Director's Corner

Steve Keil

Diversity

Increasing staff diversity and broadening participation in solar physics has been a long-standing goal of the National Solar Observatory (NSO). As part of the renewal of its current National Science Foundation (NSF) Cooperative Agreement, NSO is developing a multi-pronged approach to increase the diversity within its staff and more generally within solar physics. The goal of this plan is to provide a better focus and to establish connections with other underrepresented minority programs, combined with an advisory structure that will help NSO meet its and NSF's goals for increased diversity.

Some important elements of this plan include: establishing a Diversity Advocate on the NSO staff (along with a diversity advisory panel), establishing stronger relationships with universities conducting programs for underrepresented minorities through both the NSF Partnerships in Astronomy & Astrophysics Research and Education (PAARE) program and through joint programs with selected schools and universities, recruiting at professional meetings of minority organizations, and establishing an assessment mechanism to determine what does and does not work.

NSO currently has a comprehensive public affairs and educational outreach plan that includes public programs, media information, elements of distance learning (Internet) education, K-12 education, undergraduate and graduate research, teacher research, and research-to-classroom experiences. These programs, while playing an important role in developing the next generation of solar astronomers and instrumentalists and having some effect on bringing more women into astronomy, have not yet had a major effect on diversity in the NSO staff or solar physics in general.

After receiving guidance from several successful programs, NSO believes the most effective approach toward broadening participation is through personal contact at both the professional and student levels. Thus, the plan we are developing includes taking advantage of our geographic locations—New Mexico, Arizona, and our planned presence on Maui with the Advanced Technology Solar Telescope—to create programs that would reach Hispanic, Native American, and Native Hawai´ians. To involve more African-Americans, NSO's initial efforts include developing working relationships through Fisk/Vanderbilt University in Nashville, Tennessee, and through Alabama A&M University in Huntsville.

Over the next few months, we will establish an advisory group for diversity and effective education and public outreach. If you would be interested in serving on such a group, please contact me at *skeil@nso.edu*.

Developments

It has been a long road moving the Advanced Technology Solar Telescope (ATST) toward construction, but—hopefully—the end appears to be in sight. Final National Historic Preservation Act (NHPA) Section 106 meetings were held on Maui in June and August 2008. The Advisory Council on Historic Preservation, National Park Service (NPS), Haleakalā National Park (HNP), and the State Historic Preservation Division participated actively in the discussions. A summary of the consultation was prepared and will be incorporated into the Final Environmental Impact Statement (FEIS).

The draft FEIS is now under final preparation at NSF. Discussions with NPS and HNP included the contents of a Memorandum of Understanding (MOU) for development of a Supplemental Use Permit to allow access to the road through HNP up to the observatory site. The MOU has been signed by AURA and HNP and covers cost recovery and National Environmental Policy Act, NHPA, and Ecological Society of America compliance. The next step is to complete and publish the FEIS, pass a Final Design Review, and obtain NSF's Record of Decision on whether to proceed with construction. Hopefully, all of this will come together by next summer, which could potentially allow construction to begin in the fall. Meanwhile, the ATST project team is conducting a series of System Design Reviews with outside reviewers in preparation for the Final Design Review at NSF in March 2009.

SOLIS full-disk vector magnetograms from the Vector Spectromagnetograph (VSM) took a big step toward becoming routine with the development of a robust method of removing fringes in the images. As soon as the fringe removal algorithm can be added to the reduction software pipeline, SOLIS full-disk vector magnetograms should become routinely available. We are currently shooting for the first part of next year. The new SOLIS Data Acquisition System and Sarnoff cameras were delivered and characterized. The new camera mounting hardware was designed, fabricated, and is now in place. Software interfaces have been successfully modified. Installation of the new camera system into the VSM is expected before the end of the first quarter in FY 2009. This will allow the VSM to perform to the original specifications.

The NSF Division of Astronomy (NSF/AST) Senior Review recommended that GONG should either find non-NSF/AST funding for the majority of its operations or that it should close down one year after the Solar Dynamics Observatory (SDO) is successfully commissioned. SDO is now scheduled to launch in January 2010. Assuming about six months for commissioning and one year of overlapping observations, the GONG closure could commence in mid-2011. To avoid this, NSO has been actively seeking funding from other sources. Because of GONG's rapid, full-disk magnetograms and farside imaging, the Air Force has shown strong interest in helping to support GONG. As a first step, they plan to fund an H-alpha capability at the GONG sites. This should be followed by operational funding.

