From the NSO Director's Office

Steve Keil

AURA completed its review of my first five years as NSO Director, and as a result, I started my second term as director on 9 May 2004. I look forward to working with the solar community over the next five years to obtain the resources needed to construct the Advanced Technology Solar Telescope (ATST) and to maximize the usefulness and impact of the new capabilities provided through adaptive optics (AO), new infrared (IR) arrays, the Synoptic Optical Long-term Investigations of the Sun (SOLIS), and the upgraded, high-resolution capabilities of the Global Oscillation Network Group (GONG). To exploit the new AO and IR capabilities, NSO will upgrade the operational and data collection systems at its major facilities, the Dunn Solar Telescope and the McMath-Pierce Solar Telescope. We will also continue to collaborate with other groups to provide instrumentation capable of exploiting the diffraction-limited images delivered by AO. Some of the current collaborations include development of diffraction-limited Stokes polarimetry with the High Altitude Observatory (HAO), diffraction-limited narrowband imaging with Arcetri Observatory and Marshall Space Flight Center, and thermal IR imaging and spectroscopy with NASA Goddard Space Flight Center. These efforts will require the allocation of additional engineering time on our facilities, but the payoff will be worth it.

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The ATST construction proposal is currently being reviewed, while the ATST design continues to progress. NSO is holding a public session on the ATST at the Solar Physics Division (SPD) meeting of the American Astronomical Society in Denver on Wednesday, June 2 from 12:30–1:30 PM. The current status of ATST science and design will be discussed and opportunity provided for public input.

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NSO hosted the planning workshop for the 2007 International Heliophysical Year (IHY) at Sunspot, New Mexico, from 20–22 April 2004. Researchers from several communities, including solar, interplanetary, magnetospheric, ionospheric, atmospheric, and climate, participated in the workshop. IHY, along with the Electronic Geophysical Year (e-GY), is being held on the 50th anniversary of the International Geophysical Year (IGY). IHY planners hope to bring together researchers from various disciplines to develop joint observational and theoretical programs leading toward a comprehensive picture of the coupled processes in the heliosphere, from the Sun to Earth and out to the boundary of the interstellar medium. The initial meeting explored ideas in each of the subdisciplines, including areas of common interest and overlapping needs.

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The NSO AO program, led by Thomas Rimmele, continues to progress at a rapid pace. The NSO low-order AO system has been upgraded to high-order (76 degrees of freedom) this fiscal year. Currently there are two high-order AO systems in the Dunn Solar Telescope (DST), one feeding the new Diffraction-Limited Spectro-Polarimeter (DLSP) and the other feeding the Advanced Stokes Polarimeter (ASP) and the narrowband filter of the Italian Interferometric BI-dimensional Spectrometer (IBIS). Both ports have room to set up additional filters and cameras. The port with the DLSP will be dedicated to the DLSP and the setup frozen to minimize set-up time between users. This system will be commissioned for routine use in the next few months. In addition to the AO systems on the DST, the AO team delivered and installed a high-order AO system at the Big Bear Solar Observatory. HAO, in collaboration with NSO, plans to develop a more capable replacement for the ASP that will take advantage of the diffraction-limited imaging. The new project, the Spectro-Polarimeter for Infrared and Optical Regions (SPINOR), will extend the functionality of the ASP through the next decade and add IR capabilities. The SPINOR instrument will demonstrate ATST concepts for the spectropolarimeter being designed by HAO.

For their role in developing the AO systems, Steve Hegwer and Kit Richards received the NSO 2004 AURA service and technical achievement awards, respectively. Congratulations to both of them on a job well done, and to Thomas for leading this very successful effort.

NSO 2004 AURA service and technical achievement award winners Steve Hegwer (left) and Kit Richards.

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NSO Director's Office continued

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After several months of operation at the GONG farm in Tucson, the SOLIS mount and the vector spectromagnetograph (VSM) were installed on Kitt Peak on April 13 and May 4, respectively. Power, helium, data, and cooling fluid connections have been restored to the VSM. The mount has been roughly aligned to the polar axis, but one of the position encoders is not working correctly. That problem will be fixed and daily observations are expected to resume very shortly.

