Director’s Corner

Steve Keil

ATST

Is there an end in sight? After a decade of preparing to build the Advanced Technology Solar Telescope (ATST), it appears we may be rapidly approaching the beginning of construction. The NSF final design review (FDR) of the project prior to a construction start was held on 18–22 May 2009. The final environmental impact study should be completed this July, allowing NSF to reach a Record of Decision on building ATST on Haleakalā before the beginning of FY 2010. The past several months have seen a series of systems-level design reviews of major telescope subsystems in preparation for the FDR. Needless to say, we are very excited about getting started on construction and looking forward to the science that ATST will produce.

SOLIS

SOLIS has achieved a milestone with the recent release of full-disk vector magnetograms after solving some of the difficult issues with flat fielding and full-disk inversions. To view the data, visit solis.nso.edu/solis_data4.html and click the List of Available Milne-Eddington Inverted Vector Observations link. SOLIS has collected these data with the Vector Spectromagnetograph (VSM) starting in 2003 and will process the backlog as time allows. New data are being reduced and put online as they are obtained. The full-disk vector magnetograms provide a new tool for more accurately modeling the overlying magnetic field structure, looking for unstable magnetic configurations, and comparing with coronal data. In addition to the VSM data, Integrated Sunlight Spectrometer (ISS) data are also available on the Web at: solis.nso.edu/solis_data4.html.

Decadal Survey

We would like to express our appreciation to those of you who submitted solar white papers to the astronomy and astrophysics decadal survey Astro2010. There were a substantial number of Science white papers covering many of the unsolved problems in solar and solar/stellar physics and the need for new observing tools to address them. A solar sub-panel for this survey does not exist, but hopefully these papers will give solar a high level of visibility during the survey process. The white papers are available at wso.stanford.edu/wsowiki/Astro2010WhitePapers.

Awards

The 2009 AURA Service award was presented to Ron Kroll for his outstanding service managing the daily operations, maintenance, and servicing of the hardware and software systems of the instruments comprising the GONG worldwide network. Ron Kroll has served as the GONG Operations Manager for the past twelve years. Ron has been very effective in leading the GONG operations team and interacting with the site host personnel in the 24/7 day-to-day operations, demanding a high degree of attention in order for the GONG program to continue supplying high-quality helioseismic and magnetic field data to the scientific community.

Mark Warner is the recipient of the AURA Technical Achievement award for his outstanding leadership in the Advanced Technology Solar Telescope (ATST) mechanical design effort. Mark is lead mechanical engineer and is responsible for many unique and innovative elements of the ATST. The ATST’s innovative design brings together many new elements for an AURA facility: large off-axis solar telescope, integrated adaptive optics and wavefront correction, large rotating coudé lab, and extensive thermal control. Mark was personally responsible for the design of the Telescope Mount Assembly, which features an optical support structure accommodating a four-meter cooled off-axis mirror, silicon carbide cooled secondary mirror, and other optical support elements for 11 feed mirrors. The design also includes a 16-meter diameter rotating instrument laboratory where a suite of large instruments will reside. (See figure 1.)

Figure 1: Steve Keil (center) with 2009 AURA Service award recipient Ron Kroll (left) and AURA Technical Innovation award recipient Mark Warner (right).

The AURA Science award this year goes to the team of Gianna Cauzzi, Kevin Reardon, Thomas Rimmele, Alexandra Tritschler, Han Uitenbroek, and Friedrich Wöger for their scientific exploitation of the Interferometric BIdimensional Spectrometer (IBIS) to reveal new aspects of photospheric and chromospheric structure and waves, heating of the chromosphere, current sheets above sunspot umbra, and for contributions to the understanding of the complex structure and evolution of sunspots. In the past few years, the team has made a major investment of effort to implement full Stokes polarimetry with IBIS. The many complexities involved—the complicated polarization calibration of the telescope and instrument, properly compensating for atmospheric distortions, and dealing with the large volumes of multi-dimensional data—have required pushing the limits of observa-

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National Solar Observatory. This has produced exciting new results both for the solar photosphere as well as in the largely unexplored regime of the chromospheric magnetic fields. (See figures 2 and 3.)

