



Update from Mission Operations –

Within mission ops, day-to-day activities continue to go very well for SORCE. They transitioned on Feb. 24th to the “hybrid” operating mode which has successfully allowed SORCE to take solar measurements almost every orbit and the extended mission objectives are fully met. It is called the hybrid mode because the normal operating mode is achieved during orbit day for science acquisition, and the spacecraft is put into a safe-hold condition during orbit night to conserve battery power. The hybrid mode operation plan was started when the new flight OBC 10.0 flight software was loaded. In this mode, the spacecraft autonomously powers on the OBC and the MU at sunrise, either a ground or TDRSS contact loads an ATS that commands the spacecraft to normal mode and begins science operations. This process has proven to be highly reliable, and the performance of the new flight software and our ability to reach normal mode far exceeds our expectations. We are only missing a few orbits a week where normal mode is not achieved. Either a ground contact later in the orbit or a real-time TDRSS contact then captures the science and housekeeping data for subsequent data processing. A few minutes before sunset, the spacecraft reverts back to safe mode to conserve power during orbit night in preparation for activities on the next sunlit portion of the orbit.

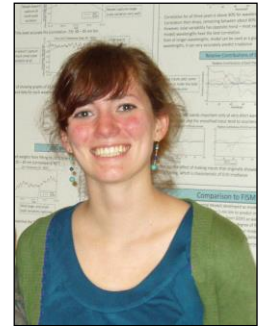


Battery charge management techniques were successfully executed during the July 2014 mini-eclipse period. The charge profile was modified as eclipse duration changed to keep the battery temperatures from fluctuating needlessly. Minimal battery degradation was noted at the exit of this mini-eclipse period.

The LASP/OSC operations team is working on the next version of flight software for the APE and the OBC which would allow the spacecraft to recover to science operations if/when we have another battery cell failure and cannot keep the APE (altitude and power electronics) in a powered-on state during eclipse as it currently does. This effort will help extend the longevity of the SORCE mission for the eventual overlap with the TSIS mission.

SORCE Student Wren Suess Receives Award –

SORCE student Katherine Suess, better known as Wren, was awarded the 2014 Charles A. Barth Scholarship in Space Research. This award goes to a University of Colorado senior who is studying space research at LASP (CU’s Laboratory for Atmospheric and Space Physics) and who demonstrates academic excellence.



Wren, a senior in the CU physics department, works with Marty Snow using GOES and SORCE data to develop a model for solar EUV irradiance. She’s also starting to use NOAA reports and magnetograms to study a timescale for sunspot evolution. Wren expects to graduate with honors next May and attend graduate school for astrophysics. Congratulations Wren!

Sr. Review Panel Assesses SORCE SSI Trends –

By Marty Snow, LASP, Univ. of Colorado

In the most recent Senior Review of the SORCE mission, the SORCE team was charged with organizing an independent review panel to “support an independent review of solar spectral irradiance method and results, to resolve discrepancies with other observations and model results.” This review panel met 16-18 September 2014. The panel included Jim Butler (GSFC) and Joe Rice (NIST) as co-chairs. The other panelists were Carol Johnson (NIST), Jeff Morrill (NRL), George Mount (WSU), and Kurt Thome (GSFC). The first day and a half of the meeting featured in-depth descriptions of the SOLSTICE and SIM methodologies for determining degradation correction factors. There was also nearly a full day of discussion about the long-term trends observed by both SORCE instruments as compared to other satellite measurements and models.

SIM and SOLSTICE have each released a new data version in preparation for this review. SOLSTICE V13 and SIM V20 are now available from the SORCE web page as well as LISIRD (<http://lasp.colorado.edu/lisird>). Users of this data will notice that the trends in Cycle 24 for both SIM and SOLSTICE are in good agreement with each

other and also in good agreement with model predictions for this time period. There are still significant trend differences during the decline of Cycle 23. The new SOLSTICE dataset really only disagrees with model predictions before 2006, so the SOLSTICE team will concentrate on understanding our instrumental corrections in this time period.

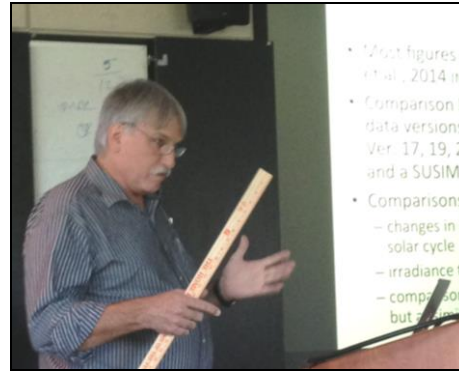
The initial result of the review panel was a list of recommendations for the SORCE team. The review panel will also produce a more detailed report in the near future. For SOLSTICE, the panel recommended further analysis of the solar/stellar field-of-view observations using both raytrace modeling and a slightly different approach to computing the correction. They also recommended a more careful comparison between SOLSTICE A and SOLSTICE B during the first few years of the mission since that is the time frame where SOLSTICE observations are controversial.



