

Solar Radiometry from SORCE

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Abstract. The Solar Radiation and Climate Experiment (SORCE) is a NASA mission launched in early 2003 to measure total and spectral irradiance from the Sun. Three instruments measure solar spectral irradiances from 0.1 to 2700 nm, while a fourth monitors total solar irradiance. The instruments provide daily irradiance measurements, from which solar activity and irradiance variations can be correlated on short time scales and Earth climate may be correlated on long time scales. I present an overview of the SORCE instruments and their different approaches to long-term, space-based solar radiometry.

SORCE Radiometers

The Solar Radiation and Climate Experiment (SORCE) is a NASA mission to monitor solar irradiance inputs to the Earth's atmosphere. Launched in January 2003 into a low Earth orbit, this spacecraft monitors the Sun during the daylight portion of each 95-minute orbit. Mission operations are done from the University of Colorado's Laboratory for Atmospheric and Space Physics (LASP), and data are available via the web at both LASP (<http://lasp.colorado.edu/sorce>) and the NASA DAAC (<http://disc.gsfc.nasa.gov/SORCE>). The four solar irradiance monitoring instruments on the SORCE are described below.

TIM The Total Irradiance Monitor (TIM) is an ambient temperature, electrical substitution solar radiometer intended to achieve 100 parts per million (ppm) combined standard uncertainty in total solar irradiance (TSI). The TIM contains four electrical substitution radiometers (ESRs), providing redundancy and tracking instrument degradation due to solar exposure. Each ESR is electrically heated to maintain constant temperature while a shutter modulates sunlight through a precision aperture and into the ESR's absorptive nickel-phosphorus (NiP) cavity. The modulation in electrical heater power needed to maintain an ESR's temperature as its shutter modulates incident sunlight determines the radiative power absorbed by that ESR's cavity. Phase sensitive detection of this heater power, combined with knowledge of the aperture area over which the sunlight is collected, yields TSI in ground processing. The instrument has demonstrated extremely low noise levels due to its phase sensitive detection system and active thermal stability. This instrument continues the 26-year record of space-borne TSI measurements, and is a predecessor to the TIMs selected for flight on the future NPOESS missions.

SIM The Spectral Irradiance Monitor (SIM) is similarly an ambient temperature ESR using a NiP absorptive coating, although this instrument is designed to work at

much lower power levels to measure solar spectral irradiance (SSI) over the wavelength range 200 to 2700 nm. The two SIM ESRs are mounted behind dual, redundant Fèry prism spectrometers, allowing degradation tracking. The instrument's spectral resolution varies from 0.2 to 30 nm with intended combined standard uncertainty of 300 ppm. This newly-designed instrument provides the first long-duration spectral irradiance measurements over an extended wavelength range encompassing approximately 95% of the solar irradiance.

SOLSTICE The Solar Stellar Irradiance Comparison Experiment (SOLSTICE) measures the spectral range from 120 to 300 nm with a spectral resolution of 0.1 to 0.2 nm and a combined standard uncertainty of 3-6%. This evolution of the highly successful UARS SOLSTICE consists of two fully-redundant grating spectrometers to monitor the highly-variable ultraviolet solar irradiance. SOLSTICE has the unique capability of observing bright blue stars with the same optics and detectors used for solar measurements, and uses an ensemble of these stars as a long term relative calibration standard.

XPS The X-ray Photometer System (XPS) measures the extreme ultraviolet solar irradiance from 0.1 to 31 nm with a spectral resolution of 7 to 10 nm while an additional channel monitors Lyman- α . The XPS's combined standard uncertainty is 12%, with a relative precision of 2%/yr. This instrument is of nearly identical design to the XPS on NASA's TIMED mission, and consists of a filter wheel photometer system using silicon diodes behind thin-film filters. The XPS's 12 photometers include 5 for daily XUV measurements, 1 for Lyman- α , 3 for XUV calibrations, and 3 for window calibrations. The SORCE XPS has observed over 800 solar flares to date.

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