Finally, an NSO Team award goes to the Dunn Solar Telescope (DST) instrumentation development and operations team for innovative development and implementation of several state-of-the-art instruments that have led and will continue to lead to new scientific discoveries in observing the Sun at high resolution. The DST technical and observing staffs have performed outstanding work to develop and support instrumentation for the Dunn Solar Telescope that employs innovative concepts and will substantially enhance scientific productivity and increase the potential for scientific discovery for the entire solar community. These new instruments, which are interfaced to the DST adaptive optics systems, are now the “work horses” in solar physics and are producing intriguing results about photospheric and chromospheric structures, magnetic fields, and energy transport. Team members are Chris Berst, Steve Fletcher, Scott Gregory, Craig Gullixson, Steve Hegwer, Wayne Jones, Brady Jones, Mark Komsa, Ron Long, and Kit Richards (DST Instrument Engineering Group), and Mike Bradford, Joe Elrod, and Doug Gilliam (DST Operations Team). (See figure 4.)

New Faces

We’re pleased to welcome Brian Harker-Lundberg, who joined us as an NSO post-doctoral research fellow in January. Brian comes to us from Utah State University, where he received his PhD in physics in December 2008. Brian is no stranger to NSO, as he has spent the past few summers at Sacramento Peak working on his thesis project with thesis co-advisor K.S. Balasubramaniam (former NSO astronomer, now an Air Force astrophysicist in residence at Sac Peak). Brian is in Tucson, investigating solar photospheric vector magnetic fields using the SOLIS VSM.

Figure 2: Steve Keil (left) congratulates Friedrich Wöger as part of the team who won the AURA Science award for 2009.

Figure 3: Steve Keil (left) presents an award to Thomas Rimmele for his contributions to the IBIS project.

Figure 4: The NSO Team award recognized members of the DST instrumentation development and operations team. Shown receiving their awards are (from left): Wayne Jones, Brady Jones, Stephen Hegwer, Scott Gregory, Steve Keil (presenting awards), Craig Gullixson, Ron Long, Mark Komsa, Kit Richards, and Steve Fletcher.
The optical path and coudé level of the Advanced Technology Solar Telescope (ATST) have been significantly modified to optimize their designs for instruments and science users. “We have a configuration that meets the requirements from the ATST Science Working Group (SWG) and for the most part is in a single plane,” said ATST Instrument Scientist David Elmore, who joined NSO in 2008. The new design, which was being refined at this writing, is to be presented at the Final Design Review with the National Science Foundation in Tucson, May 18–21, and at the next Science Working Group (SWG) meeting in Boulder in late summer 2009.

For the past several years, the baseline design has incorporated an optical tower standing in the middle of the coudé platform. The tower supported fold and power mirrors—M7 through M13—including the deformable mirror, M9, for the high-order adaptive optics (HOAO). The new design eliminates the tower and three mirrors, and it makes M10 the deformable mirror and last one in the series before light goes to the instruments.

Elmore explained that the changes came after the SWG set a series of use cases at its May 2008 meeting. “The instrument use cases showed that we needed to operate multiple instruments simultaneously,” Elmore said. “That requirement led to a rethinking of how we would distribute light to the instruments in the coudé lab.”

The first result was eliminating the tower. “The optical design of the tower did not lend itself to distributing light to multiple instruments simultaneously,” noted Elmore. Next, Project Scientist Thomas Rimmele determined that the deformable mirror could be adjusted to provide the same corrections that were supplied by M7 and M8, two off-axis conics.

In the new design, M7 is a flat at the center of the coudé platform and directly under the beam coming down from the telescope level. M7 folds the beam to a horizontal path, directing it to M8 (a power mirror) and M9 (another flat) and finally to M10. The new arrangement also places the Wavefront System, including the HOAO, Active Optics, and context imager, on a bench that is easily serviced.

Elmore added that M8 and M9 are at the correct positions for easy upgrades to deformable mirrors for a future multi-conjugate adaptive optics system that would improve ATST’s ability to compensate for atmospheric blurring.