The Dunn Solar Telescope (DST) on Sacramento Peak (SP) has seen lots of action over the past few months with successful engineering runs for the University of Hawai´i Facility Infrared Spectropolarimeter (FIRS), the Queens University Belfast Rapid Oscillation

continued

Director's Corner continued

of the Solar Atmosphere (ROSA) experiment, and the joint NSO/High Altitude Observatory Spectro-Polarimeter for Infrared and Optical Regions (SPINOR), which is currently the main NSO/SP focus. All three of these should become user-qualified instruments in 2009 and available for use at the DST.

The Arcetri Observatory Interferometric Bidimensional Spectrometer (IBIS) is now a fully functioning imaging spectropolarimeter that can be rapidly tuned in wavelength. It will soon be integrated into the DST data acquisition system, making data handling more robust and efficient. The multi-conjugate adaptive optics program (MCAO) made progress with measurements of the height of turbulent layers and comparing MCAO-corrected images with modeled performance. A dedicated MCAO bench was set up at the DST.

The McMath-Pierce Solar Facility on Kitt Peak has seen further progress to enhance the capabilities in forefront research, particularly in the solar infrared. The venerable PDP 11/73—the heart of the telescope control system—has been replaced with new hardware and emulation software so that the original FORTH language control software does not have to be substantially rewritten. Hardware has been purchased for computer monitoring of the spectrograph tank position, and the adaptive optics system has been rebuilt to accommodate a new guider. The new limb guiding system is in a preliminary design phase. In the meantime, we hope that the PDP 11/73 finds its way to the Smithsonian Institution.

Several program milestones for the workhorse infrared instrument at the McMath-Pierce, the NSO Array Camera (NAC), have been achieved. Streamlined polarimeter control, real-time flat and dark correction, and a looping capability are now features in the operation of the NAC. All of these improvements enable rapid observations to study dynamics in the solar atmosphere such as one-minute cadence magnetograms in sunspots and surrounding regions or the rapid evolution of CO clouds. In this regard, a large CO filter has been acquired that doubles the field of view in CO from 35 arcsec to 70 arcsec. This filter will be used in forthcoming visitor runs.

A collaborative project with California State University, Northridge (CSUN) to build an Integral Field Unit/Advanced Image Slicer (IFU/AIS) for diffraction-limited 3-D spectroscopy and polarimetry as a facility instrument at the McMath-Pierce is approaching completion. The IFU is scheduled to be installed and operational by January 2009. The refurbished and upgraded Fourier Transform Spectrometer is undergoing tests, and it will resume normal scheduling in January 2009.

Changes

Carl Henney, who has had responsibility for the SOLIS data program at NSO, has left to join Boston College working at Kirtland Air Force Base for Air Force Research Laboratories in Albuquerque, New Mexico. Carl plans to continue working with SOLIS data in his new job, which will focus on the study of space weather. We are pleased to note that Carl will continue an official association with the NSO as an adjunct astronomer. We wish him the best of success. NL

ATST Update

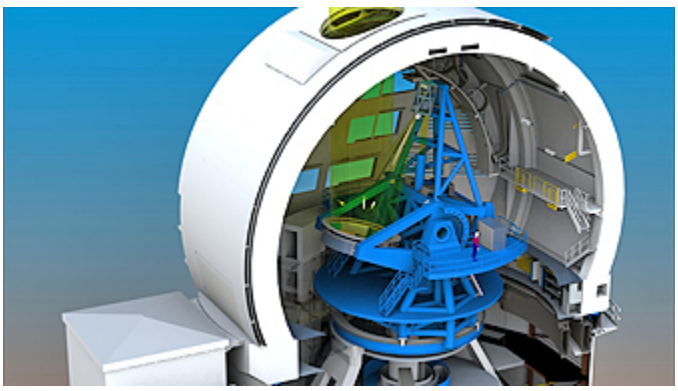
The ATST Team

The Advanced Technology Solar Telescope (ATST) team spent the last quarter preparing for a series of design reviews in Tucson at the end of October and the first week of November. These reviews set the stage for a Final Design Review to be conducted by the National Science Foundation in early 2009.