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The DST at Sacramento Peak has been the mainstay of high-resolution ground-based solar observing for decades. In recent years, aging systems and general wear on the telescope have resulted in more frequent breakdowns and loss of valuable observing time. In an effort to address and mitigate some of these issues and to enhance the quality and quantity of DST observations, NSO needs to allocate large blocks of time for systems upgrades. To accomplish some of the more critical and immediate needs, we dedicated a substantial amount of engineering time during the April–June quarter. This required postponing many of the science proposals submitted for both that quarter and the July–September quarter. Thus, during July–September 2004, the DST will be open for new proposals (which were due on May 15) only for the month of September. The telescope time allocation will return to regular scheduling during the October–December 2004 quarter, with proposals due on August 15.

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Selections for the 2004 NSO Research Experience for Undergraduates/Research Experience for Teachers (REU/RET) and Summer Research Assistantship (SRA) programs have been completed. Our students this summer include the following REUs: Frances Edelman (Yale University), advisor Frank Hill; Statia Luszcz (Cornell University), advisor Matt Penn; Stuart Robbins (Case Western Reserve University), advisors Carl Henney and Jack Harvey; Heidi Gerhardt (Towson University), advisor K. Sankarasubramanian; Joel Lamb (University of Iowa), advisor Alexei Pevtsov; Michelle McMillan (Northern Arizona University), advisors Han Uitenbroek and K. Sankarasubramanian. Undergraduate and graduate SRAs will be Cheryl-Annette Kincaid (AF Scholar, University of North Texas), advisor Joel Mozer; Anna Malanushenko (St. Petersburg State University, Russia), advisor John Leibacher; Leah Simon (Macalester College), advisor Thomas Rimmele; and Maria Kazachenko (St. Petersburg State University, Russia), advisor Alexei Pevtsov. RET participants are Mark Calhoun (Sabino High School, Tucson), advisor Bill Livingston; Matt Dawson (Brockton High School, Boston), advisor Rob Hubbard; Michael Sinclair (Kalamazoo Math & Science Center, Michigan), advisor Joel Mozer; and Creighton Wilson (Lovelady High School, Huntsville, Texas), advisor Alexei Pevtsov.

New graduate students starting this summer and working throughout the academic year with K.S. Balasubramaniam as their research advisor will be Brian Harker-Lundberg (Utah State University) and Drew Medlin (New Mexico Tech). Brian Robinson (University of Alabama, Huntsville) will be an NSO/ATST Postdoctoral Fellow working on the design of tunable filters with K.S. Balasubramaniam and Allen Gary (NASA/MSFC).

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Our congratulations to Yukio Katsukawa (University of Tokyo) for successfully defending his PhD thesis on "Photospheric Magnetic Fields and the Coronal Heating," under the supervision of S. Tsuneta, National Astronomical Observatory, Japan. Yukio used the HAO/NSO Advanced Stokes Polarimeter at the DST for portions of his work, combining ASP data with data from Yohkoh, SoHO, and TRACE.

And finally, congratulations to Christoph Keller, who was formally presented with a Friedrich Wilhelm Bessel Research Award of the Humboldt Foundation on March 26 in Bamberg, Germany. This prestigious award, which is supporting Christoph's sabbatical leave at the Max Planck Institute for Aeronomy in Katlenburg-Lindau, is in recognition of Christoph's contributions to the development of advanced instrumentation for solar physics, high-precision polarimetry techniques, and image reconstruction methods.

Working toward a Preliminary Design for ATST

Jim Oschmann & the ATST Team

As of the last *Newsletter*, we had just submitted our construction phase proposal and resumed with addressing various design aspects of the telescope and supporting systems. The proposal is currently in review at the National Science Foundation (NSF), with expectations of a face-to-face review later this summer. In the meantime, progress continues in several key areas, including the enclosure, coudé lab, thermal interface between the telescope and lab environment, and Gregorian instrument feed options. We are planning a series of small instrument workshops to help address issues required for the preliminary design review (PDR), which is to be held in the late fall/early winter.