“Now we can run three to four science instruments at a time,” Elmore explained. “It also simplifies the platform because we are working at conventional table heights.” The design still allows for vertical fold paths, about 2.8 meters up to the bottom of the air handling system in the ceiling, for other instruments.

The planned placement of the ATST’s commissioning, or “first light,” instruments on the coudé platform. Significant space remains for development of new instruments. By comparison, the coudé platform of the Dunn Solar Telescope, which served as the prototype for ATST, is 12 meters wide. (Scott Gregory, NSO/AURA/NSF)

SOLIS/VSM Inverted Vector Magnetic Field Data Now Available

We are pleased to announce that inverted vector magnetic field data from the SOLIS/VSM (Synoptic Optical Long-term Investigations of the Sun/Vector Spectromagnetograph) instrument are now available at: solis.nso.edu/. Both full-disk data and smaller field-of-view data containing active regions are available. The data are inversions of Stokes I, Q, U, and V profiles of the Fe I 630.1 and 630.2 nanometer lines using a Milne-Eddington (ME) model atmosphere and a least-squares minimization code originally developed at the High Altitude Observatory. The azimuth values have the 180-degree ambiguity removed, thanks to code and kind assistance from Manolis Georgoulis (Johns Hopkins University).

Data are available daily (weather permitting) beginning 1 April 2009. Also available is a sample of data from March 2008 containing several active regions near the Equator (see figures 1 and 2). Milne-Eddington inversions of vector observations taken since 2003 will be produced as time and personnel resources permit.

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Please note that data are only inverted if the observed polarization signal is above a threshold. A value of zero indicates that the signal was below the threshold value and no attempt was made to invert the data. Many areas contain zero values. Data without the discontinuity resulting from thresholding can easily be obtained by merging the ME data with the “Quick-Look” (QL) data, essentially filling in the missing ME data with the QL data. QL data values are determined using a weak-field approximation.

We acknowledge, with gratitude, the assistance and guidance of a VSM Vector Working Group: Christoph Keller (Chair, Utrecht), Manolis Georgoulis (Johns Hopkins University), Jack Harvey (NSO), Carl Henney (AFRL/Boston University/NSO), K. D. Leka (NorthWest Research Associates), Aimee Norton (James Cook University/NSO), Nour-Eddine Raouafi (Johns Hopkins University), Kim Streander (NSO), and Roberta Toussaint (NSO) in developing the pipeline for producing inverted vector data. Further information, including filename description, data format, and caveats, can be found on the NSO Web site at: solis.nso.edu/solis_data.html.

The data result from inversions of Stokes, I, Q, U, and V profiles of the Fe I 630.1 and 630.2 nanometer lines using a Milne-Eddington model atmosphere and a least-squares minimization code. The azimuth values have the 180-degree ambiguity removed. Note that data are only inverted if the observed polarization signal is above a certain threshold.
The Global Oscillation Network Group (GONG)

Frank Hill & The GONG++ Team

Introduction

The first quarter of 2009 was spent ramping up for the development of an H-alpha observing system. Funds from the Air Force Weather Agency (AFWA) arrived in late December, and the GONG++ team hit the ground running on January 1. The loan of a camera and a filter were scheduled to verify our selection, and lenses were obtained for a complete optical layout. After rigorous testing, which identified some issues and potential risks with the original design, adjustments and modifications were made that demonstrated the system would work well. The program conducted a preliminary design review of the optical breadboard system and, with no obvious show-stoppers, the review team gave the go-ahead for the development of a prototype system.

GONG's high-cadence magnetograms continue to attract the attention of the community. A new set of data products, one-minute network-merged magnetograms and Carrington rotation synoptic maps, are now available for downloading at: gong.nso.edu.

Science Highlights

Gordon Petrie has been working to extend the earlier results of Jack Harvey and Jeff Sudol, which demonstrated that the photospheric magnetic field changes during a flare. Gordon, along with Jack and Jeff, has been compiling a large number of magnetic-field time series for various flares. An example is shown in figure 1, which is a mosaic of longitudinal magnetic field changes over a four-hour period centered on a large X6.5 flare. Depending on the location, the field exhibits all possible variations: increases, decreases, and relatively unchanged. Correlating these variations with the morphology of the active region should provide additional insight into the flare mechanism.