The Enclosure Control System and Mount Control System (ECS/MCS) Design Reviews were held October 29. Three Systems Design Reviews (SDRs) were also held recently: the Site and Science & Operations Building on November 4; the Enclosure on November 5; and the Telescope Mount Assembly on November 6.

The NSF-conducted Final Design Review, set tentatively for March 2009, is intended to identify all risks and define the budget and schedule baseline for construction. Team managers developed a white paper for the NSF describing the project's budget requirements in light of the potential funding available for fiscal year (FY) 2009 and also a possible FY 2010 construction start scenario.

Preparations for the reviews included extensive work on Interface Control Documents (ICDs) to ensure that all subsystems interact



properly. This was essential given how various parts of the ATST have evolved and been refined over the last few years. ICD preparations ranged from minor edits to complete rewrites. As ICDs moved from draft to final release form, the team held many meetings to touch up details on the giant interface control (N^2) chart. These meetings produced some subtle changes in nomenclature, Work Breakdown

continued

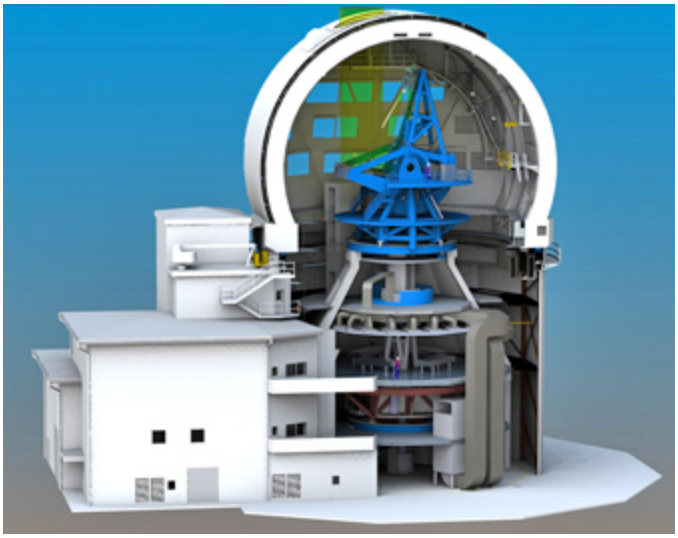
ATST Update continued

Structure (WBS) dictionary entries, and other details that significantly clarified and simplified the ATST ICDs. Since both the WBS and the N^2 chart are under change control already, these updates are carefully scrutinized before submitting them to the change control board. Finalized ICDs will allow the ATST team to prepare Request for Proposal packages.

In the Wavefront Correction System (WFS), multi-configuration Zemax designs are being studied for placing the Deformable Mirror (DM) just above the coudé floor and M10 at instrument height. This particular example has the WFS systems at optical bench height in the rotator undercarriage that was enlarged in 2007. An alternative with the DM and WFS systems located on an optical bench in the coudé room is being studied as well. Higher up, trade-offs established the optimum size for the carousel's entrance aperture for the new geometry of the Telescope Mount Assembly. The solution is a one-centimeter change in the aperture that (1) keeps M1 fully illuminated even during off-pointing for extreme coronal observations, (2) keeps sunlight off of all telescope structures (except the cooled M1 mask), and (3) has enough room for the 60-millimeter auxiliary guide telescope to have an unvignetted view of the Sun in any on-disk position.

Extensive hazards analyses—including "modern ATST" safety meetings that considered the latest design changes—were conducted with the assistance of the NOAO Safety Officer to ensure that the ATST facility and site will provide a safe working environment for all who use it. Current planning is to base the global interlock system (GIS) on the Brookhaven National Labs model.

