



## **SORCE's 13<sup>th</sup> Birthday!**

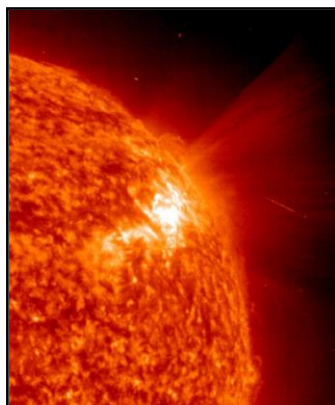
SORCE celebrated its 13<sup>th</sup> birthday on **Jan. 25!** Not bad for a 5-year mission! Go SORCE!



**Happy Birthday SORCE!**

## **Summer SIST Meeting –**

SORCE scientists and collaborators will be participating in a science meeting this summer for the NASA program called “Solar Irradiance Science Team (SIST). The primary purpose of the SIST research projects is to support the development of space-based data sets of total and spectral solar irradiance (TSI and SSI). The data sets will be used as input to global models to investigate solar variations and their impacts on the Earth climate and atmospheric composition. In 2015 NASA awarded five of the seven SIST proposals to SORCE scientists:



- *Construction of a SORCE-based solar spectral irradiance (SSI) record for input into chemistry climate studies of Solar Cycle 23-24* (PI: Jerry Harder, LASP)
- *Solar Spectral Irradiance: Lyman Alpha, Magnesium II, and Sigma k proxiEs (SSIAMESE)* (PI: Marty Snow, LASP)
- *The analysis of improved laboratory measurements in the re-calibration and re-evaluation of the SORCE SIM data record* (PI: Erik Richard, LASP)
- *A TSI Community Consensus Composite Based on an Assessment of the Accuracies and Uncertainties of Space-borne TSI Measurements* (PI: Greg Kopp, LASP)
- *How does the Sun's Spectrum Vary?* (PI: Judith Lean, NRL)

The other two awards went to:

- *Improved Composite Solar Spectral Irradiance Product Using SBUV/2 and OMI Data* (PI: Matt DeLand, SSAI and NASA/GSFC)
- *Calibration of Scattering and Diffraction Effects for ACRIM1 and ACRIM2 Satellite TSI Experiments and Reprocessing/Archiving Final Results* (PI: Richard Willson, JPL)

The SIST Meeting this summer is tentatively set for July 12-13 in the Washington DC area – probably at the SSAI corporate headquarters (Lanham, MD) located about 2 miles from NASA GSFC. The SIST team lead, Matt DeLand from SSAI and GSFC, envisions a 2-day agenda to include individual project overviews, status of current plans, plenty of workshop time each project team, and then concluding with a full team gathering to report results and discuss future plans. The SIST program is a 3-year award.

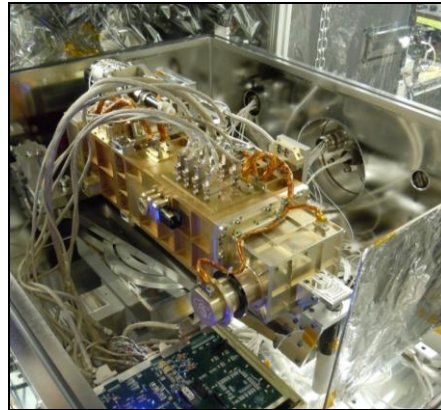
## **TSIS / SORCE Overlap –**

By Erik Richard – LASP, University of Colorado

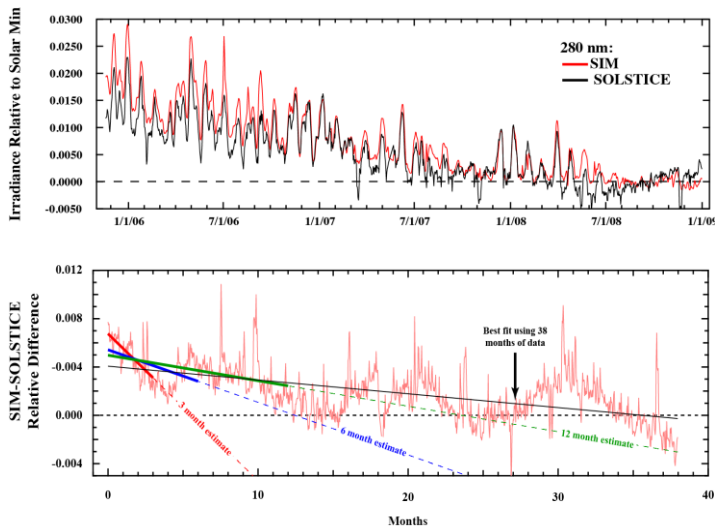
SORCE has advanced our understanding of the complex solar-terrestrial environment and maintained continuity of climate data records from space that were initiated in the late 1970s. Launched in January 2003, SORCE is now beginning its 14<sup>th</sup> year of operations. Currently it has been extended through 2018 to overlap with the NASA Total and Spectral Solar Irradiance Sensor (TSIS) scheduled for deployment on the International Space Station in late 2017. SORCE instruments are making routine daily measurements in a day-only operations (DO-Op) mode in order to compensate for reduced battery capacity. To insure continuity in the total solar irradiance (TSI) calibration scale between SORCE and TSIS in the event that SORCE end-of-mission occurs prior to the launch of TSIS, the Joint Polar Satellite System (JPSS) TSI Calibration Transfer Experiment (TCTE) was launched on the US Air Force Space Test Program Satellite-3 (STPSat-3) in 2013. TCTE has also been extended to 2017 in order to overlap with TSIS.