Network Operations & Engineering

The problem with turret oscillations at Mauna Loa and Tucson has continued into 2009. The cause seems to be modified turret seals, which appear to impart increased friction against the moving surfaces and result in an ill-tuned mechanical servo system. Alternatives to the current grease sealer and possible changes to the gain setting of the guider feedback are being investigated. A preventative maintenance (PM) trip to Big Bear occurred in March, and in addition to routine tasks, the filter/interferometer assembly was replaced. This procedure requires a subsequent optical alignment. Instances of turret oscillations were observed during the system check-out, keeping the turret oscillation problem a top priority.

In mid-February, one of the calibration wheels in the Learmonth instrument began malfunctioning. Alan Brockman, our site representative there, has been invaluable in troubleshooting the situation. A workaround solution was found, and we are again collecting calibration data. A PM team will head south to Learmonth in late April.

Eric Yasukawa, a long-term observer and original GONGster at Mauna Loa Observatory, retired recently after 37 years of service.

Figure 1: Line-of-sight magnetic field changes over a four-hour period centered at 1829UT on 12 December 2006, the start time of an X6.5 flare in AR10930. Each plot corresponds to one pixel, and the mosaic covers most of AR10930. There are systematic patterns to the changes, which should yield information about flare mechanisms.

Figure 2: Eric Yasukawa (right), a long-term observer and original GONGster at Mauna Loa Observatory, accepts the infamous “Hero of GONG” (HOG) award from Ron Kroll (left). Yasukawa retired recently after 37 years of service.

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GONG continued

service. Ron Kroll presented Eric with the infamous "Hero of GONG" (HOG) award (figure 2). Congratulations and best wishes to Eric!

Testing the camera and filter for the new H-alpha system has been a top priority. We quickly found that the original optical design, which placed the filter near a focus, resulted in an image dominated by structures within the mica inside the filter. Jack Harvey redesigned the optics to place the filter away from a focus, which removed the artifacts from the image and also produced a better point spread function. We originally chose to evaluate a cooled camera, but had problems when the seals failed in the test camera and allowed condensation to form on the CCD window. This raised concerns about operating in high humidity environments, such as our Australia and India sites. In addition, we were told that the seals had only a three- to five-year lifetime. As a result, we expanded our tests to include a cooled and an uncooled version of the same camera. At the exposure times that we expect to use, there is very little difference between the cooled and uncooled camera performance. With the new optical design and uncooled camera, we obtained a one-hour sequence of images that looks pretty good, even with a quiet Sun. (See figure 3.)

Data Operations and Software Development & Analysis

The new Data Management and Analysis Center (DMAC) Magnetogram Pipeline has been implemented. From calibrated site magnetograms, we are processing one-minute cadence network-merged magnetograms and Carrington rotation synoptic maps. As data are processed over the next few weeks, Carrington rotation 2047 (post-modulator upgrade) onward will be available for downloading at: gong.nso.edu/data/dmac_magmap.

Being able to monitor various GONG systems in real time is a critical aspect of operations. GONG monitoring Web pages can be found at monitor.nso.edu. There you will find the current status of the network instruments, calibration, and various data reduction pipelines.

Processing to date includes time series, frequencies, merged velocity and rings through GONG month 137 (centered at 18 October 2008), with a fill factor of 0.8. Last quarter, the GONG Data Archive distributed 550 gigabytes of data. All GONG data products can be obtained at: gong.nso.edu/data.

Fourth Quarter Deadline for NSO Observing Proposals

The current deadline for submitting observing proposals to the National Solar Observatory is 15 August for the fourth quarter of 2009. Information is available from the NSO Telescope Allocation Committee at P.O. Box 62, Sunspot, NM 88349 for Sacramento Peak facilities (sp@nso.edu) or P.O. Box 26732, Tucson, AZ 85726 for Kitt Peak facilities (nsokp@nso.edu).

