

A Compact Solar Spectral Irradiance Monitor for Future Small Satellite and CubeSat Science Opportunities

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The accurate and continuous measurement of solar spectral irradiance (SSI) is recognized as being increasingly important to advancing our understanding of the solar influence on Earth's climate. Recent SSI measurements are providing critical inputs in evaluating and improving present climate-chemistry models, however they are not yet of sufficient accuracy to stand alone without overlapping records – gaps in the observational record, caused by future mission delays or early failures of existing missions, effectively destroy our ability to link records from different instruments into a continuous, long-term climate quality record. Recent advancements in calibration facilities and techniques make it now possible to improve significantly the accuracy and traceability of future SSI observations and assure quantification of uncertainties as input to increasingly more sophisticated climate models. Following *SORCE*, the *Total and Spectral Solar Irradiance Sensor (TSIS) Spectral Irradiance Monitor (SIM)* is the next generation, space-borne SSI radiometer that is scheduled to be operational on the International Space Station (ISS) in late 2017. The instrument has been designed, characterized, and calibrated to achieve unprecedented levels of absolute accuracy ($u_c \leq 0.2\%$ combined standard uncertainty) and high spectral stability (0.01-0.05% per year *correctable* relative uncertainty) across a continuous wavelength region spanning 200 – 2400 nm (96% of the total solar irradiance). Unfortunately, restructuring and delays in the implementation of *TSIS* to assure future continuity of SSI records are further compounding the problem of introducing large measurement gaps in achieving a long-term record. Given these concerns, we have recently started a new development program for an instrument concept that will mitigate potential risks associated with large mission delays resulting in observational data gaps by developing a cost effective, reduced-size SSI radiometer.

The compact SSI monitor (CSIM) will cover 200-2400 nm with the required SI-traceable accuracy and on-orbit stability to meet the solar input measurement requirements defined in the Earth Science Decadal Survey for establishing benchmark climate records. Building upon our experiences and resources from the *TSIS SIM* program, the instrument will reduce the cost, size, and characterization/calibration schedule of an SSI monitor with SI-traceable absolute calibration at the 0.2% uncertainty level ($k=1$) while maintaining the *TSIS*-level high relative stability. System level performance characterizations and final end-to-end absolute irradiance calibration/validation will be accomplished with the LASP Spectral Radiometer Facility (SRF), a comprehensive LASP-NIST jointly developed spectral irradiance calibration facility utilizing the *SIRCUS* tunable laser system tied to an SI-traceable cryogenic radiometer. The completed, flight-ready instrument will be cross-calibrated with the *TSIS SIM* and will potentially mitigate data continuity risks associated with future mission delays by offering an instrument with implementation flexibility for alternative flight opportunities, including ride share and hosted payloads, small satellites, and dedicated CubeSat missions – a rapidly emerging technology for low cost orbital science.