

The Solar Radiation and Climate Experiment (*SORCE*)

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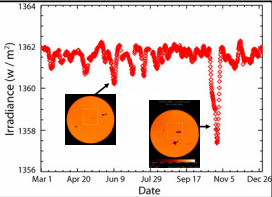


The Solar Radiation and Climate Experiment (*SORCE*) is a small free-flying satellite launched on January 25, 2003. It carries four scientific instruments to measure solar radiation incident at the top-of-the-Earth's atmosphere. This mission is one element of NASA's Earth Observing System (EOS) which is the major observational and scientific component of the U.S. Global Change Research Program. *SORCE* will operate on orbit for a period of five years, with a design goal of six years. The spacecraft carrying and accommodating the instruments was developed by Orbital Sciences Corporation in Dulles, VA. LASP operates the spacecraft from its Mission Operations Center in Boulder, CO. LASP is responsible for the acquisition, management, processing and distribution of the scientific data. For more information go to: <http://lasp.colorado.edu/sorce>.

The four instruments are the Total Irradiance Monitor (TIM), the Spectral Irradiance Monitor (SIM), the Solar Stellar Irradiance Comparison Experiment (SOLSTICE), and the XUV Photometer System (XPS).

Total Irradiance Monitor (TIM)

Four redundant electrical substitution radiometers (ESRs), each with a precision aperture and shutter, monitor total solar irradiance (TSI). Four TSI values are reported each day with precision and accuracy of roughly 300 ppm.



The Sun is the dominant energy source for the entire Earth system. It warms the Earth, heating the land and ocean. It maintains our atmosphere, generates clouds, and cycles our planet's water. It drives the winds and ocean currents. The Sun's energy sustains and nurtures all life, including plant, animal, and human.

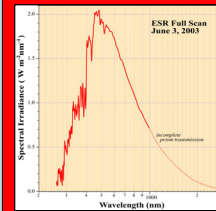
An important and difficult question is how much does the Sun's radiation vary — are there intrinsic changes in the energy output from the Sun? Moreover, since most, if not all, of the processes connecting the Sun to our environment (*Living with a Star*) are strongly wavelength dependent, it is essential that our knowledge of solar irradiance incorporates full wavelength information.

Major Features

- Phase sensitive detection at the shutter fundamental frequency
- Pulse width modulation of the heater power
- Use of Nickel-Phosphorous, NiP, black absorber

Spectral Irradiance Monitor (SIM)

A scanning prism spectrometer covering the spectral range 200 nm to 2400 nm with spectral resolution ranging from 0.25 to 33 nm. Absolute accuracy of 0.1% and relative accuracy of 100 ppm/year

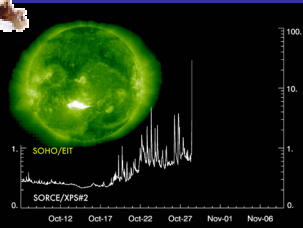


Special features

- Uses miniaturized ESR detectors
- Only a single optical element — a small Suprasil 300 figured prism
- Two identical channels for redundancy and self-calibration

XUV Photometer System (XPS)

XPS measures the solar X-ray irradiance emitted from the hot, highly variable corona of the Sun. The 12 silicon photodiodes with different thin-film filters cover the spectral range 1 to 34, as well as Lyman- α , with spectral bandpass of 7 nm.

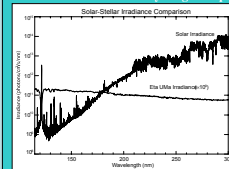


- XPS Bands:
- 0.1 - 7 nm
 - 4 - 18 nm
 - 5 - 12 nm
 - 17 - 21 nm
 - 25 - 34 nm
 - 27 - 37 nm
 - Lyman- α

XPS data up to and including the time of the flare on October 28, 2003

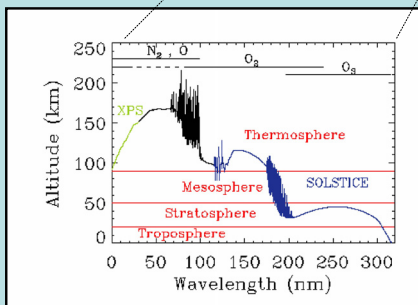
Solar Stellar Irradiance Comparison Experiment (SOLSTICE)

SOLSTICE has the unique capability of observing the UV solar irradiance, and with the same optics and detectors it observes bright, early-type stars. Individually these stars vary by only small fractions of one percent, and together they are used to determine changes in instrument responsivity. Moreover, the ratio of the Sun to these stars provides a method of establishing solar variations over arbitrarily long time periods.

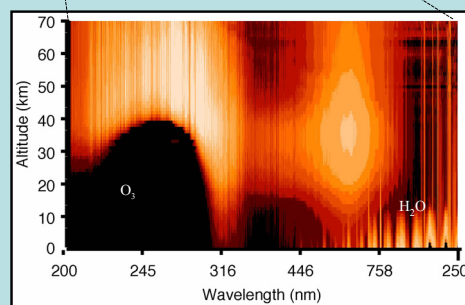


Features:

- Spectral coverage from 115 to 310 nm
- 0.1 nm spectral resolution
- Two fully-redundant channels



Atmospheric penetration depth ($1/e$) for ultraviolet wavelengths



Radiation absorbed in the Earth's atmosphere

In the 1950's the discovery of the energetic ultraviolet portion of the solar spectrum provided new insight into the complexities of solar physics and improved our understanding of the temperature and structure of the Earth's upper atmosphere.

The ultraviolet varies by large amounts — perhaps factors of two near 120 nm and factors approaching an order of magnitude for much of the extreme ultraviolet at wavelengths below 30 nm. See accompanying SOLSTICE poster for additional information.

Different wavelengths of solar radiation are absorbed at different altitudes. Only a portion of the Sun's radiation penetrates the Earth's atmosphere to its surface, and at some wavelengths the radiation is absorbed entirely. It is not possible to use ground-based observations of the Sun to estimate top-of-the-atmosphere radiation. Figure generated by MODTRAN, courtesy of Gail Anderson.

Total Solar Irradiance (TSI) has been measured from space for the past 25 years, and during that time it has been observed to vary on the order of 0.1%. These observations of TSI constrain the variability of the visible and infrared irradiance to similar small levels and pose a major challenge to spectral measurements at these important wavelengths.