Instructions may be found at www.nso.edu/general/observe/. A Web-based observing request form is available at www2.nso.edu/cgi-bin/nsoforms/obsreq/obsreq.cgi. Users’ manuals are available at nssop.nso.edu/dst/ for the Sac Peak facilities and nsokp.nso.edu/ for the Kitt Peak facilities. An observing run evaluation form can be obtained at ftp.nso.edu/observing_templates/evaluation.form.txt.

Proposers are reminded that each quarter is typically oversubscribed. It is to the proposer’s advantage to provide all information requested to the greatest possible extent no later than the official deadline. Observing time at the national observatories is provided as support to the astronomical community by the National Science Foundation.
In Memoriam of Clifford G. Toner
8 December 1959–29 March 2009

Frank Hill

Cliff Toner passed away unexpectedly at home in Tucson, Arizona, on 29 March 2009. For most of his career, Cliff was involved with the Global Oscillation Network Group (GONG), a facility of the National Solar Observatory in Tucson, Arizona.

Cliff was born on 8 December 1959 in New Westminster, British Columbia, Canada. After receiving his B.S. in Physics & Astronomy at the University of British Columbia at Vancouver in 1981, he went on to the University of Western Ontario in London, where he worked with David F. Gray, receiving his PhD in 1988 on “The Time Variability of Spectral Line Asymmetries and Equivalent Widths for the G8 Dwarf ξ Boo A: Evidence for a Starpatch.”

After graduate school, Cliff accepted a post-doctoral position at the Institute for Astronomy at the University of Hawai’i in Honolulu, where he worked primarily with Barry LaBonte leading to the discovery of halos of enhanced high-frequency acoustic power surrounding solar active regions.

Cliff joined the GONG project in 1991 and tackled the critical problem of merging the data from the six GONG sites. In parallel, he and Stuart Jefferies developed an algorithm to measure the radii of full-disk solar images to a relative precision of 0.01 percent by determining the zero points of the Hankel transform of the image. As a by-product of the algorithm, the modulation transfer function (MTF) of each image was also obtained, and this led Cliff to develop a merging scheme based on the MTF of every image. It proved to be a very effective approach, and both the radii measurement and the merging algorithm remain in daily use in the GONG processing pipeline.

Cliff also developed a sophisticated optimization scheme that determined the network-wide relative orientations of the GONG images, and then pinned down the absolute value with drift scans. He further refined the solutions to compensate for irregularities in the camera rotator units. As a result of these algorithms, Cliff was able to co-align all of the GONG images to a precision and accuracy of 0.02 degree, as verified by his observations of the transits of Mercury and Venus.

Without these complex and clever strategies and these extremely important algorithms, it would have been impossible for the GONG data to be merged into a single uniform time series of adequate accuracy for precision helioseismology. Cliff’s tireless, selfless work behind the scenes was essential for the success of GONG. Cliff also developed the scheme for merging the GONG high-cadence magnetograms, and was working on determining the radii of the forthcoming GONG H-alpha data just prior to his untimely death.

Cliff was a very tall man, and colleagues at Hawai’i enjoyed the sight of him riding around the campus on a small moped. Everyone who met him loved him for his patience and willingness to help out. As one of his colleagues from his stay in Hawai’i, K. D. Leka, recalled, “Cliff was the embodiment of a ‘gentle giant’; so tall, yet so soft-spoken and patient, and I just recall a sense of his always being ready to help any living thing. … It was always with a smile that he’d greet me when we ran into each other after the ‘Hawai’i days’; we’d swap some stories, kid updates, but only recently we were more in touch as I’m now playing with GONG data. I was heartened to hear he was working on the magnetogram merging, because I knew it would be done really well with his attention.”

Cliff was a caring and loving person, an excellent scientist, and a hero of GONG. He will be sorely missed by everyone who knew him. He is survived by his wife, Nelsey; children, Ariel, Nathaniel, Miranda, and Kayl; a sister, Gloria; and brothers, Ethan and Emanuel.