The Observatory Control System (OCS) design paper now uses a version of the Spectro-Polarimeter for Infrared and Optical Regions (SPINOR) as the "simple instrument" for examples. SPINOR, developed by the High Altitude Observatory and NSO, is a precursor to the Visible Spectro-Polarimeter (ViSP) and is well defined, and therefore provides a convenient vehicle for discussing OCS behavior without requiring details of an actual instrument. Science-use case examples being developed by the Science Working Group will be based on "A Day in the Life of SPINOR," written by Chris Berst at Sunspot and adapted for the ATST environment. Science instrument interfaces were reviewed in a meeting held October 13–17 at the Kiepenheuer Institut für Sonnenphysik in Freiburg, Germany.



The team also worked with the National Park Service to develop a memorandum of understanding leading to a Special-Use Permit for the road through Haleakalā National Park to the observatory site. In August, the team met with consulting and potentially interested parties regarding Section 106 of the National Historic Preservation Act, which covers cultural issues. The list of invitees was widened per advice from the Advisory Council on Historic Preservation, which also had representatives at the meetings, both in person and by teleconference. Comments at the afternoon and evening sessions included some pragmatic advice on potential mitigation.

In education and public outreach, NSO was invited by the National Air and Space Museum to propose activities to go with the museum's proposed Temporary Public Observatory and other activities during the International Year of Astronomy 2009 (IYA2009). NSO anticipates funding from the state of New Mexico to build its Sunspot Solar System Model as part of IYA2009. The model is designed with an eye toward deploying a copy on Maui to help educate students and the public about ATST as the project moves ahead.

SOLIS

Aimee Norton, Kim Streander & The SOLIS Team

The Solar Optical Long-term Investigations of the Sun (SOLIS) team has implemented a two-stage approach to cleaning up the spectro-polarimetric data taken by the SOLIS Vector Spectromagnetograph (VSM). The spectra contained polarization fringes with an amplitude of $\approx 3 \times 10^{-4}$ of Stokes *I*. The fringing had variable amplitude and spacing. After we fit the fringes and removed them (Stage 1), it was necessary to further process the data to remove bias and imperfections (Stage 2). For an example of the VSM data after Stages 1 and 2 fringe removal procedures, see figure 1.

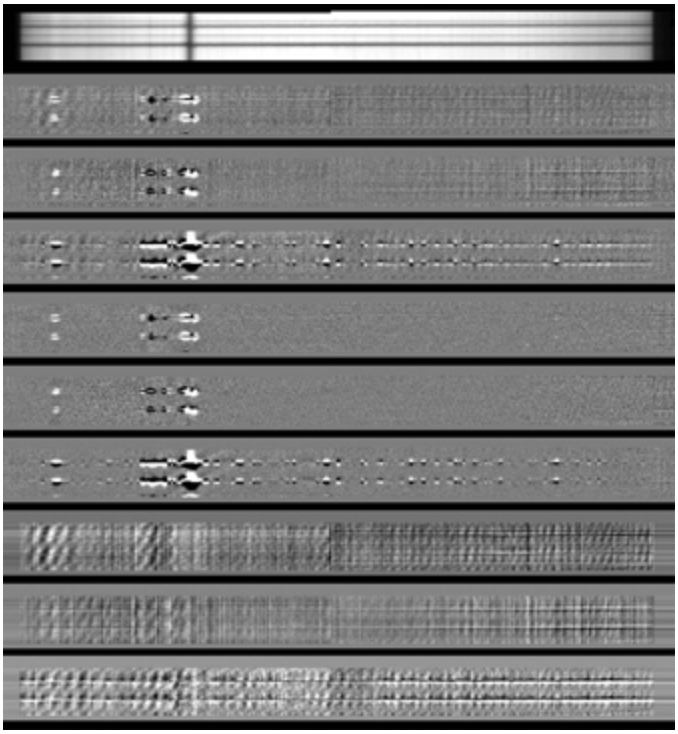


Figure 1: Example of spectro-polarimetric data observed by the SOLIS VSM for a single scanline. The x-direction is the spatial direction of the slit across the Sun. The y-direction is the spectral direction. Each column represents grayscale intensity as a function of wavelength. The top four panels show the Stokes I, Q, U, and V after Stage 1 processing. The very top panel is Stokes I, simple intensity, with the two dark horizontal lines being the 630.2- and 630.1-nanometer absorption lines, and the one dark vertical line representing the decreased intensity in a sunspot. Panels 5, 6, and 7 represent Stokes Q, U, and V after Stage 2 processing. The bottom three panels show the difference between the Stage 1 and Stage 2 results.

