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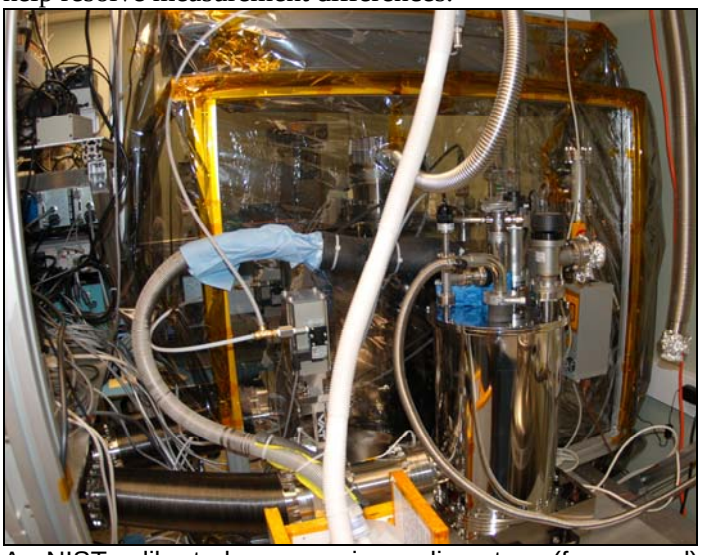
Solar Radiation and Climate Experiment Monthly Newsletter July 2009

LASP's TSI Radiometer Facility –

By Greg Kopp, LASP, University of Colorado

The TSI Radiometer Facility (TRF) was designed and built at LASP under the Glory program. Completed in 2008, the TRF is the only calibration facility in the world that is able to characterize total solar irradiance (TSI) instruments at the desired accuracy and power levels under flight-like vacuum conditions, providing the first end-to-end pre-launch validation of these instruments for irradiance measurements. The Glory Total Irradiance Monitor (TIM) was validated on this facility in January of this year, and the facility is now being used to perform similar comparisons with other flight TSI instruments to help resolve measurement differences.



A NIST-calibrated cryogenic radiometer (foreground) accurately measures input light at solar power levels in the TRF. Instruments are tested in the vacuum chamber enclosed by the clean tent toward the rear.

In early July, Wolfgang Finsterle and his PhD student André Fehlmann from the Physikalisch-Meteorologisches Observatorium in Davos, Switzerland came to LASP to test their PREMOS instrument in the TRF. André is currently completing three weeks of testing and diagnostics with both the flight PREMOS instrument intended for launch on PICARD later this year and with a ground-based PMO-6 instrument similar to that flying on SOHO. These tests will link the PREMOS flight measurements to the TRF's NIST-calibrated cryogenic radiometer in both optical power and irradiance, and should help understand the TSI measurement offsets between the on-orbit SOHO/VIRGO and the TIM. The flight instruments compared to the TRF can also be linked, via this SI-traceable ground-based reference facility, to future flight TSI instruments even if the on-orbit measurements do not overlap; while still not desirable, this potentially reduces the consequences of a data gap.

Left to right: Wolfgang Finserle, André Fehlmann, and Greg Kopp, SORCE TIM instrument scientist and Principal Investigator for the Glory/TIM instrument.

These PREMOS and VIRGO comparisons to the TRF indicate that the facility is providing the intended capabilities to better understand and thereby improve the accuracy of the TSI record – and the level of enthusiasm and openness from our PMOD colleagues in such comparisons is encouraging to see!

SORCE Battery Showing Wear –

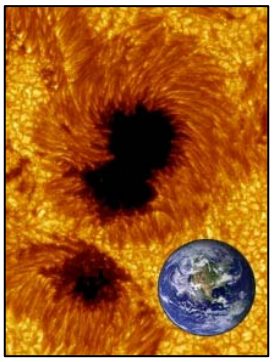
By Sean Ryan, LASP, University of Colorado

In early 2009 during routine housekeeping observations the LASP Mission Operations team began to notice that the SORCE nickel-hydrogen battery was showing signs of degradation. Specifically, in the first half of 2009, the end of the eclipse voltage of CPV 10 (common pressure vessel 10) has decreased by 0.5 volts. In addition, of the eleven CPVs in the battery, CPVs 4 and 9 are also showing minor signs of degradation. The reduced voltages on CPVs 4 and 9 may be due to the drain from CPV 10. The discharge curve for CPV 10 is consistent with a CPV that has lost capacity.

