV) 2.2 nm (MUV)	1.1 nm (FUV) 2.2 nm (MUV)

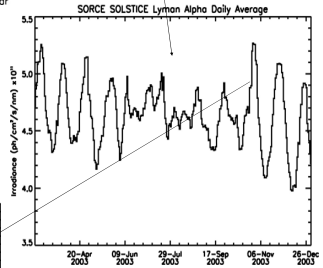
SORCE SOLSTICE Solar Spectrum

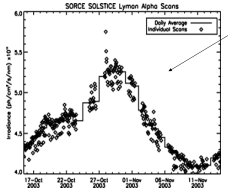


Lyman alpha (H I) Irradiance Time Series



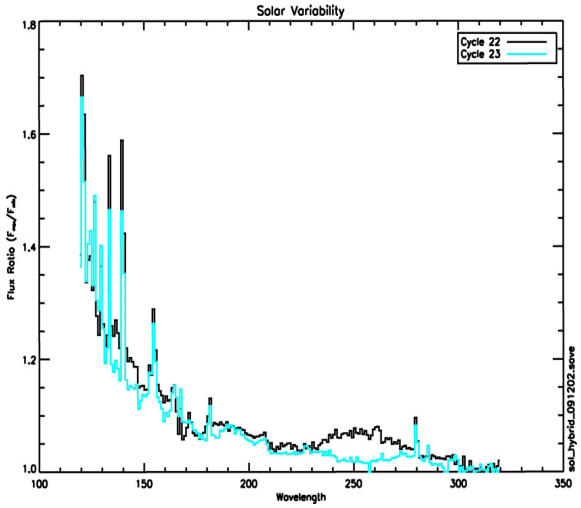
The resonance transition of H I at 121.7 nm is one of most important diagnostics of solar activity.





Various timescales for Lyman alpha variations are shown here. The decades-long time series above shows variation over the solar cycle. The middle plot shows the variation due to rotation of active regions across the disk of the sun, and the bottom plot shows the variation from orbit-to-orbit. Note the solar flare on Oct 28th.

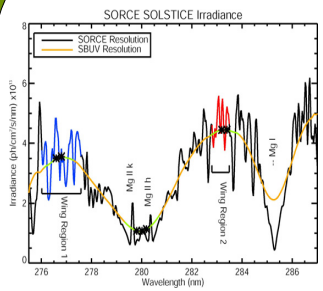
Solar Cycle Variability



This measure of solar variability is derived by taking an 81-day (3 solar rotations) average at each wavelength at maximum activity and dividing by a similar 81-day average at minimum activity. The two curves shown here are for the two maxima observed by UARS SOLSTICE.

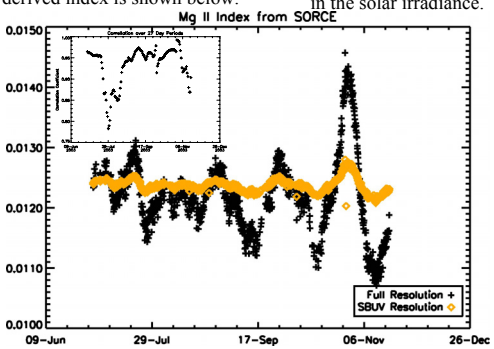
The variability in the Far UV is highly wavelength dependent due to the changes in transition region emission lines. The variability decreases in the Mid-UV to a few percent. A 2% error in the degradation correction at 250 nm will lead to a ~3% error in the ratio which is a significant fraction of the total variability. Improvements to the design of SOLSTICE have led to greater signal-to-noise ratio in MUV stellar observations, so the relative uncertainty in cycle 24's variability should be much lower.

The Magnesium Index



One important measure of the activity level of the sun is the so-called "Magnesium Index." As shown in the center panel, the variability of the sun has a large increase at 280 nm due to the Mg II h & k emission lines. Since the activity changes rapidly as a function of wavelength, the highly-active emission cores can be compared to the neighboring (inactive) photospheric continuum. Instrumental effects such as degradation change minimally over such a small range of wavelengths, so changes in the index are entirely due to changes in the solar irradiance.

The original magnesium index was produced from the SBUV instrument (Heath & Schlesinger 1986, JGR, 91, 8672). SORCE SOLSTICE has significantly higher resolution, and the effect on the derived index is shown below.



The lower resolution index tracks the large excursions well, but doesn't capture the smaller variations such as during the month of August as shown in the inset plot.