The code developed for the removal of polarization fringes was finalized, for both Stages 1 and 2, and installed on the Kitt Peak computers for automated processing of routinely observed data. Full-disk, fringe-free sample spectra can be downloaded at: *ftp://solis.nso.edu/synoptic/level1/vsm/special/betadata/20080326*.

In addition to fringe removal efforts, the SOLIS team reprocessed VSM 630.2-nanometer and 854.2-nanometer data, accounting for the location of bad pixels in the CCD, as a function of time from 2004 until the present. There were also improvements to code that predicts and tracks the evolution of solar surface magnetic fields as viewed in a synoptic Carrington rotation format. This is work being done in tandem with Air Force funding for improved space weather prediction purposes. Integrated Sunlight Spectrometer (ISS) data calibration methods were compared with those of the McMath-Pierce Solar Telescope. It was determined that slight discrepancies between spectra observed simultaneously with the ISS and the McMath-Pierce were due to a two-point calibration of the ISS data while a one-point calibration was used for the McMath-Pierce data.

More work was done to ready the SOLIS telescope for new Sarnoff cameras. Data output from the new Sarnoff cameras was incompatible with the existing Data Acquisition System (DAS) and therefore required engineering changes. Work on the new DAS to replace the current, non-supportable SOLIS system based on digital signal processing has been completed, and extensive testing in the lab and on the observing site has improved the reliability of the system. In addition, modifications to data analysis software have been completed to the point that to progress further, actual SOLIS observations are required.

Lab data was used to develop routines for removing fringes caused by the interference in the thin silicon layer of each of the new cameras. Figure 2 is an example of the typical improvement to intensity images from the NSO Sarnoff camera once its interference fringe model has been applied. The new data acquisition system will be installed once all intensity fringe-fitting routines have been finalized. Installation of the cameras will proceed as weather permits during the first quarter of 2009.

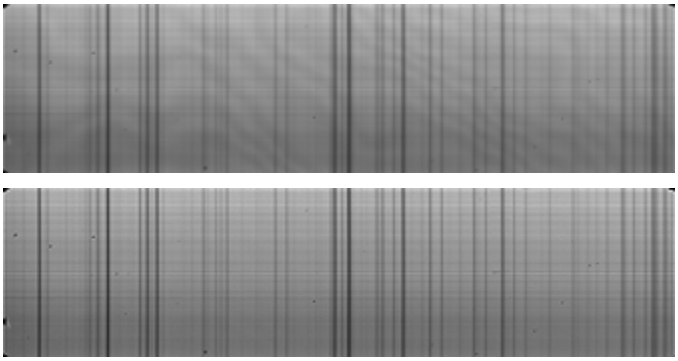


Figure 2: NSO Sarnoff camera data prior to the removal of interference fringes (top panel) and after the removal of interference fringes (bottom panel). The x-axis is the spectral direction and the y-axis is the spatial direction.

GONG++

Frank Hill & The GONG++ Team

We are very pleased to announce that the US Air Force Weather Agency (AFWA) has agreed to join with the Global Oscillation Network Group (GONG) to provide an H-alpha (Hα) observing system at each of the GONG sites. This system will produce 2048 × 2048-pixel full-disk, on-band images once per minute at each site, but with the acquisition time offset by 20 seconds between adjacent sites. This will produce an image every 20 seconds from the network continually around the clock with the same 90 percent duty cycle that GONG routinely attains. The data will be returned within one minute of acquisition to Tucson, and AFWA will pull the data to Nebraska for its flare patrol work.

The data will be fully open to all users and will be useful for studies of flare evolution, filament dynamics, Moreton waves, etc., with magnetograms, Dopplergrams, and subsurface helioseismic data from the same instrumentation. The system is expected to be fully deployed and operational in the spring of 2010. AFWA will also provide a portion of the annual operational cost for GONG. Figure 1 shows the director of AFWA, Dr. Fred Lewis, along with AFWA and GONG staff, on the occasion of his visit to Tucson on 6 August 2008.