Engineers from LASP, Orbital Sciences, NASA, and the battery manufacturer, are investigating methods to slow the degradation of CPV 10, as well as optimize longevity and performance of the other CPVs. After researching and discussing options, all parties agreed the first step would be to decrease the battery trickle charge current. On July 3rd (day 184) the battery trickle charge current was decreased from 0.46A to 0.25A to reduce the rate at which the battery is trickle charged. It is believed that reducing the integrated trickle charge current should prolong battery life. This change will be monitored over the next weeks to see if there is a noticeable difference. After that, other possible solutions will be reviewed including changing the charge rate for full charge to reduce the time spent trickle charging the battery.

Work will continue over the next several months to optimize the battery performance. The scientists and engineers are optimistic that with the right changes to the power system further degradation of the battery can be minimized. In the event that CPV 10 fails completely, the power system was designed to continue normal science operations with a failed cell. There are many options to explore yet.

Tom Woods Participates in Heliophysics Summer School –



SORCE PI Tom Woods will be lecturing on "Spectral irradiance: measurements and models" at the Heliophysics Summer School at Boulder, Colorado's NCAR facility. SORCE co-investigator, Judith Lean from NRL, provided Tom with the course materials, in addition to writing a chapter in a 3-part textbook series on Heliophysics to be published by Cambridge University Press. The sub-disciplines within Heliophysics have a rich variety of available textbooks, but no textbooks currently exist that present the diverse materials from their common physical principles. These textbooks will help teachers well-versed in one discipline to teach the directly related areas within other disciplines.

The Heliophysics Summer School is a Living With a Star NASA-sponsored program for about 30 graduate students. It focuses on long-term changes in solar activity and Earth climate, going through a variety of links and time scales. The UCAR Visiting Scientist Program is hosting the final year of the 3-year program.

2009 SORCE Science Meeting –

A modified version of the traditional SORCE Science Meeting was held in conjunction with the IAMAS 2009 Meeting in Montreal, Canada, July 27-28. A special 2-day SORCE-related session (M03) called ***"The Impact of Solar Variability on Earth"*** drew about 50 participants to the various oral and poster presentations. Below are several photos from the meeting.

<<< Peter Pilewskie from LASP spoke on "TSIS: The Total and Spectral Solar Irradiance Sensor".

>>> SORCE SOLSTICE instrument scientist, Bill McClintock takes a break from the sessions to Catch-up on email.

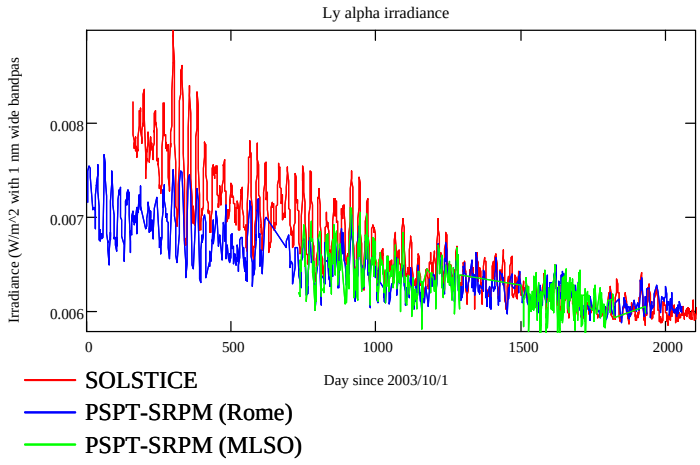
^ ^ ^ A good time was had by all, including Jerry Harder from LASP and Joanna Haigh from Imperial College in London, at the Session M03 Science Dinner held on Monday evening at *Fourquet Fourchette* near the Convention Center.

<<< LASP attendees Peter Pilewskie, Erik Richard, and Greg Kopp (left to right), take a break to discuss the morning sessions.