With respect to the SSI data record continuity, the SORCE team evaluated the requirements for sufficient overlap between the SORCE and TSIS-1 SSI measurements. This analysis is more involved than the TSI continuity analysis due to the wavelength dependence of both the spectral variability as well as the instrument

stability corrections. The present launch time frame for TSIS-1 is late 2017 to early 2018 and for the purposes of the analysis various assumptions needed to be made. Briefly, these assumptions (both solar and instrumental) include the following: solar minimum conditions where we anticipate small irradiance variability and weak SSI rotational modulation (similar to the 2007-2009 conditions), SORCE SIM performance similar to the current DO-Op mode with stable operation and uninterrupted data acquisition, and nominal (~30 day TSIS early commissioning activities). To aide in this comparison, the spectrally and temporally common SORCE data from SIM and SOLSTICE were evaluated over monthly time averages based on a 38 month data overlap range (Dec. 2005 – Jan. 2009).



TSIS SIM in the LASP Spectral Radiometry Facility (SRF) Vacuum Tank.



This common wavelength range was specific to the near ultraviolet and due to higher levels of solar variability, was found to require less overlap time than we estimate for the longer wavelengths that compare closer to the TSI levels of variability. Ultimately, when considering factors related to commensurate SORCE-TSIS wavelength overlap as well as late-SORCE vs. early-TSIS spectral degradation trends, the goal was to establish the time duration where the trend stability (at the 2-sigma level) was at or below the combined instrumental correction uncertainties. This cross-correlation analysis produced an overlap estimate of 12-14 months for SORCE SIM and TSIS SIM measurements. Operationally, we also plan to augment SORCE SIM operational/calibration schedules to follow the early mission TSIS SIM schedule. Full (3-channel) TSIS SIM calibration is presently planned for 10-month intervals.



## ISSI Team Shapes Up!

By Marty Snow

SORCE scientist, Marty Snow, organized a 2<sup>nd</sup> Solar Heliospheric Lyman Alpha Profile Effects (SHAPE) Meeting at the International Space Science Institute (ISSI) in Bern, Switzerland, January 25-29, 2016. SHAPE's goal is to study the evolution of the Lyman alpha line profile over the solar cycle. In particular, we are interested in understanding how the line shape impacts planetary atmospheres and the interplanetary medium. The international team is composed of both observers and modelers, both solar and interplanetary. At the first meeting in April 2015, five collaborative projects were identified. At the January meeting, progress was made on two of the projects. The first is to create an empirical model of the Lyman alpha profile in irradiance from SUMER on-disk observations along with feature identification of solar images, then using SORCE SOLSTICE to validate the results. The second project will use the scattered light irradiance measurements from SUMER to create a proxy model for the line profile, again cross-calibrating the result with SORCE SOLSTICE for validation.

Great progress was made on the proxy model. The SUMER off-disk measurements (Lemaire et al. 2015) were parameterized and correlated to a proxy. Matthieu Kretzschmar will present preliminary results at the Space Climate 6 meeting in April.

For the empirical model, additional work needs to be done to co-align the SUMER observations with SDO images in order to proceed with feature identification and reconstruction of the full-disk profile. An additional research project of comparing the SUMER line profiles to forward models such as COSI and SRPM will also be possible once the co-alignment has been done.

A web page (<http://www.issibern.ch/teams/shape/>) describing the team's activities is still under construction, but further details of our activities will appear there in the future. The next meeting of the full team is planned for September 2016.



SHAPE team members (left to right): Werner Curdt (MPI, Göttingen), Matthieu Kretzschmar (U. Orleans/CNRS), Ed Thiemann (U. Colorado/LASP), Margit Haberleiter (PMOD/WRC), and Marty Snow (U. Colorado/LASP). Team members not shown: John Clark (Boston U.), Vlad Izmodenov (Moscow State U.), Olga Katushkina (Moscow State U.), Randy Gladstone (SwRI), Eric Quémerais (LATMOS) and Frank Eparvier (U. Colorado/LASP).