Enclosure

Significant progress has been made in increasing the amount of airflow through the enclosure ventilation system. The new vent arrangement, depicted in figure 1, shows much larger vents than were presented at the conceptual design review (CoDR) last August. Also included are sunshades above each opening. The combination of the larger vents and shades, which help direct the wind into the dome, resulted in a 250 percent increase in air flow. This exceeded our stated throughput goal at the CoDR. An example of the new computational fluid dynamics (CFD) analysis is also shown in figure 1. Mark Warner is working with Fluent, Inc. on adding the telescope obscuration to the CFD model.

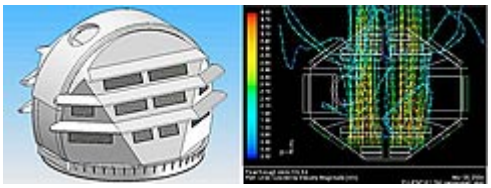

Figure 1. New enclosure vent arrangement and corresponding CFD flow analysis example.

Coudé Lab

The new simplified coudé optical feed has been fine tuned to balance performance and coudé lab rotation, resulting in very uniform image quality in all directions. Ming Liang (NOAO) is working on adding the final camera optics, which will feed the instruments in this area. A contract has been set up for a tolerance study of the complete optical train to the instrument input focal plane.

Telescope/Coudé Lab Interface

We are making progress on addressing one of the biggest issues discussed at the CoDR: the need to control the interface between the typically colder ambient air of the telescope to that of the controlled air in the laboratory environment at coudé. Bill Schoening (NOAO) has built our lab experiment as described in the last *Newsletter*. It has undergone some initial qualitative thermal testing. We are able to maintain a nearly 30°C temperature difference from inside to outside the "box" built for these tests. We also have implemented a first-cut laminar airflow knife design. We are currently setting up for initial interferometric testing of the optical quality of this interface at NOAO. Following this, we will move the system to the University of Arizona Optical Sciences Center for quantitative interferometer measurements.

Gregorian Rotator

The leading option at this point for supporting a Gregorian instrument is actually a Nasmyth rotator that utilizes a three-mirror optical relay. This allows for more instrument space than any other option, a somewhat easier gravity environment to contend with, and the best polarization performance. The optical relay is shown in figure 2. We are working with Don Mickey (University of Hawaii) on evaluating instrument concepts that will work with this arrangement and hope to confirm this choice by the first instrument workshop (scheduled for the end of May) that concentrates on the optical and infrared spectropolarimeters being designed by HAO and the University of Hawaii. A major area of emphasis for these reviews is to define in detail the polarization module requirements. David Elmore and the HAO team have been working to provide more input to the project team so that a concept can be designed in support of the PDR later this year.

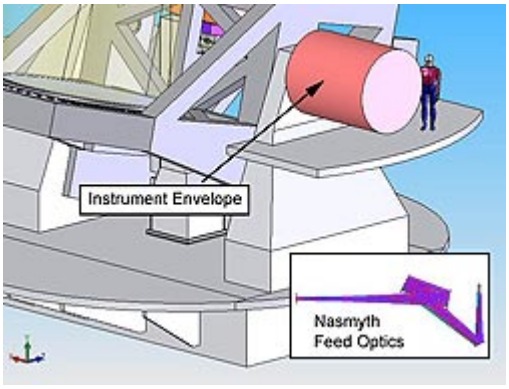

Figure 2. Three-mirror relay system used to feed the Nasmyth instrument (formerly the Gregorian instrument).

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Working toward a Preliminary Design for ATST continued

Upcoming Milestones

The project's principal activities are focused on preparations for the preliminary design review later in the year. In addition, we continue to prepare for any construction proposal review activities that may be required through the June time frame, and are extending efforts to firm up potential funding partner activities. Our European colleagues have submitted a proposal to the European Union for adding to the current Design and Development phase in many areas. We eagerly await feedback on this effort, which is expected this summer. We continue to update our Web site and encourage anyone interested to visit it periodically for the latest information.

SOLIS

Jack Harvey & the SOLIS Team

The major SOLIS event of the second quarter of 2004 was the installation of the mount and vector spectromagnetograph (VSM) instrument on Kitt Peak. The 13-ton mount was originally installed at the GONG test site in Tucson, where it was completed and placed into temporary service through March 28. It was returned to the builder for some changes on March 30, then transported to Kitt Peak and lifted to the top of the old Vacuum Telescope tower on April 13 (see figure 1). The VSM was slowly and carefully transported to Kitt Peak a few days later, on April 15. SOLIS will remain on Kitt Peak until NSO consolidates its observing facilities at the future Advanced Technology Solar Telescope (ATST) site.