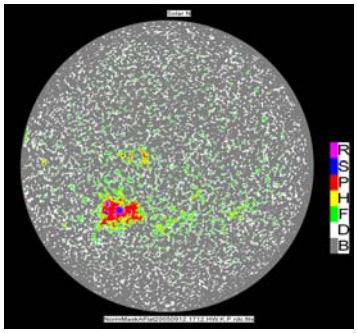
Solar Structure Research –

By Juan Fontenla, LASP, University of Colorado

Eric Quémerais and Stephane Ferron from the Service d' Aéronomie du CNRS in France visited LASP in July to work with Juan Fontenla on an ongoing collaboration to model and forecast the solar irradiance spectrum. The work requires using the SWAN and EIT data along with the Solar Radiation Physical Model (SRPM) for test cases compared to SORCE UV data. Current discussions are also relevant to the November 2008 workshop which focused on evidence concerning possible global changes on the solar structure and implications for the solar spectral irradiance (SSI). It had been clear since YOKHO that global changes in the solar corona occur in solar cycle timescales, but it is still being debated whether such global changes exist in the solar chromosphere and photosphere as well, or even in the sub-photosphere. Recent SORCE/SIM and SORCE/SOLSTICE data indicate that modeling that includes only the active region features observed on the solar surface are insufficient for explaining the SSI observations at UV, visible, and IR wavelengths, and thus SORCE brings one more piece of the puzzle.



SORCE SIM team members are hosting these discussions focused on identifying the physical processes and their relationships on this critical multi-disciplinary topic. They are exploring measurements of changes in the radiance due to relatively "quiet" areas of the Sun that may also contribute to the overall SSI variations. Solar cycle related changes in the helioseismic signal of far-side signal delays are also found, and are consistent with p- and f-mode frequency changes, and they are investigating their relationship with atmospheric changes. The relationships between these different aspects of the solar activity cycle are being explored by constructing physical models and comparing the observations. A more integrated picture is starting to emerge in which the manifestations of the solar magnetic fields at different levels of the solar atmosphere and at different wavelengths are explained.

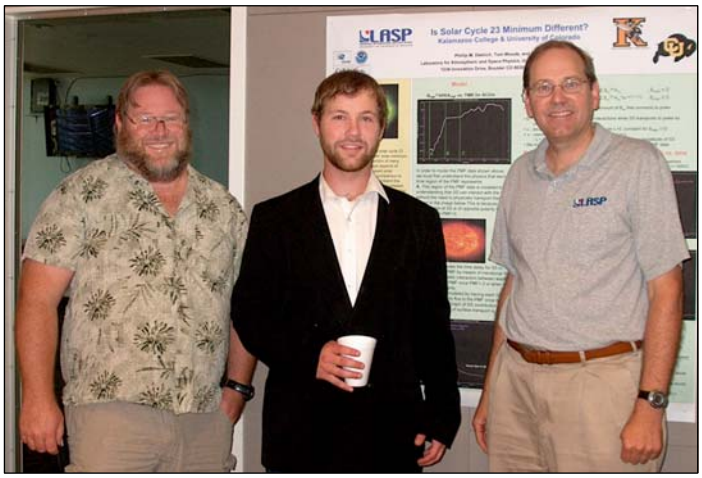


REU Students Helping SORCE –

SORCE REU summer interns, left to right: James Brenton, Anna Nuckolls, and Phillip Dietrich.

The NSF 2009 Research Experience for Undergraduates (REU) Program came to a close on Friday, July 31. The purpose of the program is to provide students with a summer 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. Three student interns worked at LASP for nine weeks on SORCE-related projects.

Phillip Dietrich from Kalamazoo College in Michigan worked with Tom Woods and Marty Snow on ***The Solar Cycle 23 Minimum: Is it Different?*** By developing a simple model of the magnetic flux transport at the surface, Phillip explored some basic parameters on how the magnetic active regions contribute to the polar magnetic field that accumulates during the solar cycle (SC) minimum period. This model was used to compare the behavior of the past and current SC. The final model included components for initial interaction of new sunspots (opposite magnetic polarity) with the old polar field and then poleward transport of the sunspots' magnetic field once the polar field transitions to the new magnetic polarity near SC maximum. The component parameters have different values for each SC, implying why SC 23 might be behaving differently. Phillip concluded that SC 23 possibly had less (by about a factor of 10) sunspot interaction with the poles before reaching maximum than



Phillip Dietrich (center) stands in front of his final poster with his RUE program mentors, Marty Snow and Tom Woods.