Figure 1: Thumbs Up for a GONG-AFWA Partnership! The US Air Force Weather Agency (AFWA) visited GONG headquarters on 6 August 2008 to discuss the plan to install an H-alpha observing system at each of the GONG sites. Shown here at the GONG engineering site are (left to right): SMSgt Craig Kirwin (AFWA), Dr. Fred Lewis (AFWA Director), Pat Eliason (GONG), Frank Hill (GONG), Maj. Herbert Keyser (AFWA), and George Luis (GONG).

Science Highlights

Irene González-Hernández has recently found that, when the phase shift used for the farside maps is averaged over the entire farside, a temporal variation that is highly correlated with the solar cycle is visible, as seen in figure 2. This is a consequence of thermal changes in the outer solar convection zone caused by magnetic fields. The presence of a magnetic field changes the temperature gradient and alters the depth at which the oscillations are reflected inward, creating a variation in the "acoustic radius" of the Sun. The variation is very

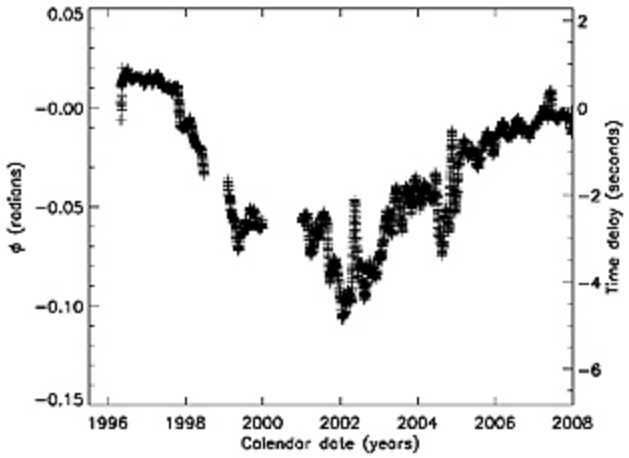


Figure 2: The Mean Phase Delay of seismic waves that propagate to the non-visible hemisphere of the Sun is plotted versus time. The right-hand-side axis presents the corresponding time delay associated with the phase shift. The change in the mean phase is highly anticorrelated with solar activity during cycle 23. A variation of the phase is directly related with changes in the cavity in which the waves propagate, namely, the acoustic radius.

small in terms of actual distance, on the order of five kilometers, and can also be precisely measured using the autocorrelation of low-degree modes, as has been demonstrated recently by Shukur Kholikov (*Solar Phys*. Vol. 251, p. 157). The variation of acoustic radius will constrain models of the outer solar convection zone that include magnetic fields.

Network Operations and Engineering

Motivated by the instability of the turret tracking, a preventive maintenance (PM) trip was conducted at Mauna Loa in August. For much of the year there was a problem of an intermittent oscillation in the pitch axis, which could sometimes last several hours after unstowing and could not be corrected by remotely adjusting the servo parameters. The PM team installed a replacement pitch head to correct the problem. Prior to the trip, the GPS receiver was found to be malfunctioning. The installation of the on-site spare improved the acquisition of satellite signals, but because certain parameters were programmed incorrectly, the data continued to be compromised. A new GPS unit was installed during the PM and configured properly. This situation prompted us to improve the remote monitoring of the GPS status, and new software to do this has since been tested and deployed.

A PM trip to Udaipur began in September and continued through the first week of October. The major effort there was to replace the entire turret, which had suffered a moisture intrusion earlier in the year. Although the turret was operational prior to the monsoon shutdown, it was feared that if any residual moisture remained in the motors, problems could arise later in the year. In addition, the usual PM tasks and upgrades were accomplished.

continued

GONG++ continued

On the engineering front, work has begun on planning for adding observations of the Sun in the Hα band to the GONG instruments. Jack Harvey has developed a promising optical design, so the mechanical design issues can now be addressed. A camera, Hα filter, and computer for data collection have been tentatively identified, and with the AFWA funding in hand, evaluation units can be procured for test and measurement purposes.