By the time this *Newsletter* is published, the 1.7-ton VSM will have been attached to the mount and resumed daily observations after a "vacation" of a few weeks. On Kitt Peak, we will no longer be constrained to a 100 gigabytes per day recording capacity, as was the case for observations at the GONG site. Subject to availability of personnel to operate the instrument, we plan to ramp up the regular observing program to its full potential as the data reduction pipeline is developed further.

Work on VSM data reduction has centered on calibration details and streamlining the data reduction pipeline. The primary emphasis has been on producing data of the same type that was produced by the old NASA/NSO spectromagnetograph. One interesting result is that the line-of-sight component magnetograms show a persistent but stable zero-point offset when none was expected. The origin of the problem is not obvious. Daily flat-field calibrations have been used to separate solar and instrumental contributions to the zero-point error problem (possible because two spectrum lines with different magnetic but identical instrumental components are observed simultaneously). We apply a constant correction to daily full-disk magnetograms and average the resulting values over the full solar disk. As shown in figure 2, aside from an

Figure 1. The SOLIS mount arrived on Kitt Peak and was lifted to the top of the old Vacuum Telescope tower in April. (Photographs by David Jaksha.)

continued

SOLIS continued

expected scale factor difference, these values agree very well with daily Sun-as-a-star magnetic field measurements from Wilcox Solar Observatory, and the SOLIS results appear to be significantly quieter.

Observations showed evidence that the spectrograph entrance slit had slowly changed in the unfiltered *f*/6 solar beam, so it was removed for inspection. We found that the 16-micron-wide slit, laser cut into a 2-micron-thick foil of aluminized nickel, had curled slightly in a few places along its 36-millimeter length. The manufacturer advised us that a new laser is now available that ablates rather than melts the foil material. This should reduce any material property changes at the slit and eliminate the curling tendency. New slits are being fabricated using 1-micron-thick foil (thinner foils produce less polarization at the slit). We are also replacing some of the optics used to calibrate the polarization properties of the VSM.

The CCD camera of the integrated sunlight spectrometer (ISS) suffered a major failure during daily testing and was returned to its manufacturer for repair. The two CCD cameras of the full-disk patrol (FDP) instrument also became inoperative. We speculate that these failures may be related to a common power glitch. The FDP is being used to debug the high-speed guider that is common to it and the VSM.

The major challenges now facing the SOLIS project are completing and commissioning the ISS and FDP, understanding and dealing with calibration issues, implementing good reduction algorithms, operating SOLIS, providing data to the community of users, and most importantly, ensuring that excellent science will be produced from the SOLIS investment. Work on all of these areas is underway, but a small staffing level is a common impediment.

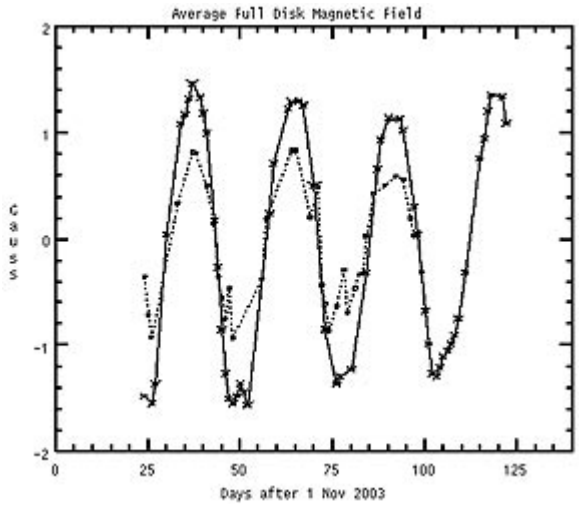

Figure 2. The solid line shows daily SOLIS VSM measurements of the line-of-sight component of the solar magnetic field averaged over the full disk. A constant correction for a zero-point error was applied to these data. The dashed lines are measurements of the line-of-sight component of integrated sunlight made at the Wilcox Solar Observatory. The 27-day modulation is caused by solar rotation and the irregular distribution of magnetic fields on the solar surface.