SC 22 had, and that SC 23 had faster meridional flow than SC 22. These factors account for the weaker polar magnetic field of SC 23/24 minimum.

Jerry Harder mentored **James Brenton,** who will be graduating from Texas A&M University this December. James's project, ***Solar Variability and the Effects on Earth's Atmosphere,*** targeted determining on what scale the solar variability affects the Earth's atmosphere. His study used two sets of data. SORCE SIM and TIM data provided spectral and total solar irradiance measurements from May 2004 through May 2009. The second set of data came from the models produced by MODTRAN 5, an atmospheric radiative transfer modeling program. His overall project objective was to gain a greater understanding of Sun-Earth interactions and the effects on climate. James' concluded that the variations on the Sun play a direct role in the Earth's atmosphere; whether it be during solar minimum, when water vapor in the lower free troposphere has an increased heating rate due to the increased amounts of infrared produced by the Sun, or during solar maximum, when ozone in the stratosphere has an increase in heating rate due to the increased amounts of ultraviolet light produced by active regions. And having a curious mind, James raised many more questions that he can explore in the future using the data he gathered for this project.

Anna Nuckolls will be a senior this fall at New Mexico School of Mining and Technology in Socorro. With Margit Haberreiter as her mentor, Anna worked with a method of determining the fractional areas on the Sun's surface covered by different features using images taken with the Extreme-Ultraviolet Imaging Telescope (EIT) onboard the SOHO satellite. By using LASP's Solar Radiation Physical Model (SRPM), which calculates the spectrum for six distinct solar features in the corona (coronal holes, quiet sun, quiet network, active network, hot loops, and super-hot features), Anna created intensity histograms of the EIT images that show distinct variations corresponding to the different features visible on the solar surface. Using these histograms, she then created a system of intensity thresholds with which to identify each solar feature. The background pixels were then removed from the SOHO images and the thresholds were applied to calculate the area covered by each coronal phenomenon. To observe variations throughout the solar cycle, this method was applied to images from July 2002 through November 2006. The resulting thresholds for the 171 Å, 195 Å and 304 Å images turned out to be practically time-independent and thus valid throughout the entire solar cycle. However, the 284 Å images show a distinctly different behavior, i.e. the thresholds for each feature are a function of solar activity. This result poses a challenge for irradiance reconstructions since the time-independent synthetic spectra require thresholds that are not a function of solar activity. The title of her project was ***A Method of Identifying Solar Features in EUV Images using Intensity Thresholds.***

All of the REU students took full advantage of their summer in Boulder to enjoy the local activities and beautiful mountains. They spent time sightseeing, hiking, biking, and in particular enjoyed movies and concerts at the Red Rocks Amphitheater in Morrison, Colorado. Each mentioned that they are strongly considering graduate school at the University of Colorado.

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Hits to the SORCE Website

(Since 4/21/03, As of 7/24/09)

Upcoming Meetings / Talks –

SORCE scientists plan to present papers or attend the following 2009 meetings:

MURI/NADIR Meeting (part of CEDAR),
June 28-July 2, Santa Fe, New Mexico
IAMAS / SORCE Meeting, July 19-29, Montreal, Canada
XXVII General Assembly of the Intl. Astronomical Union (IAU) Meeting, August 3-14, Rio de Janeiro, Brazil
SPIE Optics & Photonics Meeting, August 2-6, San Diego, California
Solar Analogs II Workshop, Sept. 21-23, Flagstaff, Arizona
SOHO-23: Understanding a Peculiar Solar Minimum, Sept. 21-25, Northeast Harbor, Maine
ISSI Working Group – Tools for UV Calibration, Sept., Bern Switzerland
AGU Fall Meeting, December 14-18, San Francisco, California

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