We are evaluating a new seal for the turret resolver covers, which present a possible failure point for allowing moisture to penetrate into the lightfeed. We also continue to work with Wind River on real-time software issues related to our instrument chassis central processing unit (CPU). The necessary software tools still do not work properly. The diaphragms in the new clean-air system pumps have been failing well before the anticipated diaphragm's rated lifespan. We are checking with the vendor and evaluating several other materials in hopes of finding one better suited to our application.

Data Operations and Software Development and Analysis
Processing to date includes time series, frequencies, merged velocity, and rings for GONG Month 131 (centered at 9 February 2008), with a fill factor of 0.88. Last quarter, the GONG Data Archive distributed 434 gigabytes of data. All GONG data products can be obtained at *gong.nso.edu/data*.

With few exceptions, nearly all of the GONG data reduction pipeline components are certified and running on Linux. The transition to Linux has not been easy, but our code is faster, more robust, and better documented as a result. On a yearly basis we will continue to add Linux-based servers as needed to support science demand for new data products. By using Conductor, a database-driven pipeline processing manager, we can easily scale up the number of CPUs that we use for any given pipeline.

Program
The GONG 2008/SOHO XXI conference was held at the Center Green Campus of the High Altitude Observatory (HAO), National Center for Atmospheric Research (NCAR) in Boulder, Colorado, 10–15 August 2008. The conference was diverse and well attended, with representatives from all of the continents except possibly Antarctica. While the focus of the meeting was the dynamo, the range of individual topics was broad, including local and global helioseismology, asteroseismology, recent results from ground-based and space-borne observational facilities, and progress reports on observational facilities and instruments in various stages of development. The conference introduced organized one-hour discussion forums for each of the major topics, an innovation for the GONG/SOHO workshops. Figure 3 shows the participants. More photos of the conference are available at *gongsoho08.ucar.edu/photos/*. Many thanks are due to the local organizers: Mausumi Dikpati, Deborah Haber, Charlie Lindsey, and Adrian Trujillo.

GONG will be running the third International Research Experience for Students (IRES) program next year. This program sends four US graduate students studying any discipline of astronomy or astrophysics to work with scientists at the Indian Institute for Astrophysics in Bangalore, India. Applications for summer 2009 are available on the Web and must be received by 16 January 2009. Further information can be found at *eo.nso.edu/ires/*.