The SORCE SSI Review Panel met at LASP in Boulder, Colorado, Sept. 16-18, 2014.

For the SIM team, the panel recommended further analysis of the changes occurring over time to the material on the ESR detector. This is the same material as on the TIM instrument, and there are also laboratory measurements of how this material ages. They also recommended that the data from the periscope measurements be re-evaluated for possible information about the long-term trends. The other major avenue of investigation that the panel recommended was to use a Monte Carlo analysis to determine the sensitivity of the SIM long-term correction to each of the parameters. Version 20 of SIM uses the measurements from both SIM A and SIM B, a raytraced correction factor for the light path through the prisms, and parameters for the

wavelength and time dependence of the degradation. Varying each of these parameters independently will provide clues about which ones are most critical for further analysis.



Panel reviewer Jeff Morrill from NRL gave a presentation entitled "Updated Comparison of UV Solar Observations by SUSIM and SORCE".

The SORCE team would like to thank the panel for their work in helping to resolve the differences between SIM, SOLSTICE, and other measurements and models. In the coming months we will implement their recommendations and share the results with the scientific community.

SORCE Values REU Students –

By Marty Snow, LASP, Univ. of Colorado

Each summer, the SORCE mission funds student research projects in concert with the University of Colorado's Research Experience for Undergraduates (REU) program. For eight weeks, the students come to Boulder, Colorado to work with SORCE scientists on a research project involving measurements from SORCE. The program pays for the students' travel costs and housing, plus a \$500/week stipend. Before jumping into their summer research project, students begin with a 1-week lecture series on Solar and Space Physics from experts in the field. Marty Snow, SORCE SOLSTICE instrument scientist, is the REU Program Organizer for the entire program which included 16 REU students working interesting solar and space physics projects in several Boulder locations.

For the summer of 2014, SORCE was fortunate to host 3 students who each had a unique project and a mentor to help them with their individual research activity. The students, projects and the lead mentors were:

1. Sara Swenson (St. Olaf College) analyzed the mathematical properties of the Magnesium II index time series; Odele Coddington, LASP, Univ. of Colorado.
2. Derek Young (Bridgewater College, Virginia) developed space weather programs for Science on a Sphere; Rodney Viereck, NOAA, Space Weather Prediction Center.



3. Natalie Vezina (Purdue) analyzed geocoronal hydrogen density estimates using exosphere occultations; Janet Machol, NOAA, National Geophysical Data Center.

The REU program, funded by a grant from NSF with additional funds from specific LASP projects, provides college students with an opportunity to work with scientists on projects spanning the field of solar and space physics, from instrument hardware to data analysis to modeling of the Sun-Earth system.

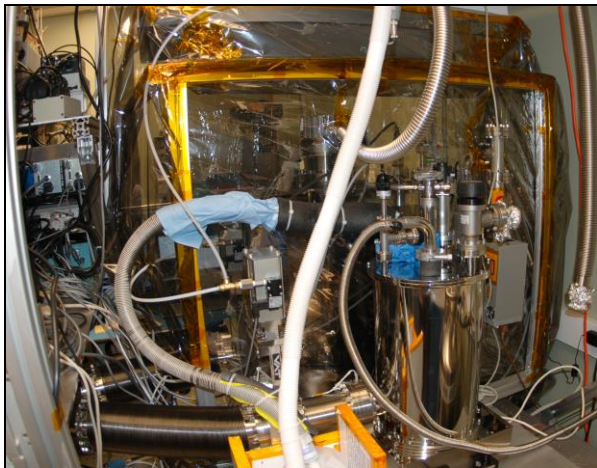


Some of the LASP REU students (left to right): Natalie Vezina, Summer Thresher, Sara Swenson, Sierra Ashley, and Derek Young.

ACRIM Team Uses LASP's TRF –

ACRIM team members visited LASP for three weeks starting in mid-June to perform ACRIM comparisons with the TSI Radiometer Facility (TRF). The testing went very well. The results of this TRF campaign, which found high scatter in the ground-based ACRIM instruments, should lower the ACRIM1 and ACRIM2 flight data to be closer to the *SORCE*/TIM values and refine the current ACRIM3 scatter corrections. This was confirmation for the ACRIM team to implement these large scatter corrections for earlier instruments. Before they can make corrections to the historical ACRIMs, they will first need to finish analyzing their data.

Overall it was an enlightening few weeks, and the ACRIM team members would like to come back to do more diagnostics with LASP's high-tech TRF to continue to learn about their ACRIM ground-based instrument.



TSI ISSI Workshop –

By Greg Kopp, LASP, Univ. of Colorado

In early summer Greg Kopp, *SORCE* TIM instrument scientist, led a “Total Solar Irradiance (TSI) Record Composite Workshop” in Bern, Switzerland at the International Space Science Institute (ISSI).

The purpose of this team meeting was to construct a new composite of the total solar irradiance (TSI) record based on the lower *SORCE* TSI values. Representatives from all currently operating TSI instrument teams and modelers were invited to participate in this workshop. Used in climate studies, the new TSI composite will be improved as follows:

- 1) It will use the lower TSI value established by *SORCE*/Total Irradiance Monitor (TIM).
- 2) It will include time-dependent uncertainties so that users can discern temporal regions where the composite is most reliable.