## *SOLSTICE Stellar Observations*

By Marty Snow

After the successful observations of a dark region of the sky last month, the next step in resuming regular stellar observations was to observe a star! The observational constraint for stellar observation is that the target must be between 20 and 30 degrees away from the Sun. The first such target was the star alpha PsA, also known as Fomalhaut. This star is bright at visible wavelengths, but in the FUV it is one of our dimmest stars. This star was in the news recently because it has a planet that is visible in photographs, although some astronomers interpret the images to be a disk of debris rather than a planet.

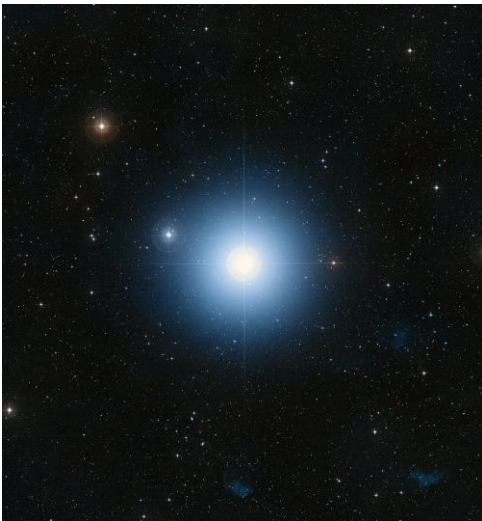
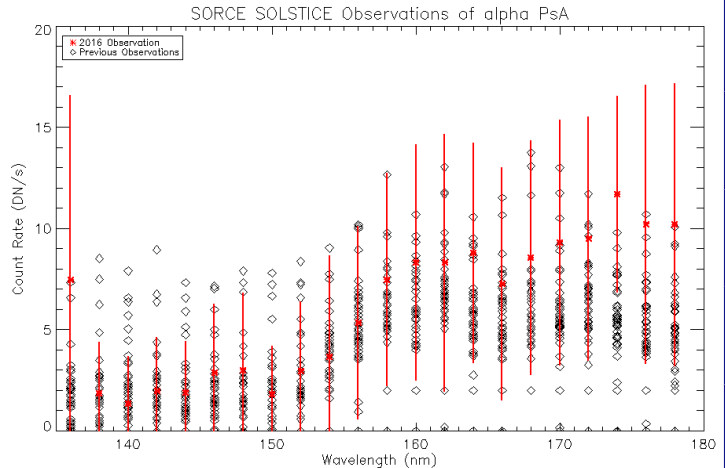


Image of alpha PsA from the Sloan Digital Sky Survey.

Obviously SOLSTICE does not observe the planet. Prior to 2016, we had measured alpha PsA's spectrum about 30 times. The count rate in the FUV is about twice the background, so the signal-to-noise ratio for this particular star is low. Other stars that we will observe are hundreds of times brighter, and will be used to update the SOLSTICE degradation correction. The operations team used this test observation to refine the planning and commanding for future stellar observations. The plan is that SOLSTICE will observe stars on a regular basis, perhaps weekly.



Spectrum of alpha PsA observed by SOLSTICE. The black diamonds are the measurements taken prior to power cycling. The red asterisks show the 2016 observation with statistical uncertainties shown as error bars. This star is not as bright as other stars in the SOLSTICE catalog, so the signal-to-noise ratio is low.

## *Upcoming Meetings / Talks –*

*SORCE* scientists will present papers or attend the following 2016 meetings/workshops:

Boulder Solar Day, March 14, Boulder, CO,

<https://www2.hao.ucar.edu/Workshop/Boulder-Solar-Day>

The Sun's Chromosphere in the Era of ALMA, IRIS, and DKIST (ChromoAID), March 15-18, Boulder, CO,

[http://www.nso.edu/workshops/Chromo\\_AID](http://www.nso.edu/workshops/Chromo_AID)

Space Climate 6 School and Symposium, March 30-

April 7, Levi, Finland, <http://www.spaceclimate.fi/SC6/>

European Geosciences Union (EGU) General Assembly, April 17-22, Vienna, Austria, <http://www.egu2016.eu/>

International Radiation Symposium (IRS) 2016, April 17-22, Auckland, New Zealand, <http://irs2016.org/>

Solar Physics Division, AAS, May 31-June 3, Boulder, CO, <http://www.nso.edu/SPD2016>

SIST Science Team Meeting, July 12-13, Lanham, MD

ISSI SHAPE Team Meeting, September, Bern,

Switzerland, <http://www.issibern.ch/teams/shape/>