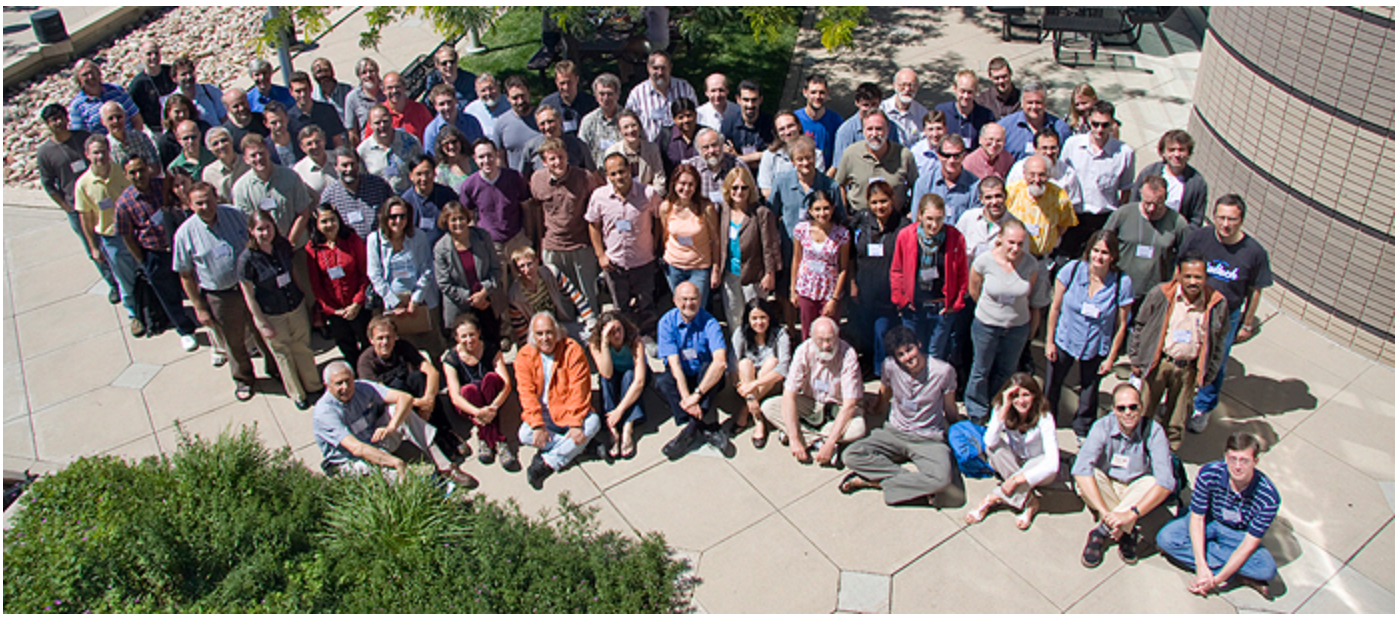
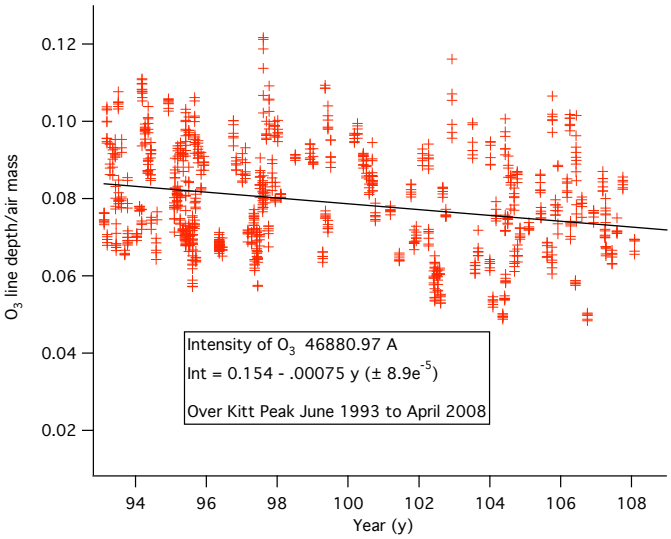


Figure 3: Participants at the GONG 2008/SOHO XXI conference held in Boulder, Colorado, 10–15 August 2008.

International Research Experience for (Graduate) Students (IRES)

NSO/GONG announces a summer 2009 research program for US graduate students sponsored by the NSF Office of International Science and Engineering (OISE). The eight-week program, which begins 10 June 2009, will take place in Bangalore, India, under the auspices of the Indian Institute of Astrophysics (IIA). The goal of the program is to expose potential researchers to an international setting at an early stage in their careers. See *eo.nso.edu/ires/* for additional information and application materials. The deadline for applications is 16 January 2009.

Stratospheric Ozone: No Trends Detected over Kitt Peak 1993–2008



Bill Livingston (NSO) and Lloyd Wallace (NOAO) have determined the strength of ozone using its near-infrared line at 46,880 Angstroms. This measurement was done intermittently over the past 15 years using the 13.5-meter vertical spectrograph of the McMath-Pierce facility. As the much more intensive Total Ozone Mapping (TOMS) satellite records show, ozone is highly variable, and our observations are too infrequent to give a definitive characterization of its presence. The plot shows the individual raw values corrected to one air mass. (The Sun overhead shines through one air mass; at the horizon, this increases to about 40 air masses.) A linear fit through the data (see box) indicates a slight downward trend, but this is not deemed significant.

First and Second Quarter Deadlines for NSO Observing Proposals

The current deadline for submitting observing proposals to the National Solar Observatory is 15 November 2008 for the first quarter of 2009. The deadline for the second quarter of 2009 is 15 February 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*).

The following Web-based information is available:
Instructions at *www.nso.edu/general/observe/*
Observing request form at *www2.nso.edu/cgi-bin/nsoforms/obsreq/obsreq.cgi*
Users' manuals for Sac Peak facilities at *nsosp.nso.edu/dst/*
Users' manuals for Kitt Peak facilities at *nsokp.nso.edu/*
Observing run evaluation form 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.