The TSI Team's ISSI meeting included participation by Will Ball, Wolfgang Finsterle, Claus Fröhlich, Greg Kopp, Werner Schmutz, and Pia Zacharias. These members include the PIs of all currently operating flight TSI instruments. The team discussed recent updates to all instrument data, summarizing changes affecting the solar irradiance climate data record such as the new hybrid mode for *SORCE* operations, the 2013 launch of the TCTE, the end of the PREMOS measurements in Feb. 2014, and the 2013 loss of the ACRIM3.

A lower TSI value of 1360.54 W/m^2 representative of the 2008 solar minimum was agreed to for the composite, addressing goal #1 in the meeting's purpose above. The team also agreed to produce both a Level 1 composite using uncorrected TSI values from each instrument plus a Level 2 composite that includes the team's best estimates of needed corrections to the earlier spaceborne TSI instruments. A Bayesian method for creating the composite was agreed to at a prior meeting, and an approach based on comparison to sunspot number to estimate time-dependent uncertainties for the initial data inputs to this method's algorithms was suggested at this more recent meeting. This approach will provide a starting point for composite generation.

SORCE Receives 2014 NASA Group Achievement Award –

The *SORCE* team was honored to receive the “*SORCE* Return To Science” NASA Group Achievement Award on August 26, 2014. Sean Ryan from LASP Mission Operations and Dave Oberg from Orbital Sciences Corporation attended the awards ceremony at NASA to accept the award on behalf of the team. The award was for

exceptional achievement in operating the *SORCE* spacecraft through an extended 6-month emergency period (July 2013–Feb. 2014), for a highly successful solar observing campaign in December 2013, and for getting *SORCE* back to making daily solar observations.

The *SORCE* Mission Operations team successfully rescued *SORCE* by creatively addressing aging battery issues. The heroics required the mission ops team to do real-time commanding for months to keep the spacecraft thermally stable. The NASA managers acknowledged how important the solar irradiance climate record is and that *SORCE*'s stability is paramount to avoid any gap. In December 2013, mission operations executed a highly successful solar observing campaign, which overlapped with the new TSI Calibration Transfer Experiment (TCTE) measurements.

The *SORCE* management at NASA and at CU/LASP is extremely proud of the *SORCE* Mission Operations team. They have been outstanding during this challenging time.



The core *SORCE* Mission Operations team with the *SORCE* PI. Left to right: Tom Woods (PI), Deb McCabe, Sean Ryan, and Emily Pilinski.

ISSI Workshop Proposal Selected –

Marty Snow, *SORCE* SOLSTICE instrument scientist, has been selected to lead an ISSI (International Space Science Institute) Workshop in Bern, Switzerland. Through a series of workshops starting in late 2014, his team will focus on improving the understanding of physical processes on the Sun and in the heliosphere.

Understanding in detail variations of the solar Lyman alpha emission is important as it interacts with the interplanetary medium and is also a significant driver for the atmospheres of the Earth, other planets.

Bringing together an international team of experts in solar physics, solar observing instrumentation, and heliospheric modeling, the SHAPE (Solar Heliospheric Lyman Alpha Profile Effects) investigators will take an in-depth look at the effect of the variation in the Lyman alpha line shape on the heliosphere. They plan to assemble a time series of spectrally resolved Lyman alpha data for at least two solar cycles, using data from *SORCE*, *UARS*, *SOHO*, and *SDO*.

To complete their task, the team will first concentrate on the solar observations, attempting to extract the true solar Lyman alpha variability from the existing record of radiance and irradiance measurements. This initial step includes reconstructing the solar Lyman alpha line profile by combining models and observations. The next step will use this new Lyman alpha dataset as input to an Interplanetary Hydrogen model, and to analyze the agreement of the model results with the *SWAN* and *MAVEN* observations.

Future SORCE Meetings –

SORCE Science Meetings will have a different look in the future as the scope is broadened somewhat. The *Sun-Climate Research Center*, a collaborative effort between NASA/GSFC and CU/LASP, will be heading up future meetings. Like past *SORCE* Meetings, each meeting will have a focus topic with contributed abstracts welcome.

Led by the Sun-Climate team at Goddard, work has already begun for a 2015 gathering. Our first step was submitting paperwork for NASA's approval to host a meeting. We are tentatively planning a meeting for November 2015, and we will keep everyone posted as soon as we have some definite news.

Upcoming Meetings / Talks –

SORCE scientists plan to present papers or attend the following 2014-2015 meetings/workshops:

Solar Metrology, Needs and Methods Workshop,
Oct. 7-10, Paris, France

SOLAR Irradiance Data Exploitation (SOLID) 2nd Annual Meeting, Oct. 28-31, Bremen, Germany

AGU Fall Meeting, Dec. 15-19, San Francisco, CA

AMS, Phoenix, AZ, Jan. 4-8, Phoenix, AZ